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Report No: PAD4574

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROGRAM APPRAISAL DOCUMENT

ON

A PROPOSED LOAN

IN THE AMOUNT OF US$380 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

YELLOW RIVER BASIN ECOLOGICAL PROTECTION AND ENVIRONMENTAL POLLUTION CONTROL PROGRAM
PROGRAM-FOR-RESULTS

March 10, 2022

Environment, Natural Resources, and The Blue Economy Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective February 28, 2022)

Currency Unit = Chinese Yuan (CNY)

CNY 1 = US$0.16

US$1 = CNY 6.31

FISCAL YEAR

July 1 – June 30

ABBREVIATIONS AND ACRONYMS

bcm	Billion cubic meters
BPMO	Basin Program Management Office
CBA	Cost-Benefit Analysis
CEA	Cost-Effectiveness Analysis
CPF	Country Partnership Framework
CNAO	China National Audit Office
COD	Chemical Oxygen Demand
DARA	Department of Agriculture and Rural Affairs
DEE	Department of Ecology and Environment
DLI	Disbursement Linked Indicator
DWR	Department of Water Resources
EC	Environmental Carrying Capacity
E&S	Environmental and Social
EIA	Environmental Impact Assessment
ERR	Economic Rate of Return
ES	Ecosystem Services
ESMS	Environmental and Social Management System
ESSA	Environmental and Social Systems Assessment
ET	Evapotranspiration
EX-ACT	Ex-Ante Carbon-Balance Tool
FB	Finance Bureau
FM	Financial Management
FSA	Fiduciary Systems Assessment
FYP	Five-Year Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPL	Government Procurement Law
GPGs	Global Public Goods
GRM	Grievance Redress Mechanism
IPF	Investment Project Financing
M&E	Monitoring and Evaluation
MARA	Ministry of Agriculture and Rural Affairs

MEE	Ministry of Ecology and Environment
MNR	Ministry of Natural Resources
MOF	Ministry of Finance
MWR	Ministry of Water Resources
NDRC	National Development and Reform Commission
NPS	Non-Point Source
O&M	Operation and Maintenance
OHS	Operational, Health, and Safety
PAO	Provincial Audit Office
PAP	Program Action Plan
PDO	Program Development Objective
PDRC	Provincial Development and Reform Commission
PDWR	Provincial Department of Water Resources
PforR	Program for Results
PFM	Public Financial Management
PIP	Program Implementation Plan
PMO	Program Management Office
PPMO	Provincial Program Management Office
PSG	Program Steering Group
PPSG	Provincial Program Steering Group
RA	Results Area
RED	Regional Economy Department
SBD	Standard Bidding Document
TBL	Tendering and Bidding Law
TOR	Terms of Reference
TP	Total Phosphorus
TPVA	Third-party Verification Agency
TVAP	Target Value Allocation Plan
VfM	Value for Money
WUA	Water User Association
WWTP	Wastewater Treatment Plant
YRB	Yellow River Basin
YRCC	Yellow River Conservancy Commission

Regional Vice President:	Manuela V. Ferro
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DATASHEET

BASIC INFORMATION

Country(ies)	Project Name	
China	Yellow River Basin Ecological Protection and Environmental Pollution Control Program	
Project ID	**Financing Instrument**	**Does this operation have an IPF component?**
P172806	Program-for-Results Financing	No

Financing & Implementation Modalities

[ ] Multiphase Programmatic Approach (MPA)	[ ] Fragile State(s)
[ ] Contingent Emergency Response Component (CERC)	[ ] Fragile within a non-fragile Country
[ ] Small State(s)	[ ] Conflict
[ ] Alternate Procurement Arrangements (APA)	[ ] Responding to Natural or Man-made Disaster
[ ] Hands-on Enhanced Implementation Support (HEIS)	

Expected Project Approval Date	Expected Closing Date
31-Mar-2022	31-Dec-2027

Bank/IFC Collaboration

No

Proposed Program Development Objective(s)

To strengthen integrated water use efficiency, water pollution control, and ecosystem management, in selected regions of the Yellow River Basin

Organizations

Borrower :	People's Republic of China
Implementing Agency :	Yellow River Conservancy Commission (YRCC), Ministry of Water Resources
Contact:	Yangbo Sun

Title:	Director
Telephone No:	8613613839926
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Implementing Agency :	Shaanxi Provincial Financial Bureau
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COST & FINANCING

SUMMARY

Government program Cost	1,520.00
Total Operation Cost	1,520.00
Total Program Cost	1,520.00
Total Financing	1,520.00
Financing Gap	0.00

Financing (USD Millions)

Counterpart Funding	**1,140.00**
Borrower/Recipient	1,140.00
International Bank for Reconstruction and Development (IBRD)	**380.00**

Expected Disbursements (USD Millions)

Fiscal Year	2022	2023	2024	2025	2026	2027	2028
Absolute	0.00	95.00	80.00	70.00	70.00	60.00	5.00
Cumulative	0.00	95.00	175.00	245.00	315.00	375.00	380.00

INSTITUTIONAL DATA

Practice Area (Lead)

Environment, Natural Resources & the Blue Economy

Contributing Practice Areas

Agriculture and Food, Social Sustainability and Inclusion, Water

Climate Change and Disaster Screening

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

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

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

COMPLIANCE

Policy

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

[ ] Yes [✔] No

Does the program require any waivers of Bank policies?

[ ] Yes [✔] No

Legal Operational Policies

	Triggered
Projects on International Waterways OP/BP 7.50	No
Projects in Disputed Areas OP/BP 7.60	No

Legal Covenants

Sections and Description

Program Institutions (Program Steering Group at national level)

Loan Agreement (LA), Schedule 2, Section I.B.1 (a): The Borrower shall by no later than three (3) months after the Effective Date, and thereafter maintain, and cause to be maintained the following entity with composition, powers, functions, staffing, facilities and other resources acceptable to the Bank: (i) the Program Steering Group chaired by NDRC and comprising representatives of MWR, YRCC, other relevant agencies, Henan Province and Shaanxi Province, responsible for reviewing Program progress and results, and providing guidance on Program implementation.

Sections and Description

Program Institutions (Basin Program Steering Group and Basin Program Management Office)

LA, Schedule 2, Section I.B.1 (b): The Borrower shall maintain, through MWR, the following entities with composition, powers, functions, staffing, facilities and other resources acceptable to the Bank: (i) the Basin Program Steering Group within YRCC responsible for guidance of the Borrower's Respective Part of the Program; and (ii) the Basin Program Management Office within YRCC, responsible for supporting the coordination, management, reporting, and supervision of the Borrower's Respective Part of the Program, and consolidating reporting to the Bank.

Sections and Description

Mid-term Review

LA, Schedule 2, Section III.2; PA, Schedule, Section III.2 : The Borrower, through YRCC, and the Program Implementing Entities, shall prepare, under terms of reference acceptable to the Bank, and furnish to the Bank no later than March 1, 2025, a consolidated mid-term review report for the Program, summarizing the results of the

monitoring and evaluation activities carried out from the inception of the Program, and setting out the measures recommended to ensure the efficient completion of the Program and to further the objectives thereof.

Sections and Description
Program Implementation Plan

LA, Schedule 2, Section I.B.4; PA, Schedule, Section I.B.3: The Borrower, through YRCC, and the Program Implementing Entities, shall apply, throughout the period of implementation of their Respective Parts of the Program, their respective Program Implementation Plan in a timely and efficient manner acceptable to the Bank.

Sections and Description
Program Action Plan

LA, Schedule 2, Section I.B.2; PA, Schedule, Section I.B.2: The Borrower and the Program Implementing Entities shall: (a) undertake the actions set forth in the Program Action Plan; (b) not amend, revise or waive, nor allow to be amended, revised or waived, the provisions of the Program Action Plan, or any provision thereof, without the prior written agreement of the Bank; and (c) maintain policies and procedures adequate to enable it to monitor and evaluate, in accordance with guidelines acceptable to the Bank, the implementation of the Program Action Plan.

Sections and Description
Program Institutions (provincial level)

Program Agreement (PA), Schedule, Section I.B.1: The Program Implementing Entities shall maintain, and cause to be maintained, the following entities, with composition, powers, functions, staffing, facilities and other resources acceptable to the Bank: (a) the Provincial Program Steering Group; (b) the Provincial Program Management Office; (c) a leading group in each of the Demonstration Sub-provincial Entities; (d) a management office in each of the Demonstration Sub-provincial Entities; and (e) an expert group.

Sections and Description
Verification Agencies

LA, Schedule 2, Section III.3; PA, Schedule, Section III.4: The Borrower, through YRCC, and the Program Implementing Entities, shall, not later than three (3) months after the Effective Date, hire, and thereafter maintain, throughout the period of Program implementation, verification agent(s) having experience and qualifications in the relevant technical fields, acceptable to the Bank, and under terms of reference, including a time-table and adequate budget for its activities, acceptable to the Bank, to monitor and verify the achievement of the DLRs.

Conditions

Type	Financing source	Description
Effectiveness	IBRD/IDA	LA, Article IV, Section 5.01: YRCC and each of the Program Implementing Entities have adopted their respective Program Implementation Plan; each in form and substance acceptable to the Bank.

I. STRATEGIC CONTEXT

A. Country Context

1. **China is transitioning from a period of rapid infrastructure-led growth toward a more balanced and sustainable development model.** China's very rapid economic growth over the past four decades has led to economic, social and environmental imbalances, with increasing challenges of natural resource depletion and environmental degradation. Nearly one-third of the country was ranked as being in poor environmental condition in 2019,[1] with low biodiversity and degraded environments considered unfavorable for human activities.[2] Around 90 percent of grasslands are degraded and prone to desertification,[3] and 40 percent of major wetlands are facing severe degradation. About half of China's vertebrates, including 62 percent of amphibians, and over 10 percent of higher plant species are threatened[4] with freshwater vertebrate populations falling more than twice as quickly as terrestrial populations globally.[5] The implied economic cost of environmental degradation was estimated as 2.2 to 3.1 percent of gross domestic product (GDP) annually between 2004 and 2017,[6] evident in widespread air, soil, and water pollution and diminishing biodiversity levels.[7] Impacts from climate change have compounded these environmental issues and contributed further to economic costs.[8]

2. **To date, supply-side solutions have dominated in the Government's response to meet increasing demand for natural resources.** China has the world's largest stock of public infrastructure, with more dams than any other country storing over 800 billion cubic meters (bcm) of water. China accounted for 20 percent of the world's 2.6 billion people who gained access to improved drinking water between 1990 and 2015 and over one quarter of the 2.1 billion people who gained access to improved sanitation.[9] Wastewater collection and treatment in urban areas have increased from 14.86 percent in 1991 to over 95 percent in 2020, with more than 413,000 km of flood control structures built across all major river basins. Extensive irrigation development has seen the agricultural sector grow at an average of over 5 percent per year since 1978.[10] While infrastructure has been central to China's achievements in water development, some infrastructure has paradoxically exacerbated the challenges of water management. In some areas, such as in the upper reaches of the Yellow River, the rise in industrial and urban demand made possible by investments in water supply

[1] Technical Criterion for Eco-environmental Status Evaluation, Ministry of Environment Protection, (*link*)
[2] China Ecology and Environment Bulletin (2019), Ministry of Ecology and Environment, (*link*)
[3] Pan, Qingmin, Jiamei Sun, Yuanhe Yang, Wei Liu, Ang Li, Yunfeng Peng, Jianguo Xue, Hao Xia, and Jianhui Huang. 2021. "Issues and Solutions on Grassland Restoration and Conservation in China." *Bulletin of Chinese Academy of Sciences* 36 (6): 666–674 (*link*).
[4] Zhigang, Jiang. 2016. "Assessing the Surviving Status of Vertebrates in China." *Biodiversity Science* 24 (5): 495–499. (*link*)
Ministry of Environmental Protection. 2013. *Assessment Report on the Red List of China's Biodiversity—Higher Plants*. Ministry of Environmental Protection of China, Chinese Academy of Sciences. (*link*) [in Chinese].
Ministry of Environmental Protection. 2015. *Assessment Report on the Red List of China's Biodiversity—Vertebrates*. Ministry of Environmental Protection of China, Chinese Academy of Sciences. (*link*) [in Chinese].
[5] WWF. 2018. *Living Planet Report - 2018: Aiming Higher*. Grooten, M. and Almond, R.E.A.(Eds). WWF, Gland, Switzerland. (*link*)
[6] Ma, G., et al. 2020. "The Valuation of China's Environmental Degradation from 2004 to 2017." *Environmental Science and Ecotechnology* 1 (*link*).
[7] Ouyang, et al. 2016. "Improvements in Ecosystem Services from Investments in Natural Capital." *Science* 352: 1455–1459 (*link*).
[8] China is ranked 32 out of 180 countries on the Climate Risk Index. A lower number indicates greater relative exposure and vulnerability to extreme weather events (*link*).
[9] WHO (World Health Organization) and UNICEF (United Nations Children's Fund). 2015. *Progress on Sanitation and Drinking Water: 2015 Update and MDG Assessment.* Geneva: WHO Press. (*link*)
[10] Wang, Jinxia, Yunyun Zhu, Tianhe Sun, Jikun Huang, Lijuan Zhang, Baozhu Guan, and Qiuqiong Huang. 2020. "Forty Years of Irrigation Development and Reform in China." *Australian Journal of Agricultural and Resource Economics* 64 (1): 126–49. (*link*)

infrastructure exceeds reductions in agricultural water demand,[11] while extensive irrigation infrastructure has led to excess water diversion, resulting in waterlogging and salinity across wide areas, accentuating water scarcity.[12]

3. **The growing pressure on China's natural resources could constrain future growth.** Water resources are roughly one-third the global per capita average,[13] with the challenges imposed by the low per capita endowment accentuated by the uneven distribution of water resources, the large and increasingly prosperous population, and the effects of climate change. Increasing water demand and unsustainable water resources utilization have led to reductions in ecological flows, resulting in the loss of hydrological connectivity with floodplains and wetlands and threatening biodiversity. These issues are particularly acute in the northern part of the country. Despite some improvements in recent years, water pollution continues to undermine water security,[14] with 29 percent of major rivers failing to meet the basic quality standards (Classes I–III) required for drinking water supply and ecosystem function.[15] Pollution sources include industrial, domestic, and agricultural activities, with challenges increasingly around non-point sources (NPSs) from agriculture run-off and livestock manure. The northern river basins of the Huai, Hai, Liao, and Yellow rivers face severe physical and pollution-induced water scarcity,[16] resulting in the Yellow River Basin (YRB) being a net importer of virtual water.[17]

4. **Climate variability and change is accentuating the challenges of sustainable natural resource management and water security.** Projected temperature increases for China are expected to be above the global average, with more significant increases expected in northern and western regions, and considerable uncertainty around changes in average monthly precipitation.[18] Reductions in precipitation are projected in the western regions under all climate scenarios and in the arid northern regions when considering lower emission reduction pathways. The probability of extreme drought is expected to increase, with extreme temperatures and associated threats to natural resources resulting in degraded ecosystems and threats to biodiversity. Water security is predicted to become a major vulnerability, especially in northern China where the availability of water is expected to decrease up to 24 percent by 2050,[19] challenging sustainable ecosystems services, reducing environmental flows and further affecting aquatic biodiversity. Increased losses associated with the impacts of natural disasters, such as droughts and floods, are not expected to be distributed equally and are likely to be most strongly experienced by marginalized and asset-poor communities. Support for adaptation will be needed by many groups, particularly smallholder farmers who face potential yield losses and species range shifts, as well as to safeguard ecosystems and vulnerable at-risk habitats with high biodiversity value, such as wetland complexes in arid basins. However, if adaptation and resilience-building efforts are not well targeted and designed to consider potentially competing demands and tradeoffs between various users and uses, they may exacerbate these threats and challenges.

5. **Recognizing these challenges, China has established a series of red line policies as part of the transition to a more balanced development model.** These 'red line' strategies are intended to safeguard ecologically fragile regions

[11] Zhang, Kang, Xianhong Xie, Bowen Zhu, Shanshan Meng, and Yi Yao. 2019. "Unexpected Groundwater Recovery with Decreasing Agricultural Irrigation in the Yellow River Basin." *Agricultural Water Management* 213: 858–67. (*link*)
[12] Gonçalves, J. M., L. S. Pereira, S. X. Fang, and B. Dong. 2007. "Modelling and Multicriteria Analysis of Water Saving Scenarios for an Irrigation District in the Upper Yellow River Basin." *Agricultural Water Management* 94 (1–3): 93–108. (*link*)
[13] World Bank Open Data. Renewable internal freshwater resources per capita (cubic meters). (*link*)
[14] Ma, Ting, Siao Sun, Guangtao Fu, Jim W. Hall, Yong Ni, Lihuan He, Jiawei Yi, Na Zhao, Yunyan Du, Tao Pei, Weiming Cheng, Ci Song, Chuanglin Fang, and Chenghu Zhou. 2020. "Pollution Exacerbates China's Water Scarcity and Its Regional Inequality." *Nature Communications* 11 : 650. (*link*).
[15] Ministry of Ecology and the Environment. 2019. *State of Ecology and the Environment Report.* (*link*)
[16] Ma et al. 2020. (*link*)
[17] Li, M., Q. Tian, Y. Yu, Y. Xu, and C. Li. 2021. "Virtual Water Trade in the Yellow River Economic Belt: A Multi-Regional Input-Output Model." *Water* 13: 748. (*link*)
[18] World Bank. 2021. *Climate Knowledge Portal - China*. World Bank, Washington DC. (*link*); IPCC (Inter-Governmental Panel on Climate Change). 2021. *AR6 Climate Change 2021: The Physical Science Basis*. Inter-Governmental Panel on Climate Change. (*link*)
[19] Mo, Xing-Guo, Shi Hua, Zhong-Hui Lin, Su-Xia Liu, and Jun Xia. 2017. "Impacts of Climate Change on Agricultural Water Resources and Adaptation on the North China Plain." *Advances in Climate Change Research* 8 (2): 93–8. (*link*)

which are prone to soil erosion, desertification and salinization, along with regions that provide important ecological functions, through measures such as water source protection, soil and water conservation, and biodiversity protection. The '*Three Red Lines*' for water, established in 2012 under the '*Most Stringent System for Water Resource Management*', are aimed at ensuring water sustainability by limiting water usage, promoting water-use efficiency, and improving water quality.[20] Binding targets have been established for 2030 based on local water availability and the need for social and economic development. These are allocated among 31 provincial units and further broken down to more than 2,500 county-level units.[21] The water red lines have been complemented through a series of '*Ecological Red lines*'[22] launched in 2017 to protect critical ecological areas and ensure national ecological security.[23] These ecological red lines define sensitive and vulnerable areas with important ecological functions that must be strictly protected. These are all part of a shift toward green development, realized under the concept of an 'ecological civilization'—a more harmonious relationship between society and the environment.[24] These are further supplemented by minimum ecological flow requirements that are intended to safeguard water for the environment and protect aquatic biodiversity.[25] While establishing clear policy benchmarks, there is a need to refine the determination of specific water and ecological targets to reflect local conditions and position these within integrated landscape approaches to catchment management. Regional indexes need to be developed relating to the integration of water availability and ecosystem services, sustainable limits imposed on water consumption, and independent assessments promoted to ensure ecological outcomes are realized.[26]

B. Sectoral (or Multi-Sectoral) and Institutional Context

6. **The YRB is emblematic of the competing demands on natural resources and the challenges in realizing integrated approaches for more balanced and sustainable development.** Considered the birthplace of Chinese civilization, the river flows through nine provinces and autonomous regions in the arid and semi-arid areas of northern China. The river has served as the political, economic, and cultural center for over 3,000 years and in 2018 the GDP generated in the nine provinces and autonomous regions within the basin was estimated at US$3.62 trillion (CNY 23.9 trillion). This accounts for 26.5 percent of the national GDP. The basin's mean available water resources have been estimated at 64.7 bcm, less than 7 percent of that in the Yangtze River Basin, with annual precipitation averaging 446 mm, 40 percent that in the Yangtze River Basin. The basin's water resources supply water to over 160 million people (12 percent of the population) and support 15 percent of the country's irrigation area.[27] Agriculture accounts for more than 65 percent

[20] The Three Red Lines stipulate that by 2030, (a) cap national annual water use to 700 billion cubic meters, (b) reduce water use to 40 cubic meters per US$1,450 industrial added value and increase irrigation efficiency to 60 percent, and (c) ensure 95 percent of major water function zones comply with water quality standards and ensure all sources of drinking water meet national standards.
[21] Wu, B., H. Zeng, W. Zhu, N. Yan, and Z. Ma. 2021. "Enhancing China's Three Red Lines Strategy with Water Consumption Limitations." *Science Bulletin* 66 (2021): 2057–2060.
[22] The General Office of the Communist Party of China and the State Council, 'Opinions on Defining and Strictly Protecting Ecological Red Lines', Feb. 7, 2017. (*link*)
[23] The term National Ecological and Environmental Security was first proposed in the 'National Outline of Ecological and Environmental Protection' in 2010, which refers to ecosystems in the country that are able to provide sustainable ecosystem services to support human lives and socioeconomic development.
[24] Ecological civilization describes a society conforming to and protecting natural environments for coexistence between people and nature. It requires social and environmental reforms to enhance resource and ecological conservation, environmental sustainability, and development.
[25] Ministry of Water Resources, Working plan to determine ecological flow for important rivers and lakes. (*link*).
[26] Wu et al. 2021; Yu, Qiyang. 2021. "Thoughts on the Intensive, Economical and Safe Utilization of Water Resources." *China Water Resources* November. (*link*)
[27] Ministry of Water Resources. 2015. *China Water Resources Bulletin (in Chinese)*. (*link*)

of water withdrawals,[28] with the irrigated area having expanded from 0.8 million hectares in 1950[29] to over 7.32 million hectares in 2018.[30]

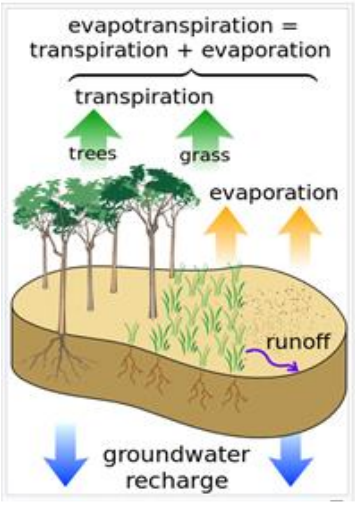
7. **Balanced development in the YRB is required to safeguard and sustain globally important biodiversity and ecosystems.** The river provides an important ecological corridor in an otherwise arid landscape, while the basin harbors biodiversity hotspots of global importance, including six wetlands of international importance,[31] at least 48 national protected areas,[32] and 83 key biodiversity areas. These provide critical winter breeding grounds and stop-over sites for migratory birds along the East Asian-Australasian and the Central Asian flyways and habitat for more than 150 threatened species.[33] The river originates in the Three River Source National Park, an area on the Tibetan Plateau that is rich in water resources and includes the headwaters of the Yellow, Yangtze, and Lancang-Mekong rivers. Regarded as the water tower of Asia, it includes important, fragile mountainous ecosystems such as grasslands, high-altitude freshwater lakes, wetlands, and forests and was one of only five areas to be designated as a national park under the new protected areas system.[34] The delta where the river discharges into the sea is being considered for national park status given its global importance in supporting over 6 million migratory birds every year and being a critical breeding habitat for endangered species such as the oriental stork and the Saunder's gull. These wetlands have been identified as national conservation priorities in the National Biodiversity Strategy and Action Plan (NBSAP), prepared as a requirement under the Convention on Biological Diversity (CBD). However, freshwater biodiversity is rapidly diminishing due to competing demands and the over-exploitation of water resources, a lack of integrated planning, cascade hydropower development, invasive species, water pollution, and overfishing,[35] with fish species richness declining 35.4 percent over the past five decades.[36]

8. **Increasing pressure on water resources in the YRB constrains social and economic development, with implications for environmental sustainability.** The YRB Water Allocation Plan adopted in 1987 was the first for any of the country's large rivers, allocating 37 bcm among the nine provinces and autonomous regions. The plan also included allocations for Hebei and Tianjin, located outside of the basin, and set aside 21 bcm for ecological water uses, primarily to facilitate sediment transportation.[37] While the 1987 Plan allocated water consumption quotas to each province, the Government lacked an effective system to monitor, evaluate, and regulate actual consumption or respond to the rapidly changing development context among the provinces, focusing primarily on water withdrawals. Understanding the difference between water withdrawal and water consumption is critical to properly evaluating and managing water stress in a water scarce basin, like the YRB (Box 1). Excessive water withdrawal and consumption in the 1980s and 1990s resulted in a reduction in streamflow, compounding a natural increase in seasonal droughts, resulting in around 11 percent of the main river drying up in 1997 and no water reaching the sea for 226 days. Following this, the central government revised the plan in 1998 and adjusted the annual allocation scheme by imposing provincial quotas in proportion to the expected

[28] Yellow River Water Resources Bulletin (2020). (*link*)
[29] Cai, X., and M. W. Rosegrant. 2004. "Optional Water Development Strategies for the Yellow River Basin: Balancing Agricultural and Ecological Water Demands." *Water Resour. Res.* 40: W08S04. (*link*)
[30] Wang, Y., W. Zhao, S. Wang, S. et al. 2019. "Yellow River Water Rebalanced by Human Regulation." *Sci Rep* 9: 9707. (*link*)
[31] The six sites under the Ramsar Convention on Wetlands of International Importance are the Eling Lake, Zhaling Lake, Gansu Yellow River Shouqu wetlands, Sichuan Ruoergai Wetlands, Gansu Gahai wetlands, and Shandong Yellow River Delta wetlands.
[32] Fei, Duan, and Sheng Li. 2020. "The Status, Distribution Patterns, and Conservation Gaps for Bird Diversity in the Yellow River Basin, China." *Journal. Biodiversity Science* 28 (12): 1459–1468.
[33] Listed in the International Union for Conservation of Nature (IUCN) Red List (*link*).
[34] The announcement was made by President Xi Jinping during the UN Biodiversity conference COP15 in Kunming, China, October 2021.
[35] Zhao, Yahui, Yingchun Xing, Binbin Lü, Chuanjiang Zhou, Wenbo Yang, and Kai Zhao. 2020. "Species Diversity and Conservation of Freshwater Fishes in the Yellow River Basin." *Biodiversity Science* 28 (12): 1496–1510. (*link*)
[36] Xie, J. Y., W. J. Tang, and Y. H. Yang. 2018. "Fish Assemblage Changes over Half a Century in the Yellow River, China." *Ecology and Evolution* 8: 4173– 4182 (*link*).
[37] Yan, Z., Z. Zhou, J. Liu, H. Wang, and D. Li. 2020. "Water Use Characteristics and Impact Factors in the Yellow River Basin, China." *Water International* 45 (3): 148–168. (*link*)

water availability for the given year.[38] The Yellow River Conservancy Commission (YRCC) was mandated to operate the scheme under which ecological flows were prioritized to safeguard water for the environment. Completion of the Xiaolangdi multipurpose dam[39] in 2001 also improved the capacity to regulate flows in the YRB and prevent the cessation of flow along the mainstream in the subsequent 22 years.

Box 1. The Difference between Withdrawal and Consumption-Based Water Management



Understanding both water withdrawal and consumption is critical to properly evaluate and manage water stress in a water scarce basin, like the Yellow River Basin.

Approaches based on water withdrawal measure the total amount of water abstracted from the river basin through either surface water or groundwater sources. This is done directly from the river or lake, from reservoirs behind dams, or through wells and boreholes. Measurements of water withdrawals help evaluate demands from domestic, industrial, and agricultural users and indicate the level of competition and dependence on water resources.

Water consumption is the portion of the withdrawn water permanently lost from the river basin through evaporation from the land surface and transpiration from plants. Measuring evapotranspiration (ET) helps quantify the impact of water withdrawals on downstream availabilities and is essential to evaluate water shortages and scarcity. It also helps understand how much water is consumed or really saved to inform better management of water withdrawal. Understanding and managing water consumption is critical for water scarce basins.

An illustrative example of this is two farmers who withdraw the same amount of water from a nearby river. The first farmer uses flood irrigation and consumes 70 percent of the water withdrawn, while the rest (30 percent) may form a return flow back to the river or aquifer, making it available for other users and the environment. The second farmer uses drip irrigation and consumes 95 percent of the water withdrawn, returning only 5 percent back to the river or aquifer. Although the two farmers withdrew the same amount of water, their impacts on the basin's water balance are different due to differences in water consumption and impacts on the return flow for other users, including groundwater recharge and the environment.

Promoting higher efficiency irrigation with the same amount of water withdrawals in the absence of regulation and control on total water consumption may exacerbate water scarcity and environmental impacts. Therefore, consumption based water management is critical to regulate water consumption to ensure environmental sustainability in water scarce basins.

9. **Significant social, economic, and environmental changes over the past three decades have accentuated water stress and resulted in the suboptimal allocation of resources.** Estimates by the Ministry of Water Resources (MWR) suggest the natural annual flow for 2001–2015 was 25 percent lower than 1956–1979,[40] while the water resources development and utilization rate reached 80 percent, exceeding the sustainable utilization threshold of 40 percent.[41] Decreases in the Yellow River flow have been attributed to climate change and intensifying human activities, such as increasing withdrawal of water for meeting growing agricultural irrigation needs.[42] Rapid development in some provinces has resulted in imbalances between water allocations, demand, utilization, and consumption, with some provinces, such

[38] National Development and Reform Commission and Ministry of Water Resources. 1998. *Yellow River Water Quantity Dispatching and Management Measures*. Government Notice No. 2520.
[39] The World Bank contributed to the construction of the Xiaolangdi Multipurpose Project through three projects: CN - Xiaolangdi Resettlement Project (P003644), Xiaolangdi Multipurpose Project (P003562), and CN - Xiaolangdi Multipurpose Project: Stage II (P034081).
[40] From an estimated average annual natural flow of 58 bcm before 1975, to 53 bcm from 1975 to 2000, and less than 50 bcm since 2000.
[41] The water resources development and utilization rate refers to the ratio of total water use to total water resources in a river basin or region. The regulatory requirements in China consider 40 percent of the water resources development and utilization rate as a threshold of sustainable water development. Exceeding the threshold indicates water resources are overdeveloped and overused, which will squeeze the environmental flow and reduce the self-purification capacity of water bodies.
[42] Zhang, Qiang, Zongjiao Zhang, Peijun Shi, Vijay P. Singh, and Xihui Gu. 2018. "Evaluation of Ecological Instream Flow Considering Hydrological Alterations in the Yellow River Basin, China." *Global and Planetary Change* 160: 61–74. (*link*)

as Shandong, Henan, Shaanxi, and Inner Mongolia, now considered to be net virtual water inflow areas, while others, such as Shanxi, Gansu, Ningxia, and Qinghai, reportedly net virtual water outflow regions.[43] Other changes also have implications for the optimized allocation of water use. For example, the 1987 Plan allocated 36 percent of the annual flow as ecological water uses, mainly for regulating the transport of sediments. However, sediment control measures and revegetation in the middle reaches have reduced sediments by around 80 percent over the past two decades and increased total water consumption. In the interim period, the South-North Water Transfer has also started delivering water to Hebei and Tianjin without any revisions to quotas allocated from the YRB.

10. **Issues of water scarcity in the YRB are accentuated by persistent challenges of water pollution, with important regional impacts.** Despite significant progress in reducing point source pollution from industrial and municipal sectors through increased collection and treatment of urban wastewater, water quality in the YRB is lower than the national average.[44] Although wastewater collection and treatment coverage is relatively high in urban areas, there are persistent challenges with the low coverage of wastewater collection and treatment in rural areas and NPS pollution from the livestock and agriculture sectors, which reportedly contribute 56 percent of chemical oxygen demand (COD) and 66 percent of total phosphorous in the YRB.[45] Intensive chemical fertilizer use in vegetable and cereal cropping in Henan, Shaanxi, and Shandong, along with livestock and poultry operations in Henan, Shaanxi, Gansu, and Inner Mongolia, are the largest contributors to NPS pollution and important drivers of greenhouse gas (GHG) emissions. Mismanaged plastic waste, including from agriculture film and urban and rural solid waste, is an additional challenge, with a 2015 study[46] estimating that China is a significant contributor to ocean plastic debris and that its rivers—including the Yellow River—are the primary conduits, making China's role in combating marine plastic pollution critically important.

11. **Ecosystem degradation undermines resilience in the YRB and is a primary driver of biodiversity loss.** The catchment area of the YRB is vulnerable due to the fragile soils, limited vegetation, and arid conditions, with direct threats to the basin's biodiversity including habitat loss and degradation, climate change, pollution, over-exploitation of water resources, and invasive species.[47] Poor land management practices have led to overgrazing and degradation of grasslands and wetlands, with about 34 percent of the catchment suffering from erosion threatening the source of the Yellow River.[48] The fragile soils of the Loess Plateau in the middle reaches of the river are particularly vulnerable to erosion,[49] contributing over 90 percent of the river's sediments.[50] Erosion undermines the ecosystem's capacity to retain water in the soil and recharge groundwater while also transporting NPS pollutants that end up in the rivers, affecting aquatic biodiversity. The combined effect has degraded the ecological integrity of the river, rendering certain stretches biologically dead and unsuitable for any use.[51] Severe soil erosion has also led to considerable amounts of sediments being deposited in the river bed, forming an 800 km long 'suspended river' in the downstream reaches and exacerbating flood risks.[52] Improved

[43] Li et al. 2021. (*link*)
[44] Ministry of Ecology and Environment. 2019. "China Ecology and Environment Bulletin." P.R. China. (*link*)
[45] Yuan, Tao, Jing Xu, Hejing Ren, et al. 2021. "Spatiotemporal Evolution of Agricultural Non-Point Source Pollution and its Influencing Factors in the Yellow River Basin." *Transactions of the Chinese Society of Agricultural Engineering* 37 (4): 257–264. (*link*)
[46] Lebreton, L. et al. 2017. "River Plastic Emissions to the World's Oceans." *Nature Communications* 8 (15611). (*link*)
[47] Yue, Cao, Shuyu Hou, Zixuan Zeng, Xiaoshan Wang, Fangyi Wang, Zhicong Zhao, and Rui Yang. 2021. "Biodiversity Conservation Strategies for the Yellow River Basin Based on the Three Conditions Framework." *Biodiversity Science* 28 (12): 1447–1458. (*link*)
[48] The headwater areas contribute to over 40 percent of the Yellow River streamflow.
[49] Li, Jingjing, Su Pengfei, and Zhang Jianguo. 2021. "Soil Erosion Characteristics and Prevention Countermeasures for Ecological Protection and High-quality Development Planning in the Yellow River Basin." *Bulletin of Soil and Water Conservation* 41 (5): 238–243. [in Chinese] (*link*)
[50] Xin, Z., L. Ran, and X. X. Lu. 2012. "Soil Erosion Control and Sediment Load Reduction in the Loess Plateau: Policy Perspectives." *International Journal of Water Resources Development* 28 (2): 325–341.
[51] Singh, Durgesh Kumar, Mengzhen Xu, Nandita Singh, and Fakai Lei. 2021. "Perspectives on Emerging Pressures and Their Integrated Impact on Large River Systems: An Insight from the Yellow River Basin." *Journal of Environmental Management* 298: 113423. (*link*)
[52] The 'suspended river', also known as the 'raised bed river', is formed due to substantial sediment deposited in the riverbed. In some river reaches in Henan Province, the riverbed is 20 meters higher than ground level, imposing substantial flooding risks to the surrounding areas.

land management practices and restoration of vegetation cover (particularly forest, grassland, shrublands, agroforestry) can reduce erosion, increase water infiltration by 40–80 percent,[53] and increase soil organic carbon by 28 to 45 percent,[54] thus increasing land productivity and soil carbon storage. Studies of restoration measures on the Loess Plateau suggest that efforts to increase vegetation cover can reduce runoff and sediment by 50 to 70 percent compared to bare land.[55]

12. **Catchment-based landscape approaches to address these challenges are undermined by institutional and planning processes that favor sectoral planning and administrative boundaries.** The 'Grain for Green' program was introduced in 1999[56] to improve catchment landscape management and ecological restoration, doubling vegetation cover between 1999 and 2013.[57] The area under soil and water conservation management has also increased from 3 percent in 1969 to 51 percent in 2012.[58] These achievements have improved land management practices, contributing to soil conservation, flood reduction, bioenergy production, and carbon sequestration.[59] However, the ecosystem integrity of many newly revegetated areas is poor, with large areas of monoculture forest that have low resilience to storms and pests, and low biodiversity values. Large scale revegetation efforts, largely focused on a handful of species, have also increased water consumption and resulted in decreased stream flow,[60] with revegetation in the Loess Plateau reportedly approaching sustainable water resource limits and requiring an adjustment of the revegetation strategy.[61] There is increasing recognition of the need for integrated approaches that can address the challenges of cross-sectoral coordination and inter-jurisdictional cooperation[62] to reconcile the complex, sometimes competing, demands and mandates between restoration of ecosystems to promote various services and protect biodiversity and economic growth associated with increased water use and pollution.

13. **An integrated landscape approach to catchment management could help address ecosystem degradation and biodiversity loss and contribute to improved water security.** While the ministerial reforms of 2018 signaled an important policy shift toward the integrated management of natural resources and clarified responsibilities,[63] they also created challenges through a new division of responsibilities. Natural resource planning and ecosystem services were allocated to the newly established Ministry of Natural Resources (MNR), while responsibilities for managing water quantity were left with the MWR and those for water quality transferred to the Ministry of Ecology and Environment (MEE). These cross-sectoral issues are complicated further by jurisdictional responsibilities, with China's river basin organizations not having the administrative authority or coordination mechanisms required to align provincial actions, build consensus with local governments, or arbitrate in cases of dispute. These divisions frequently lead to sectoral plans being implemented in

[53] Sun, D., H. Yang, D. Guan, M. Yang, J. Wu, F. Yuan, C. Jin, A. Wang, and Y. Zhang. 2018. "The Effects of Land Use Change on Soil Infiltration Capacity in China: A Meta-Analysis." *Science of the Total Environment* 626: 1394–1401.
[54] Gong, L., G. Liu, M. Wang, X. Ye, H. Wang, and Z. Li. 2017. "Effects of Vegetation Restoration on Soil Organic Carbon in China: A Meta-Analysis." *Chinese Geographical Science* 27 (2): 188–200.
[55] Hu, J., Y. Lü, B. Fu, A. J. Comber, and P. Harris. 2017. "Quantifying the Effect of Ecological Restoration on Runoff and Sediment Yields: A Meta-Analysis for the Loess Plateau of China." *Progress in Physical Geography* 41 (6): 753–774.
[56] Wang, S., B. Fu, S. Piao, et al. 2016. "Reduced Sediment Transport in the Yellow River Due to Anthropogenic Changes." *Nature Geosci* 9: 38–41. (*link*)
[57] Chen, Y., K. Wang, Y. Lin, et al. 2015. "Balancing Green and Grain Trade." *Nature Geosci* 8: 739–741. (*link*)
[58] Wang, Y., W. Zhao, S. Wang, et al. 2019. "Yellow River Water Rebalanced by Human Regulation." *Sci Rep* 9: 9707. (*link*)
[59] Chen, C., T. Park, X. Wang, et al. 2019. "China and India Lead in Greening of the World through Land-Use Management." *Nat Sustain* 2: 122–129. (*link*); Deng, L., Z. Shangguan, and S. Sweeney. 2015. "'Grain for Green' Driven Land Use Change and Carbon Sequestration on the Loess Plateau, China." *Sci Rep* 4: 7039. (*link*)
[60] Feng, X., B. Fu, S. Piao, et al. 2016. "Revegetation in China's Loess Plateau Is Approaching Sustainable Water Resource Limits." *Nature Clim Change* 6: 1019–1022. (*link*); Wang, Y., W. Zhao, S. Wang, et al. 2019. "Yellow River Water Rebalanced by Human Regulation." *Sci Rep* 9: 9707. (*link*)
[61] Feng et al. 2016. (*link*); Zhang, S., D. Yang, Y. Yang, S. Piao, H. Yang, H. Lei, and B. Fu. 2018. "Excessive Afforestation and Soil Drying on China's Loess Plateau." *Journal of Geophysical Research: Biogeosciences* 123: 923– 935. (*link*)
[62] Shan, Lun, and Wang Fei. 2021. "Some Scientific Issues in the Cooperative Management of the Yellow River Basin." *Yellow River* 43 (10): 7–10 [in Chinese]. (*link*)
[63] World Bank Group. 2018. *Watershed: A New Era of Water Governance in China - Synthesis Report*. World Bank, Washington, DC. (*link*)

isolation within administrative boundaries (provincial, municipal, or county) instead of a geographic boundary (a specific landscape, such as the river basin, or ecosystem), preventing integrated landscape approaches to catchment management. Recognizing the need to better integrate regional and catchment planning processes to manage tradeoffs, the Government is pursuing dedicated legislation for the country's major river basins, with the Yangtze River Protection Law adopted in December 2020 and the draft law on protection of the Yellow River having been discussed at the executive meeting of the State Council on October 8, 2021, and presented to the National People's Congress for review.

14. **Responding to these challenges, the Government issued the Yellow River Basin Ecological Protection and High-Quality Development Master Plan on October 8, 2021.**[64] The 'YRB Plan' calls for a new integrated model for natural resource management, recognizing water as the most rigid constraint for development, emphasizing the principle that water availability determines urban, agricultural, population growth, and production. The Plan leverages the river's cultural importance and builds on historical references to "the amount of soup determines how much bread can be put inside,"[65] positioning ecological protection and high-quality development of the YRB as a national priority.[66] The Plan recognizes the need to improve inter-jurisdictional cooperation and cross-sectoral coordination and strengthen basin-level responsibilities for monitoring, regulation, and supervision, conferring specific obligations on national agencies and basin organizations, as well as provincial and local governments. This includes encouraging provincial governments to cooperate around catchment management and protection of the river, including floodplain management and environmental restoration while providing guidance to local governments on controlling water consumption and prohibiting projects such as the large-scale planting of trees, irrigation expansion, and creation of artificial lakes. The YRB Plan further calls for integrated approaches that can address the challenges of cross-sectoral coordination and inter-jurisdictional cooperation to reconcile competing demands and optimize tradeoffs within a water-constrained environment, highlighting the role of the YRCC and the need to enhance its capacity for determining the sustainable limits within which to sustain economic growth and maintain ecosystem services. However, realizing this ambitious vision requires new approaches and improved capacity for integrated planning and monitoring, along with the alignment of incentives with the differentiated responsibilities among various levels of government.

C. Relationship to the CPS/CPF and Rationale for Use of Instrument

15. **The Program emphasizes the contributions to global public goods and is aligned with the World Bank Group's engagement strategies.** These are guided by the Country Partnership Framework (CPF) for China (FY2020–2025) (Report No. 117875-CN), which was discussed by the World Bank Board of Executive Directors on December 5, 2019,[67] and include the Green, Resilient, and Inclusive Development (GRID) framework along with the Climate Change Action Plan 2021–2025.[68] Specifically, the Program is well aligned with the CPF Engagement Area 2 "promoting greener growth" related to strengthening sustainable natural resources management, reducing water pollution, demonstrating sustainable agriculture practices to reduce water consumption and pollution, and promoting climate mitigation strategies. The World Bank Group is placing ever greater importance on catalyzing global public goods (GPGs)[69] and identifies five GPGs as part of the broader engagement strategy[70]: (a) environmental commons (including biodiversity and the prevention of climate

[64] Yellow River Basin Ecological Protection and High-Quality Development Plan. (*link*)
[65] The "amount of soup" refers to the water available, while "bread" is the development that can be sustained with the available water.
[66] Keynote speech by President Xi Jinping on September 18, 2019, at the symposium on ecological protection and high-quality development in the YRB.
[67] World Bank Group. 2021. *China - Country Partnership Framework for the Period FY2020–2025*. (Report No. 117875-CN) World Bank Group, Washington, DC.
[68] Alignment with GRID and the Climate Change Action Plan 2021–2025 is seen in the Program's focus on environmental sustainability objectives while increasing resilience to climate change threats, mitigating emissions, and promoting inclusivity in economic opportunities.
[69] Bousquet, F. 2016. *The World Bank Group as a Catalyst for Global Public Goods*. (*link*)
[70] World Bank 2015. (*link*)

change), (b) prevention of communicable diseases, (c) international trade, (d) international financial architecture, and (e) global knowledge for development. The Program will contribute directly to environmental commons (including biodiversity and climate mitigation) along with global knowledge for development, with the lessons and knowledge generated by the Program expected to be relevant for addressing integrated natural resource management issues elsewhere and may be scaled up (including with non-World Bank Group resources) in other basins in China and internationally (Box 2). Moreover, the Program is also expected to indirectly contribute to reducing marine plastics pollution through improved collection and treatment of wastewater and improved agricultural practices.

Box 2. Program Contributions to Global Public Goods

The Program primarily contributes to environmental commons and global knowledge through the following:

- **Biodiversity.** The YRB is home to globally important biodiversity and aquatic ecosystems, including six sites under the Ramsar Convention on Wetlands of International Importance and other wetlands that provide critical winter breeding grounds and stop-over sites for significant numbers of migratory birds. These include over 10,000 Whooper Swans (over 70 percent of wintering population in China) and more than 6 million migratory waterbirds that stop in the Yellow River Delta on their annual migration, along with other endangered species such as the Scaly-sided merganser and Great Bustard.

  Through its efforts to improve ecosystem and water resources management, the Program will directly address some of the main drivers of biodiversity loss in the YRB. The Program pilots improved governance models through integrated planning that will balance competing demands and ensure development within sustainable limits, safeguard biodiversity and important ecosystem services, reduce the pressure on international virtual water trade, and generate important lessons providing knowledge for development. It will also promote the integration of ecosystem and water resources management plans at provincial and basin scales, along with the establishment of an information management platform to support integrated restoration and protection measures in the YRB.
- **Climate change mitigation.** The Program will promote carbon sequestration through soil and water conservation activities to improve land management practices and ecosystem protection, increase vegetation coverage through sustainable afforestation and reforestation, and reduce GHG emissions through improved management of fertilizer application, wastewater, and manure treatment. Activities related to improved water use efficiency are also expected to contribute to climate change mitigation, by reducing the amount of energy consumed by irrigation systems. Beyond mitigation, the Program will enhance adaptation and increase resilience to climate change and related extreme weather events by reducing sediments and flood risks through soil and water conservation while mitigating drought impacts through improving water conservation and by integrated planning. The Program will also support capacity building within the YRCC to better mainstream climate change in basin-level planning and allocation processes.
- **Knowledge for development.** The integrated ecosystem and water management approach applied in this Program and the innovations in assessing and monitoring water consumption will not only support China in addressing the challenges of water scarcity in the YRB but also provide important lessons and demonstration effects for water scarce regions worldwide. The Program will also provide valuable lessons on integrated catchment-level landscape approaches to combating land degradation and achieve biodiversity outcomes, building on the experience of past projects supported by the World Bank on the Loess Plateau rehabilitation and control of desertification and land degradation.

16. **A Program for Results (PforR) has been identified as the most appropriate instrument to help improve the targeting and results orientation of public expenditures.** The Government has an ambitious national program for ecological protection and high-quality development in the YRB, with strong commitments from central, provincial, and local governments and agencies. The Program will introduce the integrated water and ecosystem management approach, initially in the two Program provinces following the national approach to innovation. If this is successful, there is a large potential for scale up across the YRB, to help drive the Government's YRB programs toward success and multiply outcomes. In this sense, Henan and Shaanxi are both pioneering provinces in the integration of ecosystems and water resources considerations under scarcity and are well placed to extract lessons useful to other provinces, and even other countries/basins with similar challenges. The PforR focuses on a subset of activities where the Government wants to

enhance the Program's efficiency, effectiveness, and impact of expenditures by linking the disbursement of funds to the achievement of specific results. The reliance on Government systems, and the design of the Program through a nested hierarchy, is aligned with China's fiscal structure and differentiated responsibilities across governance levels, in line with the principles outlined in the YRB Plan. The PforR instrument leverages significant resources under existing Government programs, providing for impact beyond traditional Investment Project Financing (IPF).

17. The Program builds on extensive World Bank experience in China and globally in reconciling the tradeoffs around complex water and environmental issues, notably the approach to water management developed in China and integrated landscape approaches to catchment management in the YRB (Box 3). The Program also draws on synergies across the portfolio in China as part of a systematic effort within the country program to support the introduction of results-based financing and leverage strategic government programs that contribute to GPGs. This includes a range of measures across various sectors as part of the World Bank's efforts to pursue goals and contribute to GPGs in areas such as environmental protection and biodiversity, climate change mitigation, and the reduction of plastic waste pollution. The results-based approach builds on previous provincial PforRs such as the Sichuan Forest Ecosystem Improvement in the Upper Reaches of Yangtze River Basin Program, the Guangxi Poverty Reduction Program, and the Hunan Governance and Rural Public Service Delivery Program. These are intended to help government create incentive frameworks that can improve implementation and introduce international practices. The Program is part of a comprehensive framework for the Yellow and Yangtze River Basins, which cover nearly 30 percent of the national territory, roughly 42 percent of water resources and a major share of GDP. The approach builds on lessons learned from innovative investment projects such as the Turpan Water Conservation Project, the Tarim River Basin Management Project, and the Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project, along with the Yangtze River Protection and Ecological Restoration Program approved in 2021, while drawing on the World Bank's international experience with river basin management in the Ganga, Senegal, Amazon, and Zambezi river basins, among others. Through this approach, it is also expected that Program experience will contribute to the World Bank's global knowledge on mechanisms for integrated landscape approaches to catchment management in multilevel governance contexts (such as federated systems or those under regional management bodies) and thus be valuable for other clients looking to make a similar transition as their development needs evolve.

Box 3. Evolution of World Bank Support to Integrated Landscape Approaches to Catchment Management in the YRB

The World Bank has financed more than 170 projects in China with over US$26 billion in commitments since 1981. The majority of these have been in transport (31 percent of financing), water (24 percent), and energy (16 percent) (figure 1). Of these, the nine provinces within the YRB have received US$8.98 billion through 62 projects (figure 2).

The Program represents the next in a series of World Bank-financed projects supporting China's efforts to address integrated landscape approaches to issues of water management. Support in the YRB includes a large number of water and environment projects such as the Loess Plateau Watershed Rehabilitation Project (P003540), Integrated Modern Agriculture Development Project (P125496), Water Conservation Project II (P114138), Second Loess Plateau Watershed Rehabilitation Project (P056216), and Wanjiazhai Water Transfer Project (P036405) along with a series of projects related to the construction of the multipurpose Xiaolangdi Dam (P003562 and P034081) and associated resettlement (P003644).

Figure 1. Sectoral Distribution of World Bank Financing in China during the Four Phases of Development

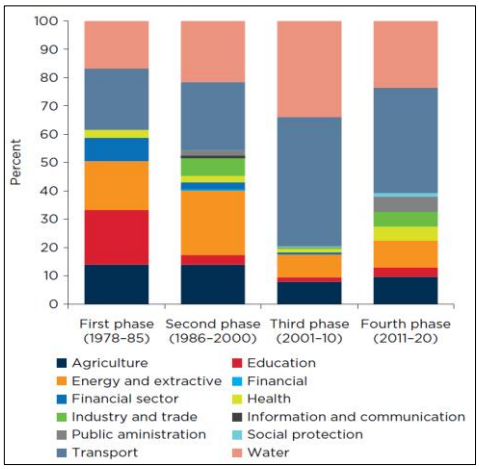


Figure 2. Projects in Provinces within the YRB

The design of these projects has evolved to respond to the changing context of development in China and the YRB. Early support in the YRB focused on infrastructure and water security. In 1994, construction of the 154 m Xiaolangdi dam focused on improving flood control and protecting 103 million people in the lower reaches of the YRB, controlling siltation, providing water for 2 million hectares of irrigation and domestic water supplies, along with 1,800 MW of hydropower capacity, and institutional support for the YRCC. The Loess Plateau Watershed Rehabilitation projects approved in 1994 and 1999 encouraged natural regeneration of grasslands and tree and shrub cover, reduced sediment flow into the Yellow River by more than 100 million tons per year, and doubled household incomes through agricultural productivity enhancement and diversification. The Ningxia Desertification Control and Ecological Protection Project (P121289), approved in 2012, introduced innovative approaches to address the main drivers of desertification and unsustainable land use practices and protect key farmland and infrastructure by tree and shrub shelterbelt plantations.

In more recent years, the focus has evolved to build on the considerable capacity for infrastructure development and focus on contemporary challenges of inter-jurisdictional cooperation and cross-sectoral coordination, and more complex issues around integrated natural resource management. The Program builds on the wealth of experiences and lessons learned throughout decades of cooperation and supports a nested hierarchy of activities that link financing with performance-based targets at the sub-basin, provincial, and basin levels, to address challenges of ecological protection and water scarcity and pollution. World Bank support aims to unblock institutional processes that are limited not by technical capacity but by constraints and incentives that undermine collaboration and cooperation across and between levels of government. The Program aims to have long-term institutional impact, improving quality by linking financing to performance-based targets, strengthened monitoring and evaluation (M&E), aligned with the environmental and social systems, and demonstration effects that amplify the impacts achieved within the Program's demonstration areas into longer-term provincial and basin-wide outcomes.

II. PROGRAM DESCRIPTION

A. Government Program

18. **The Government program is articulated in the YRB Plan, issued on October 8, 2021.** The YRB Plan is a broad, overarching document that builds on the priorities articulated in September 2019,[71] outlining six key areas: (a) enhancing ecological and environmental protection; (b) promoting water conservation; (c) strengthening disaster management; (d) enhancing integrated pollution management; (e) facilitating high-quality development; and (f) protecting, inheriting, and promoting the Yellow River culture. The YRB Plan requires the central government to establish a Central Leadership Group with an office under the National Development and Reform Commission (NDRC) in charge of guiding implementation, reviewing planning policies, and coordinating major inter-jurisdictional issues. Provincial governments are responsible for organizing and promoting implementation of the YRB Plan through sub-national provincial plans, while municipal and county governments are responsible for implementation of these. In addition, the YRB Plan designates the YRCC as the agency in charge of basin-wide monitoring, regulation, supervision, and flood management and is further tasked with providing technical support to the Central Leadership Group. The PforR Program (the Program) will support a subset of activities at the basin level as part of the YRCC program and from the sub-national provincial programs in Henan and Shaanxi Provinces (Figure 3). These provinces were selected based on technical criteria (both provinces are in the middle reach of the YRB, where erosion, ecosystem degradation, and water scarcity are pronounced) and program readiness (both provinces had developed comprehensive provincial programs, with dedicated funding, following the precepts of the YRB Plan).

19. **The YRCC program is outlined in the 'Water Security Plan for the YRB Ecological Protection and High-Quality Development'.** Following the mandate of the overarching YRB Plan and based on over 70 years of YRB experience, the YRCC identified the key water resources management challenges across the basin and prepared its own strategic plan to support the YRB ecological protection and high-quality development. The YRCC Plan focuses on five areas: (a) ensuring water resources security, including strengthening control over water resources utilization, promoting water saving, optimizing water resources allocation, and improving rural water supply; (b) enhancing water ecological protection and restoration, including protecting water sources, restoring rivers as ecological corridors, promoting delta protection and restoration, strengthening groundwater protection, and enhancing monitoring of critical rivers and lakes; (c) strengthening soil and water conservation, including promoting natural restoration, improving the monitoring of soil erosion, and enhancing integrated soil and water conservation; (d) improving flood management, including flood management infrastructure, scientifically regulating water and sediments, and enhancing capacity building on disaster management; and (e) enhancing basin management capacity, including improving the legislative and regulatory provisions for protection and management of the YRB, promoting inter-jurisdictional cooperation and cross-sectoral coordination, enhancing the capacity of basin organization, establishing a Smart Yellow River platform, and promoting relevant research.

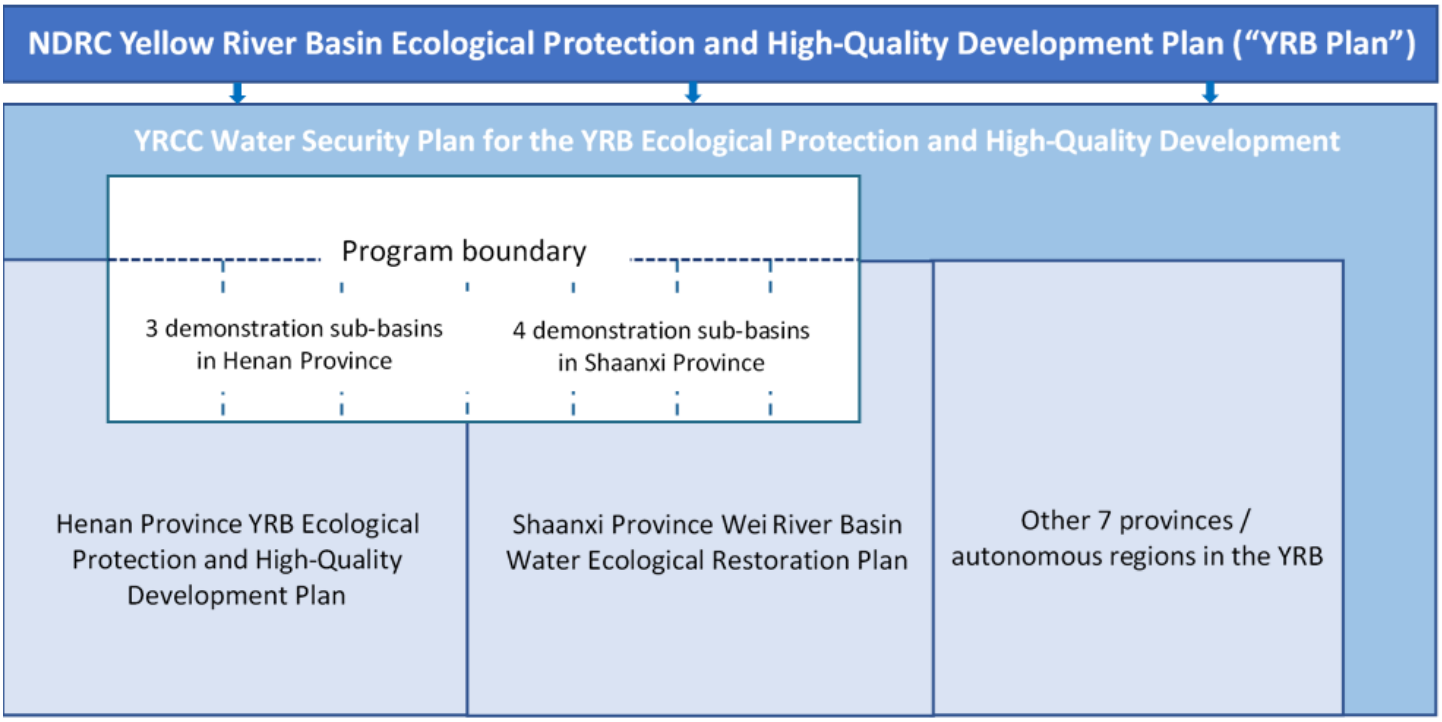
20. **The provincial program in Henan Province is outlined in the 'Henan YRB Ecological Protection and High-Quality Development Plan'.** The catchment area of the YRB within Henan Province amounts to about 36,200 km^2, making up 5 percent of the total YRB and 22 percent of the provincial land area. To improve basin management and promote high-quality development, the Plan includes the following key areas: (a) enhancing ecosystem protection and restoration, including restoring ecological corridors, enhancing wetland protection and restoration, promoting integrated spatial planning, ecological governance, and strengthening ecosystem management based on local conditions; (b) strengthening the efficient use of water resources under rigid constraints, protecting water sources and conserving water, and optimizing water resources allocation; (c) improving the long-term stability of the river, including by strengthening flood

[71] Speech at the symposium on ecological protection and high-quality development in the YRB (*link*).

management, promoting integrated river management, and enhancing the capacity for disaster management and risk reduction and integrated management of river channels and floodplains; (d) strengthening pollution management, including enhancing urban and rural domestic pollution management and promoting integrated pollution management in the industrial and agricultural sectors; and (e) promoting capacity building and institutional reform, including promoting inter-jurisdictional cooperation and cross-sectoral coordination, enhancing local regulations and legislations for protection of the YRB, and leveraging social capital and private financing to support the ecosystem protection and high-quality development.

21. **The provincial program in Shaanxi Province is outlined in the 'Shaanxi Province Wei River Basin Water Ecological Restoration Plan'.** The Wei River is the largest tributary of the Yellow River, with a catchment area of 0.135 million km^2 (18 percent of the YRB), flowing through Gansu, Ningxia, and Shaanxi Provinces, carrying 19 percent of the basin runoff and 30 percent of sediment of the YRB. The catchment area within Shaanxi Province amounts to about 0.067 million km^2, making up 50 percent of the total Wei River Basin. The Wei River Basin in Shaanxi occupies one-third of the provincial land area but provides 56 percent of the arable land and 72 percent of the irrigated area as well as houses two-thirds of the provincial population and GDP. The 'Shaanxi Province Wei River Basin Water Ecological Restoration Plan' issued in 2021 outlines tasks in six areas, including water conservation, ecological protection and restoration, and water pollution reduction, among others. The plan includes a set of targets at the provincial level, such as improving irrigation efficiency, increasing water productivity, reducing water supply pipeline leakage, increasing ecological flow and water quality compliance rates, enhancing soil and water conservation, and increasing forest coverage. To achieve those targets, an investment plan has been made for those priority activities related to irrigation water saving, water conservation, reforestation, water and soil conservation, wetland restoration and protection, urban and rural wastewater collection and treatment, and agricultural NPS pollution management.

Figure 3. Government program and PforR Program boundary

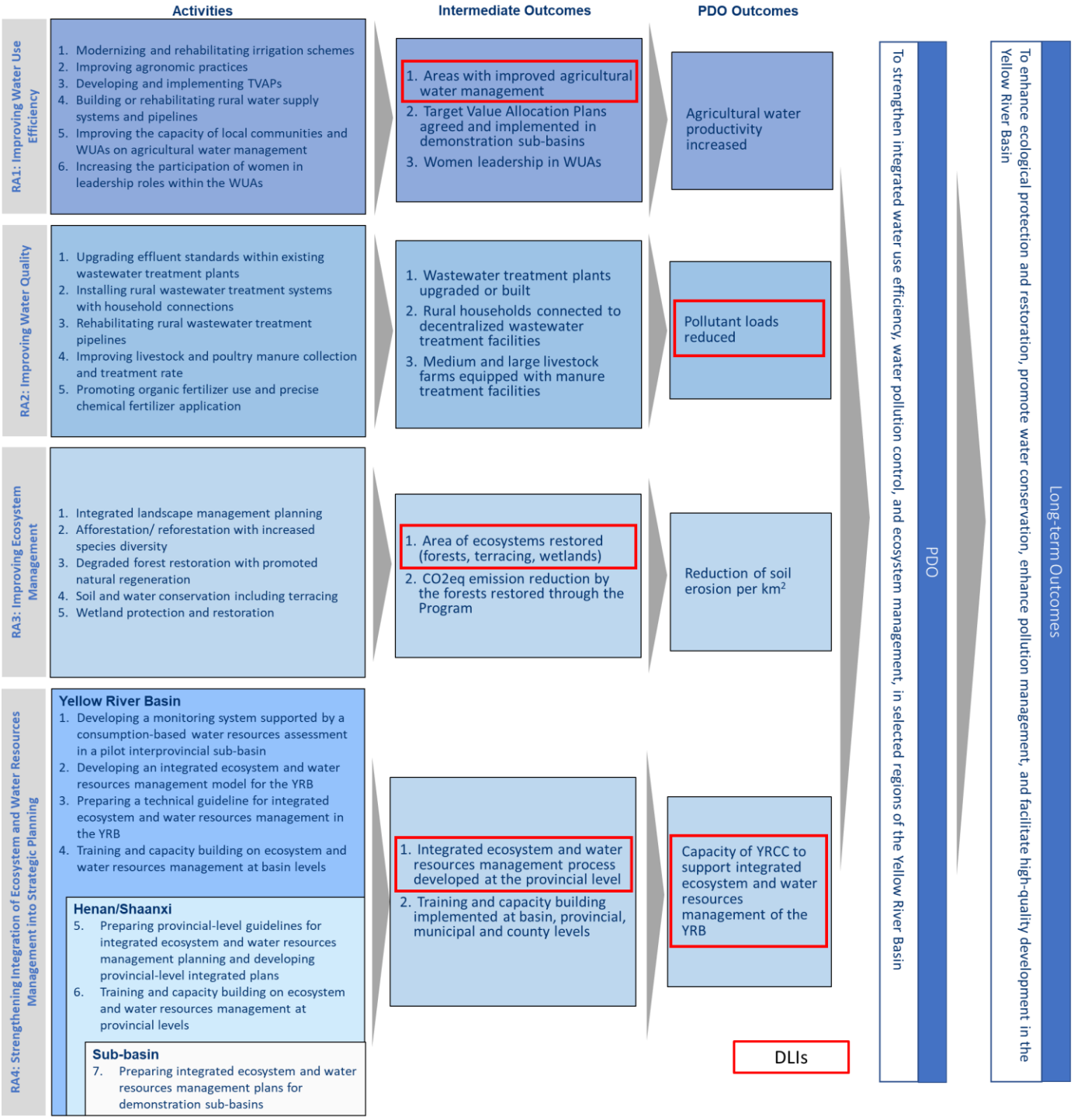


B. Theory of Change

22. **The Program contributes to a long-term vision of an economically productive, ecologically sustainable, and climate resilient YRB.** The core challenges that the Program addresses include insufficient coordination of ecological and water management actions across jurisdictions and sectors; lack of knowledge and tools at the provincial level in the form of guidelines, regulations, policies, and plans to realize water conservation and ecological protection; insufficient or inefficient wastewater collection and treatment in the rural areas; deficiencies in the management of NPS pollution, including farm manure; a need for climate change adaptation and resilience building; and greater technical understanding on key issues of water consumption and ecological management, particularly under expected climate shifts within the YRB. The Program will support interventions that address these challenges on three levels: (a) basin-level coordination, technical guidance, and capacity building; (b) provincial-level development of integrated landscape approaches for catchment management; and (c) sub-basin-level ecological protection and integrated water management. The expected results are captured in the four outcomes linked to the Program Development Objective (PDO)—on water use efficiency, water pollution reduction, ecosystem management, and the integration of the three—and reflect the Program's contribution to the Government's program. The Theory of Change is outlined in figure 4, with a detailed description of the Program structure, activities, and outcome indicators presented in section II.C.

23. **Key assumptions required for the Program's success are that:** (a) cross-sectoral coordination and inter-jurisdictional cooperation introduced by the Program at the national, provincial, and local levels will be sufficient both for implementation of Program activities (for example, information and data sharing) and M&E of Program results; (b) provincial policies developed and approved under the Program are enforced and not contradicted by county- or municipality-level actions; (c) events beyond the control of the Program, such as droughts, do not undermine the ability to meet the water quality targets or minimum flow requirements; (d) improved treatment, management, and reuse of on-farm manure leads to reduced nutrient runoff; and (e) there are no major external changes to pollutant loads that overwhelm the Program's contribution to key pollution reduction targets.

Figure 4. PforR Theory of Change



C. PforR Program Scope

24. **The Program will support a subset of activities at the basin level as part of the YRCC program and from the sub-national provincial programs in Henan and Shaanxi Provinces as a contribution to the national program for Ecological Protection and High-Quality Development in the YRB.** To address the main challenges of water scarcity, water pollution, and ecosystem degradation, the Program selected all relevant areas from the Government's programs dealing with these challenges and will thus support these Government programs in water saving and water use efficiency, water pollution management, and ecosystem protection and restoration while promoting innovation through integrated landscape approaches to catchment management. The Program will focus on select demonstration sub-basins in Henan and Shaanxi and scale up the integrated approach to provincial level for the YRB (Henan) and the Wei River Basin (Shaanxi), as well as across the whole of the YRB through the YRCC (Table 1). The World Bank's international experience and knowledge will be used to develop and introduce an innovative, integrated water and ecosystem management approach into the Government's program based on improved methodologies for the assessment of water balance, water pollution, and ecosystems. These will be used to identify tradeoffs and optimize options for improved water and ecosystem management, introducing incentives for cross-sectoral and inter-jurisdictional collaboration to further leverage the Government's program.

25. **At the basin level, the Program is anchored in YRCC's 'Water Security Plan for the YRB Ecological Protection and High-Quality Development' and will support institutional capacity building to scale up sub-basin- and provincial-level results.** The Program leverages the mandates given to the YRCC as part of the YRB Plan to enhance the YRCC's technical and regulation capacity. The Program will support results in three key areas aimed at developing innovative tools and scaling up integrated ecosystem and water resources management: (a) develop a new assessment and management tool to estimate water consumption and identify water constraints in the YRB, along with the development of an integrated hydro-economic model to optimize decision-making under uncertainty, including to climate change, enhancing the regulation of water withdrawal permits, and applying these tools to a pilot interprovincial sub-basin shared between Henan and Shaanxi Provinces; (b) further develop an integrated ecosystem and water resources management model for the YRB that optimizes water allocation for multiple purposes, including ecological flows, environment carrying capacity, and economic sectors; and (c) incorporate the integrated ecosystem and water management approaches and innovative tools developed under this Program into the YRB protection standards and guidelines to further guide basin management.

26. **In Henan Province, the Program is anchored in the 'YRB Ecological Protection and High-Quality Development Plan', with demonstration activities in three sub-basins.** These include the Hong Nong Jian, Qing Long Jian, and Jian River Basins[72] and provide a good example of the water and ecosystem related challenges in the YRB. These areas cover 6,900 km^2 in the Sanmenxia municipality, representing about 20 percent of the YRB in Henan. Sanmenxia is a water stressed area with poor water infrastructure and degraded ecosystems. About 30 percent of the land area in the sub-basins suffer from soil erosion, causing siltation of dams and limited habitat value for biodiversity. This makes ecosystem restoration a high priority for the Government. The Program will support Sanmenxia's priority investments to address these challenges and will include activities on (a) water use efficiency improvement, including establishing and implementing water consumption targets through target value allocation plans (TVAPs); improving agricultural water management through irrigation district modernization, water saving irrigation, high-standard farmland development, crop pattern adjustment, and irrigation management platform development; enhancing the capacity of farmers and water user associations (WUAs); and improving rural water supply; (b) water quality improvement, including wastewater treatment plant upgrading, agricultural NPS pollution control, and rural domestic wastewater management; and (c) ecosystem restoration

[72] The three demonstration sub-basins in Henan cover five counties and one municipality district: Lingbao, Xiazhou, Hubin, Mianchi, and Yima counties and Sanmenxia City.

and management, with a focus on water source protection, water and soil conservation, wetland restoration, re/afforestation and forest ecosystem management, terracing, and river embankment improvements, among others. In addition, the Program will support provincial-level results, including the ability to carry out integrated ecosystem and water resources management plans, which are expected to inform future programs and investments in the province.

27. **In Shaanxi Province, the Program is anchored in the Wei River Basin Water Ecological Restoration Plan, with demonstration activities in four sub-basins.** These are the Beiluo, Jing, Qishui, and Shichuan River basin areas that cover about 13.5 percent of the area in the southeastern part of the Wei River Basin in Shaanxi. The geographic boundary of the Program includes nine counties in two municipalities (Xianyang and Tongchuan).[73] The challenges facing the upstream reaches in these demonstration sub-basins include both water conservation and NPS pollution, while water and soil erosion is the main problem in the middle reaches and NPS pollution in the downstream. The Program will include demonstration activities included in the 14th Five-Year Plan (FYP) and support institutional capacity building toward (a) water use efficiency improvement, including establishing and implementing water consumption targets through TVAP, improving agricultural water management through water saving irrigation and agronomic practice improvement, and enhancing the capacity of farmers and WUAs; (b) water pollution reduction, with a focus on NPS reduction from chemical fertilizer consumption, wastewater collection and treatment, and manure management; and (c) ecosystem restoration and management, with a focus on water source protection, water and soil conservation, wetland restoration, re/afforestation and forest ecosystem management, terracing, and river embankment improvements, among others. The Program will also support provincial-level results, including the ability to carry out integrated ecosystem and water resources management plans, which are expected to inform future programs and investments in the province.

28. **The Program's four results areas (RAs) are designed to address the key challenges of water scarcity, water pollution, and ecosystem degradation and their integration at the basin, provincial, and sub-basin levels.** These are aligned with the objectives of the Government program and were informed by assessments of the water balance, water quality, and ecosystems. They are nested at three levels: (a) at the demonstration sub-basin level, integrated ecosystem and water resource management plans will be piloted following a water consumption approach and selected interventions implemented to increase water use efficiency, improve water quality, and restore key ecosystems; (b) at the provincial level, these integrated plans will be scaled up through the development of technical guidelines for integrated ecosystem and water resource management planning that will be applied in other sub-basins in Henan and Shaanxi to guide planning and implementation of investments under future government programs; and (c) at the basin level, the YRCC will prepare a technical guideline for integrated ecosystem and water resources management in the YRB based on consumption-based water balance assessments and modeling carried out at a pilot interprovincial sub-basin, with the objective of replicating this approach within the whole YRB.

29. **Duration.** The timeline for the Program is 2022 to 2027. This is aligned with the timeline for implementation of the Government's program, with the Program preparation and implementation period coinciding with the Government's schedule to prepare and implement provincial plans and implementation of the 14th FYP (2021-2025). The timeline for the Program allows the World Bank to engage early, introduce international experience and knowledge, and support the Government with innovative technologies and good international practices. It also allows for the utilization of results and experiences of the Program to inform the next phase of investment planning (15th FYP).

[73] The four demonstration sub-basins in Shaanxi spread across nine counties: Yaozhou, Yintai, Wangyi, Yijun, Xunyi, Liquan, Yongshou, Qianxian, and Xingping, in two municipalities, Tongchuan and Xianyang.

Table 1. Overview of the Government program and PforR Program: Results Areas, Activities, and Geographic Area

Government program	National program	'Yellow River Basin Ecological Protection and High-quality Development Master Plan' (YRB Plan) National guiding plan with six key areas: (a) ecological and environmental protection, (b) water conservation, (c) disaster management, (d) pollution management, (e) high-quality development, and (f) Yellow River culture. Covering 9 provinces and 752,443 km^2.			
	YRCC program	YRCC's 'Water Security Plan for the YRB Ecological Protection and High-Quality Development' Basin agency plan with five key areas on ensuring water resources security, enhancing water ecological protection and restoration, strengthening soil and water conservation, and enhancing basin management capacity. Covering 9 provinces and 752,443 km^2.			
	Henan Provincial program	'Henan YRB Ecological Protection and High-Quality Development Plan' Provincial plan with areas on enhancing ecosystem protection and restoration, enhancing water use efficiency, strengthening flood management, strengthening pollution management, and promoting capacity building and institutional reform. Covering 7 municipalities and 36,200 km^2.			
	Shaanxi Provincial program	'Shaanxi Province Wei River Basin Water Ecological Restoration Plan' Provincial plan with six key areas, including water conservation, ecological protection and restoration, and water pollution reduction. Covering 66 counties and 67,000 km^2.			
PforR Program		RA 1: Improving Water Use Efficiency	RA 2: Improving Water Quality	RA 3: Improving Ecosystem Management	RA 4. Strengthening integration of ecosystem and water resources management into strategic planning
	Program Activities	• Modernizing and rehabilitating irrigation schemes • Improving agronomic practices • Developing and implementing TVAPs • Building or rehabilitating rural water supply systems and pipelines • Improving the capacity of local communities and WUAs on agricultural water management • Increasing the participation of women in leadership roles within the WUAs	• Upgrading effluent standards within existing wastewater treatment plants • Installing rural wastewater treatment systems with household connections • Rehabilitating rural wastewater treatment pipelines • Improving livestock and poultry manure collection and treatment rate • Promoting organic fertilizer use and precise chemical fertilizer application	• Integrated landscape management planning • Afforestation/ reforestation with increased species diversity • Degraded forest restoration with promoted natural regeneration • Soil and water conservation including terracing • Wetland protection and restoration	• Preparing integrated ecosystem and water resources management plans for demonstration sub-basins • Preparing provincial-level guidelines for integrated ecosystem and water resources management planning, and developing provincial-level integrated plans • Developing a monitoring system supported by a consumption-based water resources assessment in a pilot interprovincial sub-basin • Developing an integrated ecosystem and water resources management model for the YRB • Preparing a technical guideline for integrated ecosystem and water resources management in the YRB • Training and capacity building on ecosystem and water resources management at the provincial and basin levels
	Boundary	Henan: Hong Nong Jian, Qing Long Jian, and Jian sub-basins, covering 6,900 km^2 (five counties and one municipality) Shaanxi: Qishui, Jing, Shichuan, and Beiluo sub-basins, covering 38,842 km^2 (nine counties in two municipalities)			Demonstration sub-basins in Henan and Shaanxi Yellow River Basin Henan Province, Wei River Basin Shaanxi Province YRB-wide through support to YRCC

30. **The Program's RAs are designed around an integrated landscape approach to catchment management.** These support a nested hierarchy of activities with activities under RAs 1, 2, and 3 implemented in demonstration sub-basins, while provincial and basin-wide results will be supported through RA 4. Activities within the demonstration sub-basins are built on baseline assessments of current land use patterns, biophysical and socioeconomic conditions, a remote sensing-based water balance to determine water consumption, modeling of water quality, and a diagnostic of the drivers of land degradation and biodiversity loss. These assessments were used to guide the definition of priority interventions that includes activities related to water use efficiency, water pollution control, and ecosystem management at the demonstration sub-basins (RA 1, 2, and 3) and also support the preparation of integrated ecosystem and water resources management plans within the demonstration sub-basins (RA 4). Based on the experiences and lessons learned from the preparation of these integrated ecosystem and water resources management plans within the demonstration sub-basins, RA 4 will support upscaling through the development of provincial technical guidelines and their application to preparation of provincial-level integrated plans for the Yellow River in Henan Province and the Wei River in Shaanxi Province. RA 4 will also support the YRCC to leverage the experiences and lessons learned to deliver basin-wide results on the promotion of integrated ecosystem and water resources planning and the supporting information systems and tools. The cost-benefit analyses (CBAs) (for RA 1 and 3) and cost-effectiveness analysis (CEA) (for RA 2) (section IV and annex 3) show the proposed investments have a sound strategic rationale, are economically viable, and will be carred out in a cost-beneficial/cost-effective way. Specifically,

- **RA 1: Improving water use efficiency.** This RA will support selected interventions to increase water use efficiency within sustainable limits (Table 1). RA 1 activities will be implemented in the demonstration sub-basins in Shaanxi and Henan Provinces. The activities will improve water productivity through modernization and rehabilitation of irrigation schemes, enhanced capacity and women's leadership of WUAs for agricultural water management and increased water use efficiency within agreed target values for water consumption. The combination of these activities will increase water productivity, reduce water consumption, and further safeguard ecological flows for ecosystems, which contribute to global biodiversity outcomes.

- **RA 2: Improving water quality.** This RA will support selected water pollution management interventions to address water pollution (Table 1). RA 2 activities will be implemented in the demonstration sub-basins in Shaanxi and Henan Provinces. The activities will reduce pollutant loads through improved collection and treatment of rural wastewater and addressing NPS pollution from the livestock sector.[74] These activities will further reduce GHG emissions from wastewater and livestock farms and improve water quality to support critical ecosystems, thus directly contributing to the GPGs of climate mitigation and biodiversity while indirectly contributing to reductions in the leakage and transmission of plastic waste through waterways into the ocean. Increasing collection and treatment of wastewater is also important from a climate change adaptation perspective, as wastewater can mix with floodwaters entering natural water bodies during climate-change-induced floods, aggravating water pollution and associated public health risks.

- **RA 3: Improving ecosystem management.** This RA will support selected ecosystem protection interventions to address ecosystem degradation and improve resilience (Table 1). RA 3 activities will be implemented in the demonstration sub-basins in Shaanxi and Henan Provinces. The activities will promote ecosystem restoration and catchment management while addressing the key drivers of biodiversity loss within the demonstration sub-basins. The RA will introduce a shift from monoculture forest to a diversified forest structure with mixed species, to enhance environmental benefits and increased resilience to natural disasters. It will also restore degraded

[74] As discussed in annex 3, the main drivers of noncompliance in water quality within the demonstration sub-basins are point sources of pollution from rural domestic wastewater and non-point sources from livestock farms and agricultural runoff. Other NPS pollution from agricultural practices will be addressed through the improvements in water use efficiency under RA 1.

ecosystems using close-to-nature approaches, increase interconnectivity, and support habitat conservation for biodiversity. Among others, these activities will improve ecological functions, enrich biodiversity, enhance resilience to climate change, and facilitate carbon sequestration, thus contributing to the biodiversity and climate mitigation GPGs.

- **RA 4: Strengthening integration of ecosystem and water resources management into strategic planning.** This RA will scale up selected innovations to the sub-basin, provincial, and YRB levels (Table 1). RA 4 activities will be implemented by Henan and Shaanxi at the demonstration sub-basins and provincial levels and by the YRCC at the YRB level. The activities will embed the integrated water and ecosystem management approaches into the Government programs to promote resilient, sustainable, and high-quality development for the demonstration sub-basins and the Program provinces while also introducing innovative consumption-based approaches to the assessment, allocation, and monitoring of water resources in the YRB. These integrated plans will include estimates about climate vulnerability and climate change impacts and promote adaptation and mitigation efforts (ecosystem-based adaptation, mitigation through water use efficiency and ecosystem management, and others) and gender. This RA therefore has large potential to contribute to all Program GPGs.

31. **Program financing.** The total Program financing is estimated at US$1,520 million, of which US$1,140 million (75 percent) will be financed by the Government and US$380 million (25 percent) will be financed by an IBRD loan (Table 2). Of the US$1,140 million Government financing, it is estimated that US$36 million (3.2 percent) will come from YRCC, US$421 million (36.9 percent) will come from Henan Province, and US$683 million (59.9 percent) will come from Shaanxi Province. Of the US$380 million IBRD loan, US$6.5 million will be allocated to a disbursement linked indicator (DLI) supporting the YRCC and the basin-level program, with US$186.75 million each allocated to Henan and Shaanxi Provinces in support of their respective sub-national programs. The proposed PforR will exclude high-risk activities with potentially adverse impacts on the environment and or affected people. In addition, it will exclude activities that involve the procurement of (a) works estimated to cost US$75 million equivalent or more per contract, (b) goods and non-consulting services estimated to cost US$50 million equivalent or more per contract, or (c) consulting services estimated to cost US$20 million equivalent or more per contract.

Table 2. Program Financing (2022–2027)

Source	YRCC		Henan Province		Shaanxi Province		Total	
	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total
Government	36	84.7	421	69.3	683	78.5	1,140	75
IBRD	6.5	15.3	186.75	30.7	186.75	21.5	380	25
Total	**42.5**	**2.8**	**607.75**	**40.0**	**869.75**	**57.2**	**1,520**	**100**

D. Program Development Objective(s) (PDO) and PDO Level Results Indicators

32. **The PDO** is to strengthen integrated water use efficiency, water pollution control, and ecosystem management, in selected regions of the Yellow River Basin.

33. **PDO level indicators:**

(a) Agricultural water productivity increased (tonnes/m^3)

(b) Pollutant loads reduced (tonnes/year)

(c) Reduction of soil erosion per km^2 (tonnes/year)

(d) Capacity of YRCC to support integrated ecosystem and water resources management of the YRB (text)

E. Disbursement Linked Indicators and Verification Protocols

34. **The Program's DLIs quantify the parameters and values that need to be achieved to trigger disbursements.** Each province and the YRCC are responsible for measuring achievement of DLIs within a consistent framework allowing for aggregation and reporting at the Program level. DLIs were chosen as they (a) represent improvements in key aspects of the Government's program and the key priorities in each RA, (b) are within the control of the Government, (c) are achievable in the Program period, and (d) are verifiable. They prioritize the use of existing indicators and reporting mechanisms within the Government system where possible, to ensure sustainability.[75]

35. **Verification will be carried out by a third-party agent based on data collected by the YRCC, provincial, and sub-provincial agencies.** At the sub-basin level, data collection will be carried out by the corresponding municipal/city/county Program Management Office (PMO), whereas the Provincial PMO (PPMO) will monitor progress of provincial activities. The Basin Program Management Office (BPMO) will monitor progress of YRB activities. The verification agencies will be contracted by the BPMO, PPMO and/or sub-provincial PMOs using a consistent and agreed verification protocol. The World Bank will review and provide feedback on the terms of reference (TOR) for the verification agencies, with the final agreement subject to confirmation of acceptability by the World Bank. The Program verification procedures, implementation arrangements, and M&E plan for the Program will be included in a Program Implementation Plan (PIP) to be prepared by the YRCC, Henan, and Shaanxi, by Program effectiveness, to facilitate implementation.

[75] While the definition of the DLIs is the same for Henan and Shaanxi, the interventions to deliver on the expected results are site specific, with costs varying on a range of factors such as topography, ecosystem status, crop types and others, hence the differentiated unit rates for the DLIs.

Table 3. Overview and Rationale for Program DLIs

DLI	Rationale for Selection
RA 1: Improving water use efficiency	
DLI 1: Areas with improved agricultural water management (ha)	To improve water use efficiency and reduce water consumption in the agricultural sector. It measures areas applying infrastructural and agronomy measures to improve agricultural water management. Improved agricultural water management and reduced water consumption (a) imcreases resilience toward potential extreme climate events, that is, droughts, under climate change and (b) reduces energy consumption, as well as associated GHG emissions, for water pumping and diversion.
RA 2: Improving water quality	
DLI 2: Pollutant loads reduced (tonnes/year)	To improve water quality. It measures reductions in the annual pollutant loads (COD) from urban and rural point and non-point sources due to Program activities. The collection and appropriate disposal of wastewater is expected to reduce fugitive methane emissions (a potent GHG) from polluted waterbodies. Reducing pollutant loads entering into waterways is also critical for a future climate change scenario of increased scarcity, as it increases resilience against potential extreme events such as droughts by reducing risks of pollution events. In addition, climate-resilient designs will be required in Program-supported wastewater management interventions to minimize potential impacts of climate change, for example, by requiring elevated and flood-proof equipment, sealed buildings, watertight doors, flood pathways, constructed barriers, backup power, and others.
RA 3: Improving ecosystem management	
DLI 3: Area of ecosystems restored (forests, terracing, wetlands) (ha)	To strengthen improved ecosystem management. It supports sustainable forest management and restoration, terracing restoration for soil erosion reduction and water retention capacity improvement, as well as wetland restoration for habitat and biodiversity conservation. Improved ecosystem management increases climate resilience by (a) providing stable wildlife habitats for species in a changing climate; (b) improving resilience toward droughts and floods by increasing water retention capacity; (c) increasing vegetation cover and quality of species, thus reducing runoff and potential desertification. Increased vegetation cover also increases carbon sequestration and contributes to climate change mitigation.
RA 4: Strengthening integration of ecosystem and water resources management into strategic planning	
DLI 4.1: Integrated ecosystem and water resources management process developed at the provincial level (text)	To strengthen integrated ecosystem and water resources planning at demonstration sub-basins, and their upscaling to provincial level. It supports multi-sectoral coordination and strategic planning, by integrating ecosystem and water resources management considerations under water constraints into a single plan. These plans and guidelines will consider the impacts of future climate change and will include actions for both mitigation (including by improving forest cover and quality and improving water use efficiency, leading to energy savings) and adaptation (ecosystem-based adaptation and increased resilience against extreme events).
DLI 4.2: Capacity of YRCC to support integrated ecosystem and water resources management of the YRB (text)	To incentivize upscaling of results from the provinces and promote a paradigm shift in the management of ecosystems and water resources at the basin level. Results will include the development of consumption-based hydro-economic models that inform the YRB-wide guidelines and increase climate resilience.

36. **DLI 1: Areas with improved agricultural water management (ha).** DLI 1 is defined as the areas with improved agricultural water management through (a) irrigation modernization, including irrigation and drainage rehabilitation, water saving equipment installation and application, farmland leveling, irrigation management platform development, and so on, and/or (b) agronomic practice improvement, including cropping pattern adjustment, no-till farming and straw returning, soil quality improvement, and appropriate application of agricultural mulching. These infrastructural and

agronomy improvements will improve agricultural water management to reduce total water consumption and increase water productivity.

- **Verification:** This will be carried out by (a) checking remote sensing and satellite data to verify the application of infrastructural improvements and (b) field visits to 10 percent of sampled schemes according to inventory data at county-level agricultural and water bureaus to corroborate remote sensing and satellite data.

37. **DLI 2: Pollutant loads reduced (tonnes/year).** DLI 2 is defined as the annual total amount of pollutant mass (COD) reduced from selected point (that is, from new or upgraded wastewater treatment plants [WWTPs] and new rural household connections) and non-point (that is, livestock farms) sources. Those sources make up majority of water pollution in the demonstration sub-basins according to a baseline analysis.

- **Verification:** (a) For upgraded and newly built WWTPs, pollution reduction can be estimated according to the water quality monitoring records of WWTP influent and effluent; those monitoring records can be verified at environmental bureaus; (b) for newly connected rural households to decentralized wastewater treatment facilities, pollutant reduction can be estimated according to the number of households connected and average population number per household per local statistics and pollutant generation per person per day according to technical standards; the number of households connected can be verified according to inventory data to be collected by the PMOs; and (c) for NPS, pollution reduction can be estimated by the number of livestock farms equipped with manure treatment facilities and the number/type of livestock in those farms. Pollution generation can be estimated based on the number and type of livestock according to MEE technical standards, and the number of farms equipped with treatment facilities can be obtained from the Departments of Agriculture and Rural Affairs (DARAs) at the appropriate level and verified through random sampling inventory of 10 percent of the farms. The above will be verified by the third-party verification agency (TPVA).

38. **DLI 3: Area of ecosystems restored (forests, terracing, wetlands) (ha).** DLI 3 is defined as hectares of (a) forests restored with three types of interventions: (i) mixed species plantations established, (ii) degraded and monoculture forests restored and transferred to mixed species forests, and (iii) assisted natural regeneration promotion. Specific technical requirements will apply, including the request for a survival rate of 85 percent one growing season after planting (for plantations and supplemental planting activities), low density, the use of local diversified native species, and other details. This will enable the extension of forest areas with mixed species and adjusted forest structure to enhance ecosystem functions and climate resilience; (b) terracing lands restored for erosion control defined as lands with a slope less than 25 degree restored to improve soil and water conservation and water retaining capacity; and (c) wetlands restored for habitat conservation, that is, areas of degraded wetlands restored to provide additional wildlife habitat for waterbirds and other wildlife taxa (fish, amphibians, insects).

- **Verification:** Verification will be carried out through random field surveys covering a percentage, to be agreed upon in the PIP, of county-level reported qualified areas in the completion reports submitted by all counties in demonstration sub-basins, which will, in turn, cover a percentage, to be agreed upon, of the total for each demonstration sub-basin.

39. **DLI 4.1: Integrated ecosystem and water resources management process developed at the provincial level (text).** This DLI provides incentives for multi-sectoral collaboration at different government levels, rewarding the preparation of integrated ecosystem and water resources management plans at the YRB in Henan Province and at the Wei River Basin in Shaanxi Province. The DLI will be achieved through three results: (a) Shaanxi and Henan Provinces approve

integrated plans for demonstration sub-basins (three for Henan, two for Shaanxi); the integrated plan needs to include a consumption-based water balance analysis and covers ecosystem management, water resource conservation, and water pollution reduction, considering future climate change impacts and including guidance on gender; (b) Shaanxi and Henan Provinces each approve one technical guideline on how to prepare integrated ecosystem and water resources management plans, based on the experience from the demonstration sub-basins; and (c) Shaanxi and Henan Provinces, respectively, approve an integrated plan for the Wei River Basin in Shaanxi and YRB in Henan.

- **Verification:** Official documents (sub-basin integrated plans, provincial guidelines) are approved and are made available to the TPVA. All these documents will need to be acceptable to the World Bank and hence they should have previously been reviewed by the World Bank and comments incorporated.

40. **DLI 4.2: Capacity of YRCC to support integrated ecosystem and water resources management of the YRB (text).** This DLI addresses challenges of institutional strengthening and inter-jurisdictional cooperation by working at the YRB level, incentivizing upscaling and integration of results from provincial to basin level, and promoting a paradigm shift in the way water resources are assessed. The DLI measures the results achieved in three aspects: (a) the YRCC pilots an operational water resources management and real-time monitoring system supported by a consumption-based water resources assessment in a pilot interprovincial sub-basin; (b) the YRCC develops an integrated ecosystem and water resources management model for the YRB that optimizes water allocation for multiple purposes, including ecological flows, environment carrying capacity, and economic sectors; and (c) the YRCC issues a technical guideline for integrated ecosystem and water resources management in the YRB based on consumption-based water balance assessment and modeling.

- **Verification:** (a) Reports summarizing the water resources management and real-time monitoring system, including the process followed for its development, are completed by the YRCC; (b) the basin-wide integrated ecosystem and water resources management model for the YRB is developed by YRCC; and (c) the technical guideline is issued. All these documents have previously been made available to the World Bank in draft and comments have been incorporated, and the documents have been made available to the TPVA.

III. PROGRAM IMPLEMENTATION

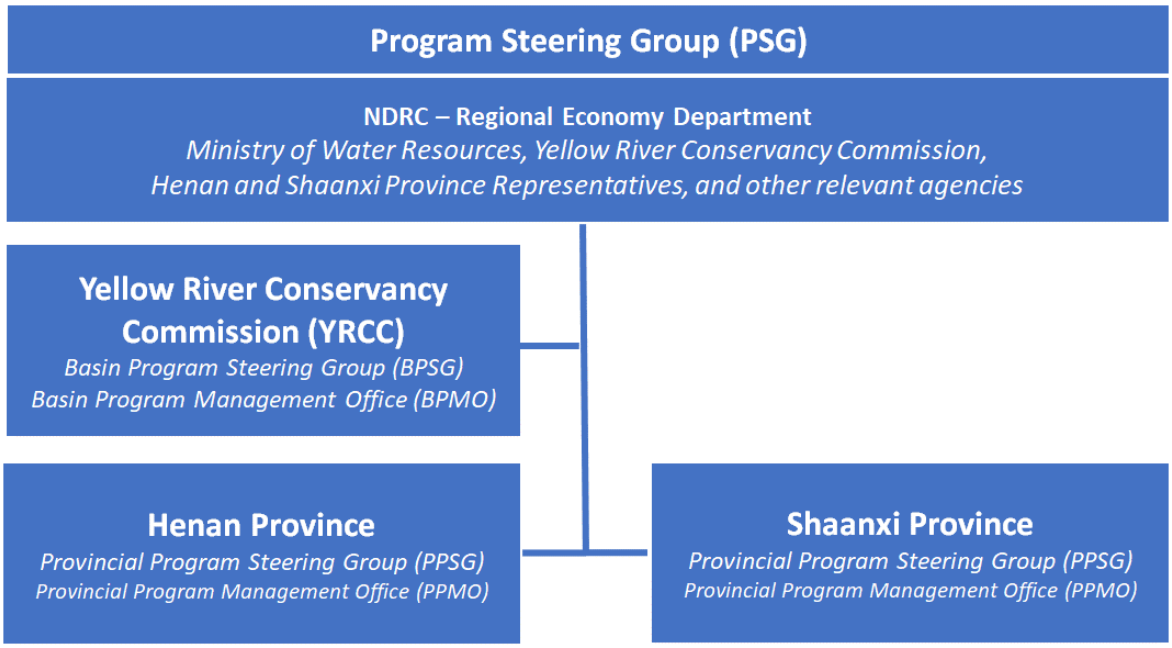
A. Institutional and Implementation Arrangements

41. **The institutional and implementation arrangements are aligned with those for the Government's national program for ecological protection and high-quality development in the YRB.** A Program Steering Group (PSG) will be established within the NDRC's Regional Economy Department (RED) and the NDRC will formalize it within three months of effectiveness. The RED houses the Central Leadership Group established to oversee implementation of the YRB Plan. The PSG will comprise leaders from the NDRC, MWR, YRCC and other relevant agencies, Henan Province and Shaanxi Province. The PSG will be responsible for reviewing Program progress and results, and providing guidance on Program implementation (Figure 5).

42. **At the basin level, a BPSG and BPMO have been established within the YRCC under the MWR.** The BPSG includes leaders from the YRCC and MWR and will provide guidance on the implementation of Program activities under the YRCC, whereas the BPMO will be responsible for achieving the Program results at the YRB level and for providing guidance to participating provinces as they develop and implement the Program. The BPMO will also be responsible for M&E of results at the YRB level, along with Program implementation support, including consolidated Program reporting.

43. **At the provincial level, Provincial Program Steering Groups (PPSGs) have been established in the two provinces to facilitate cross-sectoral coordination among departments.** The PPSG will be coordinated by the provincial governments. The PPSGs include leaders from the Provincial Development and Reform Commission (PDRC) and provincial departments of finance, water, ecology and environment, forest, agriculture, and others, as appropriate. The PPSGs will facilitate the completion of the integrated ecosystem and water resources management plans, where contribution from multiple sectors is needed. PPMOs have been established in the Provincial Department of Water Resources (PDWR) of both provinces, and both include representatives from provincial sectoral departments. PPMOs will operate under the guidance of the PPSGs and be responsible for Program preparation and implementation at the provincial level and preparation of provincial-level Program documents and plans. Similar institutional arrangements have been made for Program municipalities/cities/counties in Henan and Shaanxi, to provide close support and follow-up for activities carried out in demonstration sub-basins. An expert group will be established in Shaanxi and Henan, to provide technical advice.

Figure 5. Overview of Program Implementation Arrangements



B. Results Monitoring and Evaluation

44. **An M&E plan for the Program is under preparation with the indicators and targets summarized in the Results Framework Matrix.** Existing government systems for M&E in Henan, Shaanxi, and the YRCC will be consolidated into an M&E system to measure performance and results for the Program. These existing systems have proven effective at documenting the achievements and impacts of a wide range of ecological protection, water resource, and pollution control measures under other (World Bank and non-World Bank) projects. The BPMO, PPMO and PMOs will prepare and submit semiannual progress reports (including M&E reports), a midterm review report, and a Program Implementation Completion and Results Report (ICR) by Program close. Reporting on the Program will be consolidated by the BPMO, based on reports from the PMOs and PPMOs, and submitted to the World Bank for review. The midterm review report and the completion report of the BPMO, PPMOs and PMOs will also be submitted to the PSG for strategic guidance.

45. **The M&E system for the Program will draw on the capabilities of departments experienced in M&E within their area of responsibility.** Verification protocols will be based on existing Government technical guidelines, supported

through a strengthened verification system. The Departments of Finance monitor the management and disbursement of funds, the Departments of Water Resources (DWRs) are responsible for soil and water conservation, collection of data on water resource management, and monitoring of ecological flow compliance; Departments of Ecology and Environment (DEEs) are responsible for monitoring and providing water quality data; and the Forestry Bureaus (FBs) are responsible for monitoring and verification of forestry restoration outputs, while DARAs are typically responsible for monitoring of rural wastewater services, rural waste management, and agricultural NPS pollution. These responsibilties may vary by province and at different levels of government, and the Program will draw on the existing capacity at the provincial, municipal, and county levels depending on the activities to be monitored. TPVAs will be contracted to confirm that DLI requirements have been met. These TPVAs will be contracted by the PMOs under TORs acceptable to the World Bank within three months of Program effectiveness. Program verification procedures, technical approaches, and implementation arrangements are detailed in the relevant government regulations, and specific verification protocols are detailed in annex 2. The M&E system will be summarized in the PIP.

C. Disbursement Arrangements

46. **An advance of up to 25 percent of the loan amount is available as an advance payment under the Program.** The proposed advance, which can be requested by Henan, Shaanxi, or YRCC (up to their individual limits) upon effectiveness, will help the implementation and achievement of the initial results and support the achievement of subsequent results. The advance amount will be deducted from the total amount due to be disbursed when the DLIs are achieved and verified, and the World Bank will record this advance amount as disbursed for an achieved and verified DLI ('recovered') after it has notified the borrower of its acceptance of the evidence of achievement of the result for which the advance was provided. The reclassified amount will become available for further advances. The World Bank requires that the borrower refund any advances (or portion of advances) if the DLIs have not been met (or have been only partially met) by the Program closing date. If by the end of the Program, the PforR financing amount disbursed exceeds the total amount of Program expenditures, the borrower refunds the difference to the World Bank. The cumulative disbursement in the first two years after Board approval is reasonably estimated not to exceed 60 percent of each IBRD loan based on the amount of the advance and the DLIs expected to be achieved in the first two years of implementation with the timing of the annual verification cycles (which will need to be completed before disbursements against achieved DLIs). Accordingly, the IBRD loan for this operation is not deemed as fast disbursing.

47. **The World Bank loan will be disbursed upon the achievement of DLIs and its verification as stipulated in the legal documents signed between the World Bank and the borrowers.** The BPMO at the YRCC and the PMOs within the two provinces are responsible for submitting an official letter with the verified results to the World Bank and, upon acceptance of the verified results, the YRCC and the Provincial Departments of Finance (for Henan and Shaanxi) will prepare withdrawal applications and submit them to the World Bank through the World Bank system. Once the disbursement applications are approved by the World Bank, the World Bank loan will be disbursed to a bank account designated by the YRCC and the Provincial Departments of Finance in their disbursement applications.

D. Capacity Building

48. **Capacity building is intended to strengthen the technical, fiduciary, environmental, and social systems.** Capacity building will be carried out at the basin, provincial, municipal and county levels, requiring additional support during implementation and resources above the regional norms to ensure impact at scale. Tailored training and implementation support will address the issues identified in the technical, fiduciary, environmental, and social systems assessments (including gender). The technical training and support will focus on the integrated landscape approach to catchment management and the capacity required to carry out the necessary assessments, including remote sensing approaches to consumption-based monitoring and water balance assessments, water quality modeling, and assessments of ecosystem

functions. These will be complemented with training on Program implementation, monitoring, and verification. Training will be conducted to enhance the capacity for fiduciary management as well as the management of environmental and social systems, particularly those standards and requirements for the PforR instrument. In addition, RA 4 is specifically designed to promote and strengthen capacity, improve the ability of sub-basins and provinces to carry out integrated plans, and create information systems to support decision-making, among others.

IV. ASSESSMENT SUMMARY

A. Technical (including Program economic evaluation)

49. **The technical assessment has established a sound PforR boundary.** The Program is embedded within the Government's national program for the YRB as implemented through the YRCC's basin program, the sub-national provincial programs, and specific interventions within the demonstration sub-basins. These provide a nested hierarchy of activities and objectives, aligned with administrative responsibilities of the different levels of government and the provisions of the YRB Plan. The Plan is a key step toward ecological restoration and protection of the Yellow River and is to be supported by a dedicated Yellow River Protection Law, currently under review. The activities supported by the Program contribute to implementation of the Government's plan and more broadly to the vision for the YRB. The two participating provinces are critical to outcomes in the YRB and have signaled their commitment to the national program through their subsidiary provincial plans, with targets aligned with the 14th FYP.

50. **The assessment confirmed the technical and economic soundness of the activities and their connection to the Program's desired outcomes.** Although the Government's programs in the demonstration sub-basins outline a comprehensive investment strategy, these interventions have a markedly sectoral scope and have not been planned in an integrated manner that considers water constraints and ecosystem tradeoffs. Therefore, the interventions supported by the Program were assessed during Program preparation and prioritized following an integrated landscape approach within the demonstration sub-basins. Three assessments were carried out for all demonstration sub-basins and include a water balance using remote sensing to inform consumption-based management (ET), a water quality assessment to determine the environment carrying capacity for pollution loads (EC), and a spatial planning exercise to identify priority ecosystem services (ES). The integration of these three assessments is referred to as the 'ET-EC-ES' approach (Box 4). Cost-benefit and cost-effectiveness analyses were also carried out to ensure the viability of Program-supported activities (annex 3).

51. **The integrated 'ET-EC-ES' approach was applied to address the potential water-ecosystem tradeoffs, adjust the Government's programs, and select priority interventions to be supported by the Program.** The basic principle of the integrated 'ET-EC-ES' approach is that the total water consumption of the optimized activities should be below the sustainable level of water consumption, while the activities implemented should maximize their impacts to increase water use efficiency and improve water quality while safeguarding ecosystem services and biodiversity. Based on the assessments of the water balance, water quality, and ecosystem status, the integrated 'ET-EC-ES' provides the foundation for the RAs related to water scarcity, water pollution, and ecosystem degradation.

Box 4. An Integrated Approach to Consumption-based Water and Ecosystem Management in China

China has been piloting the development of consumption-based water management (that is, ET management) approaches with support from the World Bank for over two decades. Introduced through the CN-Water Conservation Project (P056516, 2000–2006), the approach was further developed through the China - Hai Basin Integrated Water and Environment Management Project (P075035, 2004–2011) and applied in the Xinjiang Turfan Water Conservation Project (P111163, 2010–2017). These projects showed that managing water consumption is critical for addressing the challenges of water scarcity and that investments to improve water use efficiency need to be positioned within agreed limits of water consumption.

The ET-based approach has been extended to provide a framework for integrated water and ecosystem management as part of the GEF Mainstreaming Integrated Water and Environment Management Project (P145897, 2016–2021). This incorporates measures of environment carrying capacity (EC), which is the maximum allowed pollution load of a certain water body, and basic ecosystem services (ES). The combination of all three is referred to as the 'ET-EC-ES' approach, which provides the foundation for the RAs related to water scarcity, water pollution, and ecosystem degradation under the Yellow River Program.

ET, EC, and ES are essentially interconnected—the reduction of water consumption (that is, reducing ET) and the optimization of water resources are able to increase water available for sustaining and enhancing ecosystem services (that is, enhancing ES) and diluting pollutants and improving water quality (that is, improving EC). The improvement of water quality (that is, improving EC) can further improve ecosystem services (that is, enhancing ES) and mitigate the pollution-related water scarcity. Ecosystem protection and restoration (that is, enhancing ES) provide other services beneficial to EC (water retention, infiltration, erosion control) and ET (for example, underground water recharge) but may also increase water consumption (that is, increasing ET). Therefore, these activities need careful assessment, and potential water-ecosystem tradeoffs should be considered.

The 'ET-EC-ES' approach first assesses the water-ecosystem interconnections through water balance assessment and modeling and then optimizes water conservation, water pollution management, and ecosystem restoration activities. The basic principle of the 'ET-EC-ES' approach is that the total water consumption of the optimized activities should be below the sustainable level of water consumption, while the activities implemented should maximize their impacts to increase water use efficiency, improve water quality, and enhance biodiversity.

The 'ET-EC-ES' approach is well aligned with the principles of the national program that considers water as a rigid constraint in the development of the YRB. The design of the Program applies the integrated 'ET-EC-ES approach and has used remote sensing to carry out a water balance assessment to determine sustainable limits of water consumption, carried out a water quality assessment to determine the maximum allowed pollution discharge, and completed a spatial planning exercise to identify priority ecosystem services within the watershed and enhance ecosystem protection and restoration. In doing so, this approach takes to scale a new landscape model of integrated catchment management for water scarce regions.

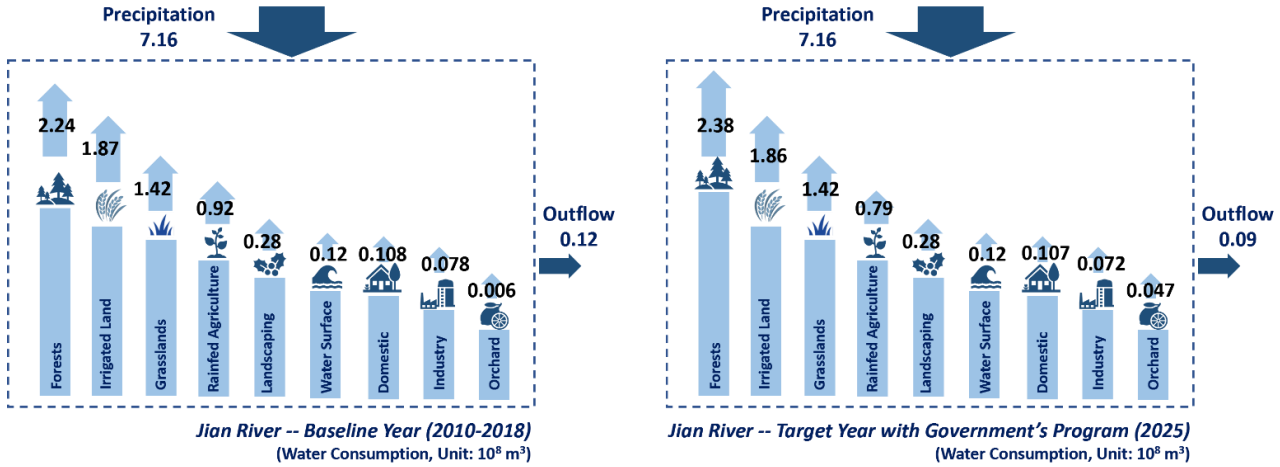
The Program provides a unique opportunity for upscaling the approach by transferring the knowledge gained over the years to the YRCC and improving its ability to apply the consumption-based water management approach. This has the potential to shift the current paradigm and approach to water resource assessments, which is the basis for allocating water resources, and make global contributions to knowledge for development. China is recognized as an early adopter of innovative approaches to ET management and has been the subject of many global knowledge exchanges. These have facilitated similar pilot programs and several World Bank-supported projects with the consumption-based water management approach, such as the Resilient and Sustainable Water in Agriculture Project (P175747) in Morocco and the Sindh Water and Agriculture Transformation Project (P167596) in Pakistan.

52. **Water balance assessments carried out for all demonstration sub-basins using remote sensing indicate that the Government program would increase total water consumption and reduce streamflow**.[76] The assessments first analyzed the historical water balance for at least six consequent years, depending on data availability.[77] The averaged water balance results of these years were considered as the baseline results. The baseline results revealed that most areas are already under severe water scarcity and facing challenges in meeting the minimum ecological flow requirements. The water

[76] The water balance was estimated based on the equation of $P + I = ET_n + ET_h + O$, with P as precipitation, I as inflow, ET_n as natural water consumption, ET_h as the water consumption induced by human activities, and O as the outflow. See annex 3 for more details.
[77] Years 2014–2019 for Shichuan River Basin in Shaanxi and 2010–2018 for Jian River Basin, Qing Long Jian River Basin, Hong Nong Jian River Basin, in Sanmenxia, Henan.

balance assessments further analyzed the impacts of Government programs for the sub-basins in Henan and Shaanxi Provinces. Comparing with the baseline results, the analyses revealed that the water consumed by the agricultural sector will decrease due mainly to irrigation modernization, adjustments in cropping patterns, and the reduction of terraces; the water consumed by the industrial and domestic sectors will decrease mainly due to improvements in water use efficiency; and the water consumed by ecosystems will increase mainly due to afforestation. As a result, the current Government programs would result in an increase in total water consumption and further threaten the assurance of ecological flows. Based on the proposed interventions under the Government programs, the outflow will decrease 10 percent in the Shichuan River Basin, 25 percent in the Jian River Basin, 25 percent in the Qing Long Jian River Basin, and 3 percent in the Hong Nong Jian River Basin. An example of water balance assessment results for Jian River Basin is shown in Figure 6. More detailed results for other demonstration sub-basins are included in annex 3.

Figure 6. Water Balance Assessment Results for Jian River Basin



53. **The water balance assessments highlight the importance of determing target values for water consumption and having a cascading system to allocate these down to the county level.** Taking Jian River as an example, and applying national standard requirements for minimum ecological flow for the dry season, the water balance assessment shows that the outflows of the baseline and "with government's program" are only 0.12×10^8 m^3 and 0.09×10^8 m^3 respectively (Figure 6), much lower than the minimum ecological flow requirements. This indicates that total water consumption in Jian River Basin already exceeds sustainable limits and the basin is facing challenges to ensure compliance with basic ecological flow requirements. Thus, there is an urgent need to prepare and implement a TVAP. Based on more detailed assessments of water consumption and water-ecosystem tradeoffs, the TVAP will establish a sustainable water consumption target (that is, ET target) for the basin, then allocate the water consumption target to each water use sector, and guide the water use sectors to reduce water consumption and increase water use efficiency under this target. The TVAP will guide the basin's development under the rigid water constraint.

54. **Water quality assessments carried out for all demonstration sub-basins found that water pollution is most severe during the dry season low flows.** The technical assessments collected the water quality data from all the monitoring stations within the demonstration sub-basins, along with the pollutant discharge data from point and non-point sources. A pollutant migration and transformation process model was applied to estimate the water pollution for each river segment. Water quality targets were determined based on the requirements of the Government water function zones. The water quality assessments revealed that COD, ammonia nitrogen, and total phosphorous (TP) are the major water pollutants in the demonstration sub-basins, driving noncompliance with water quality requirements. The assessment concludes that domestic wastewater is the primary polluting source for ammonia nitrogen, while livestock

and poultry farms, domestic wastewater, and chemical fertilizer application are the primary sources of COD and TP. The model results revealed that water quality compliance is not an issue on an annual base, but both TP and ammonia nitrogen concentration failed to meet the water quality requirement during the dry season (that is, from January to March) when river flows are low.

55. **Ecosystem assessments carried out for all demonstration sub-basins highlight opportunities to rebalance proposed investments under the Government program.** The activities and investments for the demonstration sub-basins under the Government program are focused primarily on the main waterways and water bodies, with limited attention to the upper and middle reaches. The spatial assessments of the demonstration sub-basins were used to identify water sources, areas of recharge, infiltration, erosion, and degraded ecosystems. These assessments also identified a number of challenges in relation to the protection and restoration of ecosystems in the upper reaches of the sub-basins; the need to improve land management practices in the middle reaches; and low vegetation quality that limits the ability to regulate water flows, improve groundwater recharge, or support important habitats for biodiversity. The current vegetation is dominated by monoculture plantations, croplands, and orchards, while the remaining secondary forests and shrubland vegetation have low levels of biodiversity. Introduced species that are well adapted to local conditions are used extensively for reforestation due to their rapid establishment. However, increasing evidence shows that monoculture plantations consume more water and have low ecosystem stability and limited biodiversity value. The assessment identified priority interventions to restore impaired ecosystem structure and functions in critical areas, especially these areas in upper catchments, and opportunities for improvements in forest ecosystem structure and composition, using indigenous broadleaved or conifer species and assisted natural regeneration.

56. **The assessments were used to adjust the Government program activities and select priority interventions to be supported under each of the RAs.** The integrated 'ET-EC-ES' approach provides the foundation for activities and interventions in each of the RAs based on the assessments of the water balance, water quality, and ecosystem status. The Program will support the following RAs and priority interventions:

(a) **RA 1 will support improvements in water use efficiency.** The Program is designed to support irrigation modernization and rehabilitation, which will improve water use efficiency and reduce an estimated 20–110 mm of water consumption per year.[78] The Program will also promote cropping pattern adjustment to reduce total agricultural water consumption and increase farmers' incomes. For example, the water balance assessments found that converting wheat and maize to Sichuan pepper (Zanthoxylum) will reduce water consumption by an estimated 75 mm per year. It was estimated that new orchard development will increase water consumption by around 110 mm per year. It is proposed that the Government's program limit the development of new orchards and these will not be supported under the Program. Improved agronomic practices such as no-till farming, straw returning, and application of agricultural mulching can improve soil moisture use and reduce total water consumption. Tailored training will be provided to the communities and WUAs to enhance the capacity of farmers for agricultural water management. The TVAP will be implemented to establish a sustainable target on total water consumption and allocate these to county levels to distribute among different sectors. The TVAP will guide the sub-basins to limit the total water consumption to a sustainable level. The allocation of water consumption targets in the TVAP will also lay the foundation for water trading to further improve water use efficiency. In addition, the Program will support the rehabilitation of rural water supply systems, which is aligned with the YRB Plan to accelerate the rehabilitation of water supply networks to reduce leakages, promote the application of water-saving equipment, and improve rural water supply infrastructure.

[78] ET is commonly measured as mm per unit time, with 1 mm per year equal to 1 cubic metre per hectare per year.

(b) **RA 2 will support reductions in pollution loads to improve water quality.** The assessments on water balance and water quality revealed that, even with the reduction of water consumption and the assurance of minimum ecological flows, water pollution issues would still be severe due to the significant pollutant loads entering rivers in the Program areas. Pollution control is essential to reach the water quality requirements, especially during the low flow seasons. For the point source pollution control, the Program will support the upgrading of WWTPs and increase the rural household connection to wastewater treatment facilities. For the NPS pollution control, the Program will increase livestock/poultry manure collection and treatment rate and promote organic fertilizer and precise chemical fertilizer application.

(c) **RA 3 will support improvements in ecosystem management.** The landscape assessments identified that the overall restoration targets should be focusing on improving the quality of existing vegetation community (secondary and plantation forests/shrubs) in the upper watershed for water retention and biodiversity values while putting in place soil erosion measures in gullies and other erosion-prone areas to control erosion and improve vegetation quality. The assessments highlighted the importance of bringing international and national best practices to promote the use of multifunction and mixed-species forest structures (the close-to-nature approach) to improve forest ecosystem stability. The water balance assessments estimated that the diversification of tree species will decrease water consumption per year by around 20 mm. The Program will thus promote a shift from traditional intensive-style monoculture management to the close-to-nature forest management concept, with a focus on forest ecosystem/landscape restoration and multiuse management. The Program will promote (i) the use of diversified tree species mixtures in forest management, (ii) improvements to forest structure and stability, (iii) improvements to forest ecosystem vitality, and (iv) natural regeneration and rehabilitation.

(d) **RA 4 will strengthen integrated ecosystem and water resources management and planning.** The Program recognizes the interconnections among water use efficiency, water quality, and ecosystem protection and restoration and introduced an integrated approach to address these interconnected challenges. The technical assessments also showed that consumption-based water balance analyses are critical to inform the conciliation of tradeoffs. Therefore, this RA will incentivize the preparation of such water balance analyses in the demonstration sub-basins and support the implementation of integrated ecosystem and water resources management approach. Building upon the lessons at the demonstration sub-basin and provincial levels, the YRCC will scale up the integrated approach, further develop the related tools and systems, and issue guidelines to support the integrated ecosystem and water management within the YRB. These activities will enhance the basin organization's capacity on integrated ecosystem and water resources management in the YRB.

57. **The impacts of climate change have been considered in the Program design, which contributes both climate change mitigation and adaptation in the YRB in line with China's Nationally Determined Contributions (NDCs).** All demonstration sub-basins are vulnerable to climate change and are affected by extreme temperatures and rainfall events, with a high frequency of floods and droughts. Floods damage crops and infrastructure and increase soil erosion and runoff of pollutants into rivers and lakes, while droughts reduce flows for irrigation, water supply, and other uses; damage crops and plants; and increase conditions for pests, diseases, and fires. Forest fires due to climate-induced heat waves have the potential to severely impact the ecosystem and its main functions. An ecosystem-based adaptation approach has been adopted by the Program to tackle these risks, build resilience to extreme events, and contribute to climate mitigation and adaptation measures. In terms of climate change mitigation, the Program intends to implement the following measures in select regions in the YRB: (a) reducing energy consumption of irrigation systems by improving water use efficiency (DLI 1); (b) reducing fugitive methane emissions from polluted water bodies due to reduced pollutant discharges (DLI 2); (c) increasing carbon sequestration due to forest and wetland protection and restoration (DLI 3); and (d) incorporating climate

mitigation measures into integrated ecosystem and water resources management plans and other policy documents at both basin and sub-basin levels (DLI 4.1 and 4.2). In terms of climate change adaptation, the Program intends to implement the following measures in select regions in the YRB: (a) improving resilience toward water scarcity by increasing water productivity (DLI 1); (b) improving resilience toward water pollution by reducing pollutant discharges, and resilience against floods and droughts by incorporating climate considerations into the design of wastewater management facilities (DLI 2); (c) improving forest health and ecosystem vitality to enhance ecosystem resilience to heavy rain, hail, snow, wind and droughts and against forest fires and extreme temperature and risk reduction of pest and disease breakouts; increasing local flood mitigation capacity through wetland restoration (which can act as buffer zones also able to modulate flooding during rainy season and runoff peaks), as well as enhancing water supply to wildlife in prolonged dry season; and reducing runoff and soil erosion through improved terracing, able to modulate and reduce peak runoff and floods, and to lower discharges into rivers of NPS pollutants (chemical and pesticide) (DLI 3); and (d) incorporating climate change considerations and adaptation measures into integrated ecosystem and water resources management plans and other policy documents at both basin and sub-basin levels (DLIs 4.1 and 4.2).

58. **GHG emission mitigation.** GHG emission reduction of 7.95 million tonnes CO_2-e is expected due to Program activities. A quantification of GHG net emissions is made here focusing on activities under RA 1, RA 2, and RA 3. Specifically, there are four sources of quantifiable emissions benefits, which are assessed over a 20-year period of Program life (including 5-year implementation): (a) 0.16 million tonnes CO_2-e GHG emission reduction is expected from energy savings of irrigation due to improved water use efficiency; (b) GHG emission reduction from improved forest cover of 50,725 ha will result in an estimated net mitigation of 3.66 million tonnes CO_2-e; (c) the improvements of wastewater treatment facilities are expected to result in reduced fugitive methane emissions, leading to an estimated net mitigation of 0.14 million tonnes CO_2-e; and (d) the improvement of treatment and reuse of livestock/poultry manure (through on-farm treatment facilities, biogas generation, and organic fertilizer reuse) result in a reduction of 3.99 million tonnes CO_2-e. In total, the Program is expected to realize at least 7.95 million tonnes CO_2-e in emissions mitigation over its lifetime. This represents a subset of the total expected benefits that are attributable to the World Bank's financing. The calculations are limited to the demonstration sub-basins that are the target of World Bank financing. The potential to scale up these numbers as integrated ecosystem and water resources management plans are implemented elsewhere in the two provinces and YRB is large.

59. **Program aspects related to gender were evaluated, and appropriate measures to address identified gaps have been included in the Program design.** Even though rural women undertake about 60 percent of farming and 70 percent of irrigation activities, they are underrepresented in WUAs, with limited input in decision-making beyond the household. Women's limited role in farmers' organizations is found to be a major gap which affects their uptake of water-saving technologies and engagement in water conservation.[79] Data from demonstration areas in Sanmenxia City and Shaanxi Province show that an average of 35.4 percent of the members of the agricultural association are women. However, the average proportion of women as executive members is only 15.7 percent, presenting a missed opportunity for women to play a leadership role in local water use management. The implementation of the Program brings opportunities to change women's role in local resource management, decision-making, and benefits that are influenced by gender differences, through actions targeted at increasing women's participation in WUAs as decision-makers and empowering women in local water use management. Bylaws and membership criteria of WUAs would represent opportunities to ensure fair and inclusive participation of women based on their contribution and engagement in local water use activities. The Program will promote training activities to enhance women's capacities in crop production and irrigation, water conservation techniques, and uptake of new technologies and, importantly, their leadership skills. In addition, technical assistance will also be provided to WUA leaders and executive members to improve their awareness on gender issues when developing

[79] Lu, Caizhen. 2008. "Why Is it so Difficult to Tackle Gender in Water User Associations? A Case Study from Gansu, China." European Association of Development Research and Training Institutes. (*link*)

plans, manuals, and implementation strategies. In the implementation of the activities, the Program will also actively collaborate with women's federations at the provincial and local levels, to take advantage of the contextual knowledge and outreach network of the women's federations in engaging women in public affairs. As part of the Program monitoring and evaluation plan, women's leadership in WUAs measured by percentage of females in executive bodies of WUAs will be reported as a key result of the gender actions described above (description of gender gaps, Program actions, and indicators are given in annex 3).

Program Financing

60. **As the Program boundaries are established within several sub-basins within the two Program provinces, the Program expenditure framework is assessed at the sub-basin level.** Implementation of the national program is funded through a range of instruments at the provincial and local level in accordance with the responsibilities for expenditures on ecological and environmental protection issued in May 2020.[80] The actions required to meet the objectives of the Program are not linked to specific Government budget allocations, with inputs required from a range of stakeholders, among others, the water, environment, forestry, and agricultural departments. The expenditure framework thus comprises multiple relevant budget lines rather than a single Government program fund.

61. **The expenditure framework in Henan Province presents an adequate basis for the PforR.** Program expenditures are anchored in the implementation of the 'Sanmenxia Yellow River Ecological and High-Quality Development Plan' that covers three sub-basins in Sanmenxia City with five counties. Expenditure analysis found that the budget allocated to the ecological protection of the three sub-basins under the Program amounted to US$84.2 million in 2020, with an increasing trend from 2018 to 2020. The allocation in 2020 was used to estimate that the river basin ecosystem and water management budget funding will reach US$421 million during the Program implementation period from 2022 to 2026. These funds were mostly used for 'water conservation', making up about 49.3 percent, followed by 'ecological protection and restoration' (22.2 percent) and 'water pollution control' (10 percent). The rest was used for institutional development.

62. **The expenditure framework in Shaanxi Province presents an adequate basis for the PforR.** Program expenditures are anchored in the 14th FYP for the nine counties in two municipalities (that is, Tongchuan and Xianyang) that cover the four sub-basins. Expenditure analysis found that the budget allocated to the ecological protection of the four sub-basins under the Program amounted to US$136.5 million in 2020, with an increasing trend from 2018. The annual allocation for 2020 was used to estimate that the river basin ecosystem and water management budget funding will reach US$683 million during the Program implementation period from 2022 to 2026. Of that, over 70 percent is spent every year on 'water conservation' and 'ecological protection and restoration' and about 18 percent on 'water pollution control'. In terms of the sources of funding, the funds consist of four parts: transfers from the central government, transfers from provincial governments, prefecture-level own-source funds, and own-source funds arranged by county-level cities and counties. In both provinces, the earmarked funding programs for results areas are mainly the Water Conservancy Development Fund, Water Pollution Prevention and Control Fund, Ear-marked Funds for Forestry and Grassland, Rural Environment Improvement Fund, the Agricultural Resources and Ecological Protection Fund, and Water Pollution Prevention and Control Fund. Most of the funds are sourced from both central and provincial governments, with the central share being over 50 percent, which shows budget funds for water and environment purposes in both Henan and Shaanxi are stable and can be guaranteed.

63. **Economic conditions in the provinces and the fiscal position of the provincial and prefectural governments are sound and stable (annex 3).** While the unfolding impacts associated with COVID-19 are expected to have negative impacts

[80] State Council General Office. 2020. *The Reform Plan for Delineating the Functions and Expenditure Responsibility between the Central Government and Provinces regarding Ecology and Environment Protection* (Guo Ban Fa [2020] No. 13). (*link*)

on Government finances, these are expected to be short-lived. Budget allocation for Program activities accounts for less than 1 and 3 percent, respectively, of the general budget revenue in Henan and Shaanxi, so financial sustainability and continuity of Program-related activities in the years beyond the Program are unlikely to be at risk due to these factors.

64. **The annual budget for YRCC was reviewed and it was found that financing sources for water resource planning and management are significant and stable.** In 2020, CNY 45.96 million (US$7.2 million) was allocated under the budget code (2130308) used for water resources planning and management. Three financing sources were included, including 'Yellow River important waterways protection and utilization planning', 'Water resource allocation planning', and 'Yellow River Ecological Protection and High-Quality Development earmarked fund'. Given the national strategy and emphasis on the YRB, funding allocation for 2020 has been used to estimate funding available for 2022–2026 prudently, which amounted to US$36 million through five years.

Economic Evaluation

65. **Economic evaluation.** Given the diverse range and multiple purposes of the Program interventions, the economic assessment has been conducted by results area. For RAs 1 and 3, a CBA has been applied, using a benefit transfer method. For RA 2, a CEA has been applied, as the benefits from water pollution control are difficult to quantify in a reasonably reliable manner, especially those pertaining to public health and the environment. The key objective of the CEA is to demonstrate that the proposed investments have a sound strategic rationale with regard to the overall Program objectives and that these objectives are met in the most cost-effective way (based on evaluated lifecycle costs and compared on a net present value per unit incremental cost basis). The assessment compares a 'no program' scenario to a scenario of a Government program including World Bank support.[81]

66. **The assessments were carried out for RAs 1, 2, and 3.** For RA 1, cash flows of benefits and costs for irrigation scheme rehabilitation are projected over a 20-year period to estimate the Program economic rate of return (ERR). The ERRs with and without GHG emission reduction are estimated at 20 percent and 19 percent, respectively, which are well above the discount rate of 6 percent, indicating that the schemes to be rehabilitated are economically viable. For RA 2, detailed comparisons of alternatives and selected options for the rehabilitation of WWTPs and sewage collection systems will be conducted when the feasibility study reports are prepared as required by the county development and reform committees. For RA 3, a CBA was carried out by selecting a representative watershed model for degraded and monoculture forest rehabilitation. The ERRs with and without GHG reduction are estimated at 16 percent and 13 percent, respectively, significantly above the discount rate of 6 percent, indicating that forest rehabilitation activities are economically viable.

B. Fiduciary

67. **Adequacy of the Program's fiduciary system.** Pursuant to the World Bank's Policy and its associated Directive on PforR Financing effective on November 10, 2017, and September 17, 2020, respectively, as well as the World Bank's PforR Fiduciary Systems Assessment Guidance Note effective on June 30, 2017, the World Bank's Fiduciary Team carried out a fiduciary systems assessment (FSA), including procurement, financial management (FM), and governance systems. The assessment was carried out within the procurement and financial center in the YRCC and Sanmenxia Municipality in Henan Province, along with five counties in Tongchuan Municipality and three districts and one county in Xianyang Municipality in Shaanxi Province. According to the assessment and given the agreed actions to strengthen the fiduciary systems reflected in the Program Action Plan (PAP) and other proposed mitigation measures to be implemented, the Program's

[81] This approach is used because, under a PforR, Government and World Bank funds are combined to achieve results, with virtually no distinction at the activity level between World Bank-financed and Government-financed achievements. This approach can determine whether the overall program—which the World Bank financing partly supports—is net socially beneficial.

fiduciary systems are considered to be able to provide reasonable assurance that the Program's financing proceeds will be used for the intended purposes, with due attention to the principles of economy, efficiency, effectiveness, transparency, and accountability.

68. **FM overview.** The prevailing Budget Law, Accounting Law, and Audit Law of the People's Republic of China have laid out the fundamental legal framework for government budget management, government accounting, and auditing in China. The Government Accounting Standards, approved in 2017, implemented from 2019, have set the government accounting and reporting standards for all government budget units in China. All of them constitute the China public financial management (PFM) system with various fiscal- and financial-related decrees, regulations, standards, and procedures and so on. FM for the Program is governed by the China PFM system (which is broadly consistent with internationally-accepted PFM systems), and supplemented with some additional requirements from the World Bank.

69. **FM risks and mitigation measures.** Major risks identified in the FM assessment include the following:

(a) The Program financing mainly comprises earmarked transfers from the central-level budget and provincial-level budget. However, most of the funding has a life period that might not cover the entire Program life. This might lead to financing gaps that will need to be covered by other sources of funding.

(b) No Program financial statements are required by higher-level line ministries or finance departments, and the current financial reporting architecture for government agencies makes it difficult to generate the Program financial statements; this creates risk of noncompliance with the PforR financial statement requirements which might affect the monitoring of the Program's implementation.

(c) No audit of Program financial statements is required under current China PFM practice; audit of Program financial statements will require coordination across government audit units and the application of financial audit techniques not practiced by some audit units. This might create a risk of weak audits, at least in the initial years of the Program.

(d) Multisector involvement in the Program, various budget resources supporting the Program, and large volume of Program activities bring complexity to the Program management and FM work.

70. **The proposed mitigation measures include the following:** (a) potential funding gaps that undermine the sustainability of the Program should be evaluated timely and addressed by the relevant finance and sector departments before the expiration year of each funding cycle; (b) tailored Program financial statements will be developed and introduced to the Program in format and content acceptable to the World Bank and the borrowers; (c) Program financial statements audit will be required and conducted on an annual basis; tailored audit TORs will be developed upon the agreement between the World Bank and government audit offices; and (d) appropriate institutional arrangements should be established for Program coordination and management purposes with clear roles and responsibilities. These mitigation measures are reflected in the PAP.

71. **Procurement overview.** Procurement under the Program will follow Tendering and Bidding Law (TBL), Government Procurement Law (GPL), Implementation Regulations of the two laws, provincial and sectoral regulations, ministerial orders, and measures. Open competitive bidding is the primary procurement method. Implementing agencies will mandatorily carry out procurement of large-value contracts[82] through open competitive bidding. Standard Bidding Documents (SBDs) issued by the respective line ministries will be used for procurement to be carried out under the Program. Local public resources transaction centers will provide a venue, system, and expert pool to facilitate the

[82] NDRC Ministerial Order No. 16 of 2018 (*link*)

procurement process. The overall assessment of the legal framework and the procurement system found it meets the World Bank's principles of economy, efficiency, effectiveness, transparency, and accountability.

72. Activities to be supported under the program include (a) goods: materials, equipment, and IT hardware and software for improving the current system and application of modern technologies and so on; (b) works: rehabilitation of irrigation systems, watershed management works, landscaping, afforestation/reforestation, soil and water conservation, and so on; (c) consulting services: preparation/upgrading of ecosystem and water resources management plans, assessments of water resources availability in demonstration sub-basins, training and capacity building activities with intellectual input, and so on; and (d) non-consulting services: services with no intellectual input as identified during Program implementation. The following activities are excluded: (a) works estimated to cost US$75 million equivalent or more per contract, (b) goods and non-consulting services estimated to cost US$50 million equivalent or more per contract, and (c) consulting services estimated to cost US$20 million equivalent or more per contract. The Program is not expected to include any large-value contracts based on the inherent definition of the Program boundaries. The implementing agencies shall report to the World Bank if any large contracts appear throughout Program implementation.

73. **Procurement risks and mitigation measures.** The assessment identified the following key procurement risks and provided mitigation measures: (a) when comprehensive scoring method (one of the two most used procurement methods) is used for bid evaluation of contracts with neither innovation nor complexity, the total weightings of all rated criteria other than price could be higher than 50 percent, which may not achieve value for money (VfM) and (b) there is a lack of detailed procurement-related complaint-handling procedures in the SBD. The proposed mitigation measures are the following: (a) when comprehensive scoring method is used for bid evaluation of contracts with neither innovation nor complexity, following the government policies and requirements, the price weighting should be sufficiently maximized to better achieve VfM; guidance should be prepared by PPMOs, PMOs and the YRCC on evaluation criteria; and (b) provide detailed procurement-related complaint-handling procedures in the SBD for preparation of bidding document under the Program. Standard language should be prepared by PMOs, PPMOs and the YRCC.

74. **The Program will be subject to the World Bank 'Guidelines on Preventing and Combating Fraud and Corruption in Program-for-Results Financing' dated February 1, 2012, and revised on July 10, 2015 (the Anti-Corruption Guidelines).** These guidelines shall be applied in an unrestricted manner on all activities within the Program boundary. To operationalize implementation of the various areas covered in the Anti-Corruption Guidelines, the YRCC, PPMOs and PMOs shall perform the following:

(a) Maintain and compile a quarterly report of Program-related complaints and share with the World Bank.

(b) Incorporate the World Bank's listing of ineligible firms in the filter used by procuring entities under the Program when they conduct due diligence before contract award. This list is available at the following website: http://www.worldbank.org/debarr.

(c) Incorporate and filter the World Bank's suspension list that will be obtained from the World Bank team by PPMOs and the YRCC when they conduct due diligence before contract award and share with the participating agencies.

(d) Report on a quarterly basis that none/if any contract awards are made to any ineligible/suspended firms/individual.

(e) Ensure that each participating bidder shall submit a self-declaration that the firm is not subject to ineligibility or has not been sanctioned under the World Bank's system of debarment and cross-debarment at the time of bidding.

(f) Ensure timely and appropriate actions are taken to address issues and indications of fraud and corruption and report these actions to the World Bank.

(g) Ensure that PPMOs, the YRCC, and any other stakeholders of the Program cooperate fully with the World Bank or any firm/individual appointed by the World Bank in any inquiry conducted by the World Bank into allegations or other indications of fraud and corruption in connection with the Program.

(h) TOR for the annual external audit shall include tasks of audit reviews and certifies the above actions.

75. **Fiduciary supervision.** Procurement and FM are subject to annual audit by government audit offices. Procurement following the procedures of the TBL is subject to regular supervision and oversight by the Development and Reform Commission (DRC) at various levels and relevant sector authorities (water, environment, agriculture, housing and construction, land and natural resources). The Finance Department or Bureau at various levels exercises supervision and oversight for procurement following the procedures of the GPL and for FM about budget execution/usage of funds.

76. **Fraud and corruption risks.** The Government has institutions in place to combat fraud and corruption. These institutions are designed to prevent, report, detect, investigate, prosecute, and sanction fraud and corruption. These institutions include the discipline inspection commissions within all implementation agencies, supervision bureaus, anticorruption bureaus under People's Procuratorates, and audit offices, all at central, provincial, prefectural, and county levels. These agencies have comprehensive mandates to combat fraud and corruption. Any bidder or any party can report fraud and corruption issues to any of these government agencies. The World Bank's right to conduct an inquiry into such allegations or other indications, independently or in collaboration with the borrower regarding activities and expenditures supported by the Program, as well as its right to access to the required persons, information, and documents, will be observed in accordance with the standard arrangements for this purpose between the Government and the World Bank. The Program's Legal Agreement will also oblige the client to fully comply with obligations under the World Bank's Anti-Corruption Guidelines for PforR operations.

77. **Fiduciary risk.** Considering the abovementioned FM and procurement risks and the proposed mitigation measures, the overall fiduciary risk of the Program is rated as Substantial.

C. Environmental and Social

78. **An Environmental and Social Systems Assessment (ESSA) has been conducted to provide a comprehensive review of environmental and social (E&S) systems and procedures in China and in Henan and Shaanxi Provinces.** The ESSA concludes that a comprehensive and effective system has been established in relevant sectors at both national and provincial levels to identify, assess, mitigate, manage, and monitor E&S impacts and risks related to Program activities, including (a) a comprehensive regulatory system, with applicable laws, regulations, policies, standards and technical guidelines at the state and local levels; (b) clear implementation mechanisms, with clear administrative procedures, institutional arrangements and responsibilities for E&S impacts and risks management, and necessary professionals and financial resources; and (c) good performance of the Environmental and Social Management Systems (ESMSs) according to the field investigation findings. Based on the assessment, the ESMSs related to the Program are principally consistent with the World Bank's PforR Policy and Directive, and it was concluded that the country and the Program provinces have established and implemented a sound system to screen, assess, supervise, and manage E&S risks associated with the activities under the Government program throughout preparation and implementation.

79. **The ESSA was conducted according to the following methodology:** (a) thorough screening of the potential impacts from the activities to be supported by the PforR and the potentially associated activities; (b) desktop review on E&S laws and regulations and procedures related to managing the relevant Program activities at the national, provincial,

and local levels; and (c) consultations and field visits to sites of typical Program activities in selected counties, with extensive meetings and interviews with key stakeholders ranging from implementing agencies to government officials at provincial, county, township, and village levels and representatives of local communities. Observations and discussions during these visits provided a good understanding of the potential E&S impacts associated with the Program's activities and capacity of government departments for dealing with such impacts, including measures adopted under relevant laws and regulations.

80. **The ESSA estimates the E&S risk associated with the Program to be substantial considering the diversified basin-wide activities and needs for coordination of ecological and water management action across jurisdictions and sectors.** The Program will have significant and broadly positive E&S effects, designed to address three key challenges facing the YRB: water scarcity, water pollution, and ecosystem degradation. The Program does not involve construction of associated activities/facilities, but some proposed rural water supply activities may rely on existing reservoirs as water sources. E&S screening was conducted on the proposed Program activities and the potentially associated activities to exclude those with the potential to cause significant adverse impacts on the environment and/or potentially affected people, including (a) remediation of old mines; (b) activities (such as 'creation of new wetlands') that may involve large-scale land acquisition; (c) water transfer projects; (d) reservoir dredging, dam reinforcement, and rehabilitation; (e) construction and expansion of domestic sewage treatment plants with a total capacity of more than 50,000 m^3/day, or any facilities involving industrial wastewater treatment; and (f) other activities that are classified as Class A (requiring full Environmental Impact Assessment [EIA] Report) according to the latest national Catalogue for the Classified Management of the Environmental Impact Assessment of Construction Projects, for example, river rehabilitation (including dredging) in environmentally sensitive areas, river dredging activities involving contaminated dredged material, and so on. With the application of these exclusion criteria, the range of activities required to achieve the Program results are not expected to include any which would be defined as 'High Risk'. The negative environmental impacts associated with the Program activities will generally fall within a 'Moderate' category, generally manageable with known and demonstrated mitigation measures including (a) construction-related and site-specific impacts/risks such as temporary generation of emission, wastewater, noise, solid waste, and soil erosion and operational, health, and safety (OHS) management issues; (b) impacts on local environment and ecosystems with the operation of Program-supported facilities/works such as effluent discharge and solid waste generation of wastewater treatment facilities, safe operation of facilities, labor management issues, workers' health and safety, safe application of fertilizers, impacts on farmers' livelihoods, and so on; and (c) safety management of existing dams supplying water for rural water supply activities. These adverse E&S impacts are not significant and can be well identified and readily avoided, minimized, and mitigated through mature technologies and good management practices. Also, the downstream E&S impacts of proposed planning and capacity building results are anticipated to be positive in the long term. Neither OP 7.50 - Projects on International Waterways nor OP 7.60 - Projects in Disputed Areas is applicable to the Program. However, given the number of activities and the geographic scale across the river basin, potential negative E&S cumulative impacts still need to be assessed and addressed as part of the Program in planning specific interventions at the sub-basin levels, particularly considering the various types of interventions and insufficient coordination of ecological and water management action across jurisdictions and sectors at the current stage (to be mitigated by the preparation of integrated ecosystem and water resources management plans at sub-basin and provincial level). Therefore, the overall rating of E&S risks of the Program is 'Substantial'.

81. **The ESSA recommends that the PforR be used as an opportunity to enhance the E&S management capacity and the implementation of integrated river basin/sub-basin ecological protection and restoration plans.** Some areas for improvement were identified in the assessment: (a) challenges remain with optimizing inter-jurisdictional coordination of water ecosystem and water management, which in turn has implications for E&S risk management; it is anticipated that the basin and provincial results of the Program will result in improvements in this regard; (b) a number of sewage treatment facilities, particularly those in the rural areas, have operation and maintenance (O&M) challenges such as lack

of timely maintenance, lack of technical support, and poor management; in addition to direct E&S implications created by poor outflows, other O&M issues such as OHS management, community awareness, and so on also exist; (c) documentation on public consultation, information disclosure, and grievance redress mechanism (GRM) operation is relatively weak, and some enterprises have not established the GRMs for their construction and operation. Accordingly, two particular PAP actions are recommended to address point b and c: (a) provide regular training for the staff maintaining the town and village sewage treatment facilities focusing on OHS and other E&S impacts associated with poor O&M and (b) establish monitoring and reporting mechanisms for meaningful public participation and GRM and strengthen information and documentation management during the Program social risk management.

82. **Consultation and information disclosure.** Relevant stakeholders, including both government departments and local communities, were consulted through meetings and field visits to selected counties. The draft ESSA report was shared with the Henan and Shaanxi PPMOs and all Program municipalities and counties during preparation. Consultation meetings were carried out with key stakeholders at the provincial and municipal/county levels in Henan and Shaanxi during November and December 2021. Consultation with YRCC was undertaken in January 2022. The stakeholders consulted voiced their support in implementing the proposed Program and concurred with the findings and recommendations of the draft ESSA, which were considered relevant and valuable for strengthening the implementation of the existing E&S system. Some stakeholders provided valuable opinions to improve the accuracy of the ESSA description in local context, which have been reflected in the final ESSA. The final ESSA report has been disclosed on the World Bank's website (in English) and locally on the public websites at YRCC and in Henan and Shaanxi, in February 2022 (in Chinese).

V. RISK

83. **The overall risk is rated Substantial.** The risk assessment is informed by the results of the technical, fiduciary, and environmental and social systems assessments, with a summary of substantial (or higher) risks provided below.

84. **The risk related to sector strategies and policies is rated Substantial.** The Program is informed by a comprehensive set of government strategies and programs with high-level political support. The Government's program consists of the high-level YRB Plan; the provincial programs for Henan and Shaanxi Provinces; and the YRCC plan. Limited data sharing and coordination among institutions makes the integration of planning and interventions across various sectors challenging. The Program will support the preparation of integrated ecosystem and water resources management plans at various levels and will promote coordination and data sharing through the preparation of these integrated plans. The Program will also promote the application of remote sensing for data monitoring, which will help break the obstacles of data sharing.

85. **The technical design risk is rated Substantial.** The Program strengthens the integration of water use efficiency, water pollution control, and ecosystem management, under water constraints. It requires cross-sectoral coordination among various sectors of water, ecology and environment, natural resources, and agricultural and rural development and inter-jurisdictional cooperation across the basin. While the YRB Plan calls for the strengthening and improvement of the institutional arrangement, the institutional coordination and cooperation mechanisms are still under development. In addition, the Program requires the application of some innovative techniques such as remote sensing. The Program attempts to address this risk through its support to adopt integrated planning jointly prepared by various sectors and different levels of governments, as well as through adequate technical capacity building and training.

86. **The risk related to institutional capacity for implementation and sustainability is rated Substantial.** Despite significant experience in IPF operations, there is limited experience with results-based financing in the water and environment sectors. Preparation has focused on defining simple DLIs that target priority outcomes and ensure sufficient

cashflow. Training for provincial and local government officials on the rationale and implementation of PforR has been used to improve understanding. The integrated ecosystem and water resources management plans supported by DLI 4.1 aim at mitigating some of the risks related to multi-sectoral coordination barriers.

87. **The fiduciary risk is rated Substantial.** Fiduciary systems, including the FM, procurement, and governance systems, are considered adequate to meet the World Bank's requirements. Risks include the potentially weak capacity for local governments to raise counterpart funds. In addition, the Government program has no budget classification element, and the required Program financial reporting cannot be generated from the Government treasury system. Government auditors have not yet audited the Program's funds. A tailored format for Program financial reporting will be used, drawing on the experiences of other PforR operations in China, and the annual external audit process shall be used to ensure ineligible firms or individuals have not received contracts.

88. **The E&S risk is rated Substantial considering the diversified basin-wide activities and multi-sectoral coordination requirements included under the Program.** The Program will have significant and broadly positive E&S effects in the target areas, and E&S screening has been conducted on the proposed Program activities to exclude those that could cause significant adverse impacts on the environment and or potentially affected people. Central and sub-national governments have well-established systems for mitigating risks. The negative environmental impacts associated with Program activities will be generally manageable with known and demonstrated mitigation measures, which include (a) construction-related and site-specific impacts/risks such as temporary generation of emissions, wastewater, noise, solid waste and soil erosion, and OHS management issues and (b) impacts on local environment and ecosystems with the operation of Program-supported facilities/works such as effluent discharge and solid waste generation of wastewater treatment facilities, safe operation of facilities, labor management issues, workers' health and safety, safe application of fertilizers, impacts on farmers' livelihoods, and so on. Also, the downstream E&S impacts of proposed planning activities are anticipated to be positive in the long term. The inclusion of DLIs on integrated ecosystem and water resources planning is expected to mitigate risks about multi-sectoral coordination. In addition, two PAP actions to further strengthen environmental and social systems have been included in the Program (annex 6).

89. **Stakeholder risk is rated Substantial.** The Program aims to improve institutional coordination, an ambition that inherently faces stakeholder risks, given the need to coordinate and find consensus among diverse actors at different levels of government. The Program's design addresses this issue by supporting a coordination mechanism at the basin level and promoting cooperation through integrated planning and knowledge exchange. Program-supported activities rely on cooperation of sector agencies. The implementation arrangements and the use of results-based financing that incentivizes action across sector agencies help mitigate this risk, and the PAP has an action related to monitoring and reporting mechanisms for meaningful public participation and grievance redress.

ANNEX 1. RESULTS FRAMEWORK MATRIX

Results Framework

COUNTRY: China

Yellow River Basin Ecological Protection and Environmental Pollution Control Program

Program Development Objective(s)

To strengthen integrated water use efficiency, water pollution control, and ecosystem management, in selected regions of the Yellow River Basin

Program Development Objective Indicators by Objectives/Outcomes

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
To improve integrated water use efficiency, water pollution control, and ecosystem management							
1. Agricultural water productivity increased (Text)		Henan: 2.06; Shaanxi: 1.50	Henan: 2.14; Shaanxi: 1.60	Henan: 2.23; Shaanxi: 1.70	Henan: 2.31; Shaanxi: 1.90	Henan: 2.40; Shaanxi: 2.00	Henan: 2.49; Shaanxi: 2.20
In Henan (Metric ton)		2.06	2.14	2.23	2.31	2.40	2.49
In Shaanxi (Metric ton)		1.50	1.60	1.70	1.90	2.00	2.20
2. Pollutant loads reduced (Tones/year)	DLI 2	0.00	854.66	1,193.37	1,537.76	1,861.42	553.61
3. Reduction of soil erosion per km2 (Tones/year)		0.00	80.00	170.00	270.00	370.00	480.00
4. Capacity of YRCC to support integrated ecosystem and	DLI 5	Capacity of YRCC to support integrated		YRCC pilots an operational water	YRCC develops an integrated ecosystem		YRCC issues a technical guideline for integrated

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
water resources management of the YRB (Text)		ecosystem and water resources management of the YRB not developed		resources management and real-time monitoring system supported by a consumption-based water resources assessment in a pilot interprovincial sub-basin	and water resources management model for the YRB that optimizes water allocation for multiple purposes, including ecological flows, environment carrying capacity, and economic sectors		ecosystem and water resources management in the YRB based on consumption based water balance assessment and modeling

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Intermediate Results Indicator by Results Areas

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
Improving water use efficiency							
1. Areas with improved agricultural water management (Hectare(Ha))	DLI 1	0.00	13,600.00	28,850.00	44,100.00	55,600.00	62,000.00
2. Target Value Allocation Plans agreed and implemented in demonstration sub-basins (Text)		Henan: 0 Shaanxi: 0	Henan: 0 Shaanxi: 0	Henan: 1 Shaanxi: 0	Henan: 2 Shaanxi: 1	Henan: 3 Shaanxi: 2	Henan: 3 Shaanxi: 2
3. Women leadership in WUAs (Percentage)		16.00	22.00	27.50	32.50	37.50	40.00
Improving water quality							
4. Wastewater treatment plants upgraded or built (Number)		0.00	4.00	11.00	15.00	19.00	21.00
5. Rural households connected to decentralized wastewater treatment facilities (Number)		0.00	4,266.00	9,398.00	14,248.00	18,514.00	21,612.00
6. Medium and large livestock farms equipped with manure treatment facilities (Number)		0.00	46.00	96.00	145.00	191.00	238.00
Improving ecosystem management							
7. Area of ecosystems restored (forests, terracing, wetlands) (Hectare(Ha))	DLI 3	0.00	15,734.26	30,221.52	42,044.78	52,583.04	52,583.04
Area of forests restored		0.00	15,214.25	29,161.50	40,575.75	50,725.00	50,725.00

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
(Hectare(Ha))							
Area of terracing restored (Hectare(Ha))		0.00	329.51	641.02	917.53	1,177.04	1,177.04
Area of wetlands restored (Hectare(Ha))		0.00	190.50	419.00	551.50	681.00	681.00
8. CO2eq reduction by the forests restored through the Program (Metric ton)		0.00	54,771.00	104,981.00	147,358.00	182,610.00	182,610.00
Strengthening integration of ecosystem and water resources management into strategic planning							
9. Integrated ecosystem and water resources management process developed at the provincial level (Text)	DLI 4	Integrated ecosystem and water resources management plans do not exist	Sanmenxia Municipality approves three and each of Xianyang and Tongchuan Municipalities approve one integrated ecosystems and water resources management plan for demonstration sub-basins	N/A	The Provincial Departments of Water Resources at Henan and Shaanxi each approve one technical guideline for integrated ecosystem and water resources management at provincial level	The Provincial Departments of Water Resources at Henan and Shaanxi Provinces each approve one integrated ecosystem and water resources management plan (for the YRB in Henan, and the Wei River Basin in Shaanxi)	N/A
10. Training and capacity building implemented at basin, provincial, municipal and county levels (Number)		0.00	800.00	1,600.00	2,400.00	3,200.00	4,000.00
Among which women (Percentage)		0.00	45.00	45.00	45.00	45.00	45.00

Monitoring & Evaluation Plan: PDO Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
1. Agricultural water productivity increased	Measured as the agricultural output (in metric tons) per unit (thousand cubic meters) of water consumption in demonstration sub-basins.	Semi-Annual	Semi-annual Program Progress Report	Water consumption will be monitored according to remote sensing technology. Agricultural output will be monitored according to local agricultural statistical data	Provincial and/or municipal PMOs, Departments of Agricultural and Rural Affairs (DARA) and Departments of Water Resources (DWR) at the corresponding levels
In Henan					
In Shaanxi					
2. Pollutant loads reduced	Annual pollutant (COD) reduced from point and NPS in the demonstration sub-basins due to Program activities, including (i) upgrading or building new WWTPs and pipelines; (ii) new rural household connections to decentralized wastewater treatment facilities; and/or (iii) livestock farms equipped with manure treatment facilities	Annual	Verification report	PMOs with inputs from relevant environment, agricultural and water bureaus	Department of Ecology and Environment (DEE), PPMO and/or municipal PMOs
3. Reduction of soil erosion per km2	This indicator highlights the improvement in ecological functions as a result of	Semi-Annual	Semi annual Program Progress	Field survey of soil loss intensity measurements using run-off plots or	Provincial and/or municipal PMOs and corresponding forestry

	Program interventions, reflected in the increase of soil water holding capacity, and the subsequent reduction of soil loss and water runoff, at demonstration sub-basins. The indicator measures accumulated reduction of soil loss intensity with respect to the baseline year.		Report	through outlet monitoring stations of small watersheds.	bureaus.
4. Capacity of YRCC to support integrated ecosystem and water resources management of the YRB	This DLI addresses challenges of institutional strengthening and inter-jurisdictional cooperation by working at the YRB level, incentivizing upscaling and integration of results from provincial to basin level, and promoting a paradigm shift in the way water resources are assessed. The three results included in this indicator will strengthen YRCC's capacity to manage and integrate ecosystem and water resources into planning and decision-making at the YRB.	Annual	Verification Report	BPMO aggregates results from participating departments	BPMO

Monitoring & Evaluation Plan: Intermediate Results Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
1. Areas with improved agricultural water management	Defined as the areas within the demonstration sub-basins (in hectares) with improved agricultural water management - both through irrigation modernization and improved agronomic practices	Annual	Verification Report	Data can be obtained from inventory data at local agricultural and water bureaus	DARA, DWR, PPMO and/or municipal PMOs as applicable
2. Target Value Allocation Plans agreed and implemented in demonstration sub-basins	Target Values (ET and EC) established and agreed for the demonstration sub-basins; and target values identified for specific counties within the sub-basins; Allocation Plans prepared and implemented to reduce total water consumption under the target ET and to reduce pollutant loads under the target EC; Monitoring system in place to measure actual water consumption and pollution load reduction under the Allocation Plan implementation. Target ET	Semi-annual	Semi-annual Program Progress Report	Target Values (ET and EC) for demonstration sub-basins established and agreed with provincial and local governments; Allocation Plans approved and monitoring system in place.	Provincial and/or municipal PMOs and DWRs as applicable

	refers to the sustainable limit of water consumption, and target EC refers to the maximum pollutant load under certain water quality requirement.				
3. Women leadership in WUAs	Percentage of females in executive bodies of WUA (chair/co-chair, or members of the executive committees)	Semi-annual	Semi-annual Program Progress Report	Data will be obtained from the WUA member lists	DARA and PMOs
4. Wastewater treatment plants upgraded or built	This indicator includes both upgraded and newly built WWTPs in demonstration sub-basins. Number of wastewater treatment plants with effluent discharge standard upgraded from Class 1A; treatment capacity of newly built WWTPs cannot exceed 50,000 tonnes per day. Climate-resilient designs will be incorporated in constructing or upgrading WWTPs.	Semi-annual	Semi-annual Program Progress Report	Data will be obtained from program progress report and verified by official records from relevant departments.	PPMO and/or municipal PMOs, with data from Departments of Housing and Urban-Rural Development (DOHURD) at the appropriate levels.
5. Rural households connected to decentralized wastewater treatment facilities	Number of rural households connected to decentralized wastewater treatment facilities in	Semi-annual	Semi-annual Program Progress Report	Inventory of new rural decentralized wastewater treatment facilities and household	DARAs and municipal PMOs in demonstration sub-basins

	demonstration sub-basins. Installation of decentralized facilities will consider potential climate change impacts.			connections will be verified by municipal PMOs through DARA official records	
6. Medium and large livestock farms equipped with manure treatment facilities	Number of medium and large livestock farms equipped with operational manure collection and treatment facilities within the demonstration sub-basins	Semi - Annual	Semi-annual Program Progress Report	The scale of medium and large livestock farms is to be determined, for example with more than 100 pigs. The number will be obtained from MARA direct reporting system and will be verified by random sampling of 10 percent of the eligible livestock farms.	PMOs with information from DARAs at the corresponding level.
7. Area of ecosystems restored (forests, terracing, wetlands)	This indicator measures the areas (in hectares) of forests, terracing, and wetlands restored within demonstration sub-basins	Semi-Annual	Verification Report	Surveys of restored areas	PPMO and/or municipal PMOs as needed
Area of forests restored	Hectares of forests restored based on government technical standards and specific additions detailed in the verification protocol, with a survival rate of 85 percent one year after planting and mix forest structure developed.				

Area of terracing restored	Hectares of terracing lands restored for erosion control based on the technical standards.				
Area of wetlands restored	Hectares of wetlands restored for habitat conservation based on the technical standards.				
8. CO2eq reduction by the forests restored through the Program	The increase of CO2eq sequestration by the Program is estimated based on the biomass of the increased and rehabilitated forests and other vegetation during program implementation period and its lifetime.	Semi-annual	Semi-annual Program Progress Report	The reduction of CO2eq emissions by the Program will be estimated by the use of FAO-developed models for carbon sequestration, considering a 30-year program lifetime. The estimates carried out during appraisal showed 3.6 tonnes of CO2-e reduced per hectare per year, based on EX-ACT tool calculation.	Provincial and/or municipal PMOs
9. Integrated ecosystem and water resources management process developed at the provincial level	This indicator / DLI provides incentives for multi-sectoral collaboration at different government levels, as follows: (i) Sanmenxia Municipality in Henan, and Xianyang and Tongchuan	Annual	Verification Report	Official documents are approved and have previously been reviewed by the World Bank and comments incorporated	Municipal and/or provincial PMOs as applicable

	Municipalities in Shaanxi, adopt integrated plans for demonstration sub-basins. The integrated plans need to include a consumption based water balance analysis, and cover ecosystem management, water resource conservation and water pollution reduction, considering future climate change impacts and gender; (ii) The Provincial Department of Water Resources (PDWR) in Henan and Shaanxi Provinces each approve one technical guideline on how to prepare integrated ecosystem and water resources management plans, based on the experience from the demonstration sub-basins; (iii) The PDWRs in Henan and Shaanxi Provinces each approve a provincial integrated ecosystem and water resources management plan (for the				

	YRB in Henan and Wei River Basin in Shaanxi).				
10. Training and capacity building implemented at basin, provincial, municipal and county levels	Number of people participating in trainings to build capacity on integrated ecosystem and water resources management. These trainings include issues of water assessment, landscape management, ecosystem and water resources integration, pollution control, climate change, gender, and others. The trainings will be organized by different agencies at the provincial, municipal and county levels, and by YRCC at the basin level, upon demand.	Semi-annual	Semi-annual Program Progress Report	Registration of trainings and other capacity building activities of the BPMO and PPMOs	BPMO, PPMOs and/or municipal PMOs
Among which women	Percentage of females participating in trainings and other capacity building events provided under the Program.	Semi-annual	Semi-annual Program Progress Report	Register of trainees and participants by BPMO and PPMOs	BPMO, PPMO and/or municipal PMOs as applicable

ANNEX 2. DISBURSEMENT LINKED INDICATORS, DISBURSEMENT ARRANGEMENTS AND VERIFICATION PROTOCOLS

Disbursement Linked Indicators Matrix				
DLI 1	1a. Areas with improved agricultural water management (Henan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Text	55,500,000.00	3.65
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0 ha			
2022	7200 ha		13,320,000.00	US$1,850 per hectare with improved agricultural water management
2023	8850 ha (accumulated: 16,050 ha)		16,372,500.00	US$1,850 per hectare with improved agricultural water management
2024	8850 ha (accumulated: 24,900 ha)		16,372,500.00	US$1,850 per hectare with improved agricultural water management
2025	5100 ha (accumulated: 30,000 ha)		9,435,000.00	US$1,850 per hectare with improved agricultural water management
2026	0 ha (accumulated: 30,000 ha)		0.00	N/A

2027	0 ha (accumulated: 30,000 ha)		0.00	N/A
DLI 2	2a. Pollutant loads reduced (Henan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Metric ton	30,297,300.00	1.99
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
2022	0.00		0.00	US$15,000 per ton of COD reduced
2023	58.66		879,900.00	US$15,000 per ton of COD reduced
2024	397.37		5,960,550.00	US$15,000 per ton of COD reduced
2025	475.76		7,136,400.00	US$15,000 per ton of COD reduced
2026	534.42		8,016,300.00	US$15,000 per ton of COD reduced
2027	553.61		8,304,150.00	US$15,000 per ton of COD reduced
DLI 3	3a. Area of ecosystems restored (forests, terracing, wetlands) (Henan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Text	74,031,900.00	4.87
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	Forest: 0 ha; Terracing: 0 ha; Wetlands: 0 ha.			
2022	Forest: 8865 ha; Terracing: 123 ha; Wetlands: 75		25,830,150.00	US$2,250 per hectare of forest

	ha		restored; US$16,800 per hectare of terracing restored; US$50,900 per hectare of wetland restored
2023	Forest: 7598 ha (Accumulated: 16463 ha); Terracing: 105 ha (Acc: 228 ha); Wetlands: 113 ha (Acc: 188 ha)	24,611,200.00	US$2,250 per hectare of forest restored; US$16,800 per hectare of terracing restored; US$50,900 per hectare of wetland restored
2024	Forest: 5065 ha (Accumulated: 21528 ha); Terracing: 70 ha (Acc: 298 ha); Wetlands: 17 ha (Acc: 205 ha)	13,437,550.00	US$2,250 per hectare of forest restored; US$16,800 per hectare of terracing restored; US$50,900 per hectare of wetland restored
2025	Forest: 3800 ha (Acc: 25328 ha); Terracing: 53 ha (Acc: 351 ha); Wetlands: 14 ha (Acc: 219 ha)	10,153,000.00	US$2,250 per hectare of forest restored; US$16,800 per hectare of terracing restored; US$50,900 per hectare of wetland restored
2026	Forest: 0 ha (Acc: 25328 ha); Terracing: 0 ha (Acc: 351 ha); Wetlands: 0 ha (Acc: 219 ha)	0.00	N/A
2027	Forest: 0 ha (Acc: 25328 ha); Terracing: 0 ha (Acc: 351 ha); Wetlands: 0 ha (Acc: 219 ha)	0.00	N/A

DLI 4	4.1a Integrated ecosystem and water resources management process developed at the provincial level (Henan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Text	26,920,800.00	1.66
Period	**Value**		**Allocated Amount (USD)**	**Formula**

Baseline	Integrated ecosystem and water resources management plans do not exist		
2022	Sanmenxia Municipality has approved integrated ecosystem and water resources management plans for each of the three demonstration sub-basins	12,000,000.00	US$4,000,000 per plan approved
2023	N/A	0.00	N/A
2024	Provincial Department of Water Resources has approved one technical guideline for integrated ecosystem and water resources management	4,000,000.00	Yes/No
2025	Provincial Department of Water Resources has approved one integrated ecosystem and water resources management plan for the Yellow River Basin in Henan province	10,920,800.00	Yes/No
2026	N/A	0.00	N/A
2027	N/A	0.00	N/A

DLI 5	4.2 Capacity of YRCC to support integrated ecosystem and water resources management of the YRB			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Outcome	No	Text	6,500,000.00	0.66
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	Capacity of YRCC to support integrated ecosystem and water resources management of			

	the YRB not developed		
2022	N/A	0.00	N/A
2023	YRCC has piloted an operational water resources management and real-time monitoring system supported by a consumption-based water resources assessment in a pilot interprovincial sub-basin	2,600,000.00	Yes/No
2024	YRCC has developed an integrated ecosystem and water resources management model for the YRB that optimizes water allocation for multiple purposes, including ecological flows, environment carrying capacity, and economic sectors	2,600,000.00	Yes/No
2025	N/A	0.00	N/A
2026	YRCC has issued a technical guideline for integrated ecosystem and water resources management in the YRB based on consumption based water balance assessment and modeling	1,300,000.00	Yes/No
2027	N/A	0.00	N/A

DLI 6	1b. Areas with improved agricultural water management (Shaanxi)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Text	33,600,000.00	2.21
Period	**Value**		**Allocated Amount (USD)**	**Formula**

Baseline	0 ha		
2022	6400 ha	6,720,000.00	US$1,050 per hectare with improved agricultural water management
2023	6400 ha (accumulated: 12,800 ha)	6,720,000.00	US$1,050 per hectare with improved agricultural water management
2024	6400 ha (accumulated: 19,200 ha)	6,720,000.00	US$1,050 per hectare with improved agricultural water management
2025	6400 ha (accumulated: 25,600 ha)	6,720,000.00	US$1,050 per hectare with improved agricultural water management
2026	6400 ha (accumulated: 32,000 ha)	6,720,000.00	US$1,050 per hectare with improved agricultural water management
2027	0 ha (accumulated: 32,000 ha)	0.00	N/A

DLI 7	2b. Pollutant loads reduced (Shaanxi)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Metric ton	59,715,000.00	3.93
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			

2022	100.00	1,500,000.00	US$15,000 per ton of COD reduced
2023	696.00	10,440,000.00	US$15,000 per ton of COD reduced
2024	796.00	11,940,000.00	US$15,000 per ton of COD reduced
2025	1,062.00	15,930,000.00	US$15,000 per ton of COD reduced
2026	1,327.00	19,905,000.00	US$15,000 per ton of COD reduced
2027	0.00	0.00	N/A

DLI 8	3b. Area of ecosystems restored (forests, terracing, wetlands) (Shaanxi)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Text	73,634,014.00	4.84
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0 ha			
2022	Forest: 6349.25 ha; Terracing: 206.51 ha; Wetlands: 115.5 ha		18,408,503.50	US$1,750 per hectare of forest restored; US$16,600 per hectare of terracing restored; US$33,500 per hectare of wetland restored
2023	Forest: 6349.25 ha (Accumulated: 12698.5 ha); Terracing: 206.51 ha (Acc: 413.02 ha); Wetlands: 115.5 ha (Acc: 231 ha)		18,408,503.50	US$1,750 per hectare of forest restored; US$16,600 per hectare of terracing restored; US$33,500 per hectare of wetland restored
2024	Forest: 6349.25 ha (Accumulated: 19047.75 ha); Terracing: 206.51 ha (Acc: 619.53 ha); Wetlands:		18,408,503.50	US$1,750 per hectare of forest restored; US$16,600 per hectare of

	115.5 ha (Acc: 346.5 ha)		terracing restored; US$33,500 per hectare of wetland restored
2025	Forest: 6349.25 ha (Accumulated: 25397 ha); Terracing: 206.51 ha (Acc: 826.04 ha); Wetlands: 115.5 ha (Acc: 462 ha)	18,408,503.50	US$1,750 per hectare of forest restored; US$16,600 per hectare of terracing restored; US$33,500 per hectare of wetland restored
2026	Forest: 0 ha (Accumulated: 25397 ha); Terracing: 0 ha (Acc: 826.04 ha); Wetlands: 0 ha (Acc: 462 ha)	0.00	N/A
2027	Forest: 0 ha (Accumulated: 25397 ha); Terracing: 0 ha (Acc: 826.04 ha); Wetlands: 0 ha (Acc: 462 ha)	0.00	N/A

DLI 9	4.1b Integrated ecosystem and water resources management process developed at the provincial level (Shaanxi)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Outcome	Yes	Text	19,800,986.00	1.19
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	Integrated ecosystem and water resources management plans do not exist			
2022	Each of Xianyang Municipality and Tongchuan Municipality have approved an integrated ecosystem and water resources management plan for demonstration sub-basins within their respective jurisdiction.		8,000,000.00	US$4,000,000 per plan approved

2023	N/A	0.00	N/A
2024	Provincial Department of Water Resources has approved one technical guideline for integrated ecosystem and water resources management.	4,000,000.00	Yes/No
2025	Provincial Department of Water Resources has approved one integrated ecosystem and water resources management plan for the Wei River Basin in Shaanxi.	7,800,986.00	Yes/No
2026	N/A	0.00	N/A
2027	N/A	0.00	N/A

Verification Protocol Table: Disbursement Linked Indicators	
DLI 1	1a. Areas with improved agricultural water management (Henan)
Description	This DLI is defined as the areas (in hectares, ha) with improved agricultural water management, within the demonstration sub-basins. Improved agricultural water management means management of water resources for agricultural purposes that meet both criteria as follows: (a) employment of irrigation modernization, through one or several of the following activities: irrigation and drainage infrastructural rehabilitation, water saving equipment installation and application, farmland leveling, irrigation management platform development, and other affiliated facility development; and (b) improvement of agronomic practices, through one or several of the following activities: cropping pattern adjustment, no-till farming and straw returning, soil quality improvement and appropriate application of agricultural mulching. These infrastructural and agronomy improvements will improve agricultural water management to reduce total water consumption and increase water productivity. Improved agricultural water management and reduced water consumption is key to address water scarcity and future climate change impacts, as it (i) improves resilience towards potential extreme climate events, i.e. droughts, and (ii) reduces energy consumption, as well as associated GHG emissions, for water pumping and diversion.
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification** will be carried out by (a) checking remote sensing and satellite data to verify the application of infrastructural improvements, and (b) field visits to 10 percent of sampled schemes according to inventory data at county-level agricultural and water bureaus to corroborate remote sensing and satellite data. **Disbursement** is made scalable according to the areas (0.01 hectare) applying improved agricultural water management measures as outlined in the PIP. Annual values are indicative, and can be met at any time during Program implementation.
DLI 2	2a. Pollutant loads reduced (Henan)
Description	This DLI measures the annual pollutant (COD) reduced from point and non-point sources due to Program activities in demonstration sub-basins, including (i) upgrading or building new WWTPs and pipelines; (ii) new rural household connections to decentralized wastewater treatment facilities; and/or (iii) livestock farms equipped with manure treatment facilities. Reducing pollutant loads entering into water bodies is critical to increase water quality, and is even more important under a climate change scenario in which water scarcity is forecast. Improved water quality increases resilience against potential extreme climate events, i.e. droughts, by reducing risks of pollution events. Reduced pollution loads also

	result in reduction of fugitive methane (a potent greenhouse gas) emissions from polluted waterbodies.
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification:** (1) for upgraded and newly built WWTPs, pollution reduction will be estimated according to the water quality monitoring records of WWTP influent and effluent. Those monitoring records will be verified at environmental bureaus; (2) for newly connected rural households to decentralized wastewater treatment facilities, pollutant reduction will be estimated according to the number of households connected, average population number per households per local statistics and pollutant generation per person per day according to technical standards. The number of households connected can be verified according to inventory data to be collected by the PMOs. (3) for non-point source pollution reduction, pollution reduction will be estimated by the number of livestock farms equipped with manure treatment facilities and the number/type of livestock in those farms. Pollution generation will be estimated based on number and type of livestock according to MEE technical standards and the number of farms equipped with treatment facilities can be obtained from DARA records at the appropriate level, and verified through random sampling inventory of 10 percent of the farms. **Disbursement** will be made scalable upon the amount (0.01 metric tons) of pollutant (COD) load reduced from entering water bodies. Disbursement is scalable only within each year and is capped at the annual DLI value.
DLI 3	3a. Area of ecosystems restored (forests, terracing, wetlands) (Henan)
Description	This indicator measures three areas (in ha) for activities within the demonstration sub-basins: a) Hectares of forests restored; b) Hectares of terracing lands restored for erosion control; and c) Hectares of wetlands restored for habitat conservation. Additional description: a) Forests restored includes three types of interventions: (i) mixed species plantations established, (ii) degraded and monoculture forests restored and transferred to mixed species forests, and/or (iii) assisted natural regeneration promotion. The technical specifications should meet all established technical standards, and additional details included in this verification procedure, to extend forest areas with forest species increased and forest structure adjusted to enhance ecosystem functions and resilience. For mixed species plantation establishment, a survival rate of 85 percent one growing season after planting is required; the restoration of degraded and monoculture forests will be realized through supplementary planting of native species, assisted natural regeneration promotion and other measures with additional young seedlings survived after one growing season. Applicable technical standards include: (A) National Afforestation Technical Protocol (GB/T 5776-2016); (B) Henan Forest Ecological Construction Verification Protocol (2019 -

	115); (B) GB/T 15163-2018. b) Terracing lands restored for erosion control are defined as lands with a slope less than 25 degree restored to improve soil and water conservation and water retaining capacity. Applicable technical standards: (A) Technical specification for control of soil and water conservation - Technique for erosion control of slope land (GB/T 16453.1-2008); (B) Control of soil and water conservation. Technique for erosion control of waste land (GB/T16453.2-2008). c) Wetlands restored for habitat conservation refers to areas of degraded wetlands restored to provide additional wildlife habitat for water birds and other wildlife taxa (fish, amphibians, insects). Applicable technical standards are (A) DB11/T 1300—2015 Technical Regulations for Wetland Restoration and Construction; (B) HJ 2005 - 2010 Constructed Wetland Sewage Treatment.
Data source/ Agency	Verification Report
Verification Entity	Verification agency
Procedure	**Verification**: Two levels of inspection and acceptance will be carried out according to the abovementioned technical standards. Verification will be based on county-level forest management checks carried out for all sites by local program implementation agencies; PMOs will collect completion reports from all counties in demonstration sub-basins, and submit to TPVA for verification. TPVA will carry out the verification for activities completed through random field surveys covering a percentage, to be agreed upon in the PIP, of the county's reported qualified areas, which will, in turn, cover a percentage, to be agreed upon, of the total for each demonstration sub-basin. **Disbursement** will be made scalable based on the number of hectares with restored ecosystem areas in the demonstration sub-basins. The annual values are indicative, they can be met at any time during Program implementation.
DLI 4	4.1a Integrated ecosystem and water resources management process developed at the provincial level (Henan)
Description	This DLI provides incentives for multi-sectoral collaboration at different government levels, rewarding the preparation of integrated ecosystem and water resources management plans at the Yellow River Basin in Henan Province. This DLI measures the achievement of three results: (i) Sanmenxia Municipality Water Resources Bureau approves three integrated ecosystem and water resource management plans for three demonstration sub-basins. The integrated plan needs to include a consumption based water balance analysis, and covers ecosystem management, water resource conservation and water pollution reduction, considering future climate change impacts and gender. (ii) Provincial Department of Water Resources issues one technical guideline on how to prepare integrated ecosystem and water resources management plans, based on the experience from the demonstration sub-basins; (iii) Provincial Department of Water Resources approves one integrated ecosystem and water resources management plan for the Yellow River Basin in Henan. These plans and guidelines will

	consider the impacts of future climate change, and will include actions for both mitigation and adaptation.
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification:** Official documents (sub-basin integrated plans, provincial guidelines and provincial plan) are approved and are made available to the verification agency. All these documents will need to be acceptable to the World Bank and hence they should have previously been reviewed by the World Bank and comments incorporated. **Disbursement:** (i) Disbursement will be made scalable upon the number of sub-basin Integrated Ecosystem and Water Resources Management Plans for the demonstration sub-basins approved by municipal departments. Three in total. (ii) A one-off disbursement will be made upon the provincial technical guideline being approved by the provincial department of water resources; (iii) A one-off disbursement will be made upon the integrated plan for the Yellow River Basin in Henan being approved by the provincial department of water resources.
DLI 5	4.2 Capacity of YRCC to support integrated ecosystem and water resources management of the YRB
Description	This DLI addresses challenges of institutional strengthening and inter-jurisdictional cooperation by working at the YRB level, incentivizing upscaling and integration of results from provincial to basin level, and promoting a paradigm shift in the way water resources are assessed. The DLI measures the results achieved by strengthening the capacity of the YRCC to support the integration of ecosystem and water management in three aspects: (i) YRCC pilots an operational water resources management and real-time monitoring system supported by a consumption-based water resources assessment in a pilot interprovincial sub-basin (ii) YRCC develops an integrated ecosystem and water resources management model for the YRB that optimizes water allocation for multiple purposes, including ecological flows, environment carrying capacity, and economic sectors (iii) YRCC issues a technical guideline for integrated ecosystem and water resources management in the YRB based on consumption based water balance assessment and modeling Capacity building to YRCC will include the development of climate change models that will inform the development of the guidelines for the whole YRB. The integrated ecosystem and water resource model will optimize water uses for multiple purposes including water demands for different uses, including ecosystems, environmental carrying capacity, economic sectors and others.
Data source/ Agency	Verification Report

Verification Entity	Verification Agency
Procedure	**Verification** will be based on (a) Reports summarizing the water resources management and real-time monitoring system, including the process followed for its development, are completed by the YRCC and are made available to the verification agency; (b) The basin-wide integrated ecosystem and water resources management model for the YRB is approved by YRCC and is made available to the TPVA; and (c) The technical guideline is issued and available to the TPVA. All these documents will need to be acceptable to the Bank, and hence they should have previously been reviewed by the Bank, and comments have been incorporated. **Disbursement** is not time bound, and the disbursements will be made to YRCC upon completion of each result.
DLI 6	1b. Areas with improved agricultural water management (Shaanxi)
Description	This DLI is defined as the areas (in hectares, ha) with improved agricultural water management, within demonstration sub-basins. Improved agricultural water management means management of water resources for agricultural purposes that meet both of the following: (a) employment of irrigation modernization, through one or several of the following activities: irrigation and drainage infrastructural rehabilitation, water saving equipment installation and application, farmland leveling, irrigation management platform development, and other affiliated facility development; and (b) improvement of agronomic practices, through one or several of the following activities: cropping pattern adjustment, no-till farming and straw returning, soil quality improvement and appropriate application of agricultural mulching. These infrastructural and agronomy improvements will improve agricultural water management to reduce total water consumption and increase water productivity. Improved agricultural water management and reduced water consumption is key to address water scarcity and future climate change impacts, as it (i) improves resilience towards potential extreme climate events, i.e. droughts, and (ii) reduces energy consumption, as well as associated GHG emissions, for water pumping and diversion.
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification** will be carried out by (a) checking remote sensing and satellite data to verify the application of infrastructural improvements, and (b) field visits to 10 percent of sampled schemes according to inventory data at county-level agricultural and water bureaus to corroborate remote sensing and satellite data. **Disbursement** is made scalable according to the areas (0.01 hectare) applying improved agricultural water management

	measures as outlined in the PIP. Annual values are indicative, and can be met at any time during Program implementation.
DLI 7	2b. Pollutant loads reduced (Shaanxi)
Description	This measures the annual pollutant (COD) reduced from point and non-point sources due to Program activities in demonstration sub-basins, including (i) upgrading or building new WWTPs and pipelines; (ii) new rural household connections to decentralized wastewater treatment facilities; and/or (iii) livestock farms equipped with manure treatment facilities. Reducing pollutant loads entering into water bodies is critical to increase water quality, and is even more important under a climate change scenario in which water scarcity is forecast. Improved water quality increases resilience against potential extreme climate events, i.e. droughts, by reducing risks of pollution events. Reduced pollution loads also result in reduction of fugitive methane (a potent greenhouse gas) emissions from polluted waterbodies
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification:** (1) for upgraded and newly built WWTPs, pollution reduction will be estimated according to the water quality monitoring records of WWTP influent and effluent. Those monitoring records will be verified at environmental bureaus; (2) for newly connected rural households to decentralized wastewater treatment facilities, pollutant reduction will be estimated according to the number of households connected, average population number per households per local statistics and pollutant generation per person per day according to technical standards. The number of households connected can be verified according to inventory data to be collected by the PMOs. (3) for non-point source pollution reduction, pollution reduction will be estimated by the number of livestock farms equipped with manure treatment facilities and the number/type of livestock in those farms. Pollution generation will be estimated based on number and type of livestock according to MEE technical standards and the number of farms equipped with treatment facilities can be obtained from DARA records at the appropriate level, and verified through random sampling inventory of 10 percent of the farms. **Disbursement** will be made scalable upon the amount (0.01 metric tons) of pollutant (COD) load reduced from entering water bodies. Disbursement is scalable only within each year and is capped at the annual DLI value.

DLI 8	3b. Area of ecosystems restored (forests, terracing, wetlands) (Shaanxi)
Description	This DLI measures three areas (in ha) for activities carried out in demonstration sub-basins: a) Hectares of forests restored; b) Hectares of terracing lands restored for erosion control; and c) Hectares of wetlands restored for habitat conservation. Additional description: a) Forests restored includes three types of interventions: (i) mixed species plantations established, (ii) degraded and monoculture forests restored and transferred to mixed species forests, and/or (iii) assisted natural regeneration promotion. The technical specifications should meet all established technical standards, and additional details included in this verification procedure, to extend forest areas with forest species increased and forest structure adjusted to enhance ecosystem functions and resilience. For mixed species plantation establishment, a survival rate of 85 percent one growing season after planting is required; the restoration of degraded and monoculture forests will be realized through supplementary planting of native species, assisted natural regeneration promotion and other measures with additional young seedlings survived after one growing season. Applicable technical standards include (A) National Afforestation and Forest Management Comprehensive Verification Technical Regulation (LY/T2083-2013); (B) Forest Management Verification Technical Regulation (Forestry 2014 – No. 140); (C) GB/T 15163-2004 - Technical regulations for setting apart hills including sand area for tree growing, and relevant Shaanxi Provincial Technical Standards; b) Terracing lands restored for erosion control are defined as lands with a slope less than 25 degree restored to improve soil and water conservation and water retaining capacity. Applicable technical standards: (A) Technical specification for comprehensive control of soil and water conservation - Technique for erosion control of slope land (GB/T 16453.1-2008); (B) Comprehensive control of soil and water conservation. Technique for erosion control of waste land (GB/T16453.2-2008). c) Wetlands restored for habitat conservation refers to areas of degraded wetlands restored to provide additional wildlife habitat for waterbirds and other wildlife taxa (fish, amphibians, insects). Applicable technical standards are (A) DB11/T 1300—2015 for Wetland Restoration and Construction; (B) HJ 2005 - 2010 Constructed Wetland Sewage Treatment.
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification**: Two levels of inspection and acceptance will be carried out according to the abovementioned technical standards. Verification will be based on county-level forest management checks carried out for all sites by local program implementation agencies; PPMOs will collect completion reports from all counties in demonstration sub-basins, and submit to TPVA for verification. TPVA will carry out the verification for activities completed through random field surveys covering a percentage, to be agreed upon in the PIP, of the county's reported qualified areas, which will, in turn, cover a percentage,

	to be agreed upon, of the total for each demonstration sub-basin. **Disbursement** will be made scalable based on the number of hectares with restored ecosystem areas in the demonstration sub-basins. The annual values are indicative, they can be met at any time during Program implementation.
DLI 9	4.1b Integrated ecosystem and water resources management process developed at the provincial level (Shaanxi)
Description	This provides incentives for multi-sectoral collaboration at different government levels, rewarding the preparation of integrated ecosystem and water resources management plans at the Wei River Basin in Shaanxi Province. This DLI will be achieved through three consecutive results: (i) Xianyang Municipality and Tongchuan Municipality each complete an integrated ecosystem and water resource management plan for demonstration sub-basins in Shaanxi. The integrated plan needs to include a consumption based water balance analysis, and covers ecosystem management, water resource conservation and water pollution reduction, considering future climate change impacts and gender. (ii) Shaanxi Provincial Department of Water Resources issues one technical guideline on how to prepare integrated ecosystem and water resources management plans, based on the experience from the demonstration sub-basins; (iii) Shaanxi Provincial Department of Water Resources approves one integrated ecosystem and water resources management plan for the Wei River Basin in Shaanxi. These plans and guidelines plan will consider the impacts of future climate change, and will include actions for both mitigation and adaptation.
Data source/ Agency	Verification Report
Verification Entity	Verification Agency
Procedure	**Verification:** Official documents (sub-basin integrated plans, provincial guidelines and provincial plan) are approved and are made available to the verification agency. All these documents will need to be acceptable to the Bank, and hence they should have previously been reviewed by the Bank, and comments have been incorporated. **Disbursement:** (i) Disbursement will be made scalable upon the number of sub-basin Integrated Ecosystem and Water Resources Management Plans approved for the demonstration sub-basins by municipal departments. Two in total. (ii) A one-off disbursement will be made upon the provincial technical guideline being approved by the Provincial Department of Water Resources; (iii) A one-off disbursement will be made upon the integrated plan for Wei River in Shaanxi being approved by the Provincial Department of Water Resources

ANNEX 3. SUMMARY TECHNICAL ASSESSMENT

Program Expenditure Frameworks

1. **The Program's hierarchical design is aligned with the responsibilities for ecosystem and water resources management at central, provincial, and local levels.** According to the Reform Plan for Delineating the Functions and Expenditure Responsibility between the Central Government and Provinces regarding Ecology and Environment Protection, [83] national-level ecological environment planning, policy and law making, implementation monitoring, management, law enforcement, and capacity building has been classified as a central functionality; prevention and control of water pollution in key basins has been classified as shared functionality; and local-level environmental planning, policy and law making, implementation monitoring, and capacity building, as well as the prevention and control of agricultural and rural pollution, has been classified as local functionality. The Program will support activities along these lines.

2. **Table 3.1 provides the breakdown of the Program financing by RAs and by provinces.** Of the total Program financing, RA1 accounts for 45.26 percent, RA2 for 18.28 percent, RA3 for 24.13 percent, and RA4 for 12.33 percent. The following expenditure framework assessment will focus on the budget expenditure related to the program activities under the four results areas: improving water conservation; improving water quality; restoring key ecosystems; and promoting integrated, strategic planning.

Table 3.1. Program Financing by Result Areas (2022–2026) (US$, millions)

Result Areas	2020			2022–2026 Estimated				
	YRCC	Henan	Shaanxi	YRCC	Henan	Shanxi	Sub-total	Share (%)
RA1	0.0	41.5	61.7	0.0	207.4	308.3	**515.7**	**45.26**
RA2	0.0	16.6	25.1	0.0	82.9	125.4	**208.3**	**18.28**
RA3	0.0	18.7	36.2	0.0	93.7	181.2	**274.9**	**24.13**
RA4	7.2	7.4	13.6	35.9	36.9	67.8	**140.5**	**12.33**
Sub-total	**7.2**	**84.2**	**136.5**	**35.9**	**420.8**	**682.6**	**1,139.4**	

3. As the ecological protection and high-quality development of the YRB has been listed as a national strategy, the officials from Henan and Shaanxi estimated that the budget funds related to the ecological management of the YRB during the 14th FYP period are expected to increase compared with those during the 13th FYP period. To be prudent, the World Bank team used the allocated amount for 2020 to estimate the budget funding related to results areas during 2022–2026.

4. **Program expenditure boundary.** The local governments in China adopt a uniform budget classification to prepare budget and report Government expenditures following the instruction of the central Ministry of Finance (MOF). According to the budget classification, there are some major budget lines recording the budget expenditures for the Government program: Agriculture and Rural Affairs (21301), Forestry and Grassland Affairs (21302), Water Conservancy (21303), Water Body Pollution Control (2110302), and Rural Environmental Protection (2110402). For the PforR Program, the expenditure boundary is defined as selected budget lines corresponding to the expenditures on PforR Program activities, which is a subset of the Government program expenditures (see Table 3.2). Based on the budget data of 2020, the PforR Program is about 30.5 percent of the Government program, 100 percent for the YRCC, 56.2 percent for Henan, and 44.6 percent for Shaanxi.

[83] Guo Ban Fa [2020] No. 13 (*link*).

Table 3.2. Program Expenditure Boundary 2020 (US$, millions)

Code	Budget Lline	Government Program			PforR Program			
		YRCC	Henan	Shaanxi	Result Area	YRCC	Henan	Shaanxi
21301	**Agriculture and Rural Affairs**		68.2	127.5				
2130122	Agricultural Production Development				RA 1		23.8	13.5
2130135	Protection, Restoration and Utilization of Agricultural Resources				RA 3		0.3	4.6
2130153	Farmland Construction				RA 3		5.0	5.4
21302	**Forestry and Grassland**		29.3	55.3				
2130201	Administrative Operation				RA 4		2.1	2.3
2130202	General Administrative Services				RA 4		0.4	1.3
2130205	Cultivation of Forest Resources				RA 3		8.7	14.2
2130207	Forest Resource Management				RA 3		0.7	6.5
2130209	Forest Ecological Benefit Compensation				RA 3		3.2	3.8
2130210	Management of Nature Reserves, etc.				RA 3		0.1	0.9
2130212	Wetland Protection				RA 3		0.8	0.8
2130237	Industry Business Management				RA 4			
21303	**Water Conservancy**		35.7	98.3				
2130301	Administrative Operation				RA 4		4.0	4.1
2130302	General Administrative Services				RA 4		0.7	0.5
2130304	Water Industry Business Management				RA 4		0.2	5.5
2130305	Water Conservancy Project Construction				RA 1		3.3	15.5
2130306	Operation and Maintenance of Water Conservancy Projects				RA 1		0.7	2.1
2130308	Preliminary Work On Water Conservancy	7.2			RA 4	7.2		
2130310	Soil and Water Conservation				RA 1		4.0	7.7
2130311	Water Resource Conservation Management and Protection				RA 1		2.4	3.2
2130316	Rural Water Conservancy				RA 1		3.5	3.9
2130319	Comprehensive Improvement of Rivers, Lakes and Reservoirs				RA 1		2.1	4.1
2130335	Rural People and Livestock Drinking Water				RA 1		1.6	11.8
2110302	Water Body Pollution Control		11.8	18.5	RA 2		11.8	18.5
2110402	Rural Environmental Protection		4.8	6.6	RA 2		4.8	6.6
Total Amount		7.2	149.8	306.2		7.2	84.2	136.5

5. **China takes a cascading approach to decentralization arrangements.** The central goverment decides its tax sharing and expenditure assignments with provinces and municipalities, and each province or municipality decides on its respective tax sharing and expenditure assignments with prefectures and counties in its jurisdiction. Typically, the counties receive transfers from upper-level governments and play a key role in providing public services to the local residents.

6. **The sources of budget funding on Program activities in Henan and Shaanxi consist of three parts:** transfers from the central government, transfers from provincial governments, and prefecture-level own-source funds.[84] In both provinces, the earmarked funding programs for results areas are mainly the Water Conservancy Development Fund, Water Pollution Prevention and Control Fund, Ear-marked Funds for Forestry and Grassland, Rural Environment Improvement Fund, and the Agricultural Resources and Ecological Protection Fund. Most of the funds are sourced from both central and provincial governments, with the central share being about 50 percent (see Table 3.3), which shows budget funds for water and environment purposes in both provinces are stable and can be guaranteed.

Table 3.3. Funding Sources for Results Areas in Henan and Shaanxi (2020, US$, millions)

	Funding Program	Henan					Shaanxi				
		Total	Central	%	Province	%	Total	Central	%	Province	%
1	Water Conservancy Development Fund	39.2	9.2	23.3	30.1	76.7	33.5	20.0	59.9	13.4	40.1
2	Water Ecological Compensation Fund	2.0	0.0	0.0	2.0	100.0	0.0	0.0		0.0	
3	Water Pollution Prevention and Control Fund	1.1	1.1	93.2	0.1	6.8	6.2	3.4	54.9	2.8	45.1
4	Ear-marked Funds for Forestry and Grassland	7.7	3.1	40.7	4.6	59.3	3.3	3.1	95.2	0.2	4.8
5	Farmland Construction Subsidy Fund	21.8	16.8	76.8	5.1	23.2	22.8	16.5	72.4	6.3	27.6
6	Rural Environment Improvement Fund	3.7	3.7	100.0	0.0	0.0	5.1	3.5	68.7	1.6	31.3
7	Agricultural resources and ecological protection funds	2.4	2.4	99.4	0.0	0.6	10.0	0.0	0.1	10.0	99.9
8	Agricultural Production Development Fund	47.8	47.3	99.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0
9	Agricultural production and water disaster relief funds	0.0	0.0		0.0		10.1	4.9	48.7	5.2	51.3
10	Other (OT)	0.5	0.3	63.6	0.2	36.4	4.1	0.3	8.3	3.7	91.7
Total		126.2	83.8	66.4	42.4	33.6	95.1	51.9	54.6	43.2	45.4

7. **Program expenditure efficiency mainly focuses on whether the Program expenditures can achieve the desired targets and realize value for money.** A series of documents on management of the earmarked funds have been issued by the Departments of Finance and in Henan and Shaanxi, together with other departments such as Water Resources Department, Forestry Bureau, DARA, and so on, according to which the fund shall be used only for the specified purposes. The allocation of the funds is factor based or project based and shall be subject to performance evaluation. The performance evaluation results are taken as an important factor for the fund allocation. For example, for the Water Conservancy Development Fund, one of the major earmarked transfer funds for the Program, in Henan, the relevant management measures stipulate that the scope of expenditure is related to water conservancy construction and reform and development, including water-saving reconstruction of irrigation areas and rural water conservancy construction, small and medium-size river management, water and soil conservation, silt dam management, water system connection, water resources conservation and protection, prevention and control of mountain torrent disasters, and so on. The funding allocation rules of Henan Province and Shaanxi Province can provide strong incentives for the counties to achieve the desirable objects set by provincial governments and thereby ensure value for money.

8. **Program funding predictability.** In China, many earmarked funds from the central or provincial governments are not disbursed all at once every fiscal year; instead, they may be divided into two parts with one part disbursed at the end

[84] So far, the budget funds in Sanmenxia do not include the funds raised by the subordinate counties and districts.

of the preceding fiscal year (typically in December) and the other part disbursed in the current fiscal year. More than 90 percent of the central-level Water Conservancy Development Fund in Henan was disbursed at the end of the preceding fiscal year. However, for the provincial-level Water Conservancy Development Fund in Henan and all Water Conservancy Development Funds in Shaanxi, only about 60 percent was disbursed in the preceding fiscal year. Such fund disbursement may undermine the predictability of the funds, because late distribution of budget quota prevents the local government from including the funds in its budget and delays the implementation of planned activities.

9. **Financinal sustainability.** In Henan, the Program will be carried out only in Sanmenxia. As can be seen in Table 3.4, the overall financial situation in Sanmenxia is sound and stable. The unfolded COVID-19 pandemic is expected to have negative but only short-lived impact on the government finance. Besides, the budget funding of the Program activities accounts for less than 1 percent of the general budget revenue of Henan; therefore, the financial sustainability is not a major concern.

Table 3.4. Financial Situation in Terms of General Public Budget, Sanmenxia

	CNY, Billions			As Percentage of GDP (%)		
	2018	2019	2020	2018	2019	2020
Expenditure	**24.48**	**26.72**	**27.10**	**16.02**	**18.51**	**18.68**
Revenue	**12.02**	**13.14**	**13.54**	**7.87**	**9.10**	**9.33**
Tax	8.46	9.22	8.48	5.54	6.39	5.85
Non-tax	3.56	3.92	5.06	2.33	2.72	3.49
Transfer from Upper-Level Governments	**9.47**	**9.74**	**10.94**	**6.20**	**6.75**	**7.54**
Tax Rebate	0.58	0.58	0.58	0.38	0.40	0.40
General Transfer	5.15	8.20	9.46	3.37	5.68	6.52
Earmarked Transfer	4.96	2.44	2.30	3.25	1.69	1.59
(−) transfer to Upper-level Government	1.22	1.48	1.40	0.80	1.03	0.97
Transfer from Government Fund Budget and Others	**3.05**	**3.55**	**2.56**	**2.00**	**2.46**	**1.76**
Overall Balance	**0.06**	**−0.29**	**−0.06**	**0.04**	**−0.20**	**−0.04**
Change in cash balance	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Withdrawal from Reserve	**−0.60**	**0.18**	**−0.43**	**−0.39**	**0.12**	**−0.30**
Financing	**0.07**	**−0.10**	**0.02**	**0.05**	**−0.07**	**0.01**
Borrowing	1.18	1.25	1.68	0.77	0.87	1.16
Debt Amortization	1.11	1.35	1.66	0.73	0.94	1.14

Source: Department of Finance, Sanmenxia. The final accounts for 2021 are still not available.

10. **In Shaanxi, the Program will be carried out in selected counties in Tongchuan and Xianyang.** The overall financial situation in Tongchuan and Xianyang is sound and stable (see Table 3.5 and Table 3.6). It can be seen that the budget funding of the Program activities accounts for less than 3 percent of the general budget revenue in Shaanxi, so financial sustainability is not a major concern for the Program.

Table 3.5. Financial Situation in Terms of General Public Budget, Tongchuan City

	CNY, Billions			As Percentage of GDP (%)		
	2018	2019	2020	2018	2019	2020
Expenditure	**12.80**	**12.36**	**13.21**	**38.55**	**33.48**	**34.60**
Revenue	**2.31**	**2.41**	**2.50**	**6.96**	**6.53**	**6.55**
Tax	1.75	1.84	1.60	5.28	4.98	4.18
Non-tax	0.56	0.57	0.91	1.68	1.55	2.37
Transfer from Upper-Level Governments	**7.70**	**7.88**	**8.70**	**23.19**	**21.35**	**22.80**
Tax Rebate	0.22	0.22	0.22	0.67	0.60	0.58
General Transfer	4.61	6.25	7.40	13.89	16.92	19.39
Earmarked Transfer	2.97	1.56	1.17	8.94	4.21	3.07
(−) transfer to Upper-level Government	0.10	0.14	0.09	0.30	0.39	0.24
Transfer from Government Fund Budget and Others	**2.40**	**1.75**	**1.60**	**7.24**	**4.73**	**4.19**
Overall Balance	**−0.39**	**−0.32**	**−0.41**	**−1.17**	**−0.86**	**−1.07**
Change in cash balance	**−0.21**	**−0.26**	**0.14**	**−0.64**	**−0.69**	**0.36**
Withdrawal from Reserve	**−0.06**	**0.06**	**−0.05**	**−0.18**	**0.16**	**−0.13**
Financing	**0.66**	**0.52**	**0.32**	**1.99**	**1.40**	**0.84**
Borrowing	3.07	1.10	1.69	9.24	2.99	4.42
Debt Amortization	2.41	0.59	1.37	7.26	1.59	3.58

Source: Department of Finance, Tongchuan. The final accounts for 2021 are still not available.

Table 3.6. Financial Situation in Terms of General Public Budget, Xianyang City

	CNY, Billions			As Percentage of GDP (%)		
	2018	2019	2020	2018	2019	2020
Expenditure	**37.98**	**40.38**	**41.38**	**15.98**	**18.39**	**18.77**
Revenue	**8.91**	**8.91**	**9.07**	**3.75**	**4.06**	**4.11**
Tax	7.25	7.11	7.05	3.05	3.24	3.20
Non-tax	1.66	1.80	2.02	0.70	0.82	0.92
Transfer from Upper-Level Governments	**25.61**	**26.42**	**29.57**	**10.78**	**12.03**	**13.41**
Tax Rebate	—	—	—	—	—	—
General Transfer	—	—	—	—	—	—
Earmarked Transfer	—	—	—	—	—	—
(−) transfer to Upper-level Government	0.44	0.47	0.34	0.19	0.21	0.16
Transfer from Government Fund Budget and Others	**2.17**	**2.98**	**2.47**	**0.91**	**1.36**	**1.12**
Overall Balance	**−1.29**	**−2.06**	**−0.26**	**−0.54**	**−0.94**	**−0.12**
Change in cash balance	**−0.32**	**0.95**	**−0.31**	**−0.14**	**0.43**	**−0.14**
Withdrawal from Reserve	**0.14**	**1.99**	**−0.33**	**0.06**	**0.91**	**−0.15**
Financing	**1.47**	**0.58**	**0.90**	**0.62**	**0.26**	**0.41**
Borrowing	3.23	1.90	3.29	1.36	0.87	1.49
Debt Amortization	1.77	1.32	2.39	0.74	0.60	1.08

Source: Department of Finance, Xianyang. The final accounts for 2021 are still not available.

Technical Soundness

11. **The technical assessment confirmed the soundness of the activities and their connection to the Program's desired outcomes.** Three distinct but complementary sets of activities are included in the PforR design: improvement of water conservation by reducing water consumption and increasing water use efficiency under the limit of total water consumption (RA 1), improvement of water quality in the target sub-basins by reducing pollution loads (RA 2), and the protection and restoration of key ecosystems (RA 3). These activities are integrated in RA 4 to promote integrated and strategic planning at the sub-basin and provincial levels. These are supported by the basin-wide results that will enhance the YRCC's capacity to support integrated ecosystem and water management in the YRB.

12. **During Program preparation, the interventions supported by the Program were carefully assessed and selected based on water balance assessment and the 'ET-EC-ES' approach.** Although the Government's programs outlined a comprehensive investment strategy, these interventions were not rationally planned with the consideration of rigid water constraint and the water-ecosystem tradeoffs. Therefore, the Program first conducted the water balance assessments to analyze the changes of water balance and demands for the scenarios of 'before and after the Government's programs' in all demonstration sub-basins during Program preparation. The Program also conducted water quality assessments in all demonstration sub-basins using the water quality model and carried out landscape assessment to adjust and select ecosystem restoration intervention. The results revealed that the current Government programs would significantly increase the total water consumption and exacerbate water scarcity. Therefore, the investments proposed in the Government's programs were adjusted and optimized using the 'ET-EC-ES' approach to further enhance water conservation, improve water quality, and restore ecosystems under the cap of water consumption. The Program supports the selected, prioritized interventions from the optimized Government programs in the demonstration sub-basins.

13. **Comprehensive water balance assessments were carried out using remote sensing.** Water balance was estimated based on the equation of $P + I = ET_n + ET_h + O$, with P as precipitation, I as inflow, ET_n as natural water consumption, ET_h as the water consumption induced by human activities, and O as the outflow. Various data were collected, including, but not limited to, the data of population, industrial production, GDP, crop patterns, irrigated areas, domestic water use and industrial water use, the soil and water conservations measures during the past five years, precipitation data from local meteorological stations and remote sensing-based precipitation products, flow data from gauging stations, water-level data from groundwater monitoring wells, land use and land cover data from 1990 to 2020, and high resolution irrigated land and rainfed land data. Water consumption from the agricultural sector, terrestrial ecosystems, bare land, and water bodies was calculated using the ETWatch model based on remote sensing techniques, which had been successfully applied in most river basins in China and other areas in South Asia, Middle Asia, and North Africa regions. Water consumption from the domestic and industrial sectors was estimated based on local statistical data and local water resources bulletin, with further verification of remote sensing data. The changes of soil moisture and groundwater storage were considered as zero for annual time scale.

14. **The baseline assessments of water balance revealed that most demonstration sub-basins are already facing severe water scarcity and challenges to ensure minimum ecological flow requirements.** The analyses were first conducted for at least six consequent years, depending on data availability (2010–2018 for the Shichuan River Basin in Shaanxi, 2014–2019 for the Jian River Basin in Sanmenxia, 2015–2018 for the Qing Long Jian River Basin in Sanmenxia, and 2015–2018 for the Hong Nong Jian River Basin in Sanmenxia, Henan). The average water balance results of these years were considered as the results of the baseline year. The Government's minimum ecological flow requirements set the minimum flow targets to sustain the basic ecosystem function, which are 0.1397×10^8 m^3 flow per year for the Jian River Basin, 0.1009×10^8 m^3 flow per year for the Qing Long Jian River Basin, 0.690×10^8 m^3 flow per year for the Hong Nong Jian River Basin, and 0.1988×10^8 m^3 flow per year for the Shichuan River Basin. As shown in Table 3.7, the current outflows

of most demonstration sub-basins were already lower than the minimum ecological flow requirements, except for the Hong Nong Jian River Basin.

Table 3.7. Baseline Water Balance Assessment Results[85]

ET Category		Jian River Area		Qing Long Jian River		Hong Nong Jian River		Shichuan River	
		Baseline (2010–2018)		Baseline (2010–2018)		Baseline (2010–2018)		Baseline (2014–2019)	
		Average (mm)	Amount ($10^8 \times m^3$)	Average (mm)	Amount ($10^8 \times m^3$)	Average (mm)	Amount ($10^8 \times m^3$)	Average (mm)	Amount ($10^8 \times m^3$)
Precipitation		609	7.16	652	8.1551	651	20.7236	608	13.145
Interbasin Transfer		0	0	0	0	0	0		0.15
Natural ET	Forests	661	2.244	666	3.1018	637	11.2217	632	6.484
	Orchard	643	0.005	560	1.2941	546	1.009	511	0.1684
	Grassland	535	1.423	568	0.8042	568	1.2534	556	1.9534
	Wetland	0	0	559	0.0124	617	0.0764	560	0.0007
	Waterbody	796	0.116	615	0.1328	689	0.1991	531	0.0174
	Agriculture-Rainfed	540	0.915	554	0.5482	550	2.2735	512	1.8791
	Agriculture-Irrigated	518	1.693	474	0.9059	550	2.2533	498	1.1486
	Urban Concreted Area	467	0.271	488	0.4277	519	0.8017	453	0.678
	Green Areas-Rainfed	461	0.005	569	0.0646	482	0.0047	439	0.0058
ET induced by Human Activities	Orchard-Irrigated Water	101	0.001	108	0.2486	106	0.1964	194	0.0639
	Agriculture-Irrigated Water	56	0.183	129	0.2461	121	0.4944	201	0.4635
	Green Areas-Irrigated Water	46	0.001	106	0.0121	125	0.0012	183	0.0024
	Industrial Water Consumption		0.078		0.0662		0.1007		0.0978
	Domestic Water Consumption		0.108		0.1963		0.1212		0.1378
Total Water Consumption			7.043		8.061		20.0067		13.1008
Outflow			0.117		0.0942		0.7169		0.1943
Measured Outflow			0.117		0.0949				0.1938

15. **The water balance assessments analyzed the impacts of the current Government programs and suggested further adjustments and optimization on the proposed Government intervention.** The water balance assessments further analyzed the potential water consumption changes due to the planned activities in the current Government programs. Comparing with the baseline results, the analyses revealed that the water consumed by the agricultural sector in all sub-basins will decrease mainly due to irrigation modernization, cropping pattern adjustment, and the reduction of terraces. The water consumed by the industrial and domestic sectors will decrease mainly due to the improvement of water use efficiency, and the water demanded by ecosystems will increase mainly due to afforestation. As a result, the current Government programs would increase the total water consumption and threaten the assurance of ecological flows (Table 3.8). Due to the Government's intervention, the outflow will decrease 10 percent, 25 percent, 25 percent, and 3 percent in Shichuan River Basin, Jian River Basin, Qing Long Jian River Basin, and Hong Nong Jian River Basin, respectively. The current Government programs need further adjustments and optimization to reduce total water consumption.

[85] It is worth noting that the waterbodies in Shichuan River area are seasonal ponds.

Table 3.8. Water Balance Assessments for the Government's Program

Jian River Area				Qing Long Jian River Area				Hong Nong Jian River Area				Shichuan River Area			
Planned Interventions	**Planned Areas (km^2)**	**Changes in ET (mm)**	**Total Changes in Water Consumption ($10^8 \times m^3$)**	**Planned Interventions**	**Planned Areas (km2)**	**Changes in ET (mm)**	**Total Changes in Water Consumption ($10^8 \times m^3$)**	**Planned Interventions**	**Planned Areas (km2)**	**Changes in ET (mm)**	**Total Changes in Water Consumption ($10^8 \times m^3$)**	**Planned Interventions**	**Planned Areas (km2)**	**Changes in ET (mm)**	**Total Changes in Water Consumption ($10^8 \times m^3$)**
Vegetation Quality Improvement	16.00	−21.31	−34.09	Vegetation Quality Improvement	16.00	−21.31	−34.09	Vegetation Quality Improvement	20.00	−21.31	−42.62	New Greenlands	12.71	169.05	214.92
Coverting Rainfed Agriculture to Forests	23.00	121.33	279.06	New Afforestation	10.00	112.2	112.2	New Afforestation	16.00	90.35	144.55	Irrigation Modernization	38.00	−107.74	−409.40
Coverting Rainfed Agriculture to Irrigated Orchards	5.60	102.84	114.45	New Irrigated Orchards	11.80	113.52	133.96	New Irrigated Orchards	15.90	102.41	162.83	Water Saving Irrigation	4.91	−15.94	−7.82
Coverting Rainfed Agriculture to Zanthoxylum	20.00	−75.72	−151.44	Coverting Rainfed Agriculture to Zanthoxylum	3.30	−75.72	−24.99	New Natural Restoration	10.00	21.309	21.31	Orchard Modernization	11.13	15.00	16.70
Coverting Slopes to Terrace	25.00	17.64	144.11	Coverting Slopes to Terrace	3.30	17.64	19.02	River-Bank Greening	4.20	90.346	37.95	New Irrigated Orchards	2.00	192.13	38.43
Coverting Terrace to Forests	0.33	87.48	2.89	Reducing Terrace	0.46	63.53	2.92	Coverting Rainfed Agriculture to Zanthoxylum	20.00	−75.72	−15.14	Wetland Restoration	2.88	29.13	8.40
Irrigation Modernization	9.80	−17.64	−17.29	Irrigation Modernization	13.50	−17.64	−23.82	Reducing Terrace	0.37	−30.44	−1.13	Soil and Water Conservation	47.43	119.87	568.57
								Irrigation Modernization	16.70	−17.64	−29.46	New Natural Restoration	67.18	11.31	75.98
Total	**99.73**		**337.67**	**Total**	**58.36**		**185.2**	**Total**	**85.17**		**278.29**	**Total**	**186.25**		**505.78**

16. **The TVAP is essential to guide the basins' development under sustainable limits.** Water balance assessments revealed that the total water consumptions of most of the demonstration sub-basins have already exceeded the sustainable limits. The TVAP will establish a sustainable water consumption target (that is, ET target) as a complementary target to the 'Three Red Lines' policy, which had established water withdrawal targets for river basins. As consumption-based water management is critical for water scarce regions, the water withdrawal targets failed to effectively regulate basin water consumption. Therefore, the TVAP will identify the sustainable water consumption target, then allocate the water consumption target to each water use sector, and guide the water use sectors to reduce water consumption and increase water use efficiency under this target. The allocation of water consumption targets in the TVAP will also lay the foundation for water trading to further improve water use efficiency.

17. **The water quality model assessment found that water pollution was severe during the dry season.** A water quality model was developed to estimate the water pollution for each river segment. Water quality targets were determined based on the Government's water function zone requirements. COD, TP, and ammonia nitrogen are the three major pollutants in the demonstration sub-basins. Domestic wastewater is the primary polluting source for ammonia nitrogen. Livestock/poultry farms, domestic wastewater, and chemical fertilizer application are the primary sources of COD and TP. The model results revealed that water quality compliance is not an issue on an annual base, but both TP and ammonia nitrogen concentration failed to meet the water quality requirement during the dry season, that is, from January to March, when river flow is low.

18. **Based on ecological flow requirements, the limit on water consumption was identified.** The water balance assessment suggested that the total water consumption should be at least lower than 7.02×10^8 m^3 to ensure the basic ecological flow for Jian River Basin. The current water consumption in Jian River Basin is 15 percent higher than this sustainable limit. The Government's programs need further adjustment and optimization to reduce total water consumption under the sustainable limit. Similarly, the water consumption in Shichuan River Basin, Qing Long Jian River Basin, and Hong Nong Jian River Basin should be further reduced to reach the water consumption limit.

19. **The interventions on agricultural water conservation will be further promoted.** The Program will support irrigation modernization, which will reduce around 110 mm water consumption per year and improve water use efficiency. The Program will also support cropping pattern adjustment. For example, converting wheat and maize to Zanthoxylum (Sichuan Pepper) will reduce 75 mm water consumption per year. It was estimated that new orchard development will increase around 110 mm water consumption per year. Therefore, the Program will not support new orchard development and suggests adjusting the Government's program to limit the development of new orchards.

20. **Pollution control is essential to reach the water quality requirements in the dry season.** Even if the basic ecological flow required by national standards is ensured during the dry season due to the reduction of water consumption, the water quality model revealed that these sub-basins will still fail to meet the water quality requirements in the dry season because of high pollutant loads. Thus, it is necessary to further reduce point and non-point source pollutants entering the rivers. The Program will support the upgrading of wastewater treatment plants and increase the rural household connections to wastewater treatment facilities. The Program will also increase livestock/poultry manure collection and treatment rate and promote organic fertilizer and precise chemical fertilizer application.

21. **Assessment of baseline conditions of key watersheds reveals low ecosystem quality in both Shaanxi and Henan sub-basins.** The ecosytem assessment consisted of a baseline assessment of current land use patterns, existing biophysical and socioeconomic conditions, a diagnostic of degradation drivers, and expected restoration targets. The assessment identified the key driver of ecosystem degradation in the demonstration sub-basins to be soil erosion and water runoff, which was largely heightened by low vegetation quality, low biodiversity habitat values, and inapropriate agriculture land

management. In the Wei River Basin, the environmental quality of 37.7 percent of the counties shows no change or has worsened and 55.7 percent shows slight improvement; only 4 counties showed noticeable improvement. The upper catchment needs significant improvement of its water retention capacity and quality. Much of the natural vegetation has been destroyed and recreated. Over half of the current vegetation is not considered natural, for example, croplands, orchards, and monoculture plantations. For the remaining secondary forests and shrubland vegetation, the biodiversity level is low. For instance, the overabundance of black locust (Robinia pseudoacacia); this broadleaf tree species is well adapted to central and south China and a popular choice of reforestation as it establishes itself relatively quickly. However, increasing evidence shows that monoculture plantations, like those of the black locust, consume more water and have low ecosystem stability and limited biodiversity values. This necessitates improvement of forest ecosystem structure and composition using indigenous broadleaved or conifer species, ideally using assisted natural regeneration.

22. **The technical assessments identified the key degradation problems: low vegetation quality failed to regulate water flow, improve groundwater infiltration and water quality, and provide biodiversity habitats.** Accordingly, the overall restoration targets will focus on improving the quality of existing vegetation community (secondary and plantation forests/shrubs) in the upper watershed for water retention and biodiversity values while putting in place soil erosion measures in gullies and other erosion-prone areas to control erosion and improve vegetation quality. The integrated landscape management approach adopted by this PforR follows the prevalent mountain-river-forest-farmland-lake-grassland restoration approach. It requires integrated consideration of landscape patches and ecosystem processes, with a tailored restoration approach to different site conditions, especially using indigenous species in restoration, and aims at restoration of multi-story vegetation community structure. In summary, restoration should prioritize the upper catchment area where water retention is easiest and erosion is strongest while restoring the critical landscape patches such as riparian zones and wetlands to enhance their contribution to landscape functioning.

23. **Based on the analysis, the Program will support three types of ecosystem restoration activities.** In the upper watershed region, the Program will support vegetation improvement, including assisted natural regeneration, reforestation and silviculture management, and community-based close-to-nature forest management, that facilitates rapid establishment of local regeneration and minimizing of human disturbance, all of which can contribute to diversification of species composition and community structure. For instance, species diversification of black locust monoculture plantation using local conifer species (for example, Manchurian red pine) can improve water and soil conservation capacity by 2–4 times while reducing landscape evaporation. In the middle watershed and gully areas, the Program will support soil and water conservation measures, including terrace farming and gully engineering for erosion control. Terracing land has proven to be an effective soil and water conservation strategy to retain almost all surface runoff and increase groundwater infiltration by 1.62 times compared to forests. Given that the erosion rate of the program area is around 2,000–5,000 tonnes/km^2, terracing land can hold back almost all surface runoff while increasing food production. Soil and water conservation can also be combined with sustainable use of land resources and improvement of rural livelihoods. The Program requires local development to be within ecosystem carrying capacities and strive to improve irrigation efficiency and minimize pollution and plastic wastes from agriculture, especially land cover membranes. In the riparian areas, the Program will support wetland restoration, including using natural materials, leaving cracks along the embankments to facilitate natural exchange of energy and nutrients, and using wetland vegetation cover for bank stabilization to restore critical riparian wetlands and riverbanks and establish additional wildlife habitats.

24. **The current Government programs on afforestation and ecosystem restoration need further adjustment and optimization to reach the water consumption limit.** The water balance assessment showed that the baseline water consumption was higher than the water consumption limit, while the Government's programs will further increase total water consumption. To reduce water consumption, the potential interventions on afforestation need to be adjusted. The Program will promote the water-saving afforestation technical approaches. It will be achieved by largely supporting

degraded forest restoration and promoting the use of diversified tree species mixtures in forest management and reforestation to gradually transition from monoculture to mixed structure forests, reducing planting density, and selecting species that consume less water and by not supporting city greening and communal forests. Based on the remote sensing data, it was estimated that the diversification of tree species will decrease around 20 mm water consumption per year. The use of indigenous tree species and a minimum species richness threshold will be established in the Program verification standards. The Program will also promote natural restoration and reduce the impacts of human activities. It was estimated that new afforestation will increase around 120 mm water consumption per year according to the remote sensing data. Therefore, the Program will not support large-scale afforestation and suggests adjusting the Government's program to limit afforestation.

25. **Existing Government technical interventions and standards have been assessed and improved with innovative and integrated land management approaches for tackling degradation drivers along the sub-basins.** Technical designs for key activities under the Program are the following:

(a) **Vegetation improvement in the upper areas of the sub-basins,** including through assisted natural regeneration, degraded forest restoration, and afforestation. The proposed activities include (i) restoration of degraded and monoculture forests, which will focus on improving the stocking, growth, quality, and ecology of low-productivity and degraded monoculture forest stands—the close-to-nature concept will be used to tend the upper story and supplement planting at the understory (interplanting and underplanting) with native species, to create a more productive mixed species, multilayered, and uneven aged forests, with increased ecological benefits; (ii) promotion of natural regeneration of native species on site, which involves identifying target trees for retention, the selective cutting of competing vegetation to favor the diverse regeneration of mixed-species clusters, habitat protection, and target tree management—to the extent possible, full advantage will be taken of natural processes that increase stand productivity, improve ecological functions, and enrich biodiversity; and (iii) afforestation, which will involve planting and managing diversified mixed species and ecologically stable forests in priority areas.

(b) **Soil and water conservation measures in the middle areas and gullies of the sub-basins,** which include terrace farming land and gully engineering in slope areas for erosion control. Terracing land has proven to be an effective soil and water conservation strategy to retain almost all surface runoff and increase groundwater infiltration. Soil and water conservation will also combine sustainable use of land resources and improving of rural livelihoods.

(c) **Wetland restoration and river rehabilitation across the landscape** will restore critical riparian wetlands and riverbanks to add additional wildlife habitats. This includes using natural materials, leaving cracks on embankments to facilitate natural exchange of energy and nutrients, and restoring wetland vegetation cover for bank stabilization.

26. **Human health considerations.** China has a national infectious disease reporting system that includes 40 infectious diseases, among which, 7 are waterborne, and 4 are vector-borne. Both Henan and Shaanxi have lower incidence of waterborne diseases than the national average, and national trends show that the incidence of many waterborne diseases is stable or declining in the country. The incidence of infectious diarrhea, which causes the majority of waterborne diseases, has been increasing nationally in recent years and inadequate water is considered the largest contributing factor in China.[86] Activities inclunded under RA 2 are expected to reduce water pollution and thus have the potential to further reduce infectious diarrhea and incidence of other waterborne diseases in Program sub-basins. Vector-borne diseases are

[86] World Health Organization's Global Health Observatory, 2016 data.

not a major concern in China; their average annual incidence is dwarfed by other categories of infectious diseases and there are appropriate surveillance systems in place.[87] RA 3 includes wetland restoration, and, in the unlikely situation that these activities lead to any increased disease incidence, this increase would be detected by existing provincial systems.

Gender Results Chain

Gender Gaps

27. **Women's limited role in farmers' organizations affects their uptake of water-saving technologies and engagement in water conservation.** Women are underrepresented in WUAs with limited input in decision-making beyond the household, even though rural women undertake about 60 percent of farming activities and 70 percent of irrigation activities, including extensive participation in water conservancy, canal renovation, silt dredging, and irrigating activities.[88] Data from demonstration areas in Sanmenxia City and Shaanxi Province show that women's representation in local WUAs and irrigation-relevant farmers' organizations is low. The proportion of women as members of the association ranges from 5 percent to 50 percent across different regions, with an average of 35.4 percent. The average proportion of women as executive members is 15.7 percent (ranging from 0 to 44 percent). Both figures show large variance in the engagement of women in rural water management. The finding is also consistent with the previous study in terms of the overall underrepresentation of women in farmers' WUAs, especially in leadership positions.[89] In the associations where women account for one-third or less of the membership, with 6 or more male executive members for every female executive, women's voice and influence in local water management can be marginalized.

28. **There is a need to reinforce women's engagement and leadership in WUAs to realize the potential role of both genders in local water management.** Literature suggested that a number of factors may limit women's participation in decision-making and in the WUAs, which include the protocol for household heads to attend community meetings, the male-dominant professional culture, relatively low educational level and social skills of rural women, and their high domestic and productive workloads.[90] More importantly, traditional perceptions of gender differences in leadership and management capacity further marginalize women's role in local water use governance. Research further found that farmers' groups are effective vehicles in building a sense of shared purpose and enabling cooperative actions in sustainable natural resources management and development.[91] The lack of women's engagement in WUAs therefore presents a missing opportunity for women's empowerment in the adoption of new and improved water-saving technologies. To make change happen, it is imperative to challenge the practices that marginalize women from effective participation and greater role in the decision-making of WUAs, which will empower women to act beyond the household domain of water use and actively participate in the public decision-making domain of agricultural water management.

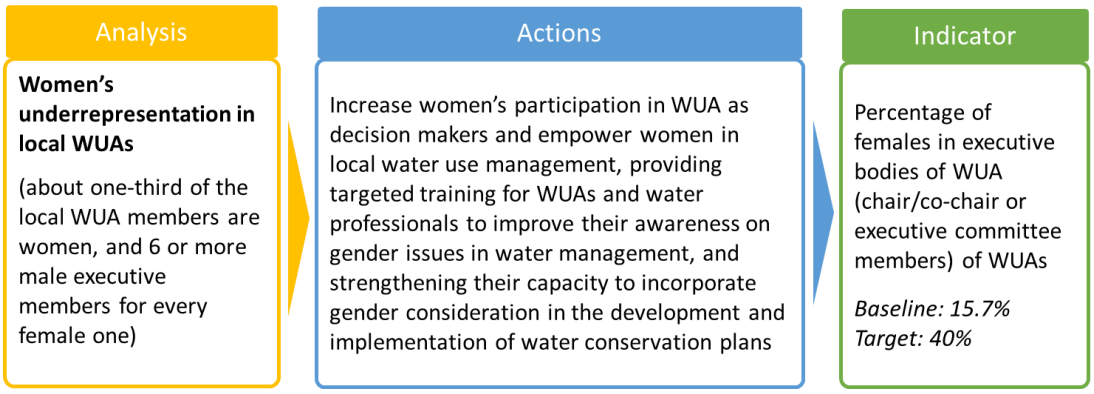
29. **The implementation of the Program brings opportunities to change women's role in local resource management, decision-making, and benefits that are influenced by gender differences.** Specific actions target increasing women's participation in WUAs as decision-makers and empowering women in local water use management. Bylaws and membership criteria of WUAs would represent opportunities to ensure fair and inclusive participation of women based

[87] Geng, M. J., et al. 2021. "Changes in Notifiable Infectious Disease Incidence in China during the COVID-19 Pandemic." *Nat Commun* 12: 6923. (*link*)
[88] Gender Equality and Women's Development in China (September 2015), Information Office of the State Council of the People's Republic of China. (*link*)
Wang. 2007. *Analysis on Barriers in Women's Participation in Water User Associations*.
[89] Ministry of Water Resources. 2007. *Monitoring and Evaluation Report on WUAs in Poor Areas under the Rural Water Reform Project*.
[90] Lu 2008. (*link*)
[91] Ibid.

on their contribution and engagement in local water use activities (for example, ensure that WUA membership is not limited to registered landowners only [usually men] and represents multiple water users including irrigators, livestock owners, and others). During Program implementation, measures to ensure women's fair participation regardless of their economic status will be explored. The Program will also train key stakeholders, including WUA leaders, staff from water conservancy departments, and rural development agencies, to increase their gender awareness and to create an enabling environment for women's engagement (for instance, incorporating considerations on provision of childcare, organizing extension services, and training at locations and times convenient for women). Specific training activities will be organized to enhance women's capacities on vegetable/crop production; irrigation methods; water conservation techniques and uptake of new technologies; and, importantly, their leadership skills. Technical assistance will also be provided in the development of the water conservation plans, manuals, and implementation strategies that take gender into consideration. In the implementation of the activities, the Program will actively collaborate with women's federations at the provincial and local levels, to take advantage of the contextual knowledge and outreach network of the women's federations in engaging women in public affairs.

30. **The Program will monitor and report gender results throughout its lifecycle to ensure effective engagement of both genders.** Specifically, the Program will monitor women's leadership in WUAs, measured by the percentage of females in leadership roles, that is, chair, co-chair, or executive committee members of WUAs. The baseline is 16.8 percent and the target is set as 40.0 percent by the end of the program.

Figure 3.1. Gender Results Chain



Economic Assessment

31. **Rationale for public sector provisioning/financing.** Public sector financing is justified by the provision of public goods (both global and domestic) to be generated by Program interventions. The Program will support soil and water conservation activities to increase vegetation coverage, which would increase carbon sequestration; the Program will also further reduce GHG emissions through improved livestock waste management and reduced fertilizer application. In addition, the Program will improve both terrestrial and aquatic ecosystems, which will contribute to biodiversity. In particular, wetland protection and restoration, enhanced ecological flows for aquatic ecosystems, and improved water quality—and the upscaling of these at the provincial level—will improve downstream flows to sustain water use, ecosystems, and biodiversity, including the Yellow River Delta and coastal region. The Program is further addressing cross-sectoral and inter-jurisdictional barriers that impede the efficient and optimal allocation of resources (under a water scarcity situation). The Program is addressing inefficiencies caused by the presence of externalities, and public goods that the private sector would not have the incentive to address, as it cannot capture the economic benefits of most Program outcomes.

32. Furthermore, the Program will improve the efficiency and effectiveness of public goods delivery through strengthening institutional systems and capacity building. The Program will support integrated ecosystem and water resources management plans in the demonstration sub-basins, which will inform the preparation of provincial guidelines for integrated planning and facilitate the integration of ecological and water resources information into ecosystem and water resources management models and guidelines to support decision-making at the YRB. It will further promote data-sharing and coordination mechanisms in line with the strategies for the ecological protection and high-quality development of the YRB.

33. **Value added of the World Bank's support.** The Government has an ambitious national program in the YRB with strong commitments from the central to local governments. The World Bank's value added includes the application of innovative approaches for ecosystem and water resources management, the application of results-based financing and incentives to reach scale, and leveraing of national and international experiences. More specifically, the Program will introduce an integrated ecosystem and water resources management approach, which can be further scaled up in the existing Government programs to drive the Government's YRB programs toward success. By leveraging the existing Government programs, the PforR instrument will provide geographic coverage beyond that possible through traditional IPF operations. The Program will also support the demonstration sub-basins in Henan and Shaanxi Provinces on integrated water and ecosystem management through activities in water use efficiency, water pollution control, and ecosystem restoration. The reliance on Government systems, and the design of the Program through a nested hierarchy, is aligned with China's fiscal governance structure and differentiated responsibilities across governance levels as specified under the YRB Plan.

34. The World Bank's involvement will help leverage international experience and good practices in landscape/watershed management, water pollution control, and environmental/ecological restoration. In addition, the World Bank has supported the implementation of a number of projects related to ecosystem restoration and water pollution control in China and conducted analytical work including through the Country Water Resources Partnership Strategy, the Water Governance Strategy, and studies on eco-compensation mechanisms. Lessons learned and good practices generated from these documents can be readily incorporated during Program preparation and implementation.

35. **Assessment methodology.** Given the diverse range and multiple purposes of the Program interventions, the economic assessment has been conducted by results area. For RA 1 (improving water use efficiency) and RA 3 (improving ecosystem management), a CBA has been adopted, using a benefit transfer method.[92] For RA 2 (improving water quality), a CEA has been applied, as the benefits from water pollution control are difficult to quantify in a reliable manner, especially those pertaining to public health and the environment. The key objective of the CEA is to demonstrate that the proposed investments represent a priority with regard to the overall Program objectives and that these objectives are met in the most cost-effective way (based on evaluated lifecycle costs and compared on a net present value per unit incremental cost basis).

36. The economic assessment compares a scenario of 'no Government program' to a scenario of a Government program including World Bank support. This approach is used because, under a PforR, Government and World Bank funds are combined to achieve results into a single Program, with virtually no distinction at the activity level between World Bank-financed and Government-financed achievements. This approach can determine whether the overall Program is socially beneficial after considering economic benefits and economic costs.

[92] Benefits transfer refers to the process of applying valuation results, functions, data, or models derived in one location or context to estimate economic values of ecosystem services in an alternative context or location.

Assessment Results by Results Area

Results Area 1 (improving water use efficiency)

37. CBA has been conducted to assess this results area's economic viability by selecting a representative irrigation scheme (in terms of size and status of the infrastructure) for rehabilitation. The major quantifiable benefits (on an incremental basis) of the Program are derived from (a) the incremental agricultural production from improved irrigation efficiency and water productivity, realized through irrigation infrastructure improvement and construction, and improved water management and agronomic practices; (b) economic value of water resources saved by measuring the reduction in ET; and (c) climate benefit as estimated by the GHG reduction through substituting fertilizer with treated livestock waste.

38. To increase water productivity and reduce consumptive use of water in irrigated agriculture, the water-saving technologies supported under the Program will follow the concept of real water savings and ET management and adopt integrated measures including engineering (land leveling, canal lining, low-pressure pipes, improved drainage, micro-sprinkler), agronomic (cropping pattern changes, adoption of improved variety, soil fertility improvement through application of treated livestock waste, and soil salinity control), and water management measures (irrigation scheduling and conjunctive use of surface water and groundwater).

39. **Program economic benefits**. With Program interventions, the increases in crop production would be achieved through (a) enhanced cropping intensity, (b) crop yield increases arising from timely provision of water in the critical stages of crop production, and (c) changes in crop patterns shifting to high-value produce. Additional benefits will accrue from the value of water resources saved, which has been valued conservatively as the value of water productivity in agriculture, that is, the value of crop produced per m^3 of water.

40. The costs include (a) investment costs for additional irrigation works and canal rehabilitation, (b) on-farm costs for dripping/pumping system and equipment, (c) incremental costs for crop production, and (d) O&M costs for works and equipment.

41. The main assumptions include the following: (a) a representative rehabilitation model of a medium-size scheme of 1,000 ha is selected for analysis; (b) the economic life of the scheme after rehabilitation will be 20 years; (c) both cost and benefit flows are based on 2020 constant prices, net of duties and taxes; and (d) the discount rate adopted by the analysis is 6 percent according to guidelines from the NDRC, which is in line with the World Bank's guidance for discount rate.[93]

42. Cash flows of benefits and costs for the scheme are projected over a 20-year period to estimate the Program ERR. Based on the technical parameters and efficiency coefficients (crop yield increases, water productivity improvement, fertilizer use reduction, real water savings, and investment and O&M costs) of the World Bank China Water Conservation Project II[94] (covering Hebei, Shanxi, and Ningxia Provinces, all in the YRB), the **ERRs with GHG reduction are estimated at 20 percent (with low carbon shadow price) and 21 percent (with high carbon shadow price)[95] and ERR without GHG**

[93] World Bank. 2015. *Technical Note on Discounting Costs and Benefits in Economic Analysis of World Bank Projects*. The discount rate is recommended as 6 percent for investments with long-term unquantified E&S benefits.
[94] https://projects.worldbank.org/en/projects-operations/project-detail/P114138.
[95] According to the World Bank's guidance note on shadow price of carbon in economic analysis issued on November 12, 2017, projects' economic analysis should use a low and high estimate of the carbon price starting at US$40 and 80, respectively, in 2020 and increasing to US$50 and US$100 by 2030; the low and high values on carbon prices are extrapolated from 2030 to 2050 using the same growth rate of 2.25 percent per year that is implicit between 2020 and 2030, leading to values of US$78 and US$156 by 2050.

reduction at 19 percent, which is well above the discount rate of 6 percent, indicating that the scheme to be rehabilitated is economically viable.

43. No sensitivity test is warranted due to (a) output prices in the analysis representing a conservative trend for the Program life and (b) significant unquantifiable E&S benefits including (i) mitigation of overuse of scarce water resources and accompanying degradation of ecological environment and (ii) benefits from improved water management, social capital, and institutional capacity.

44. It should be noted that the above ex ante assessment is based on the findings and results of the World Bank China Water Conservation Project II, which was completed in 2017. This assessment, using the benefit transfer method, should therefore be treated as indicative. Ex post assessment should be conducted using the technical parameters actually achieved after Program completion.

Results Area 2 (improving water quality)

45. **CEA is applied to RA 2.** Activities at demonstration sub-basins were selected based on their relative contribution to pollution noncompliance, as described in annex 3, and include point source pollution control through upgrading WWTPs to meet higher effluent standards, that is, reducing residual pollutant discharge at WWTPs, as well as increasing rural household access to decentralized wastewater treatment facilities and rural household connection to sewage systems. An integrated method covering the entire wastewater collection system of the demonstration sub-basins and counties within them has been adopted to design the wastewater collection system to increase the coverage of wastewater collection and improve the operation of existing WWTPs.

46. For WWTPs, the technical design alternatives, location options, and other parameters will be evaluated in the mandated feasibility study reports against technical, environmental, and economic criteria to identify the most cost-effective solution along all key design dimensions including the collection system. With regard to the design of the collection system, various topological, land availability, and gravity flow versus pumping stations cost considerations and other parameters will be assessed to ensure consistency with projected local development patterns and the existing drainage master plans. Detailed comparisons of alternatives and the selected options will be conducted in activity-specific feasibility study reports as required by the county development and reform committees to ensure the least cost alternative is selected.

47. RA 2 will also support activities to reduce NPS pollution, mainly from the agriculture sector. Improved manure management at livestock and poultry farms will be supported by increasing manure collection and treatment. The Ministry of Agriculture and Rural Affairs (MARA) issued 'Technical Norms and Specifications for Livestock/Poultry Waste Management' in 2018,[96] which provides technical details to select the most effective and least cost options for various sizes and animal-specific waste management approaches. Each county has developed its own plan to promote the application of organic fertilizer to replace chemical fertilizer use and to reduce NPS pollution, following MARA's guidance for waste management.

[96] http://www.moa.gov.cn/gk/tzgg_1/tfw/201801/t20180111_6134801.htm.

Results Area 3 (improving ecosystem management)

48. CBA has been conducted to assess this results area's economic viability by selecting a representative watershed model for rehabilitation of degraded and monoculture forests. Degraded and monoculture forests would be restored and transferred to mixed forests through supplementary planting of native species and natural regeneration.

49. The incremental costs and benefits have been estimated for the Program using the ongoing China Forest Ecosystem Improvement in the Upper Reaches of Yangtze River Basin Program[97] as departure point, adjusted for the Yellow River conditions as advised by the local experts. Costs include both rehabilitation and O&M costs, while benefits include (a) carbon sequestration, (b) reduced soil erosion, (c) increased water conservation, and (d) reduced tree losses due to lower pest incidence (potential opportunity costs in the without-Program scenario were evaluated; however, no relevant one was identified, whereas timber and non-timber forest goods and services are negligible in the demonstration sub-basins). The main assumptions include the following: (a) a representative rehabilitation model of small watershed of 100 ha is selected for analysis; (b) the economic life will be 30 years; (c) both cost and benefit flows are based on 2020 constant prices, net of duties and taxes; and (d) the discount rate adopted by the analysis is 6 percent.

50. Cash flows of benefits and costs are projected over a 20-year period to estimate the base case Program ERR. Based on the technical parameter and efficiency coefficients (including carbon sequestration, reduced soil erosion, increased water conservation, and reduced tree losses due to lower pest incidence) of the World Bank's China Forest Ecosystem Improvement in the Upper Reaches of Yangtze River Basin Program (covering Sichuan Province and is ongoing), the **ERRs with GHG reduction are estimated at 16 percent (with low carbon shadow price) and 19 percent (with high carbon shadow price) and ERR without GHG reduction at 13 percent**, which is substantially above the discount rate of 6 percent, indicating that the degraded and monoculture forests rehabilitation is economically viable.

51. No sensitivity test is applied as the shadow prices of carbon, water conserved, and soil erosion reduced are based on lower ends of estimations. Further, the assessment does not include the benefits of improved biodiversity, amenity services of forestry cover, institutional capacity building, and improved forest planning and development strategies, which are not readily quantifiable. ERRs are conservative estimations and therefore no sensitivity test is warranted. It should be noted the above ex ante assessment is based on the design of the ongoing World Bank's China, Sichuan Forest Ecosystem Improvement in the Upper Reaches of Yangtze River Basin Program. The assessment, using benefit transfer method though adjusted for this Program's conditions, should be treated as indicative. As for RA 1, ex post assessment should be conducted using the technical parameters actually achieved after the Program completion.

Greenhouse Gas Emission Mitigation Assessment

52. **GHG emission mitigation.** A quantification of GHG net emissions is made here focusing on activities under RA 1, RA 2, and RA 3. Specifically, there are three sources of quantifiable emission reduction benefits, which are assessed over the 20 years of Program life (including 5-year implementation).

(a) The improvements in water use efficiency will lead to water savings in irrigation, which in turn will result in energy use reduction for drafting/pumping water, estimated at 9.27 million kWh annually. Using the Ex-Ante Carbon-Balance Tool (EX-ACT) for GHG accounting, this is converted into 0.16 million tonnes of CO_2-e reduction during Program lifetime.

[97] https://projects.worldbank.org/en/projects-operations/project-detail/P164047.

(b) Forest cover with improved water retention capacity in the demonstration sub-basins (50,725 ha). The EX-ACT tool was used for GHG accounting. The carbon-balance is defined as the net balance from all GHGs expressed in CO_2 equivalent that will be emitted or sequestered due to Program implementation compared to a 'without project' scenario. EX-ACT is a land-based accounting system, estimating carbon stock changes (that is, emissions or sinks of CO_2) as well as GHG emissions per unit of land, expressed in equivalent tonnes of CO_2 per ha and year. With baseline conditions of forests and type of reforestation identified, inputting improved forest cover of 50,725 ha into the forest management tab (in the tool) will result in an estimated net mitigation of 3.66 million tonnes CO_2-e over the Program life.

(c) COD reduced at wastewater treatment facilities in demonstration sub-basins (tonnes). Improvement in wastewater treatment efficiency is expected to result in an improvement in the reduction of COD concentrations (influent minus discharge) from 50 mg/L to 65 mg/L. The improved efficiency is expected to apply to wastewater services for people in the Program counties. Most of the counties use an anaerobic-anoxic-oxic (A2O) method, and no methane capturing technology is currently being applied. The improvements are expected to result in reduced fugitive methane emissions, leading to 141,499 tonnes of CO_2-e reduction over the Program life.

(d) Treatment and reuse of livestock/poultry manure (through on-farm treatment facilities, biogas generation, and organic fertilizer reuse). Additional manure use is expected to be 85,570 tonnes accounting for the two provinces,[98] which will substitute chemical fertilizer use. Assuming a conservative NFRV (Nitrogen Fertilizer Replacement Value) of 0.5 kg for total N in treated livestock manure with respect to urea,[99] 43,435 tonnes of urea are to be reduced, which would result in a reduction of 3.99 million tonnes of CO_2-e over the Program life.

53. In total, the Program is expected to realize at least 7.95 million tonnes CO_2-e in emission mitigation over the Program life. This represents a subset of the total expected benefits that are attributable to the World Bank's financing. The calculations are limited to the demonstration sub-basins included in the Program. In addition, relative energy savings arising from on-farm improvements in irrigation efficiency under RA 1 are expected to be substantial, with estimates carried out by both provinces indicating a 20.4 percent energy saving for Henan, and 35 percent for Shaanxi. These values were calculated based on the expected area where irrigation improvements are to be implemented, water consumption estimates, and average energy consumption for the different irrigation methods. Further, RA 4 would lead to more GHG mitigation benefits that add substantially to those calculated above. These are challenging to quantify, and so the quantitative estimates presented here should be considered a lower bound on the Program's overall GHG mitigation.

[98] Assuming annual standing pig population at 39,000 in 78 pig farms (each with 500 pigs); each pig produces 0.73 tonnes manure annually.
[99] Hijbeek, R. et al. 2018. *Nitrogen Fertiliser Replacement Values for Organic Amendments Appear to Increase with N Application Rates*. *Nutrient Cycling in Agroecosystems* 110: 105–115. (*link*)

ANNEX 4. SUMMARY FIDUCIARY SYSTEMS ASSESSMENT

1. **FSA conclusion.** The FSA was conducted following the World Bank's Policy for PforR and the related directives, identified key fiduciary risks that may affect the Program's development outcomes, and recommended system improvement and capacity strengthening mitigation measures that will be implemented during the life of the Program. The scope of the FSA is limited to the Program scope and boundary of the proposed Program Expenditure Framework. The FSA of the Program concludes that the present fiduciary systems together with proposed mitigation measures will provide reasonable assurance that the Program financing proceeds will be used for the intended purpose, with due attention to the principles of economy, efficiency, effectiveness, transparency, and accountability.

2. **Fiduciary risk and mitigation measures.** Based on the FSA, the fiduciary risk of the Program is assessed as 'Substantial'. Given the decentralized nature of the Program, activities being undertaken by multiple agencies at the central, provincial, city, and district levels, there is an inherent risk associated with variations in fiduciary capacity and compliance with agreed fiduciary mitigation measures. Risks and mitigation measures are provided in the PAP and PIP for implementation before and/or during the Program. With the implementation of recommended risk mitigation measures, the capacity and performance of respective implementing agencies will be found adequate to provide a reasonable assurance that funds will be used for the intended purposes.

3. **Major FM risks identified in the FSA are the following:** (a) the Program financing comprises earmarked funding from the central-level and provincial-level budgets; however, most of the funding has a life period that might not cover the entire Program life; this might lead to financing gaps that will need to be covered by other sources of funding; (b) no Program financial statements are required by higher-level sector agencies and finance departments and the current financial reporting architecture for government agencies makes it difficult to generate the Program financial statements; this creates risk of noncompliance with the PforR financial statement requirement which might affect the monitoring of the Program's implementation; (c) audit of Program financial statements is not required under the current China PFM practice; audit of Program financial statements will require coordination across government audit units and the application of financial audit techniques not practiced by some audit units—this might create a risk of weak audits, at least in the initial years of the Program; and (d) multisector involvement in the Program, various budget resources supporting the Program, and large volume of Program activities bring complexity to the Program management and FM work.

4. The proposed mitigation measures include the following: (a) potential funding gaps that undermine the sustainability of the Program should be evaluated timely and addressed by the relevant finance and sector departments before the expiration year of each funding cycle; (b) tailored Program financial statements will be developed and introduced to the Program in format and content acceptable to the World Bank and the borrowers; (c) audit of Program financial statements will be required and conducted on an annual basis; tailored audit TORs will be developed upon agreement between the World Bank and government audit offices; and (d) appropriate institutional arrangements should be established for Program coordination and management purposes with clear roles and responsibilities. These mitigation measures are reflected in the PAP.

5. **Procurement.** The assessment identified the following key procurement risks and provided mitigation measures: (a) when comprehensive scoring method (one of the two most used procurement methods) is used for bid evaluation of contracts with neither innovation nor complexity, the total weightings of all rated criteria other than price could be higher than 50 percent, which may not achieve VfM and (b) there is a lack of detailed procurement-related complaint-handling procedures in the SBD. The proposed mitigation measures are the following: (a) when comprehensive scoring method is used for bid evaluation of contract with neither innovation nor complexity, following the government policies and

requirements, the price weighting should be sufficiently maximized to better achieve VfM; guidance should be prepared by PMOs, PPMOs and the YRCC on evaluation criteria; and (b) provide detailed procurement-related complaint-handling procedures in the SBD for preparation of bidding document under the Program. Standard language should be prepared by PMOs, PPMOs and the YRCC.

6. **Fiduciary assessment.** The proposed Program will directly support the provincial YRB programs as part of the national YRB program. In Shaanxi, the Program is anchored in the Wei River Basin Water Ecological Restoration Plan, with demonstration activities in four sub-basins (that is, Beiluo, Jing, Qishui, and Shichuan Rivers) based on their 14th FYP of investments, for 2021 to 2025. In Henan Province, the Program is centered around three sub-basins within the Yellow River catchment in Sanmenxia municipality. The FSA assessed the PFM system, the public procurement system, and governance of key program implementing agencies and their line agencies. These agencies include, but are not limited to, at the central level, YRCC; at the provincial level, Finance Bureau (FB), DRC, DEE, DWR, DARA, and Provincial Audit Office (PAO); and at the county level, Water Resource Station (WRS), Housing and Construction Bureau (HCB), Agriculture and Rural Affairs Bureau (ARAB), and Environment and Ecology Bureau (EEB), of nine counties/districts of two cities in Shaanxi and three counties and two districts in Henan. The assessment covers the review of the PFM cycle, Program systems and capacity improvements, and the Program implementation support.

7. **Tracking of expenditures under the Program.** The Program boundary and Program scope, as defined by the expenditure framework that supports this Program, consists of a series of government budget codes that are closely linked with Program activities, which will be listed in the PIP prepared by the YRCC and the two provinces. Since the Program geographic scope is mainly focused on the demonstration sub-basins (five counties and one municipality in Henan and nine counties and two municipalities in Shaanxi), Program expenditures are expected to be easily extracted from the Government's treasury single account system and/or reconciled with the sector agencies' financial records and then presented in the Program financial statements. Program financial statements will be developed according to the identified budget codes and will be presented in an acceptable format and content.

8. **PFM system.** The prevailing Budget Law, Accounting Law, and Audit Law of the People's Republic of China have laid out the fundamental legal framework for government budget management, government accounting, and auditing in China. The Government Accounting Standards, approved in 2017, implemented from 2019, have set the government accounting and reporting standards for all government budget units in China. All of them constitute the China PFM system with various fiscal- and financial-related decrees, regulations, standards, and procedures. The Program FM is governed by the China PFM system and supplemented by some additional requirements from the World Bank.

9. The key FM stakeholders of the Program are mainly finance departments, sector agencies, and government auditors. Sector agencies plan, propose, and implement the Program activities and supervise Program implementation to lower-level sector agencies; finance departments review budget preparation, make budget appropriation, and oversee the budget execution for Program activities together with sector agencies; and government auditors exercise necessary audits to the Program financial records as required.

10. This is a multi-sectoral Program to be implemented by several sectoral government agencies. They are mainly the YRCC and its procurement and finance center, municipal/county/district-level sector agencies including Water Resources Department, Agriculture and Rural Affairs Department (ARAD), Forestry Bureau (FB), and Ecology and Environment Protection Department (EEPD) in Henan and Shaanxi Provinces.

11. The majority of the Program budget is from central and provincial-level budget transfers which account for more than 80 percent and 75 percent of total Program funding in Henan and Shaanxi, respectively. Each sectoral government

agency has its budget resources to support the Program activities. The budget allocation is done using a factor method or a combination of factor method and project-based method every year following the regular government budget preparation, review, and approve process. The financial data in the past three years provided by the two provinces indicated a stable and sustainable financial contribution to the government program activities.

12. The central-level and provincial-level budgets for the Program are appropriated to county FBs from provincial FB through prefecture FB as necessary by issuing budget circulars. Once the budget is appropriated to county FBs, it is entered into the Government Financial Management Information System (GFMIS) with its circular reference number, transfer name, source, and amount so that the treasury division of county FBs can manage payments according to the approved budget. The GFMIS is a mutual platform shared by budget units and FBs horizontally across any level of government. Governments at all levels have integrated all financial funds into the treasury single account system. All Program expenditures are paid through the treasury single account to ensure they are used within the budget.

13. Reasonable internal control policies and procedures are placed on the Program funds and activities. For each Program fund, following the national policy and regulations issued by the MOF and line ministries, the provincial governments have issued a series of regulations regarding fund management, implementation measures, performance evaluation, and so on. Although the internal audit function had not been widely established within the Program implementing agencies, other types of inspection and supervision from higher-level FB and sector agencies provide alternative reasonable assurance of the proper implementation of the Program. For example, in Henan, annual performance evaluation was performed in the past three years for the Water Resource Development Fund financed activities by a third party appointed by a provincial-level sector agency.

14. According to the MOF's requirement, Government Accounting Standards apply to all the implementing agencies. They maintain their accounting records in dual parallel ways of budget accounting on a cash basis and financial accounting on accrual basis. The implementing agencies are to prepare final accounts reports and financial reports on an annual basis. Final accounts reports will provide information related to the implementation of the government's budget while financial reports will provide the government's financial and operating conditions (including operating costs) as well as cash flow and other relevant information. No Program financial statements are required and the current financial reporting architecture for government agencies makes it difficult to generate the Program financial statements. A set of tailored Program financial statements will be developed and introduced to the Program in format and content acceptable to the World Bank and the borrowers. A guideline will be developed to support the Program financial staff to properly prepare and present the Program financial statements.

15. Although government auditors do audit Program funds when they carry out budget execution audit, accountability audit, and other types of audits, no specific Program financial statements audit was required or conducted in the past years. The financial statements audit of the proposed Program will be required and conducted by the Audit Service Center of CNAO and the two PAOs. For quality assurance purpose, the first year's audit report issued by the PAOs is subject to the quality review by the CNAO.

16. The Program FM function and responsibilities mainly rest within the existing finance and accounting division of each implementing agency. The Program is a part of the Government programs. The finance and accounting division of each implementing agency has financial staff with adequate experience in the FM work of Government programs. The FM capacity is deemed acceptable to the World Bank and appropriate for the Program FM work. The financial staff might not fully understand the Program and its scope and boundary clearly. The related FM training, guidance, and guidelines provided by the PPMOs and/or the World Bank when needed will help strengthen their awareness in this regard.

17. **Public procurement system - procurement profile of the Program.** Based on activities identified in the Program scope, the main procurable items include (a) goods: materials, equipment, and IT hardware and software for improving the current system and application of modern technologies and so on; (b) works: construction and rehabilitation of irrigation schemes, river and watershed management works, landscaping, afforestation and reforestation, soil and water conservation, and so on; (c) consulting Services: preparation/upgrading of ecosystem and water resources management plans, assessments of water resources availability in demonstration sub-basins, training and capacity building activities with intellectual input, and so on; and (d) non-consulting services: services with no intellectual input as identified during Program implementation. The Program is not expected to procure any large contracts valued at or above the Operational Procurement Review Committee (OPRC) thresholds (US$75 million for works, US$50 million for goods and non-consulting services, and US$20 million for consultant services), which are based on a 'Substantial' risk rating. This conclusion is drawn based on analysis of procurement data of all agencies in two provinces and the YRCC.

18. **Procurement regulatory framework.** Public procurement in China is governed by two laws: Tendering and Bidding Law (TBL), effective from 2001, and Government Procurement Law (GPL), effective from 2003. TBL regulates procurement activities to be carried out through open bidding or invitation bidding in the fields of construction, supervision, geographic survey, and construction design as well as the procurement of important equipment and materials related to the construction. GPL governs procurement to be carried out by government authorities, public service institutions, and group organizations at all levels for goods, construction, and services, according to the law, being listed in the centralized procurement catalogue or with value exceeding a prescribed threshold. The overlapping activities of works procurement through open and invitation bidding under GPL will follow GPL Article 4, which states that where open bidding or invitation bidding is adopted for government procurement of construction, TBL shall apply. Implementation details are provided through implementation regulations of the respective laws, various sectoral and provincial regulations, orders, and decrees. Though administered by different authorities, there is no conflict among them.

19. **Procurement process and procedures.** GPL has provided a range of modern procurement methods: open bidding, invitation bidding, competitive negotiation, single source selection, request for quotation, and any other methods approved by the MOF. GPL Article 26 provides open bidding as the primary procurement method. GPL-governed works procurement adopting open and invitation bidding will follow TBL. SBDs issued by line ministries will be used for open and invitation bidding contracts under the Program. The assessment reviewed all documents and noted the lack of detailed procurement-related complaints-handling procedures in the SBD as one of the key risks. At the bid evaluation stage, two methods are commonly used: (a) comprehensive scoring method and (b) the lowest evaluated responsive bid method. The review noted that when comprehensive scoring method is used for contracts with neither innovation nor complexity, the total weightings of all rated criteria other than price could be higher than 50 percent, which may not achieve VfM. While a complaint mechanism is available in both TBL and GPL, the assessment noted there were no procurement complaints in the past three years in the procurement records of two provinces and the YRCC. Therefore, the system soundness would be hard to assess. Contract management follows contract terms and conditions. The assessment found most contracts—85 percent for Shaanxi and 74 percent for Henan—completed on time. The rest may be delayed due to land acquisition delay, unforeseen geological conditions, and additional work.

20. **Procurement capacity.** All agencies have extensive experience in carrying out procurement following domestic procurement laws and regulations. The procurement staff strength is adequate in all agencies assessed. Trainings on procurement policies, procedures, and case studies are provided and attended regularly.

21. **Governance and anti-corruption arrangement.** Legal liability provisions of TBL and GPL regulate conduct and provide remedial measures of misconduct in the course of tendering and bidding. Integrity Responsibility Letter is a mandatory part of the issued procurement document and later part of the signed contract for signing by both parties. The

Integrity Responsibility Letter regulates behavior of the two parties to prevent the violation of laws and disciplines for seeking illegal interest. The CNAO at the central level and PAOs at the provincial level carry out compliance and performance audit annually. Where violations of state regulations on government and financial revenues and expenditures are identified, remedial measures will be taken in accordance with the law. An audit institution, within its mandate, can make an audit decision or put forward to the department in charge its recommendations on how to deal with or take remedial measures.

22. The Program will be subject to the World Bank 'Guidelines on Preventing and Combating Fraud and Corruption in Program-for-Results Financing' dated February 1, 2012 and revised on July 10, 2015 (the Anti-Corruption Guidelines). These guidelines shall be applied in an unrestricted manner on all activities within the Program boundary. To operationalize implementation of the various areas covered in the Anti-Corruption Guidelines, the YRCC, PPMOs and/or PMOs as relevant shall perform a series of recommended actions (Table 4.1).

23. **Key conclusions and recommendations.** The fiduciary systems associated with the agreed actions to strengthen the fiduciary systems, as reflected in the DLIs, PAP, and other proposed mitigation measures to be implemented, are deemed comprehensive and adequate and can provide reasonable assurance that the Program's financing proceeds will be used for the intended purposes, with due attention to the principles of economy, efficiency, effectiveness, transparency, and accountability.

Table 4.1. Program Fiduciary Systems Risks and Mitigation Action

Risk	Mitigation Action
Risks of not meeting the World Bank's Anti-corruption Guideline's requirements	• Maintain and compile a quarterly report of Program-related complaints and share it with the World Bank. • Incorporate the World Bank's listing of ineligible firms in the filter used by procuring entities under the Program when they conduct due diligence before contract award. This list is available at the following website: http://www.worldbank.org/debarr. • Incorporate and filter the World Bank's suspension list that will be obtained from the World Bank team by PPMOs, PMOs and the YRCC when they conduct due diligence before contract award and share with the participating agencies. • Report on a quarterly basis that none/if any contract awards are made to any ineligible/suspended firms/individual. • Ensure that each participating bidder shall submit a self-declaration that the firm is not subject to ineligibility or has not been sanctioned under the World Bank system of debarment and cross-debarment at the time of bidding. • Ensure timely and appropriate actions are taken to address issues and indications of fraud and corruption and report these actions to the World Bank. • Ensure that PPMOs, PMOs, the YRCC, and any other stakeholders of the Program cooperate fully with the World Bank or any firm/individual appointed by the World Bank in any inquiry conducted by the World Bank into allegations or other indications of fraud and corruption in connection with the Program. • TOR for the annual external audit shall include tasks of audit reviews and certifies the above actions.

Risk	Mitigation Action
When comprehensive scoring method (one of the two most used procurement methods under domestic procedures) is used for bid evaluation of contracts with neither innovation nor complexity, the total weightings of all rated criteria other than price could be higher than 50%, which may not achieve VfM.	When comprehensive scoring method is used for bid evaluation of contracts with neither innovation nor complexity, following the government policies and requirements, the price weighting should be sufficiently maximized to better achieve VfM. Guidance should be prepared by PPMO, PMOs and the YRCC on evaluation criteria.
Lack of detailed procurement-related complaint-handling procedures in the SBD	Provide detailed procurement-related complaint-handling procedures in the SBD for preparation of bidding document under the Program. Standard language should be prepared by PPMOs, PMOs and the YRCC.
The Program financing comprises earmarked funding from the central-level and provincial-level budgets. However, most of the funding has a life period that might not cover the entire Program life; this might lead to financing gaps that will need to be filled from other sources.	Any funding gap that could undermine the sustainability of the Program should be evaluated timely and addressed by the MOF and relevant sector ministries mutually before the expiration of each funding cycle.
No Program financial statements are required by higher-level sector agencies and finance departments and the current financial reporting architecture for government agencies makes it difficult to generate the Program financial statements; this creates risk of noncompliance with the PforR financial statement requirement which might affect the monitoring of the Program's implementation.	Tailored Program financial statements will be developed and introduced to the Program in format and content acceptable to the World Bank and the borrowers.
Audit of Program financial statements is not required under current China PFM practice; audit of Program financial statements will require coordination across government audit units and the application of financial audit techniques not practiced by some audit units. This might create a risk of weak audits, at least in the initial years of the Program.	Audit of Program financial statements will be required and conducted on an annual basis. Tailored audit TORs will be developed and agreed upon between the World Bank and government audit offices.
Multisector involvement in the Program, various budget resources supporting the Program, and large volume of Program activities bring complexity to the Program management and FM work.	Appropriate institutional arrangements have been established for Program coordination and management purposes with clear roles and responsibilities (see Section III - Program Implementation).

ANNEX 5. SUMMARY ENVIRONMENTAL AND SOCIAL SYSTEMS ASSESSMENT

1. The objective of the Program is to strengthen integrated water use efficiency, water pollution control, and ecosystem management, in selected regions of the YRB. The Program will be implemented through the World Bank's PforR financing and will support a subset of physical, planning, and capacity building activities from the national and sub-national programs for Ecological Protection and High-Quality Development in the YRB, particularly in Henan and Shaanxi Provinces. Program interventions will be implemented at three levels: (a) basin-level coordination, technical guidance, and capacity building, including the development of an integrated information management platform (a geographic information system [GIS]-based basin management system); (b) provincial-level development of integrated ecosystem and water resources management plans for improved catchment management; and (c) demonstration sub-basin-level investments on ecosystem management and water resources. At the sub-basin level, the Program activities (Table 5.1) will cover seven sub-basins, three in Henan (involving five counties of Sanmenxia Municipality) and four in Wei River Basin in Shaanxi (involving nine counties of Xianyang and Tongchuan Municipalities).

Table 5.1. PforR Program Activities

Result Areas	Activities
1. Improving water use efficiency	(a) Modernizing and rehabilitating irrigation schemes (b) Improving agronomic practices (c) Developing and implementing TVAPs (d) Building or rehabilitating rural water supply systems and pipelines (e) Improving the capacity of local communities and WUAs on agricultural water management (f) Increasing the participation of women in leadership roles within the WUAs.
2. Improving water quality	(a) Upgrading effluent standards within existing wastewater treatment plants (b) Installing rural wastewater treatment systems with household connections (c) Rehabilitating rural wastewater treatment pipelines (d) Improving livestock and poultry manure collection and treatment rate (e) Promoting organic fertilizer use and precise chemical fertilizer application.
3. Improving ecosystem management	(a) Integrated landscape management planning (b) Afforestation/ reforestation with increased species diversity (c) Soil and water conservation including terracing (d) Wetland protection and restoration (e) Vegetation restoration with promoted natural regeneration.
4. Strengthening integration of ecosystem and water resources management into strategic planning	(a) Preparing integrated ecosystem and water resources management plans for demonstration sub-basins (b) Preparing provincial-level guidelines for integrated ecosystem and water resources management planning and developing provincial-level integrated plans (c) Developing consumption-based water management approaches for the YRB and piloting them at the sub-basin level (d) Developing and operationalizing an integrated ecosystem and water resources information management platform for decision-making at the YRB (e) Preparing technical standards and guidelines for the protection of YRB (f) Training and capacity building on ecosystem and water resources management at the provincial and basin levels.

2. The Program will manage E&S risks in accordance with the existing national and local legal framework and institutional system. The ESSA reviewed the applicable national and local E&S safeguard systems and procedures, assessed to what extent the national and local systems comply with the core principles and key elements of the World Bank PforR

policy and directive, and identified gaps/inadequacies and proposed actions to fill the gaps and recommendations to improve implementation effects based on the issues identified in the assessment, as summarized below.

Screening of E&S Considerations and Risks

3. An E&S risk screening was conducted for the Program-supported activities and the potentially associated activities, during ESSA preparation. A review of the planned activities under the Government programs with field visits to targeted Program areas indicates that this Program does not involve construction of associated activities/facilities that are necessary to meet the development goals but are not explicitly included in the scope of the Program. It is noted that some proposed rural water supply activities may require reservoirs as water sources. To this end, the World Bank team conducted a due diligence review and concluded that the contextual risk related to dam safety is moderate to substantial since all proposed rural water supply and irrigation renovation subprojects rely on existing reservoirs, all (except some small village-operated reservoirs) managed by special institutes with professionals and sufficient funding. Thus, the associated dam safety risk is expected to be moderate.

4. According to the screening results, the following activities are excluded as they may carry high E&S risks:

(a) Remediation of old mines

(b) Activities (such as 'creation of new wetlands') that may involve large-scale land acquisition

(c) Water transfer projects

(d) Reservoir dredging, dam reinforcement, and rehabilitation

(e) Construction and expansion of urban sewage treatment plants with a total capacity of more than 50,000 m^3/day or any facilities involving industrial wastewater treatment

(f) Other activities that are classified as Class A (requiring full EIA Report) according to the latest national Catalogue for the Classified Management of the Environmental Impact Assessment of Construction Projects,[100] for example, river rehabilitation (including dredging) in environmentally sensitive areas,[101] river dredging activities involving contaminated dredged material, and so on.

5. With the application of these exclusion criteria, the range of activities required to achieve the Program results are not expected to include any which would be defined as 'High risk'.[102] If the activities are viewed in isolation, the E&S risk would generally fall within a 'Moderate' category. However, given the number of activities and the geographic scale across the river basin, potential negative E&S cumulative impacts still need to be assessed and addressed as part of the Program in planning specific interventions at the sub-basin levels, particularly considering the various types of interventions and insufficient coordination of ecological and water management action across jurisdictions and sectors at the current stage (to be carried out through the preparation of integrated ecosystem and water resources management plans). In the highly populated Program areas, the tradeoff between economic output and environmental protection should be carefully analyzed to secure the achievement of positive environmental impacts while avoiding and minimizing potential negative

[100] Currently, Version 2021, which was issued on November 30, 2020.
[101] Environmentally sensitive areas refer to the areas subject to the control requirements of ecological red lines, including national parks, natural reserves, world culture and nature heritage, famous scenic spots, particularly sensitive sea areas, drinking water protection zones, permanent basic farmland, basic grassland, natural parks (forest parks, geological parks, ocean parks), critical wetland, natural forests, critical natural habitats, nature-based aquaculture sites, key areas identified for soil erosion prevention and control, desertified areas, and enclosed and semi-enclosed sea areas.
[102] Risk categorization based on Section C of the Bank Directive - Environmental and Social Directive for Investment Project Financing, March 2019.

impacts on various water users in the river basins as the cumulative result of Program implementation. The Program will also require strengthened coordination of ecological and water management across jurisdictions and sectors. Therefore, the overall rating of E&S risks of the Program is rated as 'Substantial'.

6. Institutional strengthening and capacity building in the two provinces aim to improve environmental management and promote ecological protection and are not included in the scope of the Program. The basin component results are all capacity building activities (research and information systems) and only involve small-scale civil works for monitoring facilities. Therefore, these types of activities can be included in the scope of the Program for further E&S impact and management system analysis.

Implementation Arrangements

7. A PSG will be established at the NDRC, with representatives from MWR, YRCC, Henan and Shaanxi Provinces, and other relevant agencies. The PSG will be responsible for reviewing Program progress and results, and providing guidance on Program implementation.

8. A BPMO will be hosted at the YRCC under the MWR. The BPMO is responsible for achieving the Program results at the YRB level and for providing guidance to participating provinces as they develop and implement the Program. There will be PPMOs in Henan Province and Shaanxi Province, to operate under the guidance of PPSGs, and PMOs at municipal and county levels. The PMOs and PPMOs will be responsible for the preparation and implementation of their parts of the Program, and management of Program implementation. An expert group will be established in each province to provide technical advice.

Key Findings and Recommendations (including PAP)

9. The Program aims to support the Chinese Government's key actions in ecological conservation in the YRB and promote the E&S resilience of Program sub-basins.

10. The field investigation of ongoing or completed typical activities in the sample counties show that E&S impacts and risk management measures have been implemented effectively. Based on the assessment, the ESMSs related to the Program are generally consistent with the requirements of the World Bank's PforR policy and directive.

11. Comprehensive and effective ESMSs have been established in relevant sectors in China and in Shaanxi and Henan Provinces to identify, assess, mitigate, manage, and monitor E&S impacts and risks related to the Program activities, including

(a) A comprehensive regulatory system, with applicable laws, regulations, policies, standards, and technical guidelines at the state and local levels;

(b) Clear implementation mechanisms, with clear administrative procedures, institutional arrangements and responsibilities for E&S impacts and risks management, and necessary professionals and financial resources; and

(c) Good performance of the ESMSs according to the field investigation findings.

12. Some areas for improvement were identified in the assessment:

(a) Challenges remain with optimizing inter-jurisdictional coordination of ecosystem and water resources management, which in turn has implications for E&S risk management. It is anticipated that the basin and provincial results of the Program will show improvements in this regard.

(b) A number of sewage treatment facilities have O&M challenges such as lack of timely maintenance, lack of technical support, and poor management. This results in frequent breakdowns, unstable operations, and therefore poor sewage treatment quality. In addition to direct E&S implications created by poor outflows, other O&M issues such as OHS management and community awareness also exist. Building technical capacity through targeted and meaningful training (as well as additional technical and financial resources) would greatly improve the results.

(c) Documentation on public consultation, information disclosure, and GRM operation is relatively weak, and some enterprises have not established the GRMs for their construction and operation.

13. The following PAP actions are recommended to address numbers (b) and (c) above:

(a) Provide regular training for the staff maintaining the town and village sewage treatment facilities focusing on OHS and other E&S impacts associated with poor O&M.

(b) Establish monitoring and reporting mechanisms for meaningful public participation and GRM, and strengthen information and documentation management during the Program social risk management.

14. **Consultation and information disclosure.** Relevant stakeholders, including both government departments and local communities, were consulted through meetings and field visits to selected counties. The draft ESSA report was shared with the Henan and Shaanxi PPMOs and all Program municipalities and counties during preparation. Consultation meetings were carried out with key stakeholders at the provincial and municipal/county levels in Henan and Shaanxi during November and December 2021. Consultation with YRCC was undertaken in January 2022. The stakeholders consulted voiced their support in implementing the proposed Program and concurred with the findings and recommendations of the draft ESSA, which were considered relevant and valuable for strengthening the implementation of the existing E&S system. Some stakeholders provided valuable opinions to improve the accuracy of the ESSA description in local context, which have been reflected in the final ESSA. The final ESSA report has been disclosed on the World Bank's website (in English), and locally on the public websites at YRCC and in Henan and Shaanxi, in February 2022 (in Chinese).

ANNEX 6. PROGRAM ACTION PLAN

Action Description	Source	DLI#	Responsibility	Timing		Completion Measurement
Provide regular training for the staff maintaining the town and village sewage treatment facilities focusing on OHS and other E&S impacts associated with poor O&M	Environmental and Social Systems		Provincial and/or municipal PMOs	Recurrent	Semi-Annually	Semiannual progress reports are submitted to the Bank, including the implementation of related trainings
Establish monitoring and reporting mechanisms for meaningful public participation and GRM, and strengthen information and documentation management during the Program social risk management	Environmental and Social Systems		Provincial and/or municipal PMOs	Recurrent	Semi-Annually	Semi-annual reports are submitted to the Bank, including information of land selection/screening, or approvals, information disclosure records and public participation, GRM establishment and operation, and support to vulnerable groups
Prepare and issue guidance note on evaluation criteria and weightings for bid evaluation of contracts where comprehensive scoring method is used	Fiduciary Systems		BPMO, provincial and/or municipal PMOs	Other	Within six months from the date of effectiveness	Preparation and issuance of guidance on evaluation criteria
Provide detailed procurement related complaint handling procedures to supplement the general description in SBDs for preparation of procurement documents under	Fiduciary Systems		BPMO, provincial and/or municipal PMOs	Other	Within six months from the date of effectiveness	Standard language on procurement related complaint handling procedures to be added into issued procurement documents

the Program.						
Develop and issue a guideline about the preparation and presentation of Program financial statements	Fiduciary Systems		BPMO, provincial and/or municipal PMOs	Other	Before the first Program financial statements year end	Finalized official guideline provided to the Bank
Develop an audit Terms and Reference for the Program financial statements audit	Fiduciary Systems		BPMO, provincial and/or municipal PMOs	Other	Before the first Program financial statements audit	TORs shared and approved by the Bank.

ANNEX 7. IMPLEMENTATION SUPPORT PLAN

1. The implementation of the Program will require continuous support and attention from the World Bank team, both in relation to the lending instrument and the technical innovations. The PforR instrument is new to some government teams involved in the Program, and support will be provided to ensure all teams are acquainted with its requirements. Technical innovations around water resources assessments using new technologies and the preparation of TVAPs and their integration within the landscape will require enhanced support and collaboration during Program implementation for government teams to internalize the approaches and available national and international experiences. This annex also outlines the key activities proposed to address risks identified by the risk assessment and provides an indication of the technical assistance and resources needed to improve the quality of Program implementation. Emphasis is placed on (a) supporting early-stage implementation and building institutional capacity, (b) reviewing implementation progress (including PAP implementation) and achievement of Program results and DLIs, (c) providing support to resolve emerging implementation issues, (d) monitoring the adequacy of systems performance and monitoring compliance with Legal Agreements, and (e) supporting the Government in monitoring changes in risks.

2. The strategy and approach for implementation support includes an emphasis on the technical, fiduciary, and E&S support needed during implementation. During Program preparation, the World Bank team provided technical expertise—and will continue to do so during implementation—as well as guidance to the agencies on fiduciary and E&S aspects to ensure completion of the actions agreed in the PAP. Implementation support from the procurement and financial management team will focus on reviewing and monitoring compliance with the Government's own systems and the actions defined in the PAP, while the implementation support will also provide technical assistance to address shortcomings identified during the assessment.

3. Given the multi-provincial, cross-sectoral characteristics of the Program, its basin-wide ambition, and the innovations included in the Program, significant resources above the regional norms will be needed during implementation. This support will be ensured through leadership and close contributions from team members in the China Country Office, in Beijing, with additional support and leadership from international technical specialists. This combination will leverage the World Bank's global knowledge and local expertise to enable timely and effective responses to the needs of the borrowers. Formal implementation support missions and field visits covering all aspects of implementation will be conducted periodically during implementation. The characteristics of the Program necessitate that these implementation support missions will be longer than the standard single province or agency engagement. Tables 7.1 and 7.2 outline the estimated inputs from different specialists and resources required at different stages of Program implementation.

Table 7.1. Main Focus of Implementation Support

Time	Focus	Skills Needed	Resources Estimate (Staff Weeks)
First 12 months	• Implementation of program management systems • Setting up implementation and coordination mechanisms • Staff capacity building, on-the-job training on E&S and fiduciary • Procurement process and training • Technical support to activities and implementation (water balance, landscape approach to watershed management, etc) • Financial management and disbursement training and capacity building	• Core team, particularly technical, FM, procurement, E&S experts. M&E support • Integrated ecosystem and water resources management expert, water balance support	72
12–48 months	• Technical support to implementation, including monitoring and evaluation • Peer learning between provinces, engagement of the basin-wide elements of the Program • Conduct policy and technical research • Continued improvements in project management systems including fiduciary and safeguards • Program Midterm Review	• Core team, particularly technical, FM, procurement, E&S experts. M&E support • Integrated ecosystem and water resources management experts	120
Other	• Completion of activities • Capacity building and facilitate knowledge exchange and events • Support technical and financial analysis of program investments • End-term evaluation and client ICR	• Core team, particularly technical, FM, procurement, E&S experts • Integrated water and environment management	56

Table 7.2. Task Team Skills Mix Requirements for Implementation Support

Skills Needed	Number of Staff Weeks per year	Number of Trips	Comments
Task team leader/program management	10	Three in the first year, two thereafter	Internationally based staff
Task team leader(s)/program management	14	Three in the first year, two thereafter	Country office-based staff
Procurement specialist	3–6	Two per year	Country office-based staff
Financial management specialist	3–4	Two per year	Country office-based staff
Operations specialist	4–6	Two per year	Country office-based staff
Environmental specialist	3–4	Two per year	Country office-based staff
Social specialist	3–4	Two per year	Country office-based staff
Monitoring and evaluation specialist	4–6	Two per year	Country office-based staff
Integrated ecosystems and water resources management expert	2–4	Two per year	Consultant (national)
Water balance and satellite monitoring expert	2–4	Two per year	Consultant (national)
Water pollution modeling expert	2–4	Two per year	Consultant (national)

ANNEX 8. TEAM LIST

No.	Name	Title	Unit
1.	Mr. Daniel Mira-Salama	Senior Environmental Specialist	SEAE1
2.	Mr. Liping Jiang	Senior Water Resources Management Specialist	SEAW1
3.	Mr. Marcus Wishart	Lead Water Resource Specialist, Task Team Leader	SEAW1
4.	Ms. Jin Liu	Senior Environmental Specialist	SEAE1
5.	Ms. Si Gou	Water Resources Specialist	SEAW1
6.	Mr. Xiawei Liao	Water Resources Specialist	SEAW1
7.	Ms. Jia Li	Natural Resources Management Specialist	SEAE1
8.	Mr. Paul Jonathan Martin	Lead Natural Resources Management Specialist/ Peer Reviewer	SLCEN
9.	Mr. William Young	Lead Water Resources Management Specialist/ Peer Reviewer	SCAWA
10.	Mr. Parameswaran Iyer	Adviser/ Peer Reviewer	SWADR
11.	Mr. Ross Butler	Senior Social Development Specialist	SEAS1
12.	Mr. Xiaodan Huang	Senior Environmental Specialist	SEAE1
13.	Mr. Harold Bedoya	Operations Manager	EACCF
14.	Mr. Ladisy Komba Chengula	Lead Agriculture Economist	SEAAG
15.	Ms. Haixia Li	Senior Financial Management Specialist	EEAG1
16.	Ms. Jingrong He	Senior Procurement Specialist	EEAR1
17.	Mr. Aristeidis Panou	Senior Counsel	LEGAS
18.	Ms. Minghe Zheng	Finance Officer	WFACS
19.	Ms. Jieli Bai	Program Assistant	EACCF
20.	Mr. Xueming Liu	Senior Economist Consultant	FAO
21.	Ms. Fang Yang	Gender Specialist Consultant	EACF
22.	Mr. Guoxin Zhou	Social Specialist Consultant	SEAS1
23.	Ms. Chunyan Hou	Environmental Specialist Consultant	SEAE1
24.	Mr. Guobin Liu	Natural Resources Management Specialist Consultant	SEAE1
25.	Mr. Bingfang Wu	Water Resources and Remote Sensing Consultant	SEAW1
26.	Mr. Yan Chen	Environmental Specialist Consultant	SEAE1
27.	Ms. Li Du	Senior Financial Consultant	SEAW1
28.	Mr. Yun Ma	Financial Consultant	SEAW1
29.	Mr. Hongkun Yang	Procurement Specialist Consultant	EEAR1
30.	Mr. Jianxin Chen	Senior Interpreter	SEAW1
31.	Ms. Yanling Zang	Senior Interpreter	SEAE1

ANNEX 9. MAPS


CHINA
RUSSIAN FEDERATION
KAZAKHSTAN
MONGOLIA
KYRGYZ REP.
TAJIKISTAN
AFGHANISTAN
Urumqi
XINJIANG
XIZANG
QINGHAI
GANSU
NEI MONGOL
NINGXIA
SHANXI
SHAANXI
HEBEI
BEIJING
TIANJIN
SHANDONG
HENAN
ANHUI
JIANGSU
SHANGHAI
HUBEI
SICHUAN
CHONGQING
ZHEJIANG
JIANGXI
HUNAN
GUIZHOU
YUNNAN
FUJIAN
TAIWAN
GUANGXI
GUANGDONG
HONG KONG, SAR
MACAO, SAR
HEILONGJIANG
JILIN
LIAONING
Harbin
Changchun
Shenyang
Hohhot
Yellow River (Huang He)
BEIJING
Tianjin
Shijiazhuang
Taiyuan
Jinan
Yinchuan
Xining
Lanzhou
Zhengzhou
Xi'an
Hefei
Nanjing
Shanghai
Wuhan
Hangzhou
Nanchang
Changsha
Fuzhou
Guiyang
Kunming
Nanning
Guangzhou
Haikou
Chengdu
Chongqing
Lhasa
DEM. PEOPLE'S REP. OF KOREA
REP. OF KOREA
JAPAN
Sea of Japan
East China Sea
PHILIPPINES
VIETNAM
LAO P. D. R.
THAILAND
MYANMAR
For detail, see IBRD 46261
IBRD 46259 | DECEMBER 2021
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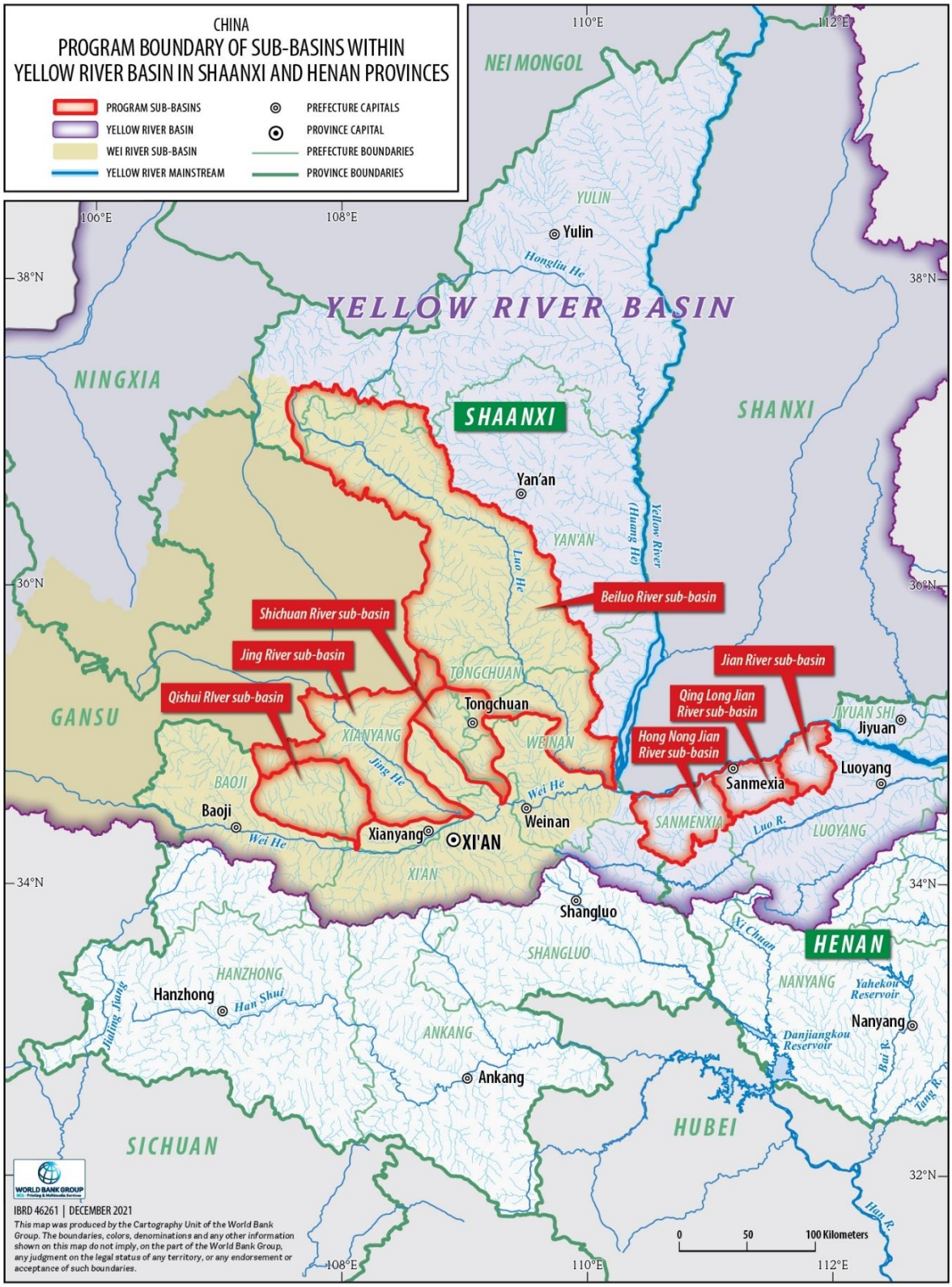
CHINA
THE YELLOW RIVER BASIN
YELLOW RIVER BASIN
PROGRAM SUB-BASINS
WEI RIVER SUB-BASIN
PROVINCES ALONG MAINSTREAM
MAIN WATERWAY NETWORK
OTHER WATERWAYS
PROVINCE CAPITALS
NATIONAL CAPITAL
PROVINCE BOUNDARIES
INTERNATIONAL BOUNDARIES
0 300 Kilometers
0 100 200 300 Miles
80°E
90°E
100°E
110°E
120°E
130°E
40°N
30°N
20°N


CHINA
PROGRAM BOUNDARY OF SUB-BASINS WITHIN YELLOW RIVER BASIN IN SHAANXI AND HENAN PROVINCES
PROGRAM SUB-BASINS
YELLOW RIVER BASIN
WEI RIVER SUB-BASIN
YELLOW RIVER MAINSTREAM
PREFECTURE CAPITALS
PROVINCE CAPITAL
PREFECTURE BOUNDARIES
PROVINCE BOUNDARIES
YELLOW RIVER BASIN
NEI MONGOL
NINGXIA
SHAANXI
SHANXI
GANSU
SICHUAN
HUBEI
HENAN
YULIN
YAN'AN
TONGCHUAN
XIANYANG
BAOJI
XI'AN
WEINAN
SHANGLUO
HANZHONG
ANKANG
SANMENXIA
LUOYANG
JIYUAN SHI
NANYANG
Yulin
Yan'an
Tongchuan
Baoji
Xianyang
XI'AN
Weinan
Shangluo
Hanzhong
Ankang
Sanmexia
Luoyang
Jiyuan
Nanyang
Hongliu He
Yellow River (Huang He)
Luo He
Jing He
Wei He
Han Shui
Jialing Jiang
Ni Chuan
Luo R.
Bai R.
Tang R.
Han R.
Yahekou Reservoir
Danjiangkou Reservoir
Beiluo River sub-basin
Shichuan River sub-basin
Jing River sub-basin
Qishui RIver sub-basin
Jian River sub-basin
Qing Long Jian River sub-basin
Hong Nong Jian River sub-basin
100°E
108°E
110°E
112°E
38°N
36°N
34°N
32°N
0
50
100 Kilometers
IBRD 46261 | DECEMBER 2021
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