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Technical Assessment

ON

PROPOSED LOANS

IN THE TOTAL AMOUNT OF US$400 MILLION EQUIVELANT

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

YANGTZE RIVER PROTECTION AND ECOLOGICAL RESTORATION PROGRAM

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Technical Assessment

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ABBREVIATIONS AND ACRONYMS

APEC	Asia-Pacific Economic Cooperation
BP	Bank Procedure
CA	Conservation Agriculture
CCERs	China Certified Emissions Reductions
CPF	Country Partnership Framework
CPMO	County Project Management Offices
CWRC	Changjiang Water Resources Commission
DARA	Department of Agriculture and Rural Affaires Department
DEE	Department of Environment and Ecology
DLI	Disbursement Linked Indicator
DOF	Department of Finance
DOFt	Department of Forestry
DOHURD	Department of Housing and Rural – Urban Development
DWR	Department of Water Resources
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
E & S	Environmental and Social
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESMF	Environmental and Social Management Framework
ESRC	Environmental and Social Risk Classification
ESRS	Environmental and Social Review Summary
ESSA	Environmental and Social Assessment
FAO	Food and Agriculture Organization
FI	Financial Intermediaries
FM	Financial Management
FSA	Fiduciary Systems Assessment
FYR	Five Year Plan
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GEF	Global Environment Facility (GEF)
GHGs	Greenhouse Gases
GPL	General Public License
GRS	Grievance Redress Service
IBRD	International Bank for Reconstruction and Development (IBRD)
IDA	International Development Association
INT	Integrity Vice Presidency
IPF	Investment Project Financing
MARA	Ministry of Agriculture and Rural Affairs
M&E	Monitoring and Evaluation
MEE	Ministry of Ecology and Environment
MIS	Management information System
MNR	Ministry of Natural Resources
MOF	Ministry of Finance
MWR	Ministry of Water Resources
NDRC	National Development and Reform Commission

NKEZP	National Key Ecological Zone Program
OP	Operational Policy
PAD	Project Appraisal Document
PAO	Provincial Audit Office
PAP	Program Action Plan
PDO	Project Development Objective
PDRC	Provincial Development and Reform Commission
PFD	Provincial Finance Department
PforR	Payment for Results
PMO	Project Management Offices
POM	Project Operation Manual
PPMO	Provincial Project Management Offices
PSC	Project Steering Committee
RAP	Resettlement Action Plan
RBECP	River Basin Eco-Compensation Program
RPF	Resettlement Policy Framework
S & T	Science and Technology
SEF	Stakeholder Engagement Framework
SORT	Systematic Operations Risk-Rating Tool
SWM	Solid Waste Management
TN	Total Nitrogen
TP	Total Phosphorus
TORs	Terms of References
WB	World Bank
YREB	Yangtze River Economic Belt
YRB	Yangtze River Basin

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1 INTRODUCTION

1. **This Technical Assessment (TA) has been carried out as part of the preparation of the Yangtze River Protection and Ecological Restoration Program (YRPERP, "the Program,").** YRPERP is based on Program-for-Results (PforR) financing. The purpose of this TA is to present the World Bank's evaluation – undertaken with data and support from the National and Provincial Governments – of Program arrangements across four aspects: (i) strategic relevance and technical soundness, (ii) expenditure framework, (iii) results framework and monitoring and evaluation capacity, and (iv) economic justification.

2. **The PforR is anchored in the Government's program for the Yangtze River Economic Belt (YREB) as implemented through sub-national Provincial YREB programs.** The YREB is the strategic roadmap towards green, resilient, and inclusive development in the Yangtze River Basin. The plan encompasses crosscutting and sector-based policies, regulatory and institutional actions, as well as priority investments. The PforR will support a sub-set of activities based on the priorities and targets articulated in the national and provincial YREB-related plans. These activities contribute to improving interjurisdictional and intersectoral coordination, ecological protection, and water pollution reduction.

2 PROGRAM DESCRIPTION

2.1 The Yangtze River Basin and Economic Belt

3. **The Yangtze River Basin and the economic belt it defines is a necessary focus of the Government's efforts toward a greener China.** The Yangtze River Basin includes 19 provinces, municipalities, and autonomous regions, including the nine provinces and two municipalities that define the Yangtze River Economic Belt (YREB). [1] The Yangtze River—the world's third largest—and its basin play a major role in the historical, cultural, and political identity of China and have important implications for China's water, food, and energy security. The annual water resources of the basin are estimated at over 995 billion cubic meters, roughly 35 percent of the national total. Over 200 billion cubic meters of water is drawn from the basin annually, supporting industry and providing drinking water for almost 600 million people.[2] The YREB is an important manufacturing hub, lying at the heart of global supply chains, and is one of the world's busiest inland waterways for freight traffic. In 2018, the GDP generated in the YREB was estimated at US$5.7 trillion (CNY 40.3 trillion), accounting for 45 percent of national GDP.[3] If the YREB were a country, it would be the third-largest economy in the world.[4]

4. **The Yangtze River Basin has some of the highest levels of biodiversity in the world**. The Basin is one of the world's most biologically diverse ecoregions due to its climatic and geographic variation, as well as its complex hydrology and floodplain dynamics.[5] The Basin supports over 200 fish species, more than 84 mammal species, 60 amphibian species, and 87 reptile species. It has a forest coverage rate of over 40 percent and is home to some of China's most iconic and endangered species, including the Chinese sturgeon, finless porpoise, Chinese alligator, and the giant panda. It is home to 33 percent of the rare or endangered freshwater fish species in China and accounts for around 40 percent of the country's rare or endangered plants. The Basin's lakes provide critical habitat for internationally migratory birds, including

[1] The Yangtze Basin provinces/autonomous regions are Qinghai, Tibet, Gansu, Shaanxi, Henan, Guangxi, Guangdong, and Fujian. The YREB comprises Yunnan, Sichuan, Chongqing, Guizhou, Hubei, Hunan, Jiangxi, Anhui, Jiangsu, Zhejiang, and Shanghai.

[2] This includes direct beneficiaries of the South-to-North Water Transfer (around 120 million people).

[3] China Statistical Yearbook, 2019

[4] After the United States (US$22.32 trillion) and China (US$15.27 trillion) (link).

[5] WWF. 2020. *Living Yangtze Report*. World Wildlife Fund, Beijing (link).

95 percent of the wintering Siberian crane population.

5. **The Yangtze River and its tributaries face persistent challenges of water pollution and ecological degradation.** Over the past four decades, the Basin has experienced large-scale, high-intensity development and water-polluting industrial activity, and the Yangtze is today one of the most human-affected large rivers in the world. Development has severely impeded hydrological flows, sediment transportation, and nutrient distribution. Urban areas have increased dramatically, and lake and wetland areas have decreased, with more than 800 lakes within the central basin lost to land reclamation. Over 40 percent of lakes and reservoirs basin-wide are subject to eutrophication[6] with agricultural NPS pollution, notably runoff from excessive fertilizer application, a major contributor.[7] The resulting degradation of water quality and loss of ecological function is driving losses of globally significant biodiversity, as well as undermining the Basin's contribution to human uses.[8]

6. **Of water pollutants affecting the Yangtze, total phosphorus is one of the most problematic.** China's chemical fertilizer use, at 322 kg per ha, is almost three times the global average of 137 kg per ha.[9] The Yangtze River is among the top five major rivers globally most severely affected by phosphorus.[10] The largest source of phosphorus in the Yangtze River Basin is intensive agriculture, including chemical fertilizer use in vegetable and cereal cropping, along with livestock and poultry operations. Domestic wastewater is another major source. Phosphorus contributes to reduced water quality in important lakes, including Poyang and Dongting, two of Asia's largest resting points for internationally migrating birds. Phosphorus that reaches the oceans contributes to algal blooms and hypoxia in coastal waters. These challenges are not unique to China, with the United Nations Environment Programme (UNEP) and others highlighting that there is an imbalance in the global phosphorus cycle that threatens ecosystems and food security.[11]

7. **The Yangtze River is also a major source of global marine plastic pollution.** China's contribution to marine plastic pollution is critically important, with a 2015 study[12] estimating that China is a significant contributor to ocean plastic debris and that its rivers—most notably the Yangtze—are the primary conduit. While there is a need for more research on precise volumes, uncollected or mishandled rural waste and agricultural plastics are likely to be major sources,[13] with the Yangtze River delivering an estimated 0.31–0.48 million tons of plastic to the ocean every year Marine plastic pollution has detrimental impacts on marine ecosystems through entanglement and indigestion by wildlife and ecotoxicity impacts on micro-organisms.[14] Plastics remain in the oceans for hundreds of years, gradually

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[6] The process of eutrophication is driven by changes in the concentration of nutrients (that is, phosphorous and nitrogen), which are indicated by the levels of dissolved oxygen, chlorophyll a, and transparency. It is a serious environmental problem that leads to reduced oxygen levels in the water, toxicity from algal blooms, and ecological decline.

Tang, et al. 2020. "Response of Eutrophication Development to Variations in Nutrients and Hydrological Regime: A Case Study in the Changjiang River (Yangtze) Basin." *Water* 12: 1634 (link).

[7] Zhang, Y. et al. 2021. "Estimation of Nitrogen Runoff Loss from Croplands in the Yangtze River Basin: A Meta-analysis." *Environmental Pollution* 272 (116001) (link).

[8] See footnote **Error! Bookmark not defined.**.

[9] Data from the Food and Agriculture Organization (of the UN) via World Bank Data Bank (link).

[10] Mckonnen and Hoekstra. 2017. "Global Anthropogenic Phosphorus Loads to Freshwater and Associated Grey Water Footprints and Water Pollution Levels: A High-Resolution Global Study." *Water Resources Research* 54 (1): 345–358 (link).

[11] Brownlie, et al. 2021. "Global Actions for a Sustainable Phosphorus Future." *Nature Food* 2 (71–74) (link).

[12] Lebreton, et al. 2017. "River Plastic Emissions to the World's Oceans." *Nature Communications* 8 (15611) (link).

[13] World Bank. 2019. *Urban and Rural Municipal Solid Waste in China and the Circular Economy*. Washington, D.C. (link).

[14] Beaumont, et al. 2019. "Global Ecological, Social and Economic Impacts of Marine Plastic." *Marine Pollution Bulletin* 142: 189–195 (link).

disintegrating over time, with small particles and polymers entering food chains with potential risks for human health.[15] Direct economic damages include reduced fisheries value, losses in the marine and coastal tourism sector, and impacts on shipping, with an estimated direct cost of at least US$11 billion annually in the Asia Pacific region alone.[16]

8. **Many of the challenges facing the Yangtze River Basin are exacerbated by climate change, while the region is itself a source of GHG emissions.** Projections for the basin indicate a hotter future, with more, and more variable, rainfall. A 10–21 percent increase in runoff is forecast for 2041–2070 relative to 1970–2000,[17] which is likely to exacerbate flooding and associated economic costs[18] and increase the levels and variations in water pollution (including plastic debris) due to more intense precipitation and floods events resulting in spikes in runoff. Changes in the hydrological regime are likely to increase pressure on biodiversity and ecosystems, and the fact that past flows are not necessarily a good predictor of future flows will have implications for longer-term ecological protection. Water pollution also contributes to GHG emissions, notably due to methane released from the eutrophication process that occurs in nutrient-enriched waters. The overapplication of synthetic fertilizers also leads directly to GHG emissions from the soil, most notably nitrogen dioxide.[19]

9. **Efforts to improve ecological protection and reduce water pollution in the Yangtze River Basin are critical if the Government is to achieve its stated water and environment objectives.** The Government's overarching objectives are articulated by a series of targets and plans for water and the environment. The 'Most Stringent System for Water Resource Management' was established in 2012, setting 'Three Red Lines' with specific targets for water withdrawals, water use efficiency, and water quality. The 'Water Ten Plan', issued in 2015, proposed measures to strengthen water pollution control and improve ecosystem services. These have been complemented by three further 'redline' policies promoting green development: the 'Ecological Redlines', the 'Environmental Quality Baseline', and the 'Resource Utilization Threshold'. These complement wide-ranging sectoral reforms aimed at addressing persistent challenges of pollution. For example, a National Sustainable Agricultural Development Plan (2015–2030) targets zero growth of fertilizer as part of efforts to combat NPS pollution and reduce GHG emissions. The waste management sector is under transition as part of efforts toward a circular economy. Sector developments include policies banning certain plastic waste imports in 2017, plastic pollution control measures (January 2020), and specific provisions in the Solid Waste Law (April 2020) to improve the management of solid waste and reduce plastics use, including agricultural plastic mulch.[20] The geographic and economic significance of the Yangtze River Basin ensures that progress within the basin will substantially determine national outcomes.

10. **Significant public and private infrastructure investments have resulted in improved water quality in the Yangtze River Basin; however, further improvements will require institutional measures.** The proportion of major river basins meeting drinking water standards (class I–III) increased from 61 percent in 2011 to 83 percent in 2020. Despite these achievements, control of some specific pollutants remains challenging. Total phosphorus levels, for example, remain above national standards in some

[15] In this document the term plastics includes macro-plastics (size > 5mm) and micro-plastics (size < 5 mm) leaking into waterways from point and non-point sources.

[16] APEC. 2020. *Update of 2009 APEC Report on Economic Costs of Marine Debris to APEC Economies*. Asia Pacific Economic Cooperation Oceans and Fisheries Working Group (link).

[17] CWR. 2016. *Yangtze Water Risks, Hotspots, and Growth*. China Water Risk, Hong Kong (link).

[18] Floods in 2020, for example, impacted 63 million people and caused estimated economic costs of US$26 billion. See Pike, L 2020. "China's Summer of Floods is a Preview of Climate Disasters to Come." *Inside Climate News,* August 17, 2020 (link).

[19] Dijuan, X. et al. 2021. "China's Greenhouse Gas Emissions for Cropping Systems from 1978–2016." *Scientific Data* 8 (171) (link).

[20] NDRC and MEE. 2019. *Further Strengthening Plastic Pollution Control* (link).

water quality monitoring sections.[21] The portion of lakes and reservoirs in the Yangtze River Basin included in the eutrophication evaluation increased from 10 in 2008 to 61 in 2018 and the proportion of lakes exhibiting 'moderate' eutrophication[22] increased from 31 percent in 2009 to 42 percent in 2018.[23] While further infrastructure investments are needed for the control and treatment of point and non-point sources of pollution in specific locations, broader and sustained improvements will require improvements in institutions and management systems. These include harmonized and better-enforced standards, integrated monitoring platforms, basin-wide data and management systems that can improve coordination between branches and levels of government, and improved technical understanding of pollution hotspots and sources.

11. **Recognizing these needs, the Yangtze River Protection Law[24] was approved by the National People's Congress on December 26, 2020.** The law came into effect in March 2021 and is the first legislation for a specific river basin in China. It was formulated to strengthen the protection and restoration of the ecological environment in the Yangtze River Basin; it proposes the establishment of a National Yangtze River Basin Coordination Mechanism[25] and infers obligations on the national line agencies and provinces to align with its goals of ecological protection and improved water quality. The law calls for local governments to establish water quality baselines, prepare total phosphorus pollution control plans, reduce pollutant discharge through investments in wastewater treatment facilities and piped networks, and control agricultural NPS pollution, including through the promotion of organic fertilizers and control of agricultural plastic film. The law also calls on governments to protect and restore ecological function and biodiversity (including through ecological flows) and improve systems for information sharing and inter-jurisdictional coordination. The law is an element of the Government's national strategy for the Yangtze River Economic Belt, which was articulated in the 'YREB Development Plan' developed by the National Development and Reform Commission (NDRC) in 2016.

12. **The Yangtze River Protection Law represents the latest in a series of national-level reforms aimed at improving the management of natural resources and the coordination of water resources development.** Earlier reforms include an amendment to the National Water Law in 2016 to support integrated planning and coordinated basin development.[26] Water-related responsibilities were reorganized within Government in 2018, with water pollution control responsibilities transferred to the Ministry of Ecology and Environment (MEE), a new Ministry of Natural Resources (MNR) established, and responsibilities within the Ministry of Water Resources (MWR) consolidated. The Government established the River Chief System (RCS), a network of officials at the provincial, municipal, county, and township levels, who are assigned responsibility for outcomes along each section of every major waterway. The

[21] 2013–2018 Yangtze River Basin and Southwest Rivers Water Resources Bulletin and the 2020 Annual Report on Surface Water Quality for the Yangtze River Basin and Southwest Rivers.

[22] Eutrophication is a process in which a water body becomes enriched with nutrients (notably phosphorus and nitrogen), leading to rapid algal growth and consequent oxygen depletion and ecological degradation (including fish deaths). Eutrophication can leave water unfit for human consumption.

[23] Changjiang Water Resources Commission (CWRC) Draft Program Proposal (August 2021).

[24] The Yangtze River Protection Law of the People's Republic of China (March 2021) *(*link*).*

[25] The coordination mechanism has the responsibility of "coordinating, guiding and supervising Yangtze River protection work; coordinating and negotiating the management work between relevant State Council departments and provincial-level governments along the river; organizing and coordinating joint law enforcement; organizing the establishment and improvement of relevant standards, monitoring, risk early warning, assessment and evaluation, information sharing and other systems in the Yangtze River basin, and carrying out overall coordination of the operation of all systems."

[26] Clause 15 of the amended Water Law indicates that "planning for regions within the boundary of a river basin should follow [principles of] river basin planning, and sector planning should follow [principles of] integrated planning."

system evolved from efforts to solve water pollution issues in Lake Tai in 2007[27] and was implemented nationally in 2016. It raises the priority of water-related issues and has proven useful in addressing challenges of coordination and cooperation between responsible departments and regions. [28] Implementation of the RCS is supported through various mechanisms including River Chief Offices (RCOs), that usually sit within water agencies at the respective levels.[29] China now has over 1.2 million river chiefs with more than 460,000 in the Yangtze River Basin, providing opportunities to address information asymmetries, promote integrated basin management, and increase public participation in the decision-making process.[30]

13. **While these institutional reforms provide the foundation for integrated river basin management, the transition is challenged by overlapping institutional and jurisdictional mandates, among other factors.** The YREB Development Plan and Yangtze River Protection Law are relatively high-level instruments, and their measures require new regulations and operating procedures at multiple levels of government. More broadly, while the institutional reforms of 2018 signaled an important shift toward environmentally oriented water policies and clarified responsibilities, they also created challenges, such as the division of responsibilities in basin-level organizations between water quantity management (under the MWR), water quality management (under MEE), and ecosystem services (under MNR). China's river basin organizations do not have the administrative authority or the coordination mechanisms required to align provincial actions, build consensus with local government, or arbitrate in cases of dispute. Operating efficiency in some water-related infrastructure is low, and the knowledge base for integrated river basin management (for example, hydrology of pollution flows) requires further development. Key water-related data are still segregated across various platforms and agencies, and the availability of data and consistency over time and between different sources remain a challenge.[31] Data sharing within and between the RCS and the traditional basin management authorities is limited, and data collection protocols are not fully standardized.[32] Addressing these challenges requires an appropriate institutional framework, such as that envisaged by the National Yangtze River Basin Coordination Mechanism, the continued resolve of political leaders, and mechanisms that can facilitate inter-jurisdictional coordination and cross-sectoral cooperation.

2.2 The Government's YREB Program

[27] Li Y, J Tong, and L Wang. 2020. "Full Implementation of the River Chief System in China: Outcome and Weakness." *Sustainability* 12 (9): 3754. (link)

[28] The River and Lake Chief System is intended to strengthen enforcement and accountability regarding water use control, water quality protection, and restoration of degraded waterways. River chiefs at the village-level are required to patrol no less than once a week while also promoting river protection and mobilizing the community to assist in the removal of waste. See "Opinions on Full Implementation of the River Chief System across the Country" (2016) *(*link*).*

[29] The six complementary mechanisms supporting the river chiefs are (a) River Chief Meetings, (b) Information Sharing, (c) Information Reporting, (d) Supervision, (e) Accountability and Incentives, and (f) Completion and Acceptance.

[30] Wu, et al. 2020. "Public Participation of the River Chiefs System in China: Trends, Problems, and Perspectives." *Water* 12: 3496 (link).

[31] Hsu. A., et al. 2012. "Seeking Truth from Facts: The Challenge of Environmental Indicator Development in China." *Environmental Development* 3: 39–51.

Zhang, B., et al. 2021. "Big Data Challenges in Overcoming China's Water and Air Pollution: Relevant Data and Indicators." *SN Appl. Sci.* 3: 469 (link).

[32] Wang, Y., and X. Chen. 2021. "River Chief System as a Collaborative Water Governance Approach in China." *International Journal of Water Resources Development* 36 (4): 610–630 *(*link*).*

World Bank and DRC (Development and Reform Commission). 2018. *Watershed: A New Era of Water Governance in China - Synthesis Report*. World Bank, Washington, D.C.

14. **The Government's national program for the Yangtze River Economic Belt (YREB) is articulated by the YREB Development Plan.** The YREB Development Plan aims to prioritize ecological protection, river basin coordination, and integrated development across the YREB. Implementation of the YREB Development Plan is guided by the 'Action Plan for Yangtze River Protection and Restoration' (the Action Plan).[33] In addition, provincial-level subsidiary plans outline local actions and the expected results that contribute to the YREB Development Plan and Action Plan. These national-level and provincial-level plans are an integrated package that collectively define the Government program. The national-level plans provide the overarching vision and broadly defined actions, with the provincial subsidiary plans outlining more specific actions tailored to each province's circumstances. The Yangtze River Protection Law (see para. 10) provides important elements of the legal framework for the Government's program.

15. **The Government's program at the provincial level in Jiangxi is outlined in the '5-Rivers-1-Lake' Plan.**[34] Issued in March 2019, the 5-Rivers-1-Lake Plan covers the Poyang Lake Basin, defined by the lake and its five major tributaries,[35] which spans 94 percent of the province. The plan aims to "promote coordinated socio-economic development and sustainable resource management, safeguard the health of rivers and lakes, and ensure environmental protection while supporting a rich, beautiful, happy and modern Jiangxi." It outlines the basic principles, guidelines, and implementation arrangements for management and protection of Poyang Lake Basin, along with specific activities and targets within seven priority areas: (a) coordination for integrated management, (b) spatial management and shoreline protection, (c) water resources protection, (d) water pollution control including solid waste management, (e) water environment improvement, (f) rehabilitation of river and lake ecosystems, and (g) enhancement of river-and-lake management capacity. Implementation is supported by the Jiangxi River Basin Eco-Compensation Mechanism, which pools[36] a range of financing sources including earmarked funds from national, provincial, municipal, and county governments, as well as private sector contributions.

16. **The Government's program at the provincial level in Hunan is outlined in the 'Integrated Water and Environment Management Plan for Dongting Lake Basin'.**[37] Issued in December 2018, the plan covers Dongting Lake Basin, defined by the lake and its four major tributaries.[38] The basin area spans 97 percent of Hunan, along with small parts of Hubei Province. The objective of the plan is to ensure the safety of water supply and to significantly improve water and environmental quality. It outlines the basic principles, guidelines, and implementation arrangements for governance and protection and describes specific activities, expected results, and indicative targets. To support the Dongting Lake Basin Plan, Hunan issued an implementation plan[39] which includes the expectation that by 2025 (a) 95 percent of rivers and waterbodies will reach water quality of Grade III, and the level of total phosphorous will be reduced by 10

[33] Eight priorities are outlined in the Action Plan: (a) establishing an ecological and environmental control system and strictly implementing the ecological redlines (see para. 9); (b) investigating and managing sewerage outlets and promoting integrated land-water monitoring and management systems; (c) strengthening the control of industrial pollution and reducing environmental risks; (d) improving environment conditions in rural areas including control of agricultural non-point source pollution; (e) addressing gaps in environment-related infrastructure, and ensuring the security of drinking water sources; (f) strengthening pollution control from inland waterways transport, and preventing environmental risks at harbors and ports; (g) optimizing the allocation of water resources and ensuring ecological flow requirements; and (h) enhancing ecosystem protection. See MEE and NDRC. 2019. *Action Plan for the Uphill Battle for the Conservation and Restoration of the Yangtze River* (link).

[34] "5-Rivers-1-Lake" refers to the Gan, Fu, Xin, Rao, and Xiu Rivers that flow into Poyang Lake.

[35] The Gan, Fu, Xin, Rao, and Xiu Rivers are the major tributaries of Poyang Lake.

[36] The Jiangxi River Basin Eco-Compensation Mechanism is not a single provincial budget line and instead comprises a related set of budget lines (coherently monitored and implemented) that form a program. See Technical Assessment (Annex IV).

[37] NDRC. 2018. *Integrated Water and Environment Management Plan for Dongting Lake Basin* (link).

[38] The Yuan, Xiang, Zi, and Li Rivers are the major tributaries of Dongting Lake.

[39] Hunan Province. 2019. *Implementation Plan for the Dongting Lake Integrated Water Environment Management Plan in Hunan Province (2018–2025)* (link).

percent relative to 2018; (b) the utilization rate of animal manure will remain at least 75 percent, and fertilizer consumption will remain at zero growth relative to 2020; (c) the coverage rate of rural wastewater treatment facilities will reach 90 percent, and the coverage rate of rural solid waste collection and treatment will reach 100 percent; and (d) the area of wetland restoration will reach 1 million mu (66,000 ha). As in the Jiangxi program, the Hunan program pools a range of financing sources including earmarked funds from national, provincial, municipal, and county governments, as well as private sector contributions.

2.3 The World Bank Financed Program

17. **The PforR will support a subset of activities from the Government's national program for the YREB as implemented through the sub-national provincial YREB programs in Jiangxi and Hunan Provinces.** Activities supported by PforR financing contribute to ecological protection and water pollution reduction goals contained in the provincial plans (see paras. 15 and 16), that themselves contribute to the overarching YREB Development Plan (see para. 2.2) (Figure 1). The timeline for the PforR is 2022 to 2026, with 2021 being the baseline year against which outcomes are measured. Provinces are responsible for repayment of the PforR financing under the Government system.

18. **The Program has a layered geographic scope reflecting the tiered governance structure of the YREB national program.** The YREB covers nine provinces and two municipalities[40] from the 19 provinces and autonomous regions that fall within the Yangtze River Basin. The results areas, indicators, outputs, and outcomes are consistent across the two target provinces, Hunan and Jiangxi. The geographic scope of the Program differs by activity—with basin-, province-, sub-basin-, and county-level activities reflecting the differentiated responsibilities of government and nature of the activity.

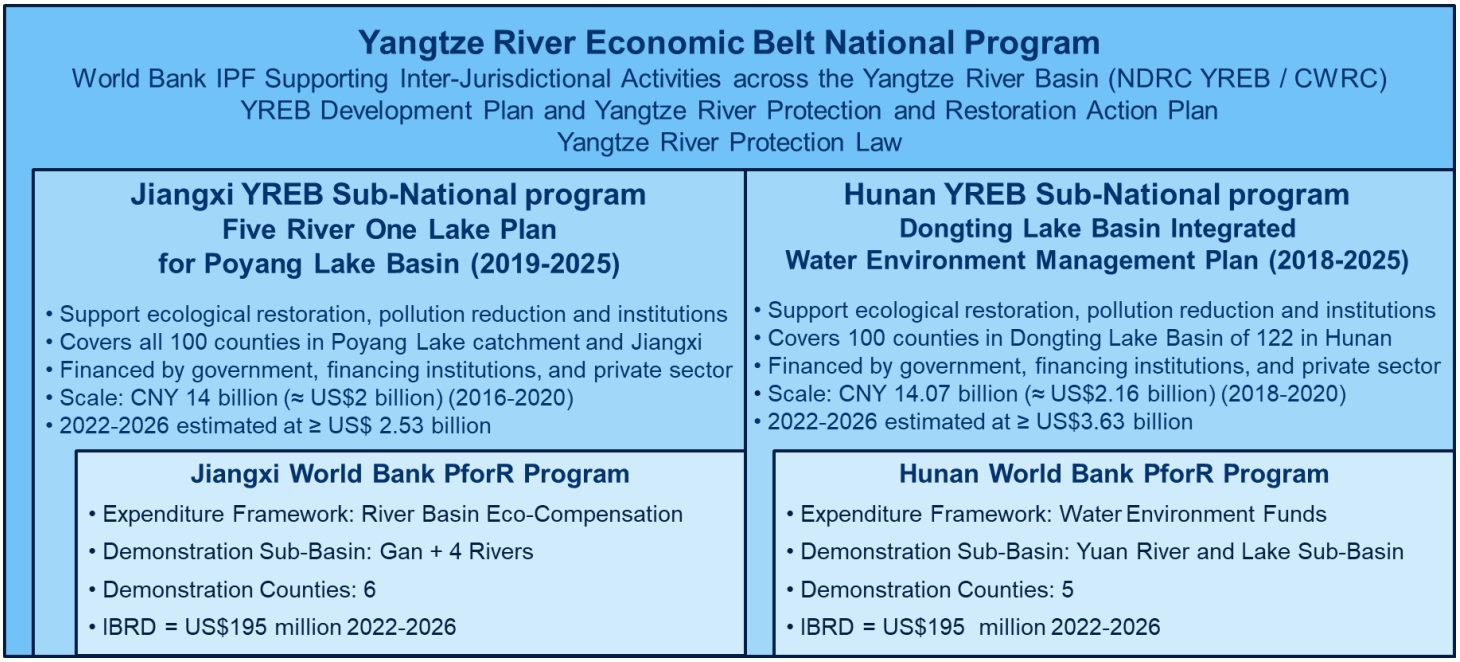
- **The Program's geographic focus within Jiangxi Province is the Poyang Lake Basin.** The lake basin covers 94 percent of the province and 90 out of 100 of the province's counties. Within this area, the PforR will focus select activities within three results areas. Results Area 1 supports activities at the provincial level aimed at institutional improvements. Results Area 2 supports ecological protection and climate resilience in the Gan River sub-basin, which has a length of 766 km and a catchment area of 83,500 km^2 covering 51 percent of the province, making it the largest river in Jiangxi Province and the fourth largest tributary of the Yangtze River in terms of annual runoff. The sub-basin includes 44 counties in Jiangxi Province, including more than 10 counties that were designated national-level poverty counties before 2021. Results Area 3 supports activities to reduced water pollution and transmission of plastic waste in the PforR related counties, including the demonstration counties of Dayu county, Chongyi county, Yudu county, and Yongfeng county of Ji'an municipality; Yugan county of Shangrao municipality; and Fuliang county of Jingdezhen municipality.[41]
- **The Program's geographic focus within Hunan Province is the Dongting Lake Basin.** The lake basin covers 97 percent of the province, 100 of the province's counties along with parts of Guangxi, Guizhou, Chongqing, and Hubei. The total catchment area is 262,000 km^2, accounting for 14 percent of the Yangtze River Basin. and includes four major tributaries. Within this area, the PforR will focus select activities within three results areas. Results Area 1 supports activities at the provincial level aimed at institutional improvements. Results Area 2 supports ecological protection and climate resilience in the Yuan River sub-basin, the second largest river in Hunan Province with a length of

[40] Yunnan, Sichuan, Chongqing, Guizhou, Hubei, Hunan, Jiangxi, Anhui, Jiangsu, Zhejiang, and Shanghai.

[41] Demonstration counties were selected based on a number of factors, including but not limited to: (a) a river chief system in place and either an existing management information platform or willingness to connect to the provincial river chief platform; (b) a long-term water environment protection plan or an equivalent plan under preparation; (c) plans to take innovative measures to ensure sustainability of program investments; and, (d) preference given to counties in the demonstration sub-basin.

1,033 km and a catchment area of 89,163 km^2 covering 24 percent of the province. Results Area 3 supports activities to reduced water pollution and transmission of plastic waste in the PforR related counties, including the demonstration districts and counties of Wancheng district of Changsha municipality, Miluo county-level city of Yueyang municipality, Ziyang district of Yiyang municipality, Shimen county of Changde municipality, and Yuanling county of Huaihua municipality.

Figure 1. Relationship between the Proposed PforR Program and the Multilevel Government Program Comprising National and Provincial Plans



19. **In addition to the PforR financing of provincial-level activities, the Program includes a Central Basin IPF to support basin-level activities aligned with the Government's national program for the YREB (with the central government as the borrower for the IPF).** The Central Basin IPF will finance US$7.5 million in TA.[42] The supported activities will promote cross-sectoral coordination and inter-jurisdictional cooperation toward improved water quality, ecological protection, and climate resilience in the Yangtze River Basin. The Central Basin IPF will be led by the Changjiang Water Resources Commission (CWRC), the basin management authority for the Yangtze River under the Ministry of Water Resources (MWR). Activities under the Central Basin IPF are detailed in annex 7 and summarized below:

(a) **Operationalization of basin-level coordination mechanisms:** This comprises operationalization of a basin-level RCS coordination mechanism (a forum for decision-making, coordination, and learning), based on a design for such a mechanism completed by the CWRC with World Bank support in 2021,[43]

[42] The final loan size is subject to confirmation by the Ministry of Finance (MoF). This is based on further detailed technical review by the Budget Division in the MoF which takes at least two weeks from receipt of the revised proposal, expected to be resubmitted in early September. The NDRC (supported by the CWRC) has prepared a proposal for US$27 million. The Project Appraisal Document (PAD) is based on US$10 million as a low-cost scenario, with an intermediate scenario of US$20 million also prepared. The activities are designed to be scaled, either geographically, temporally, or through a reduced set of prioritized activities.

[43] Working rules for this mechanism were drafted in 2021 with World Bank financing under the China Economic Transformation and Institutional Capacity Building Project (P144270).

including a basin RCS platform to promote the sharing of information. This includes technical protocols for the collection and sharing of data and capacity building for use of the platform that will be connected with provincial platforms supported under the PforR.

(b) **Research on ecological protection and restoration of lakes and tributary systems:** This comprises research inputs for policies, management mechanisms, and guidelines for freshwater ecosystem restoration and protection. Research will support river health guidelines to inform evaluation of riverine ecology, guidelines for determining appropriate ecological flows, and mechanisms for protection and restoration of the aquatic ecosystems of Poyang Lake, Dongting Lake, and important tributaries.

(c) **Investigation and tracing of water pollution sources:** This comprises research inputs for policies, management mechanisms, and guidelines for persistent pollutants, focused on phosphorus. This includes identification of major phosphorus sources, transportation of phosphorus in the Yangtze River system, and the impact of climate change (extreme weather) on phosphorus pollution and proposing of policy options for prevention and control (including under climate extremes).

(d) **Research on 'value realization mechanisms' (ecological incentives):** This comprises research on the economic value of ecosystem services in the Yangtze River Basin, methods for integrating ecological data into statistical accounts, and the design of incentive mechanisms for ecosystem and water quality protection (such as eco-compensation and pollution discharge fees).

(e) **Capacity building and program support:** Activities to support technical capacity, including training and knowledge exchanges (including international exchanges focused on Basin coordination mechanisms), and program implementation support (including compilation of provincial-level Program activities and results).

Figure 2. Overview of the Government Program and PforR Program, with Results Areas and Activities by Geographic Unit

		Results Area 1: Improving Institutions and Innovations	Results Area 2: Advancing Ecological Protection through Integrated River Basin Management	Results Area 3: Reduced Water Pollution and Transmission of Plastic Waste
Government Program	National	National Program for the Yangtze River Economic Belt (YREB) Covers nine provinces and two municipalities		
	Jiangxi	*5-Rivers-1-Lake Plan (2019–2025)* Covers 94 percent of the province and 90 of the 100 counties		
	Hunan	*Integrated Water Environment Management Plan for Dongting Lake Basin (2018–2025)* Covers 97 percent of the province and 100 of 122 counties		
PforR Program	Geographic boundary	**Provinces** Jiangxi Province Hunan Province	**Demonstration Sub-Basins** Gan River in Jiangxi Province Yuan River in Hunan Province	**Demonstration Counties** 6 counties in Jiangxi Province 5 counties in Hunan Province
	Program Activities	(1) Integration of county, municipal, provincial, and basin RCS information platforms (2) Development of water environment management regulations and guidelines (river health, ecological flows) (3) Development of plastic waste management policy (4) Development of monitoring and evaluation protocol for agricultural plastic mulch collection and recycling (5) Development and dissemination of public engagement manuals for the RCS (6) Public pollution awareness campaigns	(1) Development of integrated water environment management systems (2) Development of river health assessment guidelines (3) Implementation of water allocation scheme (4) Determination of ecological flow requirements and supervision	(1) Improved integrated wastewater management services (2) Prevention of plastics entering waterbodies through collection and recycling of agricultural plastic waste (3) Management and utilization of livestock/poultry manure

20. **The Program's results areas support a nested hierarchy of activities, at provincial, sub-basin, and county levels.** As described above, these PforR results areas are aligned with the basin-level activities under the Central Basin IPF that supports enhanced coordination mechanisms, policy inputs for technical guidelines and standards relating to ecological protection, research and studies into key water pollutants, improved data compilation and management, and capacity building. The PforR results areas are the following:

- **Results Area 1: Improving Institutions and Innovations (provincial level).** This results area will support institutional improvements for inter-jurisdictional cooperation and cross-sectoral coordination in Hunan and Jiangxi. Activities under Results Area 1 include

  (a) Strengthening of River Chief System coordination via integration of county and municipal, provincial, and basin-level RCS information platforms;

  (b) Development of provincial level policies, regulations and guidelines on integrated water environment, ecological protection and plastic waste management; and

  (c) Public engagement in water management, through pollution awareness campaigns, participatory management and river cleanup activities, development and dissemination of public engagement manuals for the river chief system.

  Activities supported by Results Area 1 will be implemented by the Provincial Development and Reform Commission (PDRC) as the coordinating counterpart, with the Provincial Department of Finance (PDF), Department of Water Resources (DWR), Department of Ecology and Environment (DEE), and Department of Agricultural and Rural Affairs (DARA) in each province. The supported activities are expected to provide institutional coordination and the policy foundation for environmental and water management outcomes and increased resilience via healthier river and lake ecosystems, across the two provinces. The Central Basin IPF will support basin-level activities that (while financed separately from the PforR supported activities) are aligned with the goals of Results Area 1 (research and policy support aims to inform and harmonize provincial-level guidelines, regulations, and policies) and provide capacity building and knowledge exchange activities that will support the provinces in their implementation of Results Area 1.

- **Results Area 2: Advancing Ecological Protection through Integrated River Basin Management (sub-basin level).** This results area will support ecological protection and climate resilience of river and lake ecosystems in the demonstration sub-basins of Gan River Basin (Jiangxi) and Yuan River Basin (Hunan). Activities under Results Area 2 include

  (a) Strengthening of integrated water environment management systems, including development of water environment management plans for the sub-basins;

  (b) Development of river health assessment and ecological flow guidelines based on national standards;

  (c) Implementation of water allocation schemes for the sub-basins based on national standards; and

  (d) Determination of ecological flow requirements and incorporation into county water allocations to ensure long-term restoration and protection of the ecosystem services.

  Activities supported by Results Area 2 will be implemented by the PDRC as the coordinating counterpart, with the DWR and DEE. Activities are at the provincial (and lower) level and are supported by the PforR. Activities will contribute to improved ecological conditions and climate resilience[44] through improved water management. Activities are aligned with the Central Basin IPF, which will contribute to basin-wide guidelines to inform and harmonize sub-basin-level guidelines (such as those on ecological flows), regulations and policies and to capacity building. The Central

[44] Activities supported under Results Area 3 are expected to enhance ecological resilience to climate change. Ecological flows maintain ecosystem function and provide habitat, expand thermal refugia by providing microclimates that buffer organisms from the impact of heat, and aid in building ecological resilience to extreme events such as floods and droughts.

Basin IPF also focuses on ecological research activities and resulting management recommendations in the Poyang Lake and Dongting Lake (key geographic areas under Results Area 2).

- **Results Area 3: Reduced Water Pollution and Transmission of Plastic Waste (county level).** This results area will support reduction of point- and non-point-source pollution in demonstration counties. This will contribute to the reduction of water pollution loads, including plastics, by improving the operation of township wastewater infrastructure, improving the management and utilization of livestock/poultry manure, and collecting and recycling plastic waste, in line with provincial policies in the demonstration counties. Activities under Results Area 3 include

  (a) Improved integrated wastewater management services and collection systems at township level;

  (b) Prevention of plastics entering waterbodies through collection and recycling of agricultural (plastic) mulch; and

  (c) Reduced nutrient runoff via improved management and utilization of livestock/poultry manure.

  Results Area 3 will be implemented by the DARA and DHURD, and respective equivalents in demonstration counties. In addition to local benefits of reduced water pollution loads, activities supported by Results Area 3 are expected to contribute to reduced GHG emissions (methane) associated with polluted water bodies (see the technical assessment summary for GHG emissions calculations).[45] Activities will again be supported by the Central Basin IPF through knowledge exchange activities on water and environmental management and its contribution to basin-wide guidelines that will inform county-level activities.

21. **Program financing.** Total Program financing over 2022-2026 is expected to be US$6,526 million, of which an expected US$6,126 million (93.87 percent) will be financed by the Government and US$400 million (6.13 percent) by IBRD loan (Table 1). Of the US$6,126 million government financing, it is estimated that US$2,519 million will come from Jiangxi Province and US$3,607 million will come from Hunan Province. The IBRD loan will comprise US$392.5 million as part of the PforR in support to the two sub-national provincial programs, with US$196.25 million for each province, and US$7.5 million for the Central Basin IPF. The proposed PforR will exclude activities with potentially adverse impacts that are sensitive, diverse, or unprecedented 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, information technology and non-consulting services estimated to cost US$50 million equivalent or more per contract; or (c) consulting services for firms estimated to cost US$20 million equivalent or more per contract.

Table 1. Program Financing (2022–2026)

Source	Central (IPF)		Jiangxi (PforR)		Hunan (PforR)		Total	
	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total
Government	0	0	2,519	92.77	3,607	94.84	6,126	93.87
IBRD	7.5	100	196.25	7.23	196.25	5.16	400	6.13

[45] Downing, J. A., et al. 2021. "Protecting Local Water Quality Has Global Benefits." *Nature Communications* 12: 2709 (link).

Total program financing	**7.5**	**0.12**	**2,715.25**	**41.60**	**3,803.25**	**58.28**	**6,526**	**100**

3 PROGRAM RESULTS FRAMEWORK AND MONITORING & EVALUATION

3.1 Program Development Objective

22. **The Program Development Objective (PDO) is *to improve institutional coordination, enhance ecological protection and reduce water pollution loads in select regions of the Yangtze River Basin*.** The PforR contributes to the achievement of the Government's national strategy for the ecological protection and water pollution control in the Yangtze River through: (i) basin level coordination, policy development, and capacity-building; (ii) provincial level development of policies, regulations and guidelines; (iii) sub-basin level ecological protection and integrated water management through implementation of policy measures, regulations and guidelines; and (iii) county level investments aimed at reducing water pollution, including plastics.

23. **PDO-level indicators:**

- **PDO#1: Strengthened river chief system for institutional coordination:** indicated by the number of county- and municipal-level information platforms connected to provincial-level platforms, plus the number of provincial-level platforms connected to the basin-level platform (for integrated data sharing from local to basin scale).
- **PDO#2: Improved integrated water environment management system for the demonstration sub-basins:** indicated by the number of defined water environment management actions undertaken at sub-basin level, including (a) approval of sub-basin water environment protection plans for the two sub-basins; (b) enhancement of inter-jurisdictional coordination (that is, inter-provincial river chief cooperation agreement for Hunan and a water environment information sharing platform for Jiangxi), and (c) compliance of ecological flows (meeting defined flow targets) on the mainstream and major tributaries, in each of the two demonstration sub-basins.
- **PDO#3: Annual targets for key pollutant reduction met:** indicated by the number[46] of key pollutant reduction targets met (yes/no) by the demonstration counties. The pollution reduction targets refer to (a) reductions in chemical oxygen demand (COD)[47] (quality difference between inflow and outflow) at township wastewater treamtent plants, (b) the weight (tons) of agricultural plastic film collected, and (c) livestock/poulty manure utilization rates (i.e. treatment and use of manure for biogass and organic fertilizer), (d) establishment of integrated wastewater service systems agreements, and (e) establishment of wastewater management strategies.

24. Data for indicators are collected at the country and/or provincial level, using consistent definitions and measurement, and are aggregated for reporting.

3.2 Theory of Change

25. **The Program contributes to a long-term vision of an economically productive and ecologically sustainable Yangtze River Basin (Figure 3).** The core challenges to this vision include insufficient coordination of ecological and water management actions across jurisdictions and sectors; a need for

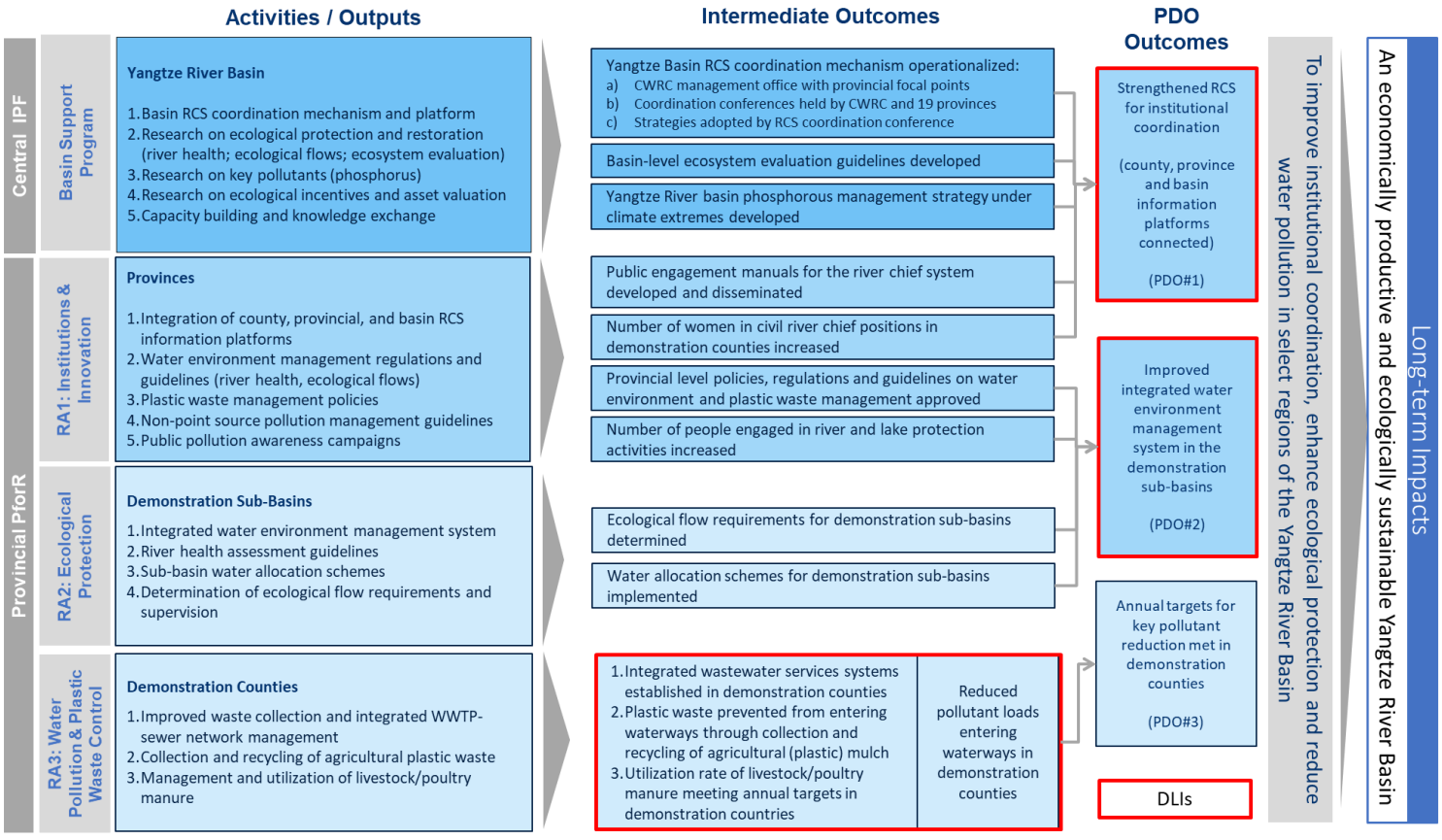
[46] There are three pollutant reduction targets for each of the two provinces each year for the period 2022–2026.

[47] Chemical oxygen demand (COD) is a measure of water and wastewater quality, with greater oxygen demand associated with greater water contamination. A COD test is often used as a measure of WWTP efficiency.

provincial level guidelines, regulations, and policies to operationalize the new Yangtze River Law; inefficient wastewater treatment; deficiencies in the management of NPS pollution, including farm manure and agricultural plastics; and a need for greater technical understanding (and data sharing) on key issues of pollution and ecological management. The Program will support interventions that address these challenges on four levels: (a) basin-level coordination, technical guidance, and capacity building; (b) provincial-level development of policies, regulations, and guidelines; (c) sub-basin-level ecological protection and integrated water management; and (d) county-level activities to reduce plastics and nutrient pollution. The expected results are captured in the three outcomes linked to the Program Development Objective (PDO)—on institutional strengthening, ecological management, and water pollution reduction—and reflect the Program's contribution to the Government's program as articulated collectively by the YREB Development Plan, Action Plan, and provincial subsidiary plans.

26. **Key assumptions required for the Program's success are that:** (a) cross-sectoral and inter-jurisdiction cooperation at the national, provincial, and local levels will work effectively both for implementation of program activities (e.g. information and data sharing) and monitoring and evaluation of program results; (b) the basin RCS platform is established on schedule to facilitate connection of the provincial platforms; (c) provincial policies developed and approved under the Program are enforced and not contradicted by county- or municipality-level actions, (d) improved treatment, management and reuse of on-farm manure leads to reduced nutrient runoff, (e) there are no major external changes to pollutant loads that overwhelm the Program's contribution to key pollutant reduction targets, and (f) improved RCS information platforms inform river chief actions.

Figure 3. Theory of Change for the Yangtze River Protection and Ecological Restoration Program



Note: DLI = Disbursement-linked indicator; RA = Results area; WWTP = Wastewater treatment plant.

3.3 Disbursement Linked Indicators and Verification Protocols

27. **The Program's DLIs quantify the parameters and values that need to be achieved to trigger disbursements (Table 2).** Each province is responsible for measuring achievement of DLIs within a consistent framework allowing for aggregation and reporting at the Program level. DLIs that were chosen (a) represent improvements in key aspects of the Government program and the key priorities in each results area, (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.

28. **Verification will be carried out by an independent third party based on data collected by the provincial and county agencies.** At the county level, inspection will be conducted by the county Program Management Office (PMO) on behalf of the county government; at the province level, sample inspections will be conducted by the Provincial PMO (PPMO) on behalf of the Provincial Government. County-level inspections will cover county-level Program activities; provincial-level inspections will randomly select a percentage (differing by activity) of the reported accomplishments in the demonstration counties. Third-party verification agencies will be contracted by the PPMOs using a consistent and agreed verification protocol. The World Bank will review and provide feedback on the terms of reference (TOR) for the verification agent, with the final agreement subject to confirmation of acceptability by the World Bank. The Program verification procedures and implementation arrangements are to be detailed in an M&E plan for the Program.

Table 2. Overview and Rationale for **Disbursement Linked Indicators.**

Disbursement Linked Indicator	Rationale for Selection
Results Area 1: Improving Institutions and Innovations	
DLI 1: Strengthened River Chief System for institutional coordination	➢ The purpose of this DLI is to improve the effectiveness of the RCS as a mechanism for cross-sector coordination and inter-jurisdiction cooperation through information sharing. It supports the connection of county and municipality river chief information platforms to the provincial information platform and connection of the provincial platforms to the basin platform.
Results Area 2: Advancing Ecological Protection through Integrated River Basin Management	
DLI 2: Improved integrated water environment management system in the demonstration sub-basins	➢ The purpose of this DLI is to improve environmental water management. It supports approval of water environment protection plans for the demonstration sub-basins, enhancement of inter-jurisdictional coordination, and monitoring compliance of ecological flows on the mainstream and major tributaries, in each of the two demonstration sub-basins.
Results Area 3: Reduced Water Pollution and Transmission of Plastic Waste	
DLI 3: Reduced pollutant loads entering waterways in demonstration counties	➢ The purpose of this DLI is to improve systems for wastewater services and to reduce plastic and NPS pollution in waterways. It supports the establishment of integrated wastewater systems, the collection of agricultural plastic waste, and the increased utilization of livestock and poultry manure.

29. **DLI 1: Strengthened River Chief System for institutional coordination.** DLI 1 is defined as the number of counties and municipalities that have connected their river chief information platform to the provincial river chief information platform and the number of provinces that have connected their provincial platform to the basin river chief information platform.

- **Verification:** Information on the number and connection status of river chief platforms will be collected by the provincial River Chief Offices, and verified through the independent verification agency.

30. **DLI 2: Improved integrated water environment management system in the demonstration sub-basins.** DLI 2 is a composite index with a series of discrete actions with recurrent compliance monitoring, including (a) approval of water environment protection plans for the demonstration sub-basins (Gan River in Jiangxi and Yuan River in Hunan); (b) establishment of a water environment information platform (Jiangxi) or a cross-provincial river chief cooperation mechanism (Hunan with Guizhou); and (c) implementation of ecological flows (meeting defined flow targets) on the mainstream and major tributaries, in each of the two demonstration sub-basins.

- **Verification:** Public disclosure of the integrated water environment management plans will be required for verification, along with publication of ecological flow monitoring bulletins. This information, plus the status of the information platform (in Jiangxi supporting data sharing and decision making) and cooperation mechanism (in Hunan as recorded in meeting minutes), will be collected by the DEE and the River Chief Office in the two provinces, and verified through the independent verification agency.

31. **DLI 3: Reduced pollutants entering waterways in demonstration counties.** DLI 3 includes three sub-DLIs that are aimed at reducing plastic and point and non-point source pollution in waterways:

- **DLI 3.1 (wastewater)** is defined by the number of demonstration counties with integrated wastewater systems established and meeting requirements of (a) a consolidated operator (one entity responsible for the sewer network and plant) to encourage integrated and efficient maintenance and operations, (b) a reduction of chemical oxygen demand (COD) by at least 10 percent during project implementation at WWTPs due to efficient utilization of plant capacity, and (c) integrated planning (a county-level strategic plan is in place for sustainable township wastewater services).

Verification: Confirmation of integrated wastewater systems is based on (a) utility records of operations and maintenance (O&M) arrangements for wastewater systems, (b) public disclosure of the integrated wastewater management plans, and (c) a 10 percent reduction in COD at WWTPs over its baseline during the project implementation period. Information will be collected by the Provincial DHURD and verified through the verification agency.

- **DLI 3.2 (plastics)** is defined by the quantity of agricultural plastic film (mulch) recovered through plastic collection and recycling services. Plastic film is a major contributor to waterborne plastics pollution.

Verification: DARA will report on agricultural plastic film collected and recycled within the demonstration counties. Reported quantities will be verified based on random sampling by the independent verification agencies.

- **DLI 3.3 (manure)** is defined by the rate of utilization of livestock and poultry manure from large-scale[48] farms in the demonstration counties. Unutilized and improperly managed manure is a source of NPS water pollution. Utilization of manure includes generation of biomass energy and use as organic fertilizer on fields (a partial substitute for synthetic fertilizer).

Verification: Regular data on the quantities of livestock and poultry waste produced and utilized are reported in the direct reporting system of the Ministry of Agriculture and Rural Affairs (MARA). Reported quantities will be verified based on random sampling by the independent verification agencies.

[48] A large-scale animal farm is defined as 500 or more head of pigs, 2,000 or more egg chickens, 10,000 or more meat chicken, or 30 or more head of cattle.

4 PROGRAM EXPENDITURE FRAMEWORK

4.1 Description and assessment

32. **The Expenditure Framework Assessment (EFA) was conducted based on information provided by Jiangxi and Hunan Governments.** The EFA defines the Program boundary in terms of budget expenditure, and reviews the fiscal context, government budget reporting and expenditure efficiency, and financial sustainability. The EFA is prepared based on the Bank Guidance on PforR Financing Technical Assessment effective July 26, 2019.

33. **Total Program financing over 2022-2026 is expected to be US$6,526 million.**[49] Of this, an expected US$6,126 million (93.87 percent) will be financed by the Government and US$400 million (6.13 percent) by IBRD loan (Table 3). Of the US$6,126 million government financing, it is estimated that US$2,519 million will come from Jiangxi Province and US$3,607 million will come from Hunan Province. The IBRD loan will comprise US$392.5 million as part of the PforR in support to the two sub-national provincial programs, with US$196.25 million for each province, and US$7.5 million for the Central Basin IPF.

Table 3. Program Financing (2022–2026)

Source	Central (IPF)		Jiangxi (PforR)		Hunan (PforR)		Total	
	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total
Government	0	0	2,519[50]	92.77	3,607[51]	94.84	6,126	93.87
IBRD	7.5	100	196.25	7.23	196.25	5.16	400	6.13
Total program financing	**7.5**	**0.12**	**2,715.25**	**41.60**	**3,803.25**	**58.28**	**6,526**	**100**

4.1.1 Fiscal Context

34. **China is one of the most fiscally decentralized countries in the world, with responsibilities for providing most public services held by sub-national governments (SNGs).** As of 2019, SNGs accounted for about 85.30 percent of total public expenditure. Tax rates for major taxes are set centrally with revenues shared between different levels of governments. Significant shares of revenues are transferred from the central government to the provinces, and from provinces to lower-level governments, both as earmarked and general-purpose grants. These transfers are generally adequate to cover the gap between revenues and recurrent expenditures at the subnational level.

[49] The exchange rate is US$1 for CNY 6.5.

[50] See Table 5 below.

[51] See Table 10 below.

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

36. **During the 13th Five Year Plan period, the central government's fiscal relationship with provinces has evolved.** One of the major changes was the delineation of the expenditure responsibility between levels of government, which aimed to clarify mandates and accountability for SNGs. In principle, provision of basic public services, or other public services involving cross-region benefits, shall be classified as a shared functionality; provision of public services where benefits are more confined to local residents shall be classified as a local functionality.

37. **This delineation has implications for water pollution control and ecological protection.** According to 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, issued May 2020), national level ecological environment planning, policy and law making, implementation monitoring, management, law enforcement and capacity building has been classified as central functionality; prevention and control of water pollution in key basins such as the Yangtze River and Yellow River has been classified as shared functionality; local level ecological environment planning, policy and law making, implementation monitoring, management, law enforcement and capacity building, as well as the prevention and control of soil pollution, agricultural and rural pollution, solid waste pollution, chemical pollution, groundwater pollution and other local air and water pollution, has been classified as local functionality (Table 4).

Table 4: Assignment of Expenditure Responsibilities for Ecology and Environmental Protection.

Function and Expenditure Responsibility		Responsible authority
Ecological environment planning	The formulation of national ecological environment planning, cross regional ecological environment planning, key river basin and sea area ecological environment planning.	central
	The formulation of local eco-environmental planning.	provincial
Ecological environment monitoring and law enforcement	Construction, operation and maintenance of the national ecological environment monitoring network, inspection and supervision on the implementation of ecological environment laws and regulations and related policies; national ecological environment law enforcement inspection and supervision.	central
	local ecological environment monitoring, law enforcement inspection and supervision.	provincial
Ecological environment management affairs and capacity building	The environmental impact assessment and supervision of planning and construction projects in the charge of relevant departments of the State Council, the evaluation and assessment of ecological civilization construction goals such as national key pollutant emission reduction and environmental quality improvement, the setting and management of national river and sea sewage outlets, and the unified supervision of national pollutant emission control license system, paid use and trading of emission rights, and carbon emission trading management, etc.	central

	The environmental impact assessment management of local planning and construction projects and the supervision during and after the event; the evaluation and assessment of local key pollutant emission reduction, environmental quality improvement and other ecological civilization construction objectives; the local supervision and management of pollutant emission control permission system etc.	provincial
Prevention and control of environmental pollution	The prevention and control of cross-border water pollution	central
	The prevention and control of radioactive pollution, the prevention and control of air pollution in key areas with greater impact, and the prevention and control of water pollution in key basins such as the Yangtze River and Yellow River, key sea areas and key areas with greater impact.	Central /provincial
	The prevention and control of soil pollution, agricultural and rural pollution, solid waste pollution, chemical pollution, groundwater pollution and other local air and water pollution.	provincial
Other matters in the field of ecological environment	The research and formulation of laws and regulations, national policies, standards and technical specifications in the field of ecology and environment.	central
	The research and formulation of local laws and regulations, local policies, standards and technical specifications in the field of ecology and environment.	provincial

38. **Fiscal transfers are made vertically from one level of government to the next subordinate level.** The national government makes transfers to provincial governments, provincial government to municipal or county government and so on. All such fiscal transfers are conducted between the finance departments of the respective government levels, after which funding is distributed from finance to the individual departments of the respective level of government. As a result, the financial departments are important gatekeepers for funding flows.

39. **So far, Hunan and Jiangxi have not delineated functions and expenditure responsibility between the provincial government and counties regarding ecology and environment protection.** However, following the principles set by central government through Guo Ban Fa[2020] No.13, the Program activities for RA1 and RA2 will be financed by the provincial government with support of the central government, and the Program activities for RA3 will be financed mainly by county governments with the support of the provincial government.

40. **In Jiangxi and Hunan, the central and provincial transfers play a key role for financing the RA1 and RA2 Program activities.** As for RA3, county governments shall mainly rely on its own-source budget funding, supplemented by upper-level government transfers and private sector contributions. However, as the PforR Program will cover only part of the county governments' activities on water pollution reduction, plastic waste prevention, etc., and the upper-level transfers do provide financial support to these activities, the Program boundary does not include all funding for RA3 type activities, but keeps relevant central and provincial transfers as the boundary.

41. **Eco-compensation[52] is one important means for such transfers between levels of government.[53]** In 2018, the Ministry of Finance issued the Guiding Opinions on Establishing Eco-Compensation and Long-Term Protection Mechanism in the YREB which outlined four tasks for central government to (1) emphasize ecological protection in general fiscal transfers; (2) increase national key ecological zone transfers to the YREB provinces; (3) implement the "YREB Ecological Protection and Rewards Policy" in 2018, which committed CNY 18 billion from 2017 to 2020 to incentivize the establishment of horizontal eco-compensation schemes in the YREB, including intra provincial and inter-provincial schemes; and (4) increase various special funding in the YREB, including for reforestation, among others.

42. **Eco-compensation transfers under the National Key Ecological Zones Program (NKEZP) have increased significantly in the Yangtze River Economic Belt from 2018.** The NKEZP program is one of the largest ecological fiscal transfers in China and aims to support local governments in complying with the National Key Ecological Function Zones Spatial Plan, which designates development restrictions in certain local regions of ecological importance. Transfers under the NKEZP to the 11 provinces in the YREB increased from CNY 23.99 billion in 2017 to CNY 32.51 billion in 2020.

4.2 Program Expenditure Boundary

4.2.1 Hunan Provincial Program

43. **In Hunan, the major Program activities are covered by the 'Integrated Water Environment Management Plan for Dongting Lake Basin' (2018–2025).** The Plans covers the entire Dongting Lake Basin. From 2018 to 2020, roughly CNY 14 billion (US$2.16 billion) was allocated from the central and provincial governments for water environment management in the Dongting Lake Basin. The total funding increased significantly from CNY 4.3 billion in 2018 to CNY 4.9 billion in 2020, which is 15 percent higher than in 2018 (Table 5). The total program financing during the 2021 to 2025 Five Year Plan (FYP) period is estimated at CNY 23,446 million (US$3,607 million) based on the average financing for the three years from 2018 to 2020.

Table 5: Scale of Water Environmental Management Funds in Hunan Province (2018–2025)

	2018	2019	2020	2021–2025 (Estimated)
Total funding (CNY, millions)	4,300	4,807	4,961	23,446
% of total general public budget revenue	1.50	1.60	1.65	1.58
% of GDP	0.12	0.12	0.12	0.12

4.2.1.1 Source of funds

44. **These funds were sourced primarily from four programs**. The CNY 14 billion funding on water pollution reduction, plastic waste treatment or chemical fertilizer reduction in the Dongting Lake Basin was from primarily four programs listed below (Table 6). In terms of funding source by department, DARA

1. [52] Eco-compensation is a diverse set of tools for environmental management rooted in the use of fiscal transfers to reduce environmental externalities. Four of the more common types include: (1) vertical fiscal transfers between different levels of governments, from central to provincial and from provincial to municipalities/counties; (2) horizontal fiscal transfers between governments of the same level; (3) direct payments to individuals, e.g. farmers, and (4) market-based mechanisms, such as water trading and water pollution trading.

[53] World Bank (2021). Eco-compensation in China's evolving environmental governance regime: status, trends, and opportunities. World Bank, Washington, D.C. *(forthcoming).*

provides the largest proportion (49.34 percent), followed by DWR (37.70 percent) and DHURD (12.97 percent). The source of funds for the water environmental management in Hunan province is largely stable and guaranteed.

Table 6: Funding source for water environmental management in Hunan 2018 – 2020 (CNY million) by year

	Funding Source	2018			2019			2020		
		Total	Central	Provincial	Total	Central	Provincial	Total	Central	Provincial
1	Wastewater Treatment	516.91	259.79	257.12	708.29	435.81	272.48	598.78	486.41	112.37
2	Rural Environment Improvement (including rural waste and wastewater management)	1857.12	400	1457.12	1315.24	710.04	605.2	969.61	537.46	432.15
3	Water pollution control and reduction	1146.48	1009	137.48	1744.31	1597.21	147.1	2412.22	2232.22	180
4	Livestock and Poultry Breeding Pollution Management	779.09	747.99	31.1	1039.59	944.59	95	980.05	937.24	42.81
Total		**4299.6**	**2416.78**	**1882.82**	**4807.43**	**3687.65**	**1119.78**	**4960.66**	**4193.33**	**767.33**

Table 7: Funding source for water environmental management in Hunan 2018 – 2020 (CNY million) in total.

	Funding Source	Three-year (amount)			Three-year (share)		
		Total	Central	Provincial	Total	Central	Provincial
1	Wastewater Treatment (including sludge management)	2798.73	2629.82	168.91	38%	91%	9%
2	Rural Environment Improvement (including rural waste and wastewater management)	2303.18	411.71	1891.47	20%	94%	6%
3	Water pollution control and reduction	1838.79	1235.79	603	16%	18%	82%
4	Livestock and Poultry Breeding Pollution Management	1823.98	1182.01	641.97	13%	67%	33%
Total		**5303.01**	**4838.43**	**464.58**	**100%**	**73%**	**27%**

Note: funding source no. 2 combines two types of funds: rural environment (including toilet revolution) and rural environment (including rural wastewater)

4.2.1.2 Usage of funds

45. **The funding programs included in Table 6 are ear-marked funding programs**. These funds can only be used for their specified purposes. In Hunan, the majority of the funds were used to finance projects such as building of sewage treatment plants, building of water quality monitoring stations, renovating toilets and existing drains, etc., however, a share of the money was used for awards for water quality improvements.

46. **Notably, in 2019, Hunan began the trial of a river basin eco-compensation mechanism**. Part of the Wastewater Treatment Fund from the central government was allocated to finance this mechanism (see Table 8). Under this mechanism, counties that have concluded eco-compensation agreements with neighbouring counties and the upstream counties that successfully met the water quality standards can achieve awards.

Table 8: Funding of the river basin eco-compensation mechanism in Hunan (CNY million)

Year	Total Wastewater Treatment Fund	Funding for basin eco-compensation mechanism	Percent
2018	722	136.55	18.9
2019	966	250	25.9
2020	1041	140	13.4

Notes and source: In 2018, the mechanism was not established, but part of the Wastewater Treatment Fund was arranged as awards for water quality. Data source: Department of Finance of Hunan Province.

47. **The relevant expenditure is reflected by a series of budget lines** (Table 9). The World Bank PforR program will support only part of the activities covered by the government plan, and the scope of expenditure under a specific budget line is typically larger than that supported by the Bank Program. Meanwhile, major Program activities, namely, water pollution reduction, plastic waste collection and disposal, and treatment and use of manure fertilizer, are mostly financed by a few major ear-marked funding sources. These major funding sources are thus used as the Program expenditure boundary.

Table 9: Budget expenditure on water-environment management in Hunan 2018-2020 (CNY billion)

Code	**Expenditure**	**2018**	**2019**	**2020**	**2021-2025 (Estimated)**	**Percent**
2110302	Water pollution prevention and Treatment	2.94	4.20	4.48	19.37	47.73
2110401	Ecological protection	0.41	0.77	0.62	3.00	7.41
2110402	Rural environment management	1.72	2.39	1.87	9.97	24.58
2111101	Ecological and environment monitoring and information	0.13	0.53	0.26	1.53	3.99
2111102	Ecological and environmental supervision and law enforcement	0.03	0.02	0.02	0.12	0.28
2130205	Forest conservation and cultivation	1.21	0.96	0.72	4.82	11.84
2130212	Wetland protection	0.20	0.18	0.11	0.82	2.02
2130310	Water and soil conservation	0.20	0.21	0.17	0.97	2.38
Total		**6.83**	**9.27**	**8.24**	**40.57**	**100**

Notes and Source: The annual value of 2021 to 2025 is estimated as the average of 2018 to 2020. Data source: Department of Finance of Hunan Province.

4.2.2 Jiangxi Program

4.2.2.1 Introduction

48. **Jiangxi has been allocating budget funding to counties through a "River Basin Eco-Compensation Program" (RBECP) since 2016.** The RBECP covers all 100 counties in Jiangxi, including over 90 counties in the Poyang Lake Basin and several counties in the Dong River Basin.[54] The counties are required to use the allocated budget to support ecological protection, water environment improvement, forest protection and improvement, water resource protection, ecological poverty reduction and livelihood improvement. Each county is evaluated against four sets of indicators annually: (i) water quality improvement; (ii) forest and ecological conservation; (iii) water resource and water-environment integrated management； and (iv) the ecological importance of the county. The results of the annual evaluation of those indicators are used to determine the counties' available amounts for the subsequent year. The provincial program is managed by the Budget Division of the PFD, and the performance evaluation for the counties is conducted by the PDRC with support from five sector departments, including Environmental and Ecology, Water, Forestry, Agricultural and Rural Affairs, Housing and Urban-Rural Development. As the expenditures of the RBECP are well-aligned with the proposed Program Result Areas and constitute a major budget funding source, the Bank team defines the government expenditure boundary as the expenditures arranged through RBECP.

49. **From 2016 to 2020, about CNY 14 billion (US$2 billion) government expenditures has been arranged through RBECP.** This averages around US$400 million annually, of which, approximately US$14 billion is arranged from a major general transfer item from the central government, the National Key Ecological Zone Program (NKEZP), and the rest comes from provincial general budget and contributions of the counties. Given the priority of Yangtze River Revitalization on the policy agenda of various levels of government, it is estimated that total government expenditures on Program activities during 2021-2025 will continue to grow steadily.

50. **As shown in Table 10, many budget items are related to the Program's activities, but the budget items may also include some activities that do not fall within the Program's boundary.** Therefore, existing budget lines in the government budget accounting and reporting system can only provide approximate information on budget expenditures regarding the Program's activities.

Table 10: Budget expenditure on water-environment management in Jiangxi 2018-2020 (CNY billion)

Code	Expenditure	2018	2019	2020	2021-2025 (Estimated)	Percent of total
2110302	Water pollution prevention and Treatment	2.86	3.44	5.17	19.12	52.10
2110401	Ecological protection	0.38	0.61	0.49	2.48	6.75
2110402	Rural environment management	1.59	1.57	1.54	7.84	21.38
2111101	Ecological and environment monitoring and information	0.12	0.13	0.18	0.72	1.96
2111102	Ecological and environmental supervision and law enforcement	0.06	0.05	0.05	0.25	0.67

[54] While the five rivers flow northward into the Poyang Lake and then the Yangtze River, the Dong River, which occupies a small fraction of the southern part of Jiangxi, flows southward into the Pearl River Basin.

2130205	Forest conservation and cultivation	0.86	0.97	1.20	5.04	13.74
2130212	Wetland protection	0.03	0.05	0.06	0.25	0.67
2130310	Water and soil conservation	0.16	0.17	0.27	1.00	2.73
Total		**6.07**	**6.99**	**8.96**	**36.69**	**100**

Notes and source: The annual value of 2021 to 2015 is estimated as the average of 2018 to 2020. Data source: Department of Finance of Jiangxi Province

51. **In November 2015, Jiangxi Province issued the "River Basin Ecological Compensation Methods in Jiangxi Province (for Trial Implementation)" (The Methods).** The document pointed out that to speed up the establishment of ecological civilization pilot demonstration areas, an ecological compensation mechanism would be established for the river basins within the province. The scope of implementation mainly includes Poyang Lake and its five major tributaries of Gan, Fu, Xinjiang, Rao, and Xiu, as well as the Yangtze River section in Jiangxi and the Dong. Funds will be distributed to the counties (cities, districts), and will involve 100 counties (cities, districts) in the province. Table 11 shows the scale of River Basin Ecological Compensation Funds in Jiangxi Province from 2016 to 2020. The amounts have grown substantially from 2016 to 2018, and then largely stayed stable in 2019 and 2020, despite the negative impact of massive tax-cut and COVID-19 on the fiscal revenue. According to officials from Jiangxi Province Department of Finance, the slight decrease in 2019 is due to an environmental incident which made the central government cut the transfer from NKEZP. The RBECP funds will reach CNY 3275 million in 2021 and at least keep this level during the 14th FYP period. Therefore, the World Bank team projects that the RBECP funds in 2021 to 2025 will reach CNY 16,375 million, or US$ 2915 million (using an exchange rate of 6.5:1).

Table 11: Scale of River Basin. Ecological Compensation Funds in Jiangxi Province (2016-2025)

	2016	2017	2018	2019	2020	2021-2025 (Estimated)
Total Funding (CNY million)	2,091	2,690	3,125	3,118	3,125	16,375
% of total general public budget revenue	0.97	1.20	1.32	1.25	1.25	2.00
% of GDP	0.11	0.13	0.14	0.13	0.12	0.13

Source: Department of Finance of Jiangxi Province

4.2.2.2 Source of funds

52. **The River Basin Ecological Compensation Funds in Jiangxi Province have three major sources**. These are grants from central government, ear-marked funds from provincial government, and contributions from county/city governments. In 2016, grants from central government account for about 52.18 percent, ear-marked funds from provincial government account for 28.69 percent, and the funds raised by the counties/cities accounted for 19.13 percent of the total. From 2016 to 2020, among the sources of watershed ecological compensation funds, the funds allocated by the central government accounted for the highest proportion. Since 2017, funds from the central government accounted for more than 60 percent of the total funds. This shows that the source of funds for ecological compensation in the river basin in Jiangxi province is stable and relatively guaranteed (Figure 4).

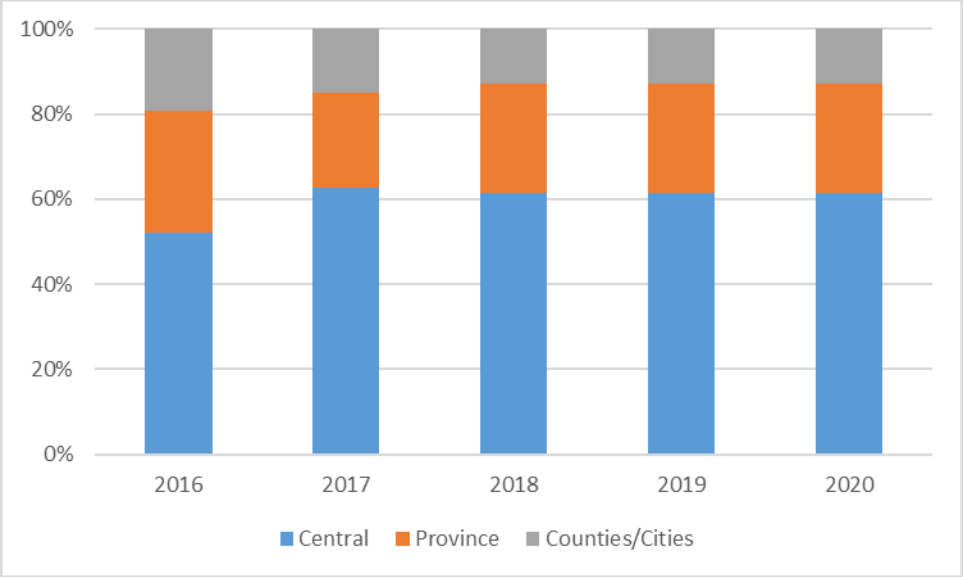


Figure 4: The source structure of RBECP funds in 2016-2020 (%)

53. **As of 2018, grants from central government were mainly from a general grant, the Key National Ecological Function Zone Program.** In 2019, funds from an ear-marked grant, the Pollution Reduction Rewards Program, were added to the pool.

4.2.2.3 Usage of funds

54. **Main uses of the funds:** According to the "Jiangxi Province River Basin Ecological Compensation Methods" issued in 2015 and amended in 2018, the RBECP funds should be mainly used for ecological protection, water environment management, forest quality improvement, forest resource protection, water conservation and protection, ecological poverty alleviation, and improvement of people's livelihoods.

55. **There is no program-based expenditure classification in China's budget management system.** As a result, the expenditures arranged from the RBECP funds cannot be tracked precisely. At present, the use of the RBECP funds can only be assessed through the annual self-review reports prepared by most counties.[55] According to the self-review reports, funds may be for exclusive use or blended use with other financial sources. **Error! Reference source not found.**9 show the expenditure modality of RBECP in various counties (cities, districts). Most local governments (64.95 percent) use the RBECP as earmarked funds, and a small proportion of local governments (27.84 percent) blended the RBECP with other financial sources at the county level. Five counties (cities, districts) have not reported the specific usage of the RBCEP. Two counties (cities, districts) have not used the RBECP in the current year.

Table 12: Modes of RBECP spending by counties/districts

Mode	Number of counties/districts	Proportion (%)
Earmarked Funds	63	64.95

[55] Among the 100 districts and counties under the jurisdiction of Jiangxi Province, 97 districts and counties provided the World Bank team with self-examination reports on ecological compensation funds in the river basin. Except for the districts and counties under the jurisdiction of Jingdezhen, the prefecture-level city, which provide self-examination reports for 2017, the other districts and counties provide self-examination reports for 2018.

Blended with other financial sources	27	27.84
Unused	2	2.06
Unreported	5	5.15
Total	97	100

Data source: Department of Finance of Jiangxi Province.

56. **Of all RBECP spending, expenditures on water pollution reduction accounted for 28.5 percent.** In addition, water ecological management accounted for 13.3 percent, water ecological management accounted for 13.3 percent, waste management accounted for 12.9 percent, rural and urban environment improvement accounted for 13.3 percent, forest improvement accounted for 5.9 percent, and institution improvement accounted for 4.0 percent (Figure 5). In general, the expenditure of the RBECP is aligned with the proposed Result Areas of the Yangtze River Revitalization Project. Table 12 lists activity categories and corresponding activities of the expenditures of RBECP.

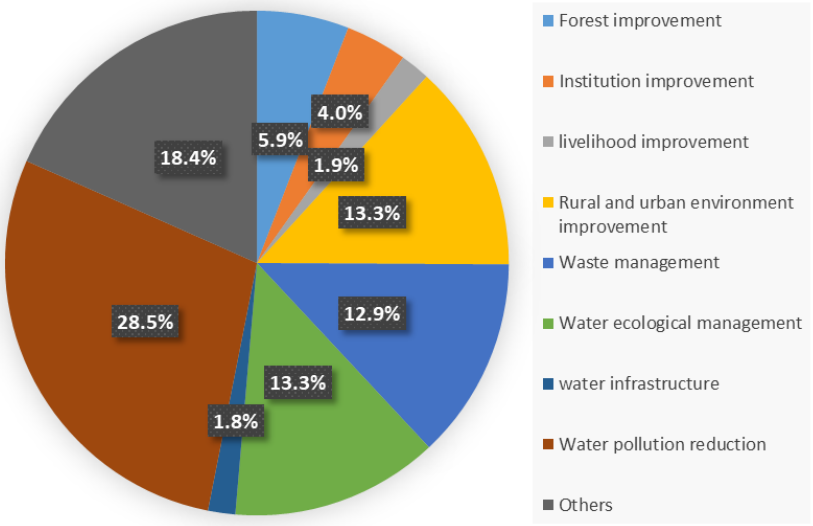


Figure 5: The expenditure structure of RBECP funds in 2018 (%)

Table 13: Activity categories and corresponding activities of the expenditures of RBECP

Activity Category	Activities
Forest Improvement	Forest Improvement; Forest Infrastructure; Forest Maintenance; Forest Pesticide; Forest Protection Patrol; Forest Restoration; Forest Subsidy; Forest Survey; Forestation; Wetland and Migratory Bird Protection
Institution Improvement	Air and Water Monitoring; Air monitoring; Consultancy; Eco-compensation; Ecological Improvement; Environmental Monitoring; Environmental Campaign; Environmental Capacity Building; Environmental Information Platform; Environmental Management; Environmental Monitoring Stations; Forest Monitoring; Key Ecological Zone Evaluation Fee; Pollution Source Survey; Report Development; River Chief System Information Platform; Soil Environmental Monitoring; Wastewater Monitoring; Water Quality Monitoring; Water Quality Testing; Water Resource Monitoring; Water Source Monitoring Stations; Water Survey; Water Withdrawal Survey
Livelihood Improvement	Agricultural Industry Fund; Air Pollution Reduction; Animal Pandemic Prevention; Disaster Warn System; Industrial Closure; Industrial Parks; Polluting Vehicle Exit Subsidy; Port Maintenance; Rural Water Supply Security; Soil Pollution Reduction; Others

Rural and Urban Environment Improvement	Ecological Countryside; Green Parks; New Countryside; Public Space Greening; Railway Greening Road Greening; Road Maintenance; Road Upgrade; Road Cleaning; Rural Environment Improvement; Urban and Rural Environment Management; Urban Cleaning; Urban Greening; Urban Improvement
Waste Management	Rural Waste Collection; Rural Waste Management; Rural Waste Treatment; Urban Waste Collection; Waste Collection and Landfill; Waste Collection Station; Waste Management; Waste Treatment
Water Ecological Management	Basin Ecological Improvement; Dead Tree Cleaning; Ecological Improvement; Embankment Greening; Fish Breeding; Fish Breeding Area Restoration; Land and Soil Conservation; Landslide Management; Landslide Restoration; Mine Area Ecological Restoration; Port Ecological Management; Reservoir Aquaculture Exit; Reservoir Area Greening; River Channel Management; Shoreline Improvement; Shoreline Restoration; Sub-basin Management; Wetland and Migratory Bird Protection
Water Infrastructure	Embankment Enhancement; Farm Water Infrastructure and Ecological Management; Flood Protection; Pollution interception; Reservoir construction; Reservoir maintenance; Water Infrastructure Maintenance
Water pollution reduction	Heavy Metal Treatment; Industrial Closure Subsidy; Livestock Pollution Management; Livestock Prohibition Subsidy; Rural Wastewater and Waste Management; Wastewater Pipeline; Wastewater Treatment; Water Environment Management; Water Pollution Treatment; Water Source Protection
Others	Others

Data source: Department of Finance of Jiangxi Province

4.3 Program expenditure efficiency

57. Program expenditure efficiency mainly focuses on whether the Program expenditures can achieve the desired targets and realized value for money.

4.3.1 Funding allocation rule to ensure value for money

58. **Jiangxi Provincial Development and Reform Commission (PDRC) has jointly issued a Funding allocation method in 2016.** Along with Department of Finance (DOF), Department of Environment and Ecology (DEE), Department of Forestry (DF) and Department of Water Resources (DWR), this was subsequently amended in 2018 with two other departments, Department of Agriculture and Rural Affairs (DARA) and Department of Housing and Rural-Urban Development (DHURD). According to this Method, the RBECP funds are allocated to different counties according to four sets of indicators: (i) performance in water environment improvement; (ii) performance in forest quality improvement; (iii) performance in water resource management; and (iv) the ecological importance of the county. Each year, evaluation of those indicators will be conducted by relevant departments and the results used to determine the counties' available amounts for the subsequent year. Therefore, the funding allocation rule provides strong incentive for the counties to achieve the desired objects set by provincial government and helps to ensure value for money.

59. **In Hunan, expenditure performance evaluation rules have been established**. These are applied to all ear-marked funds, which helps to ensure value for money.

4.3.2 HLG transfer mechanism and other factors that affect value for money

60. **According to 2018 data, the amount of RBECP allocated to each county (cities, districts) has a significant negative correlation with its economic development level or the level of local government financial resources** (Figure 6 and Figure 7). The less developed the economy is and the less its fiscal revenues are, the greater amount of RBECP is allocated to the county. This is in line with the program's intention to compensate the foregone development opportunities of less-developed counties associated with protecting the environment and ecology.

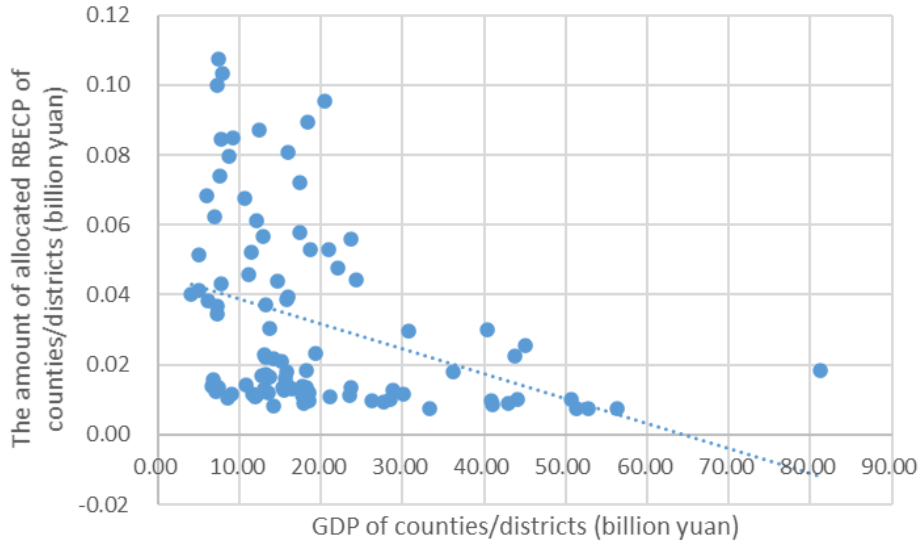


Figure 6: RBECP Allocation and GDP by counties/districts in 2018 (CNY Billion)

Data source: Department of Finance of Jiangxi Province

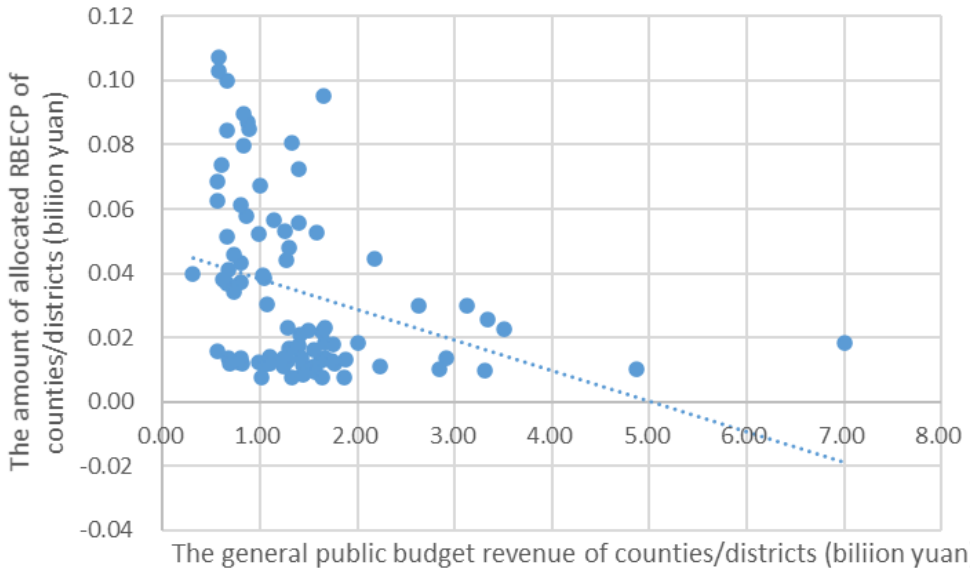


Figure 7: RBECP Allocation and Fiscal Revenue by counties/districts in Jiangxi in 2018 (CNY Billion)

Data source: Department of Finance of Jiangxi Province

61. **Some counties have formulated special county-level ecological compensation fund use management methods for the use of RBECP.** This helps the county-level governments to manage and use the RBECP funds more transparently and effectively. Table 14 shows the names of the five districts/counties mentioned in self-inspection reports that have formulated special management methods for the use of RBECP and the names of the corresponding management method documents.

Table 14: List of documents issued by counties (districts) on the use of RBECP

Prefecture	County/District	Document Issued
Ji'an	Jishui	"Interim Measures for the Management of Ecological Compensation Funds in Jishui County (Trial)"
Ji'an	Yongfeng	"Yongfeng County Measures on the use and management of river basin ecological compensation funds"
Jiujiang	Hukou	"Hukou County Watershed Ecological Compensation Fund Use Management Measures (Trial)"
Jiujiang	Duchang	"Duchang County Watershed Ecological Compensation Fund Management Measures"
Shangrao	Wannian	"Administrative Measures on Transfer Payment Funds for Ecological Function Zones in Wannian County"

Data source: Department of Finance of Jiangxi Province

62. **However, even though the allocation rule contributes much to the efficiency of RBECP expenditure, districts/counties typically do not conduct direct performance evaluation for the RBECP funds.** At present, the main targets of budget expenditure performance evaluation in county-level governments in Hunan and Jiangxi are still ear-marked expenditures.

4.4 Program funding predictability

63. **In Jiangxi, the RBECP funds are not disbursed all at once every year but are divided into two parts**. One part is disbursed in the end of the preceding fiscal year (typically in December), and the other part is disbursed in the current fiscal year (typically in September). The distribution of the two parts was consistent from 2016 to 2018, at about 1:1 (Table 15). Such manner of fund disbursement may undermine the predictability of the funds, because late distribution of the second batch of budget quota prevents the county government from including the entire compensation funds in its budget and delays the implementation of planned activities.

Table 15: Timing of Disbursement of Jiangxi RBECP funds (2016-2020)

year	Total funds (CNY million)	Amount disbursed before current year (CNY million)	% of total	Amount disbursed during current year (CNY million)	% of total
2016	2091	1017.2	48.65	1073.8	51.35
2017	2690	1447.0	53.79	1243.0	46.21
2018	3125	1662.0	53.18	1463.0	46.82
2019	3118	1918	61.51	1200.0	38.49
2020	3125	1925	61.60	1200	38.40

Data source: Department of Finance of Jiangxi Province

64. **In Hunan, the provincial government has been trying to disburse more ear-marked funds to the counties before the current fiscal year.** For example, more than 60 perent of the Wastewater Treatment

Fund was disbursed in advance in 2020, with the percentage much higher than previous years (Table 15). However, still some funds are allocated in the second half of the current fiscal year, which undermines the predictability of the program's funding.

Table 16: Timing of Disbursement of Wastewater Treatment Fund in Hunan (2018-2020)

year	Total funds (CNY million)	Amount disbursed before current year (CNY million)	% of total	Amount disbursed during current year (CNY million)	% of total
2018	722	255.0	35.32	467.0	64.68
2019	966	0.0	0.00	966.0	100.00
2020	1041	662.0	63.59	379.0	36.41

Data source: Department of Finance of Hunan Province

4.5 Financial Sustainability

65. **The overall financial situation in Jiangxi Province is sound and stable** (Table 17). The CODIV-19 pandemic is expected to have negative but only short-lived impact on the government finance. The budget funding of the Program activities accounts for only about 1 percent of the general budget revenue in Jiangxi (see **Error! Reference source not found.**10), so the financial sustainability is not a major concern for the Program.

Table 17: Financial Situation in terms of General Public Budget, Jiangxi (CNY Billion)

	Billion CNY				As Percentage of GDP (%)			
	2016	2017	2018	2019	2016	2017	2018	2019
Expenditure	**60.85**	**63.70**	**73.73**	**69.81**	**3.31**	**3.15**	**3.25**	**2.83**
Revenue	**14.66**	**24.88**	**27.98**	**28.98**	**0.80**	**1.23**	**1.23**	**1.17**
Tax	4.05	11.74	13.91	14.26	0.22	0.58	0.61	0.58
Non-tax	10.61	13.14	14.07	14.72	0.58	0.65	0.62	0.60
Transfer from Upper-Level Governments	**213.33**	**231.06**	**244.82**	**269.04**	**11.60**	**11.43**	**10.78**	**10.91**
Tax Rebate	20.44	25.96	25.96	25.96	1.11	1.28	1.14	1.05
General Transfer	128.81	138.02	150.21	224.24	7.00	6.83	6.61	9.09
Earmarked Transfer	65.34	68.86	69.92	22.55	3.55	3.41	3.08	0.91
(-) Transfer to Upper-level Government	1.26	1.76	1.26	3.70	0.07	0.09	0.06	0.15
Transfer from Lower-Level Governments	**-179.44**	**-208.34**	**-216.45**	**-238.24**	**-9.76**	**-10.31**	**-9.53**	**-9.66**
Transfer from cities and counties	8.41	4.98	5.05	9.82	0.46	0.25	0.22	0.40
(-) Transfer to Lower-Level Governments	187.85	213.32	221.50	248.06	10.22	10.55	9.75	10.06
Transfer from GFB and Others	**1.54**	**1.72**	**4.92**	**6.76**	**0.08**	**0.09**	**0.22**	**0.27**
Overall Balance	**-10.76**	**-14.38**	**-12.46**	**-3.26**	**-0.59**	**-0.71**	**-0.55**	**-0.13**
Change in cash balance	**4.69**	**4.22**	**3.01**	**-0.73**	**0.25**	**0.21**	**0.13**	**-0.03**
Withdrawal from Reserve	**-0.71**	**1.54**	**0.92**	**-3.73**	**-0.04**	**0.08**	**0.04**	**-0.15**
Financing	**6.78**	**8.62**	**8.53**	**7.73**	**0.37**	**0.43**	**0.38**	**0.31**
Borrowing	64.77	53.82	53.15	42.03	3.52	2.66	2.34	1.70
Debt Amortization	57.99	45.20	44.62	34.31	3.15	2.24	1.96	1.39

Notes and Source: Department of Finance, Jiangxi Province. The final accounts for 2020 are not available at time of writing.

66. **The overall financial situation in Hunan Province is sound and stable** (Table 18), it can also be seen that the budget funding of the Program activities accounts for only about 3 percent of the general budget revenue in Hunan (Table 5), so we can conclude financial sustainability is not a major concern for the Program.

Table 18: Financial Situation in terms of General Public Budget, Hunan (CNY Billion)

	Billion CNY				As Percentage of GDP (%)			
	2016	2017	2018	2019	2016	2017	2018	2019
Expenditure	**55.69**	**63.82**	**75.12**	**79.55**	**1.81**	**1.89**	**2.07**	**1.99**
Revenue	**42.31**	**48.12**	**51.44**	**51.93**	**1.37**	**1.42**	**1.42**	**1.30**
Tax	32.08	34.59	38.14	37.83	1.04	1.02	1.05	0.95
Non-tax	10.23	13.53	13.30	14.10	0.33	0.40	0.37	0.35
Transfer from Upper-Level Governments	**310.28**	**325.53**	**346.61**	**362.69**	**10.06**	**9.62**	**9.54**	**9.09**
Tax Rebate	27.55	30.93	30.94	30.93	0.89	0.91	0.85	0.78
General Transfer	181.62	196.18	214.21	307.71	5.89	5.80	5.90	7.71
Earmarked Transfer	104.30	101.94	104.19	30.73	3.38	3.01	2.87	0.77
(-) Transfer to Upper-level Government	3.19	3.52	2.73	6.68	0.10	0.10	0.08	0.17
Transfer from Lower-Level Governments	**-316.92**	**-323.14**	**-336.83**	**-355.08**	**-10.27**	**-9.55**	**-9.27**	**-8.90**
Transfer from cities and counties	6.46	6.23	11.44	11.10	0.21	0.18	0.31	0.28
(-) Transfer to Lower-Level Governments	323.38	329.37	348.27	366.18	10.48	9.74	9.59	9.18
Transfer from GFB and Others	**3.51**	**1.83**	**0.30**	**0.35**	**0.11**	**0.05**	**0.01**	**0.01**
Overall Balance	**-16.51**	**-11.48**	**-13.60**	**-19.66**	**-0.54**	**-0.34**	**-0.37**	**-0.49**
Change in cash balance	1.42	-3.96	-1.44	-1.07	0.05	-0.12	-0.04	-0.03
Withdrawal from Reserve	-2.13	-1.31	-1.97	2.84	-0.07	-0.04	-0.05	0.07
Financing	**17.22**	**16.75**	**17.01**	**19.89**	**0.56**	**0.50**	**0.47**	**0.50**
Borrowing	186.90	119.24	110.20	122.22	6.06	3.52	3.03	3.06
Debt Amortization	169.68	102.49	93.19	102.33	5.50	3.03	2.57	2.57

Notes and source: Department of Finance, Hunan Province. The final accounts for 2020 are not available at time of writing.

4.6 Recommendations

67. In Jiangxi, budget funding for Program activities is largely stable. The RBECP funds provide financial support for each of the Program's activities. The allocation of the funds is based on evaluation of pollution reduction results and other performance indicators alike, which helps to ensure value for money. The funds allocation also favors less-developed counties, which helps to prevent the needs of local economic development hampering environment protection efforts.

68. However, the current fund allocation methods may prioritize regions with already relatively good environmental performance and conditions. This can encourage maintaining good environmental quality and penalize environmental degradation, but some poor counties may lack the initial support to move up the development 'ladder'. It is recommended that fund allocation, fund use, and monitoring follow a hot-spot analysis approach by identifying environment hot-spots, investing in environmental improvement, and monitoring the results.

69. Although the general fund use of the RBECP is aligned with the program priorities, some funds were used as a general budget blended with other financial resources. This makes it challenging to monitor the overall fund use strictly and to evaluate its efficiency. It is recommended that a tag to the program funding in the provincial budgeting system be added.

70. In Jiangxi, though the funding from RBECP has been steadily increasing, part of the budget quota is disbursed in the second part of the fiscal year, which prevents the county government from including the entire compensation funds in its budget and delays the implementation of planned activities. Therefore, it was suggested that a Multi-Year Program Budget System shall be established for the RBECP, which will enable the recipient county government to incorporate the RBECP into their original budgets and fundamentally improve the predictability the program funding.

71. In Hunan, the Program activities are mainly financed by ear marked HLG transfers, therefore, the funding usage is clear and can be ensured in general. However, there is no centralized mechanism for budgeting and execution monitoring of the funds, and many budget funds are not disbursed to the counties prior to the beginning of the budget year. A budget tagging and Multi-Year Program Budget System are again recommended.

72. Meanwhile, in Hunan, most of the funding allocation at the provincial level are based on projects, instead of on results, and the river basin eco-compensation mechanism has been implemented only on a trial basis involving a small share of the overall Program funding. Therefore, it is recommended that Hunan arrange more result-based high-level government transfers to provide stronger incentives to the counties for better implementation of the Program.

73. The National Key Ecological Zone Transfer Program, the major financing source for both Jiangxi and Hunan, could be improved by:

(i) optimizing basin-level compensation outcomes. While implementation is focused within sub-basins, eco-compensation is carried out within administrative areas (i.e. county, municipality or province), missing an opportunity for gains through coordinated approaches between administrative units within a river basin. These can be informed through establishing environment goals at the basin-level to guide the design of eco-compensation schemes, including the targets and locations, by focusing on hot spots and synergies

(ii) (ii) Strengthening performance evaluation systems. While the program's actions are correlated with improved ecological condition in the province, limitations in monitoring limit the possibility of causal attribution. Demonstrating impact could support efforts to target the program towards high-impact activities and locations and increase funding support from other levels of government. Evaluation would be strengthened by tagging eco-compensation funds to better monitoring fund uses and for outcome evaluations.

5 STRATEGIC RELEVANCE AND TECHNICAL SOUNDNESS

74. **The PforR is anchored in the Government's program for the Yangtze River Economic Belt (YREB) as implemented through the sub-national Provincial YREB Programs.** This is a large and long-term engagement that is guided by the associated basin level action plan, and by extension the sub-national programs at the provincial level**.** These together focus on improving institutional coordination and integrated development for improved ecological protection and water pollution control in the YREB. The Basin Plan provides the overarching vision and framework; the subsidiary plans at the provincial level outline local actions and intermediate targets consistent with and contributing to the larger strategy. In doing so, the national strategy provides the overarching development objective to guide implementation at the provincial level and a platform for high-level policy and regulatory harmonization, cooperation between sub-national levels of government, and coordination among different sectors.

75. **A Program for Results (PforR) has been identified as the most appropriate instrument given the scale and complexity of the YREB.** The use of PforR is motivated by high Government capacity as well as the opportunity to leverage ongoing activities and significant resources under existing Government programs. This structure is designed to support a nested hierarchy of interlinked institutional improvements at multiple levels—basin, province, sub-basin, and county—that are required to address the Basin's challenges. Through leverage of existing Government programs, the PforR instrument provides geographic coverage beyond that possible through traditional Investment Project Financing (IPF). The PforR will focus on a subset of activities where the Government wants to enhance efficiency, effectiveness, and impact of expenditure 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 governance structure and differentiated responsibilities across governance levels (as specified under the Yangtze River Protection Law). The PforR instrument is also conceptually aligned with the results-based design of many of China's land and water management programs (known as eco-compensation), making it a natural complement in this sector.[56] The PforR financing is complemented through a basin-level IPF to support cross-jurisdictional technical assistance (TA) activities at the basin scale.

76. **The Program is aligned with the World Bank Group's Country Partnership Framework (CPF) for China** (FY 2020–2025) (Report No. 117875-CN). This CPF was discussed by the World Bank Board of Executive Directors on December 5, 2019,[57] along with the new phase of the World Bank's engagement in China. Specifically, the program focuses on institutions and systems for integrated basin management that can make a significant contribution to global public goods through pollution reduction and biodiversity protection. It thus contributes to Engagement Area 2 of the CPF, "promoting greener growth", by reducing water and marine plastic pollution and strengthening sustainable management of natural resources. Moreover, lessons and knowledge generated by the Program are 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.

5.1 Results Area Overview

[56] Eco-compensation programs aim to financially incentivize improved land and water management by sub-national governments, firms, or households. See World Bank (2021). Eco-compensation in China's Evolving Environmental Management Regime: Ecological Protection and Water Pollution Control in the Yangtze River Basin. World Bank Group, Washington, D.C. *Forthcoming.*

[57] World Bank Group (2021). China - Country Partnership Framework for the Period FY2020–2025. (Report No. 117875-CN) World Bank Group, Washington, D.C. (link).

77. **Results Area 1 is focused on improving institutions and innovations for integrated river basin management (provincial level).** it aims to strengthen the river chief system and other institutional mechanisms with innovations for integrated approach to river and lake protection. Due to fragmented administration for management of water as a common-pool resource (water resources management regime at basin scale combined with jurisdiction-based management as mandated by the Water Law), cross-sector coordination and inter-jurisdiction cooperation are the most challenging tasks for improving river basin management in the YREB. To enable such coordination and cooperation, a balanced approach with both administrative measures and incentive policies is required.

78. **Results Area 2 is focused on advancing ecological protection through integrated river basin management (sub-basin level).** This is intended to contribute to the operationalization of integrated water resources management covering water allocation, water permit validation, ecological flow determination and enforcement, joint operation of reservoirs, water quality monitoring and data-sharing for management. In doing so, this results area will support ecological protection and climate resilience in the demonstration sub-basins of Gan River Basin (Jiangxi) and Yuan River Basin (Hunan).

79. **Results Area 3 is focused on reducing water pollution and transmission of plastic waste (county level).** It will support reduction of point- and non-point-source pollution in demonstration counties. This will contribute to the reduction of water pollution loads, including plastics, by improving the operation of township wastewater infrastructure, improving the management and utilization of livestock/poultry manure, and collecting and recycling plastic waste, in line with provincial policies in the demonstration counties.

5.2 Technical Soundness

5.2.1 Results Area 1 Improving Institutions and Innovations for Integrated River Basin Management

80. **Complex problems exist in interregional, intergovernmental, and inter-departmental collaboration in water resources management, which reduces the coordination of water resources and water environment management.** The inefficiency of the IWRM and the difficulty implementing it in China may be ascribed to factors such as amorphous definition, operational difficulty, departmental conflicts, and lack of authority in river basin management.[58] Institutional reforms in China are facilitating improved coordination and cooperation. For example, the Yangtze River Protection Law, passed in 2020, provides a legal foundation for basin-specific coordination in China and could be eventually transposed to other major river basins.

5.2.1.1 River Chief System

81. **The River Chief System has evolved as an innovative system to address the challenges of integrated water resources management and water pollution control.** The system was first piloted in 2007 when the Vice Mayor of Wuxi City was appointed as the river chief to solve the problem of long time and serious blue-green algae outbreak in Lake Tai that was endangering the city's drinking water. The "*Targets and Assessment Measures of Water Quality Control for River Cross-sections in Wuxi*" stipulated that the results of water quality evaluation should be included in the administrative assessment of officials in charge. This career-related incentive and accountability mechanism led to observed improvements in

[58] Wang and Chen (2020). River Chief System as a Collaborative Water Governance Approach in China. *Int. J. Water Resour. Dev*. 36: 610–630.

water quality after only two months of its implementation and has since been referred to as the origin of the river chief mechanism.

82. **The River Chief System was subsequently formalized through the "*Opinions on Fully Promoting the River Chief Mechanism*" released by the State Council in 2016**. The River Chief System establishes river chiefs at four-levels: provincial, municipal, county and township cross the country, as well as village-level river chiefs in many areas, with each part of a river and lake assigned to a particular official who is responsible for addressing coordination and cooperation between departments and regions. The River Chief System is focused on six main tasks, including: (i) water resources protection, (ii) shoreline management, (iii) water pollution prevention and control, (iv) water environment management, (v) restoration of water ecology, and (vi) law enforcement. The system is implemented under an Inter-Ministerial Joint Committee on River Chief System (RCS Committee) chaired by a Vice Premier and including representatives from MWR, NDRC among other line agencies. Ministry of Water Resources has established a Leading Group, headed by the Minister, to promote the River and Lake Chief System.

83. **The provincial and county level river chiefs receive assistance and support from the River Chief Office (RCO) that often sits within the related water agencies at the respective levels.** The RCO comprises chiefs of RCO and key staff from major related departments. Six complementary mechanisms are requested to be established to support the river chiefs: (i) River Chief Meetings; (ii) Information Sharing Mechanisms; (iii) Information Reporting Mechanisms; (iv) Supervision Mechanisms; (v) Accountability and Incentives; and (vi) Completion and Acceptance Mechanisms. To promote the inter-jurisdictional and cross-sector coordination, many provinces have established a regular river chief meeting mechanism, where river chiefs have meetings with sector department leaders for consultation and decisions on various issues. More than 1.2 million river and lake chiefs down to the village level[59] have been appointed since 2017, with over 460,000 River Chiefs among the 11 provinces in the YREB.

84. **The national guidelines have requested establishment of information management platforms at various levels of government to support implementation and operation of the River Chief System.** Given the complexity of the task, major gaps are the absence of a basic foundation for the system, as well as insufficient investment and technical capacity. Established or planned platforms greatly range from relatively simple administrative systems to more sophisticated information platforms with decision-support functions supported by physical monitoring networks and promoting public participation (Table 19). The key functions, types of data included in the data platform along with the information shared between the different sector agencies and between the counties and the provincial platforms depends on the level of sophistication. The simpler systems typically focus only on the river chief administrative functions while more sophisticated platforms include a range of data that support analytical functions to inform decision making. For sophisticated platforms, data include (a) administrative functions relating to the river chiefs, such as river patrol, water pollution and illegal natural resources exploitation supervision, reporting and resolution coordination, public participation; (b) water quantity data (precipitation, water level, flow, hydrology information), (c) water quality data (temperature, pH, dissolved oxygen, conductivity, turbidity, ammonia nitrogen, total phosphorus, total nitrogen, permanganate index, fluoride, (d) monitoring, soil and water conservation, illegal construction and solid waste dumps; and (e) drainage and solid waste management, such as drainage networks, conveyance systems, sewage pipelines and pump stations.

Table 19: Types of river chief data platform, functions, and data collected.

	Simple	**Intermediate**	**Advanced**

[59] There are 2.61 million villages in China in 2020.

Data	1. Basic information for river chief administration 2. Lakes and rivers characteristics 3. River chief patrol information 4. Water pollution reporting 5. Emergency coordination 6. Social supervision	1. Water quality monitoring (temperature, pH, dissolved oxygen, conductivity, turbidity), ammonia nitrogen, total phosphorus, total nitrogen, permanganate index, fluoride. 2. Monitoring of water pollution, black and smelly water removal, soil and water conservation, illegal construction, and garbage dump identification. 3. Drainage monitoring: pump station, pipe network flow. 4. Hydrological monitoring: rainfall, water level, flow. 5. River chief administration, patrol, events reporting and coordination, public participation.	1. Water quality monitoring: five-parameter analyzer (temperature, pH, dissolved oxygen, conductivity, turbidity), ammonia nitrogen, total nitrogen, permanganate, total phosphorus 2. Hydrological monitoring: rainfall, water level, flow 3. Remote sensing for water pollution, black and smelly water remote, flood damage, water eutrophication, water sediment content 4. River chief administration: river patrol, events reporting and coordination, public participation, video surveillance for pollutants, water bodies, river courses. 5. Solid waste monitoring
Major Functions	Data uploaded directly by county to provincial platform.	1. Data collection and management: Collect monitoring data, aggregate manual monitoring data, data storage and management. 2. Water environment monitoring and early warning platform, monitoring quality of river and lakes, early warning of water environment quality issues. 3. RCS information management system: support the river chief system supervision and evaluation 4. Drainage network management system, monitoring and warning system of pumping station and drainage network	1. Data collection and management: collect monitoring data, aggregate manual monitoring data, data storage and management 2. Water environment monitoring and management and visual presentation 3. Intelligent analysis of water environment status 4. Water pollution prevention and control, prediction of pollutant migration and traceability results management. 5. Water environment decision support, realization of river and lake management assessment, waterlogging big data with early warning analysis and emergency response 6. Release of water environment information support mobile office of river and lake management for river chiefs, inspectors and the public. 7. Solid Waste service monitoring and management
Examples	Shimen County	Fenxin County	Jing'an County

85. **A National River Chief System information management platform has been developed by MWR and is in trial operation.** It is limited to the common administrative functions of the river chief system between the central and local level with five main functions/modules, including:

(i) Basic information for river chief administration, such as the names of the river chiefs, the supervision scope, their corresponding responsible river/lakes, and whether there is public participation channel);

(ii) Rivers and lakes information management such as the characteristics of rivers/lakes, major water issues, shoreline management);

(iii) Administrative information service such as river patrolling by river chiefs, issue reporting,

coordinated process and results, statistics of issues solved, unsolved issues;

(iv) supervision and evaluation, including the aggregated national and provincial policies/guidance the supervision and evaluation results;

(v) Information presentation and publication, such as the evaluation results, the issues solved, the statistics of public reported issues solved, and public participation events.

86. **This set up is cascaded to the provincial level who can add tailored functions/modules based on the local needs, financial conditions, and technical resources.** Some provincial RCS platforms including Jiangxi and Hunan are being implemented on trial basis. However, these often have limited functionality and are only partially connected across different jurisdictions and levels of government and lack county level data inputs.

87. **Jiangxi Province is among the first provinces to establish a multi-level river and lake chief system which is operating with an increasing focus on stakeholder participation.** Provincial regulations on the "*Implementation of the River / Lake Chief System*" have been issued to provide legal basis for its operation. More than 25,365 river chiefs have been appointed in all seven major rivers and lakes within the province as of 2017. Roughly 92,000 people have been recruited for river patrol and cleaning, many of them as part of poverty eradication programs at the village level. Various operational systems are in place, including a provincial information sharing and office operation platform with an expanding network of hydromet and water quality monitoring and an incentive mechanism that provides funds to reward outstanding local river chiefs. Notwithstanding this progress, there is a strong need for improved integration across the various systems, platforms, and initiatives to leverage the data, information and opportunities for improved ecological protection and water pollution control, and a need to further strengthen the technical capacity of the river chief system management office at different levels. Sustainable financing mechanisms, such as basin eco-compensation schemes, and continuing to increase the participation of the public, represent further opportunities to improve effectiveness.

88. **In addition to the regular set up, the Jiangxi provincial RCS platform has the functions for enforcement, river patrol, emergency consultation and evaluation.** It receives water quality data shared by the DEE monthly. The county platforms are connected to the provincial platform in three ways, namely (i) simple direct data upload from county to province; (ii) simple standalone county platform focused mostly on administrative systems; (iii) advanced platforms such as those supported under the YRPRP that provide a decision support system.

89. **Hunan Province piloted the River Chief System for the protection of Xiangjiang river prior to the national initiative in 2015 and is currently investigating the preparation of a Provincial River Chief regulation.** In addition to an established multi-level river/lake chief system, it has extended the system for river chiefs to smaller streams and ponds in Xiangtan city to provide comprehensive protection and supervision. In some counties, volunteer river chiefs also participated in administrative river chief meetings, jointly discussing with the official river chiefs on the challenges and solutions for river and lakes protection and water pollution control. Hotlines and mobile applications have been set up to encourage broader public supervision and participation. As part of the river chief system, river cleaners have been appointed with responsibility for collecting solid waste from along and within waterways. A local NGO "Green Hunan" has created a mobile application to engage the public to join volunteer river patrols and clean up campaigns. A monitoring plan has been established for solid waste in the rivers and reports through the application. There is a possibility to combine these two channels for deeper engagement for plastics waste reduction in the waterways.

90. **Hunan has initiated a provincial wide river chief administrative platform following the national**

guidelines. As Jiangxi, the local (city or county) level platforms are connected to the provincial one in three ways, namely (i) direct data exchange with the provincial platform; (ii) standalone local platform focused mostly on river chief administrative systems, and (iii) advanced platforms that provide decision support functions. Hunan river chief platform aims to create one system for the entire province, from provincial, city, county, townships and villages, encouraging inter-jurisdiction data sharing. The remain gaps are the connection by the counties to the province with consolidated cross sector data, which can provide data for the provincial platform to facilitate overall decision making and timely management.

Box 1: Lake management platform (LMP) in Poyang Lake Basin Town Water Environment Management Project

The World Bank financed Poyang Lake Basin Town Water Environment Management Project (P153604) supports Jiangxi Provincial government's efforts to reduce pollutant discharge into selected waterways and improve management of water quality in selected counties in the Poyang Lake basin. The US$150 million IBRD financed IPF includes support to the development of Lake Management Platforms (LMPs) that are expected to significantly contribute to improvements in environmental quality by facilitating the identification of hotspots and targeting interventions in a systematic way.

The LMPs help to: (i) manage data sharing architecture and facilities to enable agencies and the public to monitor the lake basin and decide on effective actions; (ii) facilitate proper consultation; (iii) develop participatory water environment management plans; (iv) identify water quality hotspots and assess implications of development proposals on the lake water quality; (v) facilitate the exchange of knowledge among other lake initiatives within China and internationally; and (vi) serve as a mechanism to build partnerships.

The LMPs are more complex (and costly) than regular RCS information platforms. They include decision-support functions, and the data collected goes beyond hydrological and water quality data and river inspection information to include wastewater and solid waste management information. These platforms are connected to physical monitoring networks and spatial data acquisition facilities such as drones and remote sensing.

The project offers useful experience on the use of data platforms for institutional coordination that can benefit the YRPRP:

(i) The LMP has been shown to be an important information platform represents enabling evidence-based decisions with scientific data support.

(ii) It is important to establish data platforms over an extended period, recognizing the time taken to develop the systems and embed their operation in management activities. The time taken to develop the LMPs ranged from one and half years to three years, with two in trial operation and the rest due for completion in June 2022.

(iii) Procurement processes can be challenging for development of data platforms, with a need to find specialist firms suitable for bidding. Timelines can be slowed by procurement processes, as occurred under the LMP. Engaging a qualified designer from the start is recommended.

(iv) Quality control mechanisms are important to ensure development of a functional systems that can deliver fit-for-purpose data. There is a need to involve the river chief office early in development of the quality control mechanism.

Source: Authors

91. **A basin wide coordination mechanism for the River Chief System along the Yangtze River was initiated by the Changjiang (Yangtze) Water Resources Commission (CWRC) through "Working Guidelines" issued on July 26, 2021.** The objectives of the coordination mechanism revolve around the six main tasks of the River Chiefs, with the aim of promoting coordination among the 19 Provincial River Chief Offices and the CWRC. The coordination mechanism is supported by an office set up at CWRC, headed by the Director of the CWRC River Chief Office. Design of the basin wide RCS coordination mechanism was

partially supported through the World Bank financed technical assistance project "Promoting Economic Reform and Capacity Building" and its establishment was included as part of CWRC's plan during the 14th FYP period for implementing the Yangtze River Protection Law. The working guidelines outline a number of key tasks, including:

a. Conduct studies to support planning of transboundary rivers and lakes
b. Implement the water resource management mechanism
c. Jointly promote shoreline protection of the Yangtze River
d. Jointly promote water pollution reduction and eutrophication management
e. Jointly promote river and lake ecological protection and restoration
f. Jointly enforce relevant regulations and policies
g. Establish a monitoring network covering hydrology, water quality, water ecology and so forth
h. Establish information sharing and river health assessment
i. Conduct joint research on key issues including water ecology restoration technologies, horizontal eco-compensation and so forth
j. Conduct information, education, and communication activities to improve public awareness

92. **A working conference mechanism is to be established under the basin RCS coordination mechanism.** The working guidelines for the basin RCS coordination mechanism provides for plenary meetings attended by all members, including representatives from the 19 provinces and CWRC, along with thematic meetings attended by the relevant member representatives involved in the matters to be negotiated and other relevant departments as required, and outlines the main tasks of the working conference as including: (i) discussing and implementing the tasks determined by the inter-ministerial joint meeting for the full implementation of the river and lake chief system and the provincial joint meeting of river and lake chiefs in the Yangtze River Basin; (ii) research and jointly advance the tasks related to the collaboration mechanism; (iii) exchange the progress and successful experience of the river and lake chief system in various provinces (autonomous regions and municipalities directly under the Central Government), and discuss the important and difficult problems and related suggestions; (iv) other matters proposed by member units that need to be resolved through negotiation. The conference will be organized by the CWRC with the participation of the members from the 19 provinces. According to the needs of the work, representatives from the Leading Group Office of the River Chief System and Lake Chief System of the Ministry of Water Resources can be invited to participate.

93. **A basin-level information management platform is to be established under the basin RCS coordination mechanism.** The working guidelines for the basin RCS coordination mechanism requires each of the Provincial River Chief Offices to strengthen cooperation and coordination through the joint development, co-management and sharing of information. Under the provision of the working guidelines, CWRC is to lead in establishing and improving an information management system for the Yangtze River Basin RCS. Each of the provinces is required to establish a provincial level RCS information management system which should be developed and synchronized to promote basin wide information-sharing. Each of the members of the coordination mechanism are required to provide, maintain, and update information in a timely manner to ensure the completeness, accuracy, timeliness and availability of information and data, including sectoral planning (water, mining, environment, waterway etc.), water resources, water quality, water ecology, water emergency, pollution discharge licenses among others.

94. **Development of these elements of the River Chief System provides a unique opportunity to strengthen cooperative governance of water resources in the YREB.** It provides a mechanism for collaborative solving of within- and cross-jurisdictional issues in water management in China. The assessment has identified several potential areas for enhancing the river chief system: (i) cross-sector and inter-jurisdictional coordination can be enhanced between provincial river chiefs; (ii) more integrated and

comprehensive data monitoring and information sharing platforms, with advanced technologies such as remote sensing, can be used to complement the manual river patrols and improve the efficiency and effectiveness of the river chiefs; (iii) while the evaluation and supervision system is yet to be developed, a third-party monitoring and verification can be introduced to enhance the accountability of the river chiefs; (iv) the river chief system could be better coordinated with other existing institutional structures, such as river basin organizations; (v) the incentive system of river chiefs can be further enhanced, potentially with eco-compensation schemes, both horizontal and vertical; and, (vi) more standardized approaches to public engagement could leverage greater impact through development of a manual for the river chief system.

95. **The Bank-financed YRPERP will support implementation and enhancements of the River Chief Coordination mechanism, including the information management platforms.** The nested hierarchy of Program activities provides for vertical integration by linking the provincial (and county) platforms to the basin and national RCS information management platforms. The PforR is thus supporting improvements in the river chief system by incentivizing integration of platforms across levels of government.

96. **The Central Basin IPF will support operationalization of the coordination mechanism**. This includes promoting the connection of provincial platforms with the basin level RCS platform to be established, while the Provincial PforRs incentivize counties to connect to the provincial platform and the province to connect to the basin platform through DLI1. These together contribute to PDO1 "Strengthened River Chief System for Institutional Coordination." The indicator covers the connection of the provincial platforms to basin information platform; as well as connection of provincial, municipal and county-level platforms within a province-wide smart information management system (including independently established platforms and non-independently established platforms). Three functions will be performed by the interconnected system: (1) support of RCS operations; (2) inter-jurisdictional data sharing; and (3) provision of channels for public participation in river/lake management and protection.

97. **A methodology has been agreed for verification of the results of river chief platform connections.** This includes connection of the two provincial platforms to the Yangtze River Basin platform to be established; (ii) connection of the platforms of all the 14 municipalities and 122 counties in Hunan and 11 municipalities and 100 counties in Jiangxi to the provincial platforms, with each providing the three functions described above. At baseline (2021), Hunan has 30 countries/municipalities with connected platforms, and Jiangxi has 50. A sample of county collection statuses for the Program's 11 demonstration counties shows that of this selection, most have established their river chief information platforms, with a range of intended connection dates (Table 20).

Table 20: Connection status of county/municipality-level river chief information platforms

		Demonstration County	Year of establishment of river chief system	Year of establishment of information platform	Access to the provincial platform	
					Year of access	Intended access year
Hunan	1	Wangcheng District	2017	2018	N/A	TBD
	2	Miluo City	2018	2018	2018	N/A
	3	Shimen County	2017	2018	2018	N/A
	4	Ziyang District	2017	2017 Hunan Province Platform 2019 Yiyang City Platform	2017	N/A
	5	Yuanling County	2017	2017	2017	N/A

Jiangxi	6	Chongyi County	2016	2018	N/A	TBD
	7	Yudu County	2016	2020	2018	N/A
	8	Dayu County	2017	2018	2020	N/A
	9	Yongfeng County	2016	2018	N/A	2022
	10	Fuliang County	2016	2017	N/A	2024
	11	Yugan County	2016	2018	N/A	2021

Data source: Collected by Bank Team from county governments

98. **The River Chief System also provides an opportunity to promote engagement of the public in river protection and water pollution control.** The River Chiefs are active in organizing different public awareness campaigns and education programs, appointing non-governmental river chiefs, inspectors, cleaners, supporting volunteer groups, and setting up hotlines and mobile applications. Mechanisms have also been established to incentivize citizens to provide feedback on the performance of the river chiefs in performing their tasks. For instance, the JingAn Water Affairs Bureau launched a WeChat public account for River Chiefs, through which citizens can report illegal activities or water pollution in rivers and lakes online Similarly, Deqing County, Huzhou City, Zhejiang Province, initiated the Ecological Green Currency mechanism. The public can obtain a certain amount of green currency by completing the task on the water protection platform. The exchange ratio of green currency to CNY is 10:1, which can be used at the designated exchange point for physical exchange and can also be exchanged for discounts in terms of a loan quota, loan interest rate, or guarantee.

99. **There are currently no systematic guidelines to structure engagement of the public in efforts around ecological protection and water pollution control in the YREB.** This notwithstanding, there have been calls for government to encourage the public to participate in the operation and maintenance of rivers and lakes, undertake the cleaning and maintenance of certain river sections or water bodies in front of and behind houses, and volunteer to carry out river and lake cleanings and inspections.[60] The working guidelines for the basin wide RCS coordination mechanism requires all of the 19 provinces and the CWRC to jointly promote the public awareness and participation of the river and lake chief system. It further requires the members to continuously enhance the public's awareness of responsibility and participation, creating an environment for wider society to care for and protect rivers and lakes.

100. **Women are under-represented across difference roles in river resource management teams.** For this technical assessment the Bank team collected data from counties in Jiangxi and Hunan. In Hunan, the number of female river chiefs are much fewer in all instances with a female to male ratio of 1:5. The extreme example is in Yuanling city with the proportion of male to female river chief is 13 to 1. On average, only 7 percent of the river rangers and 19 percent of the river cleaners are women. For another example, in Milo County, less than 4 percent of the river cleaners are women. Considering that these are paid jobs, women may have limited access to a considerable number of the local job opportunities associated with the river protection, waste collection and recycling activities. Increasing opportunities to allow women to participate in these labor markets would allow these women to earn an income at about one-third of the local average salary. In the five demonstration counties in Jiangxi, the situation is similar for volunteer river chiefs and river rangers, with respectively 7 percent and 11 percent of them being women. However, there is a much better gender balance for the river cleaners in Jiangxi, with about 50 percent of the work done by women.

[60] Wang and Chen (2020). River chief system as a collaborative water governance approach in China. *Int. J. Water Resour. Dev.,* 36, 610–630

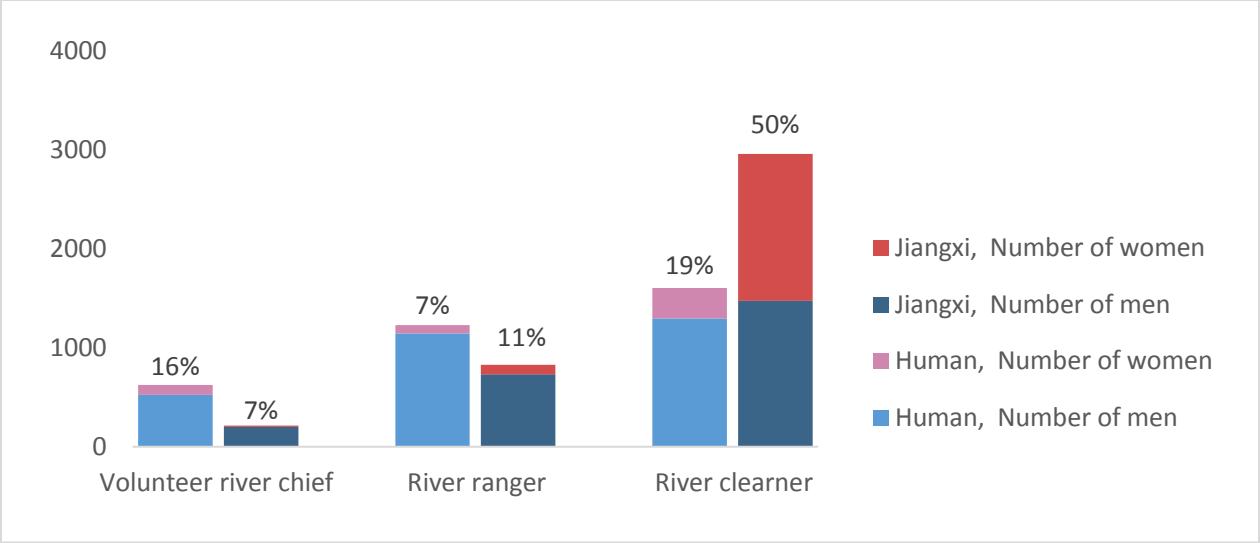


Figure 8: Proportion of women in local river resource management teams in Human and Jiangxi

101. **Gender dimensions have been incorporated into the Program design based on a screening of the volunteer river chief system and township level wastewater utilities in Jiangxi and Hunan provinces.** Gender dimensions in design are based on an assessment of two areas central to meeting project objectives – the river chief system (RCS) and township level wastewater utilities in Jiangxi and Hunan provinces. There are a range of approaches to staffing within the RCS, with some river chiefs paid and others voluntary. In both categories, women are substantially under-represented, with four or more male river chiefs for every female in the data sample provided by demonstration counties. Considering that some of these are paid jobs, women may have limited access to local job opportunities associated with river protection, waste collection and recycling activities. To address gender gaps, the Program will include provisions to encourage the participation of women in the public engagement manual to be developed for the river chief system. Specifically, it will include (a) developing and implementing procedures to build women's capacity to engage and serve in these positions and (b) increase women's awareness of these opportunities through increasing their overall engagement in consultations. Women's participation is targeted to increase from 10 percent to 30 percent. The assessment also found fewer women working in wastewater treatment plants (both in technical and managerial positions) and found that female staff earned a quarter less, on average, than male staff among the sample survey. To address this gender gap, the Program will support trainings that meet women's specific needs to improve their technical skills, equipping them for broader job opportunities and for income generation, as part of the strategic plans to be developed by the counties for sustainable township wastewater services.

5.2.2 Results Area 2 Advancing Ecological Protection through Integrated River Basin Management

102. **Jiangxi and Hunan have been developing integrated river basin management systems in recent years.** The provinces have been developing water resources management systems aligned with the three water redlines. This includes the allocation of water resources to the municipal level, regulations and guidelines for ecological protection and waste reduction, coordinated operation of reservoirs, water allocations to counties, decision support tools for validating water permits, and planning, implementing, and monitoring ecological flow determined based on river health requirements. These efforts are ongoing.

103. **Results area 2 advances these efforts, specifically those around integrated water environment**

planning and ecological flows. The Yangtze River Protection Law commits governments to determine, allocate, and monitor ecological flows for the Yangtze River's mainstream, major tributaries, and important lake sections. At the provincial level, the Program will support compliance with the law through support for activities on ecological flows, as well as the development and promulgation of sub-basin or provincial-level instruments to reduce pollution, including solid waste management plans and phosphorus management guidelines.

104. **Functional riverine ecosystems and their biodiversity require that sufficient water is allocated for environmental purposes.** Ecological flows are essential to protect and restore freshwater-dependent aquatic ecosystems, and to deliver important and wide-ranging ecological services that, in turn, support cultures, economies, sustainable livelihoods, and well-being.[61] However, in most countries, there is a lack of technical understanding around ecological requirements at multiple stakeholder levels, and a lack of consistent, easy-to-use, readily available data required to implement ecological flows, which requires baseline information to be available and a process to incorporate such information into the targets that define the desired future state of management classes. [62]

105. **Recognition of ecological flows has evolved since the late twentieth century to encompass a range of different terms and concepts** (Box 1). These include flow variability, river connectivity (longitudinal and lateral), ecosystem services and human well-being, among others. The Brisbane Declaration and Global Action Agenda on Environmental Flows (2018) defines *environmental flows as "the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being."* In this definition, aquatic ecosystems include rivers, streams, springs, riparian, floodplain and other wetlands, lakes, freshwater dependent coastal water bodies, including lagoons and estuaries, and groundwater dependent ecosystems (GDEs).

106. **Many different methods have been developed to quantify ecological flows.** Common approaches for evaluating and ensuring ecological flows can be classified into four main categories of increasing complexity: (i) lookup tables – methods that define ecological flows by rule-of-thumb, based on simple indices; (ii) desktop analysis – methods that are based on statistical analysis of time series of available data (either hydrological data only or hydrological data with ecological data); (iii) functional analysis – methods that link aspects of hydrology with ecology (i.e., direct response of species); and (iv) hydraulic habitat analysis and modeling – methods that link hydraulic characteristics with ecology. Implementation of ecological flows requires a complementary suite of policy, legislative, regulatory, financial, scientific, and cultural norms and values that ensure effective delivery and beneficial ecological and societal outcomes.

Box 2: Some terms related to providing water for the environment

Environmental Flows: defined by the Brisbane Declaration (2018 update) as describing the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being.

[61] Arthington, et al. (2018). The Brisbane Declaration and Global Action Agenda on Environmental Flows. Frontiers in Environmental Science, 6(45) (link).

[62] Sood, et al. (2017). Global environmental flow information for the sustainable development goals. Colombo, Sri Lanka: International Water Management Institute.

Environmental Water: commonly used in South Africa and Australia, this term refers to water managed to deliver specific ecological outcomes or benefits. It may refer to specific water allocations or releases made for ecological purposes.

Healthy Working River: a river that is managed to provide a sustainable compromise between the condition of the river and the level of human use. A water regime based on the healthy working river approach would not return an aquatic system to pristine condition. It would, however, sustain ecological objectives indefinitely.

Instream Flow Requirements: an older term, rarely used now, that originally addressed flows for maintaining fish habitat. The focus then was on low flows in the wetted channel, and typically did not consider riparian zones, floodplains, water quality, geomorphology, other biota, floods greater than the annual one, or social aspects.

Minimum Flow: a general term mainly used to describe a flow that must be maintained without further reduction over a specified period—generally either during the dry season or over the whole year. It implies that ecosystem functioning can be protected through the delivery of a minimum and constant flow; whereas evidence shows within- and between-year flow variability is essential to maintain healthy rivers.

Downstream Flow: this term indicates the final flow regime once environmental flows and flows for other water demands, such as irrigation and hydropower generation, have been combined.

Defining "levels necessary to sustain" or "sustainable compromises between river condition and human use" is a difficult challenge often involving deeply political decisions and tensions between social groups with very different values. Each of these terms hides complex interactions between ecosystems and human activities working at multiple spatial and temporal scales. While science can inform these decisions, it cannot make them.

Source: AWP and World Bank (2021)

107. **China has conducted ecological flow practices for around 40 years and a calculation standard of ecological flow in rivers and lakes was issued by the Ministry of Water Resources in 2014.** The standard specifies the calculation standards of holistic ecological flow, including in-stream and off-stream ecological flows. In-stream ecological flow is defined as the flow required to maintain certain ecological functions in rivers, lakes and wetlands. Off-stream ecological flows usually include the water needs of urban green spaces, the water needs of urban cleaning and water landscape, the water requirements of forests and grasslands, and the water needed to recharge lakes and wetlands.

108. **In April 2020, the Ministry of Water Resources issued an opinion to strengthen the determination and ensure ecological flows for important rivers and lakes, including the mainstream and major tributaries of the Yangtze River Basin**.[63] The opinion has the major objectives to determine the ecological flow targets for important rivers and lakes, establish the ecological flow monitoring and regulation system, and ensure environmental flows for the mainstream and major tributaries of the Yangtze River by 2025. The opinion requires the river basin commissions and local water departments to consider the environmental flow requirements as rigid targets in water allocation. For the existing reservoirs and hydropower stations, the water administrative departments and the ecology and environment departments should work together to verify/determine their ecological flow targets. The opinion also requires the river basin commissions and local water departments to establish an early-warning mechanism for ecological flow. According to different flow thresholds, various actions should be taken to ensure ecological flows, such as reservoir regulation, water withdrawal reduction, and emergent environmental water replenishment.

109. **In July 2020, the Ministry of Water Resources further issued the 'Working Plan to determine**

[63] Guiding Opinion on Determining and Ensuring Environmental Flows of Rivers and Lakes *(link)*

ecological flow for important rivers and lakes.'[64] This sets target to determine ecological flows for rivers with catchment area larger than 1,000 km^2 and lakes with surface area larger than 10 km^2 that are either trans-provincial, with ecological significance, or within key national strategic regions, such as the Yangtze River and Yellow River basins. Determination of ecological flow requirements for 52 rivers and lakes in the Yangtze River Basin were included in the tasks for CWRC from 2020 to 2022, including Xiang, Zi, Yuan and Li Rivers in Hunan and the Gan, Fu and Xin Rivers in Jiangxi. Jiangxi and Hunan are responsible for determining the ecological flows for Poyang Lake and Dongting Lake.

110. **In December 2020, Ministry of Water Resources issued the second batch of targeted rivers and lakes for ecological flow determination.** The Notice highlighted that CWRC has established an ecological flow management platform and realized real-time monitoring and dynamic supervision of ecological flow of 42 main control sections in the Yangtze River. Several provinces in the YREB (e.g., Sichuan, Hunan and Chongqing), have also established ecological flow monitoring platforms to enhance monitoring and forecasting to ensure ecological flows. Going forward, the MWR has laid out tasks to further determine ecological flows for important rivers and lakes, ensure ecological flows based on the river and lake chief systems enhance the monitoring, forecasting and evaluation of ecological flows and ultimately to establish a comprehensive system to achieve ecological flow targets.

111. **The Yangtze River Protection Law that came into effect in March 2021 further commits the State to strengthening the protection of ecological water use in the Yangtze River basin (Article 31).** The water resources departments, in conjunction with other relevant departments, are required to determine ecological flow control indicators for the Yangtze River's mainstream, major tributaries and important lake sections. Other river and lake ecological flow control indicators are to be determined by the water resources departments of the local governments in conjunction with the relevant departments. While the provinces are working on systems to determine water allocations to the municipal level and ecological flows, water allocation formulas are still based on relatively simplistic hydrological indices to determine minimum flow requirements rather than detailed assessments of ecological requirements.

112. **The law requires the relevant river basin management agencies of the water resources department to include the ecological water volume in the annual water allocation plan**. This volume must meet the basic ecological flow demand of rivers and lakes, ensure the ecological flow during the dry season and fish spawning period, the water volume and water level of important lakes, and maintain a balance in salt water and fresh water in the Yangtze River estuary. Further, the law requires that the water conservancy, hydropower, and shipping hub projects on the mainstream and major tributaries of the Yangtze River, and the upper reaches of important lakes in the Yangtze River basin incorporate ecological water allocation into daily operation and allocation procedures and establish a regular ecological allocation mechanism to ensure the ecological flow of rivers and lakes. Where the discharge flow does not meet the requirements of ecological flow discharge, the water resources departments at or above the county level shall determine corrective measures and supervises their implementation.

113. **According to the requirements of the Yangtze River Protection Law, the river basin commission and provincial governments are required to work together to formulate water allocation plans for inter-provincial rivers.** These are submitted to the State Council or its authorized departments for approval. These plans stipulate the water quota allocated to various provinces within the basin and clarify the annual flow amount and minimum flow rate requirements for the interprovincial sections and other important sections. However, such plans only establish the water quota at the provincial level, which requires a further allocation to the county level or even water user level. More detailed plans and requirements are

[64] MWR (2020). Notice of the General Office of the Ministry of Water Resources on the Work Plan for Determining the Ecological Flow of National Key Rivers and Lakes. Ministry of Water Resources (link).

needed based on the following process:

(i) *The water use quota needs to be allocated to the county level and water user level*. Water users can receive water use rights through the application of water withdrawal permits. Market mechanisms, such as trading of water (use) rights, can also be introduced to promote more efficient water allocation and create incentives for water saving.

(ii) *More detailed water allocation plans are required to ensure ecological flows.* The overall allocation plan only has the requirements of the annual flow amounts and minimum flow rates for specific sections. It does not consider the intra-annual variations, nor the more comprehensive ecological flow requirements. More detailed water allocation plans are needed to determine the annual, seasonal, and monthly allocations required to ensure ecological flow requirements. Water dispatch plans are also required to manage basin water use, jointly operate reservoirs, and respond to the emergencies of droughts and water contamination disasters.

(iii) *Water allocations should consider the requirements of both water quantity and quality.* Integrated water and environment management approaches are needed to consider the interactions between water use management and water pollution control. Integrated hydrological and water quality models can provide useful information for such allocation.

114. **The allocation of water from the Yangtze River to the provinces is still under review and approval.** The water allocation of Jinsha River (i.e., the upper stretch of the Yangtze mainstream) was approved in August 2020, while the water allocation plans for the middle and downstream reaches of the mainstream of the Yangtze River are still under review. While the water allocation plans for some tributaries have been issued, there is a need for more detailed and comprehensive water allocation plans to ensure ecological flow requirements are adequately allocated and support sustainable social and economic development.

115. **Both Jiangxi and Hunan provinces had identified the ecological flow requirements based on the minimum flow methods.** Two types of minimum flow methods are typically applied: (i) 10 percent of long-term average flow and (ii) the average flow of the driest month with 90 percent exceedance probabilities (i.e., Q90 approach). Other ecological flow requirements identified in relevant planning are also taken into consideration, such as the requirements from the Yangtze River Basin Integrated Planning, Gan River Basin Integrated Planning, and the water resources argumentation studies for important hydraulic infrastructures and hydropower stations. The final minimum ecological flow requirements are identified mainly on the higher flow results calculated from the two minimum flow methods, with some necessary adjustments to ensure the consistency with the requirements in other basin planning and studies.

116. **Sensitive ecological flow requirements are also identified for some specific river segments flowing through important ecological areas.** These important ecological areas include nature reserves, important wetlands and lakes, and critical aquatic germplasm areas. The breeding period of indicator fish species from April to June is considered as the ecological sensitive period. For the river segments flowing through the important ecological areas, the flow rate from April to June should also comply with the sensitive ecological flow requirements, which were identified as 30 percent of long-term average flow.

117. **Jiangxi and Hunan provinces had approved the basic ecological flow requirements for the major cross-sections in the Gan and Yuan River sub-basins.** Jiangxi Province had approved the basic ecological flow requirements for the mainstream and four key tributaries of the Gan River in December 2020, including the minimum flow requirements for all key cross-sections and the sensitive ecological flow

requirements for four cross-sections in the important ecological areas. Similarly, Hunan Province had approved the minimum ecological flow requirements for the Yuan River Basin in December 2019. These ecological flow requirements lay the foundation for ecological protection and restoration.

118. **In this context, the DLIs under the YRPERP are designed to ensure the compliance of these basic ecological flow requirements in the Gan and Yuan River sub-basins.** DLI.2 has the sub-indicator related to ecological flow, which is defined as "all approved control sections in the mainstream and major tributaries of the Gan River within Jiangxi Province/Yuan River within Hunan Province meet ecological flow targets 90 percent of days throughout a year." The ecological flow targets refer to the minimum and sensitive ecological flow targets approved by two provinces, including the targets for 17 control sections in the Gan River (including the sensitive flow targets for 4 sections) and 11 in the Yuan River (Table 21). Water resources agencies are responsible for the monitoring of daily flow rates at these cross-sections and submit the data to the River Basin Ecological Flow Monitoring and Management Platform operated by CWRC and MWR. The Provincial Department of Water Resources also publishes the ecological flow monitoring data for important rivers and lakes monthly. These data will provide the evidence to verify the compliance of ecological flow requirements under DLI 2.

Table 21: Ecological Flow Targets of Approved Control Sections in Gan and Yuan River

Gan River Basin in Jiangxi			Yuan River Basin in Hunan		
#	Cross-Section	Minimum Ecological Flow (m^3/s)	#	Cross-Section	Minimum Ecological Flow (m^3/s)
1	万安 Wan'an	138	1	洪江坝 Hongjiang Dam	120
2	栋背 Dongbei	148 (minimum flow) 318 (sensitive flow)	2	安江坝 Anjiang Dam	135
3	石虎塘航电枢纽 Shihutang Dam	164	3	铜湾坝 Tongwan Dam	140
4	吉安 Ji'an	198	4	清水塘坝 Qingshui Tang Dam	141
5	峡江 Xiajiang	221 (minimum flow) 492 (sensitive flow)	5	大伏潭坝 Dafutan Dam	153
6	外洲 Waizhou	281 (minimum flow) 645 (sensitive flow)	6	浦市站 Pushi Station	176
7	峡山 Xiashan	44.8 (minimum flow) 134 (sensitive flow)	7	五强溪坝 Wuqiangxi Dam	295
8	汾坑 fengkeng	19.8	8	怀化常德界 Huaihua-Changde Cross-section	295
9	翰林桥 Hanlin Bridge	7.72	9	桃源 Taoyuan Station	300
10	居龙滩 Julongtan	19.4	10	碗米坡坝 Wanmipo Dam	28.3
11	丰州 Fengzhou	1.64	11	凤滩坝 Fengtan Dam	48.4
12	上犹江 Shangyoujiang	8.03			
13	坝上 Bashang	19.8			
14	上沙兰 Shangshalan	14.1			
15	新田 Xintian	10.1			
16	江口 Jiangkou	11.3			
17	高安 Gaoan	18.4			

Source: Jiangxi Department of Water Resources; Hunan Department of Water Resources.

119. **More comprehensive ecological flow requirements would reflect international best practice.** The current ecological flow determination in the Gan and Yuan River Basin minimum flows, following the general national technical guidance. The simple minimum flow targets have established the basic requirements to safeguard ecosystems and limit unsustainable water use that would be significant harmful to the water resources and ecosystems. However, the minimum flow only sets a constant flow target, while it is now recognized that interannual and intra-annual flow variability is essential to maintain ecosystem function. More comprehensive ecological flows require water flow, velocity, temperature and quality targets to support river ecosystem health, based on detailed assessments of river health and

ecological requirements.

120. **To this end, the YRPERP will develop sub-basin level guidelines for river health and ecological flows, and subsequently update the ecological flow requirements in the Gan and Yuan River Basins.** In addition, as part of the central basin IPF, the Program will support the development of river and lake ecosystem evaluation guidelines for the overall Yangtze River Basin, including technical guidance for the ecological flows with best international practice. At the Provincial level the Program (under Results Area 2) will determine the more comprehensive ecological flow requirements for the Gan and Yuan River Basins. The Program will also support the monitoring and supervision of ecological flows at the provincial level. The achievements of these interventions will be measured by two intermediate indicators of "basin-level water-based ecosystem evaluation guidelines developed" and "ecological flow requirements determined for demonstration sub-basins," and will be incorporated in DLI.2.

121. **The Program will also support the development and implementation of water allocation schemes at county level and incorporate the ecological flow requirements into water allocation plans.** Currently, both Jiangxi and Hunan provinces allocate water at the municipal level. More detailed water allocation plans are needed to further allocate water resources down to county level. The ecological flow requirements should be incorporated into the water allocation schemes to ensure long term restoration and protection of ecosystem services. The achievement of water allocation interventions in the Gan and Yuan River sub-basins will be measured by one intermediate indicator of "Water allocation schemes for the demonstration sub-basins implemented".

5.2.3 Results Area 3 Reducing Water Pollution and Transmission of Plastic Waste

122. **The Yangtze River Protection Law requires governments to address point source and non-point source pollutants entering waterways.** Article 47 requires county level governments to make overall plans for the construction of centralized urban and rural sewage treatment facilities and supporting pipe networks, to ensure their normal operation and improve urban and rural sewage collection and treatment capacities. It also emphasizes the need to clarify the responsible entities and implement unified management. Similarly, Article 48 commits governments to strengthening the prevention and control of agricultural non-point source pollution in the Yangtze River basin, with the application of chemical fertilizers and pesticides to be reduced, the use of organic fertilizers to be promoted, and agricultural waste such as agricultural film and crop straw to be appropriately disposed. Article 46 requires provincial Governments to formulate a total phosphorus pollution control plan and organize implementation. Support for counties to address these priorities is the focus of results area 3.

5.2.3.1 Improving Point Source Pollution through Improved Wastewater Management

123. **China has invested substantially in its wastewater infrastructure systems since the 1996 amendment of the 'Water Pollution Prevention and Control Law.'** Around the same time, the State Council issued the 'Decisions on several environmental protection questions' to promote the development of the urban wastewater treatment sector. Since then, the number of newly constructed wastewater treatment plants every year increased from under 10 to nearly 100. Daily urban wastewater treatment capacity has increased from 7.14 million m^3 in 1995 to more than 200 million m^3 in 2019, with more than 5000 domestic wastewater treatment plants with a daily treatment capacity of more than 200 000 000 m3/day. Wastewater drainage pipeline has increased from 110,293 km to 630,304 km throughout this period. In 2017, the urban wastewater treatment rate reached 94.54 percent in China.

124. **With nearly universal coverage, the emphasis of China's wastewater treatment sector now is to improve the quality of services as well as the efficiency of operations.** In June 2020, the NDRC and

MoHURD issued the '14th Five-year development plan on municipal wastewater treatment and reuse'. The plan points out that insufficient or ill-maintained wastewater networks pos a main challenge for China's wastewater sector. Wastewater collection is separated from wastewater treatment in most localities in China. While treatment plants are constructed and operated by wastewater companies, the sewerage network is normally built and run by a municipal department. Local governments often levy an "urban infrastructure" component in local taxes which is intended for the construction of the sewerage network, among other local infrastructure investments, as local governments are often concerned about the high cost of building and maintaining the sewerage network driving tariffs above affordability thresholds for residents and enterprises. However, this arrangement results in large portions of the wastewater collection network lacking sufficient funding for maintenance and thus in poor quality, which leads to low pollution concentration of intake water of wastewater treatment plants; and idle capacity of wastewater treatment plants.

125. **Additional gaps include the conditions and coverage of the sewer network in some urban areas**. These gaps are due to rapid urban expansion, combined wastewater and storm water collection systems that dilutes organic strength, relatively high energy and/or chemical consumption in some plants, limited number of anaerobic digestors for solids reduction, various and complex local conditions and standards, and high sludge disposal cost.[65] Challenges are particularly acute in small towns, particularly the county seat towns, which are the focus of YRPERP interventions.

126. **The National 14th Five-Year plan aims for centralized collection of municipal wastewater to reach over 70 percent.** It also aims for counties' wastewater treatment rate (wastewater treated versus wastewater generated) to reach over 95 percent, both requiring improved collections. The plan thus also calls for stepping up construction and improvement of wastewater collection and urges localities to complete the sewage pipe network and build and renovate 80,000 km of sewer pipes. The plan also stresses enhancing the operation and maintenance of wastewater treatment facilities and network through a variety of measures, including promoting 'Plant-Network-River' Integrated Management through specialized operation service providers.

127. **Jiangxi and Hunan provinces are targeting improved water systems in line with the central government ambition.** Jiangxi province issued the 'Implementation plan to make up shortcomings of urban wastewater treatment facilities' (Jiangxi Implementation Plan) in July 2020.[66] This required all newly build and renovated wastewater treatment facilities to be complemented with sufficient network to ensure wastewater treatment plants being sufficiently utilized. For wastewater treatment plants with intake wastewater COD concentration lower than 100 mg/L, network of the service area would need to be improved. Hunan province issued a 'Four-Year Action Plan for the Construction of Township Sewage Treatment Facilities in Hunan Province (2019-2022)' (Hunan Action Plan),[67] which aims to have full coverage of wastewater treatment capacity in townships by 2022. The Plan follows a set of principles of 'government leads, market operates, unified planning, phased promotion, county coordination, bundled implementation, plant-network integration, and emphasis on both construction and operation'. It requires new wastewater treatment plants' operation loads to reach 50 percent within one year and to then increase gradually. Integrated 'Plant-Network' management needs to be strictly implemented with wastewater plants and complementary networks being designed, constructed, and accepted simultaneously. Emphasis was given to household connections in densely populated areas to make sure wastewater collection rate exceeds 80 percent.

[65] Yan Zhou (2021). Water and environment innovation in Singapore and China. *Water and Environment Journal,* 863-864.

[66] http://zjt.jiangxi.gov.cn/art/2020/8/7/art_40712_2695664.html

[67] http://www.hunan.gov.cn/hnszf/xxgk/wjk/szfbgt/201909/t20190909_10267257.html

128. **Detailed assessment of the wastewater collection and treatment systems in the demonstration counties reveal that almost all counties have sufficient wastewater treatment capacity.** However, the asset management concept and preventive maintenance are not yet well established in the small-town wastewater management services. In this context, the YRPERP is designed to address the key remaining challenges, including: (a) the domestic wastewater management services are fragmented, with the treatment plants being managed by one entity, mostly outsourced private sector operators, while the sewer network is managed by the county bureau or county-level public entity or company, resulting in a lack of accountability for ensuring service quality; (b) influent concentrations (BOD and COD) to the treatment facilities are usually very low as a result of the combined effect of incomplete collection networks and household connections, mixed wastewater and stormwater drainage, and poor conditions of the existing network due to deferred maintenance, resulting in most of the wastewater treatment plants (WWTPs) operating at a low efficiency level; and (c) a lack of sustainable financing with the costs of the domestic wastewater management services covered from two sources: (i) a wastewater service charge paid by the customers which typically covers only the outsourced treatment service provider who is responsible for the O&M of the WWTP and (ii) subsidies through budget allocations from the county finances; which are used for O&M of the wastewater collection system and often limited to urgent repairs.

129. **In addition, gender gaps exist between men and women working at local rural water treatment utilities in terms of access to jobs and equal for the same types of jobs.** An assessment based on a sample of demonstration counties found women were not equally represented in the local rural water treatment utilities, including technical positions and managerial positions. All four rural water treatment utilities reportedly have policies for equal recruitment and pay, as well as equal training opportunities for both male and female staff. However, the gender pay gap as discussed above indicated possible gaps in actual implementation of these policies. On average, female staff also earn 25 percent less than male staff, particularly for women in managerial positions. Although the sample was limited, there were exceptions observed with female technical staff in two of the utilities earn higher than their male counterparts. The survey further found that in average, the duration of employment for women in these utilities are four years less than men, and only one utility reported having maternal facilities.

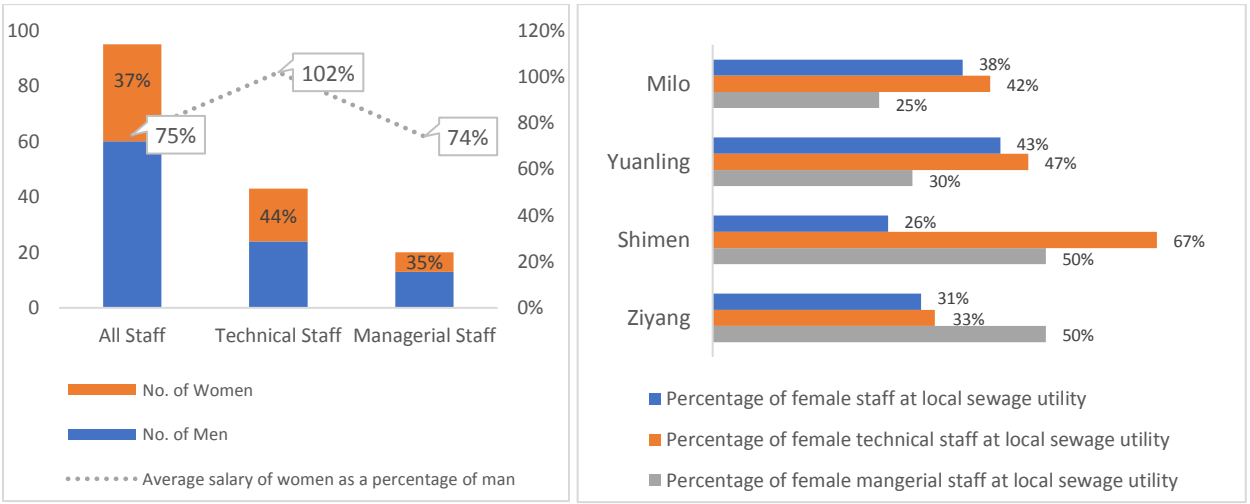


Figure 9: Proportion of women in staff positions at wastewater treatment facilities in demonstration counties.

In responding to the deficiencies identified, the Program includes a sub-DLI (DLI3-1) to incentivize financially sustainable and integrated township domestic wastewater service systems. This is defined by counties having: (1) An integrated wastewater management strategy in demonstration counties developed, including financial sustainability, integrated O&M, employment equity, workforce roadmap for women and climate resilience and low-carbon technologies; (2) Increase in COD reduction (influent COD minus discharged COD) at township-level wastewater treatment plants; and (3) An integrated institution: One entity responsible for O&M of sewer network and wastewater treatment plants.

5.2.3.2 Addressing Non-Point Source Pollution through Manure Management

130. **China's livestock subsector is a major contributor of non-point sources of pollution**. It accounts for 96 percent of the Chemical Oxygen Demand (COD), 38 percent of nitrogen, and 56 percent of phosphorus entering river systems. According to the Ministry of Agriculture, animal manure production amounts to nearly 4 billion tons per year,[68] with untreated manure and wastewater from livestock and aquaculture operations polluting waterways with fecal pathogens, nutrients (nitrogen and phosphorus), heavy metals, and drugs (antibiotics). According to the Second National Pollution Source Consensus (2010), COD discharge from the Livestock and Poultry Breeding Industry amounted to 10.01 million tons, contributing 93.76 percent of agricultural pollution; total nitrogen and total phosphorous discharges amounted to respectively 0.60 million and 0.12 million tons, contributing 42.14 and 56.46 percent of agricultural pollution.

131. **Cognizant of these challenges, the Ministry of Agriculture issued the 'Action Plan to achieve zero chemical fertilizer growth until 2020'[69] in 2015.** This was the first effort to seriously curb the overuse of chemical fertilizers and pesticides in China and outlined four ways to reduce chemical fertilizer consumption: (i) precision fertilization; (ii) fertilizer structure improvement; (iii) fertilization methods improvement; and (iv) promoting organic fertilizer. Zero growth of fertilizer consumption was included as a target in the 2016 CPC Number 1 document while the ambition was elevated in the 2019 and 2020 CPC Number 1 document to realize fertilizer reduction. Subsequently, the Ministry of Agriculture issued the 2017 Notice of Five Actions for Green Development of Agriculture, including: (a) improving management of livestock manure, (b) replacing chemical fertilizers with organic fertilizers, (c) encouraging straw treatment, (d) recycling agricultural plastic, and (e) aquatic biodiversity protection.

132. **The 'Opinions on accelerating resource utilization of Livestock and Poultry Breeding Waste' were also issued by the State Council in 2017.** This requires the national rate of resource utilization of animal manure from Livestock and Poultry Breeding to reach 75 percent by 2020, and waste treatment facility coverage of large-scale farms to reach 95 percent.[70] The Ministry of Agriculture subsequently issued the 'Resource Utilization of Livestock and Poultry Manure Action Plan (2017-2020),'[71] selecting 51 nationally important counties throughout the country to promote the utilization of livestock and poultry manure. Among the 51, 8 counties are located in Hunan Province, ranking first among provinces.[72]

133. **In March 2020, the Ministry of Ecology and Environment issued an 'Implementation Plan for Agricultural Non-Point Source Pollution Treatment and Supervision (Trial)'.[73]** This outlined overall tasks

[68] http://news.sina.com.cn/o/2017-08-30/doc-ifykpuuh9661008.shtml

[69] http://www.moa.gov.cn/nybgb/2015/san/201711/t20171129_5923401.htm

[70] http://www.gov.cn/zhengce/content/2017-06/12/content_5201790.htm

[71] http://www.moa.gov.cn/nybgb/2017/dbq/201801/t20180103_6134011.htm

[72] http://agri.hunan.gov.cn/agri/xxgk/gzdt/snyw/dtyw/201708/t20170817_4396364.html

[73] http://www.gov.cn/zhengce/zhengceku/2021-03/26/content_5595893.htm

for comprehensively controlling agricultural non-point source pollutions in important regions, especially the Yangtze River and Yellow River basins. Targets for 2025 include those for chemical fertilizer reduction, animal manure resource utilization, agricultural mulch recycling, among others. The Plan also lays out tasks to establish monitoring networks in piloting areas, develop technology catalogue and policy framework and to explore innovative financing mechanisms, including pollution trading mechanisms between point and non-point source pollutions.

134. **Collection, separation, treatment and re-use or safe disposal, is critical for addressing the challenge of non-point source agricultural pollution.** The collection and separation of animal wastes (dung from urine), proper disposal of treated solids and liquids, and recycling (compositing organic fertilizers, or using for waste to energy in biogas facilities) is not widely practiced in livestock production operations but can have significant benefits. Manure is rich in nutrients, including trace elements necessary for crop growth. Approximately 70-80 percent of nitrogen (N), 60-85 percent of phosphorus (P), and 80-90 percent of potassium (K) found in feeds is excreted in the manure.[74] These nutrients can replace fertilizer needed for pasture or crop growth, eliminating the need to purchase fertilizers. Furthermore, compared to commercial fertilizer, manure contains organic carbon, which is the key to maintaining soil health, including the characteristics of cation exchange capacity, soil tilth, and water holding capacity.

135. **Hunan Province ranked second nationally in livestock and poultry production in 2018.** According to the Second Provincial Pollution Source Consensus of Hunan (2020), the province's livestock and poultry industry generated 0.62 million tons of COD, 8.9 thousand tons of phosphorus and 38.4 thousand tons of nitrogen, contributing 48.6 percent of total COD pollution, 19.97 percent of total nitrogen and 39.91 percent of total phosphorus discharges in Hunan. [75] The provincial government has undertaken several measures to reduce pollution from livestock and poultry breeding industry and promote the resource utilization of animal manure. In 2017, Hunan Provincial Government issued the 'Implementation Opinions on accelerating the resource utilization of livestock and poultry manure'[76], which required an increase in the waste treatment facility coverage of large-scale farms to 95 percent by 2020, and increase the resource utilization rate of animal manure to 75 percent, in line with national targets. The resource utilization rate of animal manure in Hunan reached the target of 75 percent in 2020. The main use of treated animal manure was as a replacement for chemical fertilizers, which could further reduce agricultural non-point source pollution, as well as producing gas and electricity. The next steps during the 14th Five-Year Period include: (i) further increasing the resource utilization rate to 85 percent; (ii) establishing a system of animal waste treatment, processing and returning to the field as fertilizer; and (iii) attracting private financing through innovative modes, including PPP and other mechanisms.

136. **Jiangxi Province has included 'zero chemical fertilizer growth' as an indicator into a range of government performance evaluation systems since 2015, including for the river chief system and the strategy for the Yangtze River Economic Belt**. This followed a rapid increase in the use of synthetic chemical fertilizers, from 1.032 million tons in 1993 to 1.436 million tons in 2015, with chemical fertilizer consumption rates higher than the national average and exceeding levels considered safe under global guidelines.[77] This was driven mainly by rice cultivation, with over 3.3 million hectares (61 percent of the total arable land area) moving to a predominantly double cropping system, with major regions in the Poyang Lake plain (considered to be the origin of rice) and the lower Gan and Xiu river valleys. This resulted

[74] https://ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/manure-nutrient-resource

[75] Second Pollution Source Consensus of Hunan (2020) (link).

[76] http://www.hunan.gov.cn/xxgk/wjk/szfbgt/201711/t20171128_4877717.html

[77] Very high application rates of N fertilizers (up to 400 kg/ha) were common in Jiangxi, compared to an optimum rate of between 104 and 192 kg/ha.

in increasing levels of nitrogen and phosphorus in surface and ground water with corresponding water quality issues in the lake. In response, Jiangxi has realized continuous reduction in chemical fertilizer consumption during the 13th Five-Year period[78] from 1.42 million tons in 2016 to 1.16 million tons in 2019, owing to a combination of institutional, financial and technical measures.

137. **Responding to these challenges and in line with government ambitions, the Program includes a sub-DLI (DLI3-2) to incentivize increased collection, use and treatment of livestock and poultry manure.** The county level utilization ratio will be measured on farm sites, with the aim of gradually increasing the level of animal manure utilization in selected counties and maintaining the level of utilization where it is already high (no less than 80 percent). This intervention will be complimented by the development and dissemination of a provincial agricultural NPS pollution management best practice guidelines.

5.2.3.3 Reducing plastic waste entering waterways

138. **Marine plastic[79] pollution has emerged as an issue of global concern due to its potential long-term ecological, economic, and eco-toxicological effects**. Production and demand for plastic products has increased exponentially over recent decades. Around 80 percent of marine plastic debris is coming from land-based sources and the leakage of plastics into rivers and transmission to the oceans has been growing. Of the 10 rivers reported to contribute up to 95 percent of all marine plastics transported by the world's rivers, eight are found in Asia with many originating in China.[80] Among these, the Yangtze River Basin is reportedly the largest, with an annual input estimated around 0.33 (range 0.31–0.48) million tons of plastic that is discharged into the East China Sea.[81] Pollution control and plastic management in the Yangtze River Basin will therefore be pivotal in efforts to reduce marine plastic pollution globally.

139. **China produces the largest quantity of plastic, at nearly 60 million tons, followed by the US, Germany and Brazil.[82]** China has embarked upon a series of policy initiatives to combat its emerging plastic pollution issues. It has started to ban the import of various types of waste recycling materials, including plastic wastes, since July 2017. In 2018, the State Council issued the 'Waste-free City Piloting Method' and the Ministry of Environmental Protection announced that 11 cities in 2019 would pilot comprehensive programs for improving the management of all types of solid wastes. In 2020, NDRC and MEE issued the 'Opinions on further strengthening plastic pollution control' that envisaged measures to ban the use of certain single-use plastic items, substitute many other single-use plastics with biodegradable materials, regulate the use of agricultural plastic mulch, improve monitoring, reporting and supervision, and promote eco-design and material recycling.

140. **Plastics management[83] efforts in China are multisectoral, under transition and evolving very**

[78] https://www.sohu.com/a/421558569_99932204

[79] Plastic debris can generally be classified by size as macro-plastics (> 5 mm in diameter) and micro-plastics (< 5 mm in diameter).

[80] Schmidt, Krauth and Wagner (2017) Export of Plastic Debris by Rivers into the Sea. *Environmental Science and Technology*, 51, 21, 12246-12253. (link). The eight in Asia include: the Yangtze; Indus; Yellow; Hai He; Ganges; Pearl; Amur; Mekong; with two in Africa – the Nile and the Niger.

[81] Lebreton, et al. (2017). River plastic emissions to the world's oceans. *Nature Communication*: 8, 15611.

[82] https://ourworldindata.org/plastic-pollution

[83] By "Plastics management" this document includes the comprehensive set of solutions to address plastics pollution in the environment. Plastics management requires a combination of interventions from policy reforms, behavior change to infrastructure improvement along the whole lifecycle of plastics, from end – of – life capture to transitioning to a more circular approach, all of the solutions ultimately contributing to the prevention of plastic pollution in the environment and in the ocean. Stopping plastics leakages to the environment will therefore require both improving solid waste management and capturing microplastics in water treatment plants. Transitioning to a circular economy means bringing together the public and private

quickly, either in the solid waste management sector or efforts towards circular economy. Sector developments are driven by efforts to reduce pollution and transition to more sustainable practices. A major policy effort is underway, led by the NDRC, and it is expected that national regulation will include measures to ban the use of certain single-use plastic items, substitute many other single-use plastics with biodegradable materials (the nature of which is also subject to discussion), regulate better the use of agricultural plastic mulch, improve monitoring, reporting and supervision, and promote eco-design and material recycling. This will complement other recent programs and regulations at various levels of jurisdiction, such as the Waste-free City Initiative (December 2018)[84] and the new Law on Solid Waste (April 2020). The World Bank is supporting such efforts through the Plastic Waste Reduction Project ("PWRP")[85], through financing for policy measures envisaged under the NDRC's 2020 policy note "Further Strengthening Plastic Pollution Control."

141. **Several ministries have responsibility for plastics management.** Responsibilities are shared for solid waste management, with municipal solid waste under the MOHURD, and material recycling management overseen by the MOC. Environmental monitoring and supervision of all waste management and material recycling facilities is the responsibility of the MEE. Finally, the NDRC is in charge of the development of circular economy and plastics management policies at the national level. An important dimension for this operationalization is the urban and rural context of provinces, when it is recognized that urban China has near universal urban MSW collection and safe disposal, but only half of the rural MSW is disposed safely. China is estimated to have a recycling rate of about 16 percent.[86]

142. **Plastic debris sources include mismanaged waste, either by being directly dumped in waterways or leakages during waste transport, or not properly collected and ultimately transported by run-off to waterways.** These are carried on by waterways and rivers to the sea, where they become marine debris. Microplastics have been found in other countries in water supplies, freshwater, ice, rain, air, and sediments.[87] While there is no country specific data available and the extent of microplastics in the environment globally is not well known, about 1.5 million tons per year may reach the oceans and come mainly from synthetic textiles abrasion during laundry, tire erosion, textiles laundry (microfibers), city dust in run-off water.[88]

143. **China is estimated to produce more than 400 million tons of municipal solid waste (MSW) per year of which approximately 12 percent is plastic.[89]** As with other municipal services, waste service levels tend to decrease geographically from the eastern coastal cities to the west; and rural areas lag significantly compared to their urban counterparts. In 2017, according to the China's Statistical Yearbook, 215 million tons of MSW were collected and transported from the 660 Chinese cities, of which 98 percent were treated and disposed of in facilities that meet Chinese national standards. For rural areas, official statistics are scarce since the collection, transportation and treatment services are not well established, and reliable

sectors and providing an enabling environment for the private sector to invest and innovate, changing perceptions of waste to value and supporting behavior change on behalf of the industry and by consumers, using innovative policy options for plastic management. It includes improving recycling, introducing standards, alternatives to single-use plastics and more recyclable material, that will also contribute to the reduction of the upstream production and use of plastics whenever possible (for example when a sustainable, affordable alternative exists).

[84] "Waste-free City" Initiative approved by the State Council (December 29, 2018) where 10+ cities are expected to pilot comprehensive programs to improve the management of all types of solid waste.

[85] World Bank (2021). China Plastic Waste Reduction Project. Online Documents *(link).*

[86] Data compiled by PWRP task team, from various reports issued by NDRC and Ministry of Finance in 2020.

[87] World Bank (2019). Quality unknown: The Invisible Water Crisis, World Bank, Washington, D.C. *(link).*

[88] Boucher and Friot (2017). Primary Microplastics in the Oceans: A Global Evaluation of Sources. IUCN, Washington, D.C.

[89] Urban and Rural Municipal Solid Waste in China and the Circular Economy, World Bank (2019)

data is not available. Estimates based on rural population and the average MSW generation rate indicate that China's rural domestic waste generation in 2017 was about 175 million tons, of which at least 70 million tons were illegally dumped or burnt. Overall, it was estimated that approximately 47 percent of rural waste is disposed according to national standards.

144. **Addressing the sources of leakages requires a better understanding of the pathways, accumulation areas, vectors of transmission to the waterways, as well as the type of items and their origin.** One of the main bottlenecks for improving plastics management then becomes the lack of data on the transmission of plastics to waterways, and their characteristics as well as the flows of plastics into river systems. Currently there are very few field data available on the outflow of plastic waste to waterways in the Yangtze River. To fill this gap, a priority is to establish a baseline for plastics leakages in waterways, accumulations areas, typology of debris and sources of plastics to waterways, from point sources (e.g., water treatment plants) or non-point sources (e.g., from agricultural mulch). This baseline is critical to set targets, identify priority actions and investments, and develop a monitoring system.

145. **Addressing plastics pollution requires a combination of solutions, such as new policies, behavior change by consumers and industry, investments, innovation, and private sector interventions, customized to each country or municipality.** The World Bank's approach is comprehensive and follows the lifecycle of plastics: First, stop the leakage including from land-based sources, by for example improving waste management along rivers, within catchments and in coastal areas; Second, encourage a circular economy approach that includes Reduce (rethinking the source, Redesign), Repair and Remanufacture, Reuse and Recycle; Third, restore ecosystems, including clean up and removal of debris along rivers, on beaches and from waterways. This is a short-term solution, but necessary action for ecosystem recovery and one that can provide livelihoods. To be effective and sustainable, this approach would need to be supported by policy reforms—fiscal and regulatory—that create the incentives and generate financial resources to improve waste management systems, expedite the transition to circularity, and reduce plastic use.

146. **Among the different plastic plastics, agricultural mulch is a major contributor to riverine and marine plastic pollution due to the lack of management system in rural areas**. China has the world's largest agricultural mulch consumption as well as land coverage. In 2015, agricultural mulch use in China amounted to over 2.6 million tons, among which plastic mulch film amounted to 1.45 million tons, making up 75 percent of the global total[90] and covered around 20 million ha. Plastic mulching has played a key role in increasing the grain yields by 20-35 percent and cash crop yields by 20–60 percent contributing to improved dryland agricultural production and crop water use efficiency. However, it has also been found to contribute to reduced soil fertility and soil pollution from film residues. Film residues over time flow into the rivers, contributing significantly to marine microplastics pollution. The recycling rate of agricultural mulch is lower than two thirds.[91] Possible technical solutions include recycling plastic film, or using biodegradable cover, which impose additional costs and hence require regulatory and potentially financial incentives to increase adoption rates, with the assumption that materials used will not degrade

[90] According to Prof. Yan Rongchang from the Academy of Agricultural Sciences (link).

[91] MARA (2017). Notice of the Ministry of Agriculture on Issuing the "Agricultural Film Recycling Action Plan. (link)

into micro- or nano- particles of plastics[92]. In 2017, Ministry of Agriculture issued 'Action Plan for Recycling Agricultural Mulch' setting target of recycling 80 percent of agricultural mulch by 2020.

147. **Jiangxi Province has been a pioneer in combating plastic pollution.** In June 2020, Jiangxi formulated an 'Implementation Plan to Strengthen Plastic Pollution Management'.[93] The Implementation Plan set targets to ban the production, sale and use of several types of plastic products in selected areas and industries, such as single-use plastics in the catering industry. Substitute products and bio-degradable plastics are to be promoted by 2022 and a cross-sector plastic pollution management system established by 2025. In March 2021, Jiangxi further issued the 'Key tasks for plastic pollution reduction' and called for plastic wastes being removed from water bodies by cleaners mobilized by the River and Lake Chief System, for which the provincial Housing and Urban-Rural Development Department and River Chief Office in the Department of water Resources are responsible.

148. **Jiangxi Province has made good progress in increasing the coverage and collection rates of domestic solid waste collection.** Majority of the counties have built landfills and or incineration plants and have outsourced the collection and transportation services to private providers. While the practice of reduction at source, collection at village level, transfer at township level and disposal at county level is quite well established, there is no formal system established for collection and recycling of recyclable materials such as plastics. A system of sorting, recycling and differentiated transportation and disposal/treatment is being piloted in a small number of counties. A lake management platform and water monitoring systems has been established, providing the basis for plastics and solid waste information systems. Few counties have developed participatory processes around issues of water and solid waste management, that can provide the basis for strengthening participatory processes and raising awareness campaigns around plastic consumption and use. However, Jiangxi has a long way to go to establish such a system in the entire province despite the ambitious targets of collection and treatment rates it sets for the 14th FYP period.

149. **Hunan Province recorded a total amount of 83,792 tons of agricultural plastics in 2019, ranking 12th nationally and 5th in the YREB region**. In 2018, Hunan Department of Finance issued a 'Dongting Lake Ecological Environment Subsidy (2018-2020)'[94] providing a results-based financing scheme to counties located in the Dongting Lake area, with agricultural pollution reduction among the eight result areas. Other areas include urban pollution reduction, wetland protection, and vessel pollution reduction, among others. Several agricultural pollution reduction targets have been established, including completely recycling pesticide package and agricultural mulch, with CNY 10 million subsidy given as a reward to counties that reach all targets. In November 2020, Hunan Provincial Development and Reform Commission and Department of Ecology and Environment jointly issued the 'Implementation Plan to further strengthen plastic pollution control',[95] which set a target of an 80 percent recycling rate of agricultural mulch by the end of 2020 and almost complete recycling by 2025 with a complete agricultural mulch producing, selling, using, recycling and management system established for the whole province,

[92] Biodegradable plastics are polymers designed to weather and fragment in response to UV radiation. Concerns over such materials come from the biodegradation process and the products of the biodegradation, and the conditions required for the full degradation to happen. Some materials will degrade into tinier particles of the same polymers, creating micro- and nanoparticles of the polymer. In certain conditions in natural environments. Complete degradation can occur under the action of microbial action, and the complete degradation is considered when all polymers are broken down into carbon dioxide, methane and water. This process is temperature dependent and may not occur under natural conditions in agricultural soils, and may happen in conditions met in industrial composting sites. The characteristics of biodegradable is therefore crucial if they are considered as plastic films substitutes.

[93] https://www.ndrc.gov.cn/xwdt/ztzl/slwrzlzxd/zcwj01/202009/t20200916_1238875.html

[94] http://www.hunan.gov.cn/hnszf/hnyw/20180408_sxhy/wrfz/sxzxd/szbm_2/201808/t20180828_5084312.html

[95] http://www.app.czs.gov.cn/fgw/fzggdt/zlhj/content_3208432.html

which is to be led by the Department of Agricultural and Rural Affairs. The two main challenges for the collection of agricultural mulch membranes are: (a) to provide adequate financial incentives to farmers; and (b) establish financially sustainable channels for agricultural mulch membrane collection and recycling.

150. **In response to these challenges, The YRPERP will include incentivize measures to prevent plastic waste entering waterways by recycling agricultural mulch from the field (DLI.3).** Agricultural plastic film collection and statistics systems will be established with inventories made by the collection sites, including village-level solid waste sorting centers, farm plastic film sale sites, agro packaging material recycling stations, township-level waste recycling stations, and others. Farmers, especially large-scale farmers, will be required to use standard mulch films which can be recycled and reused. Provincial level support will also be included. To strengthen the monitoring and evaluation of agricultural mulch membrane collection, the Program will support development of a Provincial monitoring and evaluation protocol for agricultural mulch membrane collection and recycling in Jiangxi, as well as support the implementation of the Provincial Implementation Plan for Strengthening Plastic Pollution Management in Hunan. Analytics by the Bank and Tsinghua University are informing measures and baselines for agricultural plastics interventions, and further developing the Bank's and Government's understanding of other pollutant issues targeted by the Program (Box 3).

Box 3: Informing the Design of YRPERP through the Poyang Lake Water Pollution and Plastic Study.

Supported by the World Bank's ProBlue Trust Fund, Tsinghua University is conducting the Poyang Lake Water Pollution and Plastic Study to support the preparation of the YRPERP. Tsinghua University shared initial findings of the study with the related provincial departments and local research institutes. The study findings on water pollution, macro- and micro-plastics will be used to develop a fuller understanding of water pollution challenges in the target provinces, and to provide baseline data for some Project interventions. Tsinghua University plans to conduct the second round of water and plastic samplings in the water bodies, agricultural lands, and wastewater treatment plants in November, which will further inform implementation. Local governments are collaborating through facilitation of the plastic samplings in demonstration county wastewater treatment plants.

5.3 Definitions, Baselines and Targets in Demonstration Counties

Results Area 3 is incentivized through three sub-DLIs on wastewater service systems, agricultural plastics, and manure utilization. Results are defined by the achievements by the 11 demonstration counties. Specific definitions, baselines, targets, and verification procedures are presented below.

DLI 3-1: *Improved township domestic wastewater service system* is defined by the following three requirements, expected to be achieved on the timeline in Table 22.

1. *Integrated strategy issued:* county-level strategic plan for financially sustainable township wastewater services in demonstration counties developed, with specific focus on: (a) employment equality, security and career development and roadmap for women in wastewater utilities; (b) considering climate resilience of wastewater services and promoting low-carbon technologies for climate change mitigation;
2. *COD Reduced*: reduction in COD (influent COD minus discharged COD) at township-level wastewater treatment plants;
3. *Integrated institution*: One entity responsible for O&M of sewer network and wastewater treatment plants.

Verification is achieved by (1) County-level integrated wastewater strategies are publicly disclosed at county government websites; (2) Influent COD and discharge COD verified according to automatic real-time monitoring records by environment authority, and (3) Institutional integration verified by valid contracts of integrated county wastewater collection and treatment services.

Table 22: Expected schedule of results associated with DLI3-1 (Improved township domestic wastewater service system) (see also Program results framework).

		Demo County	Beneficiary (10000)	WW Strategy	Integration Contract	COD reduction (tons)					
						Base	Y1	Y2	Y3	Y4	Y5
Hunan	1	Wangcheng		2023	2025	5727	5847	5967	6088	6208	6329
	2	Miluo	15.5	2022	2025	582	633	673	723	773	873
	3	Shimen	16.5	2023	2024	1255	1438	1518	1610	1668	1840
	4	Ziyang	26	2022	2022	5290	5400	5500	5610	5730	5840
	5	Yuanling	9	2022	2025	434	851	1718	2041	2262	2785
	Total		**67**			**13289**	**14168**	**15376**	**16071**	**16641**	**17667**
Jiangxi	6	Chongyi	6	2022	2022	449	456	461	494	494	494
	7	Yudu	27	2022	2022	1410	1424	1452	1495	1551	1558
	8	Dayu	9	2023	2024	715	725	730	736	739	746
	9	Yongfeng	6.22	2023	2023	314	321	328	337	341	347
	10	Fuliang	7.6	2022	2024	341	479	547	593	640	717
	11	Yugan	14.3	2023	2023	374	527	565	653	675	711
	Total		70			3603	3932	4083	4308	4440	4574
Total			**137**			**16892**	**18100**	**19459**	**20379**	**21081**	**22240**

Notes and Sources: Base is 2021; subsequent years are 2021-26. Data from demonstration counties collected by Bank team.

DLI 3-2: *Plastic waste (agricultural mulch) prevented from entering water bodies* is defined by the weight (tons) of agricultural plastic mulch film collected and recycled. Achievement is expected according to the timeline in Table 23. Verification is ensured by random selection of inventories at 10 percent of farms made by farm plastic film collection and treatment network sites (including agro-input sale networks, solid waste sorting centers, recycling centers, and so on) in the demonstration counties.

Table 23: Expected schedule of results associated with DLI3-2 (agricultural plastics, tons) (see also Program results framework).

#	Demo County	2000 baseline			2022			2023			2024			2025			2026		
		Use (tons)	Collection (tons)	Collection rate (%)	Use (tons)	Collection (tons)	Collection rate (%)	Use (tons)	Collection (tons)	Collection rate (%)	Use (tons)	Collection (tons)	Collection rate (%)	Use (tons)	Collection (tons)	Collection rate (%)	Use (tons)	Collection (tons)	Collection rate (%)
1	Wangcheng		80			80			80			80			90			100	
2	Miluo	150	120	80.00%	170	150	84.80%	170	150	84.80%	170	150	84.80%	170	150	84.80%	170	150	84.80%
3	Shimen	110	90	81.00%	120	100	83.00%	122	102	83.60%	125.5	105.5	84.00%	127	106.8	84.00%	130	110	84.60%
4	Ziyang	456.7	429.6	94.07%	439.1	428.9	97.68%	425.3	416	97.81%	412.5	404	97.94%	397.9	390.2	98.06%	385.2	378.3	98.21%
5	Yuanling	130	35	26.92%	130	40	30.77%	130	42	32.30%	130	43	33.08%	130	44	33.85%	130	45	34.62%
6	Chongyi	12	1.2	10%	20	4	20%	25	7.5	30%	30	15	50%	30	18	60%	30	21	70%
7	Yudu	42.78	38.5	90%	35	24.15	69%	32	22.7	71%	28	21	75%	26	20.8	80%	26	21.32	82%
8	Dayu	19	19	100%	21.73	20	92%	22.83	21	92%	22.7	21	92.50%	23.53	22	93.50%	24.6	23	93.50%
9	Yongfeng	195	115	59%	200	136	68%	210	152	72.40%	215	160	74.40%	220	180	81.80%	230	190	82.60%
10	Fuliang	76.58	63.94	83.49%	76	65	85.53%	68	60	88.24%	77	66	85.71%	76	65	85.53%	75	63	84.00%
11	Yugan	99	81.2	81.98%	110	93.5	85.00%	112	96.32	86.00%	122	105.5	86.50%	125	108.75	87.00%	127.5	112.2	88.00%

Notes and Sources: Data from demonstration counties collected by Bank team.

DLI 3-3: *Demonstration counties meeting annual targets for manure utilization* is defined by the ratio (%) of the utilized animal wastes (tons) (used for organic fertilizer, biomass energy, and so on) to the generated amount (tons). For Jiangxi, the minimum annual target for all demonstration counties is to maintain at above 90 percent. Achievement is expected according to the timeline in Table 23. Verification will be based on large-scale farms in demonstration counties which are defined as: A farm with ⩾ 500 heads of pigs (annual production), ⩾ 2,000 egg chickens, ⩾ 10,000 meat chickens, ⩾ 50 meat cattle, and ⩾ 100 dairy cattle. During implementation, each year, 10% samples out of all the large-scale animal farms will be randomly selected and verified if they have completed their annual targets according to the MARA reporting system (if possible, pig, chicken and cattle farms must be included). Animal waste production, treatment and resource utilization data can be acquired from the established MARA direct reporting system and can be verified by supporting materials such as inventories, manure utilization contracts, inspection reports by county agricultural and environment bureaus.

Table 24: Expected schedule of results associated with DLI3-3 (manure utilization rate, percentage) (see also Program results framework).

#	Demo County	2020	2022	2023	2024	2025	2026
		Utilization rate (%)	Utilization rate (%)	Utilization rate (%)	Utilization rate (%)	Utilization rate (%)	Utilization rate (%)
1	Wangcheng						
2	Miluo	80	82	83	84	86	88
3	Shimen	82.00%	83.00%	84.00%	86.00%	88.00%	90.00%
4	Ziyang	76.00%	79.00%	81.00%	83.00%	84.00%	85.00%
5	Yuanling	58.00%	61.00%	65.00%	68.00%	71.00%	75.00%
6	Chongyi	98.65%	98.67%	98.69%	98.70%	98.72%	98.74%
7	Yudu	98.20%	98.30%	98.50%	98.60%	98.70%	98.80%
8	Dayu	99.36%	99.40%	99.46%	99.51%	99.55%	99.60%
9	Yongfeng	98.48%	98.50%	98.53%	98.56%	98.58%	98.60%
10	Fuliang	98.38%	98.50%	98.57%	98.70%	98.78%	98.89%
11	Yugan	98.77%	98.79%	98.81%	98.81%	98.87%	98.88%

Notes and Sources: Data from demonstration counties collected by Bank team.

5.4 Institutional Arrangements for the PforR

151. **The overall implementation arrangements for the Program are shown in Figure 10.** A Program Leading Group (PLG) will be hosted by the NDRC YREB Office. This will be headed by a senior official of the NDRC YREB Office and comprise representatives from the MOF, MWR, MEE, MHURD, and MARA, among others, along with representatives from the participating provinces. The PLG will be responsible for providing strategic direction as well as oversight for the Program. It will be supported by a Central Program Management Office (CPMO) which will coordinate Program implementation. It will also be supported by an expert advisory panel that will provide quality assurance on outputs from the Central Basin IPF.

152. **The Central Program Management Office (CPMO) will be hosted by the Changjiang (Yangtze) Water Resources Commission (CWRC).** The CPMO will be responsible for implementing activities under the Central Basin IPF, providing technical support to other Program components, and coordinating reporting and communications with the World Bank. The CWRC is proposed to provide support to the PLG given its alignment between its mandate and the Program objectives, plus technical capacity, to ensure an integrated river basin approach. The CPMO will appoint Executing Agencies (EA) to be responsible for implementing select activities under the Basin IPF. The EAs are: (i) Institute for Hydro-Ecology; (ii) Yangtze Scientific Research Institute; and (iii) Yangtze Water Resources Protection and Scientific Research Institute. Under the overall guidance of the CPMO, all activities and sub-projects will be managed by their respective EAs. The CPMO will require each EA to establish, as a condition for participating, a Management Office to manage all activities until completion.

153. **Provinces will establish a Provincial Program Steering Committee (PSC).** This will be headed by a provincial leader and comprised senior representatives of the PDRC, PFD and concerned sector departments (Water Resources/River Chief Office, Ecological and Environment, Housing and Urban-Rural Development, Agricultural and Rural Affairs, Natural Resources), to provide policy guidance and strategic directions. A Provincial Program Management Office (PPMO) with dedicated staff will be established within the PDRC and serve as the Secretariat of the PSC. The PDRCs have established Provincial YREB Offices, corresponding with the national YREB Office at the NDRC, that are responsible for realizing the objectives of the national YREB strategy at the provincial level. The PDRCs will be the implementing agencies for the provincial PforR programs and will manage the PPMO. The PPMO is responsible for preparation of provincial-level Program documents and Program implementation management. including coordination of the PAP implementation, work planning, monitoring and evaluation and reporting.

154. **The PPMO will have a working group comprised of representatives from the related line departments.** These are PDRC, PDF, Water Resources/River Chief Office, Ecological and Environment, Housing and Urban-Rural Development, Agricultural and Rural Affairs, and Natural Resources. The PPMO will report to Provincial PSC, which will comprise senior representatives from relevant departments, with similar structure and mandate as the national PLG. This will align with the propose implementation arrangements at the national level, led by NDRC YREB Office with a Program Leading Group including representatives from the various line agencies.

155. **At the county level, the same set up including PSCs and PMOs will be adopted in the demonstration counties.** The demonstration county DRCs will be the implementing agency with similar functions coordinating inputs from different related county bureaus and overseeing the operation of the county PMOs.

Figure 10: Overview of Implementation Arrangements

5.5 Disbursement Arrangements

156. **Both Jiangxi and Hunan Provinces have indicated that they would like to apply for a 25 percent advance payment under the PforR.** The amount of the advance will be deducted from the total amount due to be disbursed when the DLIs are achieved, and the World Bank will record an amount of the advance as disbursed for an achieved Disbursement Linked Result ('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. In addition, an amount up to US$19.5 million is proposed to be provided for results achieved before the Signature Date of the Loan Agreement but on or after the date of the Program concept review[96] under DLI 1, on provision of verified evidence indicating that the agreed prior results have been achieved. 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.

157. **The PPMO will be responsible for consolidating reports from provincial agencies participating in the PforR and submitting to the PDF, copying the CPMO.** Disbursements will be made annually upon independent verification of the results of the DLIs. The PPMO will submit a verification letter with the results to the PDF and, upon acceptance of the verification results, the PDF will prepare disbursement applications and submit them to the World Bank. The applied disbursed amount will depend on the verified results as all DLIs are scalable. The PDF can apply for disbursements as soon as the province meets targets, provides the necessary evidence to the World Bank, and the World Bank accepts that evidence in a formal notice to the borrower with the disbursement amounts. The PDF can also ask to be reimbursed for any results achieved beyond the indicative annual target up to the total PforR target and amount allocated for the relevant DLI. A designated account for Jiangxi PDF will be set up in US$, while a separate designated account will be set up by Hunan PDF in EURO.

[96] The Program Concept Review was held on April 2, 2020 (link).

5.6 Capacity Building

158. **Capacity building activities are planned at basin, provincial and county levels.** The participating provinces are experienced in investment project financing but lack experience in the results-based financing instrument (PforR). Technical assistance and training for program implementation, monitoring and verification will be provided to ensure efficient implementation and timely achievement of the results targets. In addition, the fiduciary and environmental and social system assessments prepared for the Program have identified areas requiring enhancements. These will be included in the Program Action Plan. Further, the program will introduce some innovative approaches that will require technical assistance during implementation. Capacity building will be provided through the Provincial Programs, the Central IPF Component, and the Bank's support to implementation.

159. **Technical capacity of the provinces is generally strong, and there has been prgoress towards integrated management.** However, there is a need for improved inter-jurisdictional cooperation and inter-sectoral coordination, and for the different parts of the system to be consolidated into an operational management system. This system includes water allocation, water withdrawal permit validation, ecological flow determination and enforcement, joint reservoir operation regulation, flow and water quality monitoring and data-sharing, among others. These needs are addressed by Program design measures. Technical assistance and training as part of implementation will also be used. For example, the determination of ecological flows, developing a river health index, strengthening the system for plastics management and the reduction of agricultural NPS pollution, will require capacity building in the form of technical guidance, workshops and implementation support.

160. **Support for implementation of the Program will provide targeted assistance and capacity building at all levels (central, provincial, basin and county).** This will include support in planning, design of institutional mechanisms, selection of technologies and monitoring and evaluation (including results verification), citizen engagement, among others, to ensure the intended results are achieved efficiently. The Program teams may also be able to benefit from peer exchanges and study visits to the provinces of China that have successfully implemented Bank-funded PforR programs. In addition, tailored training and implementation support are expected to address the issues identified in the fiduciary and environmental and social systems assessments (outlined in the Project Action Plan). In particular, training on ESF and the related standards applications is needed to improve the environmental and social management capacity of the CPMO for the central component implementation as this is the first time the team will be using the ESF.

5.7 Program Economic Evaluation

5.7.1 Rationale for Public Sector Provisioning/Financing

161. Public sector financing is justified by expected positive externalities in line with the Program's focus on public goods. The Program will generate environmental benefits from reducing water pollution including reduced marine debris, providing habitat for plant and animal species, and generating global benefits through reduced GHG emissions. Specific private sector actors do not capture the economic benefits of most Program outcomes, limiting the possibility for private financing for many activities (that is, benefits are diffuse and public). The Program will develop institutional systems, which will sustain and scale the activities delivering these benefits beyond the Program's life, with a focus on increasing transparency and efficiency in achieving these outcomes relative to a 'no Program' scenario.

5.7.2 Value Added of the Bank's Support

162. The PforR will focus on a subset of activities where the Government wants to enhance efficiency, effectiveness, and impact of expenditure by linking the disbursement of funds to the achievement of specific results. The design of the World Bank Program, in the form of a nested hierarchy of activities (see Section II in the main text), helps align actions of governments across levels (that is, vertically) and across jurisdictional borders (horizontally) in support of basin-wide and sub-basin wide outcomes, in ways that do not always occur under traditional programming and governance arrangements. The World Bank's involvement will increase central and provincial governments' exposure to international experience and best practices in integrated basin management, water pollution control, and ecological flows and ensure lessons from recent World Bank-supported ecological restoration and water pollution control projects are incorporated into the broader Government program for the Yangtze River Basin.

5.7.3 Assessment Methodology

163. This economic assessment uses a simple BCA based on benefit transfer, applied at the sub-basin level for Poyang Lake and Dongting Lake Basins. The assessment implicitly combines activities under Results Area 1, Results Area 2, and Results Area 3 to value outcomes as a combined water environment quality improvement. Results Area 1 (institutional strengthening) is seen as facilitating outcomes achieved under Results Area 2 and Results Area 3. The 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, with limited distinction at the activity level between World Bank-financed and Government-financed achievements. This approach can determine whether the overall program – of which Bank financing part supports – is net socially beneficical.

164. **Program costs.** Total Program financing over 2021–2026 is expected to be US$6,526 million, of which an expected US$6,126 million (93.87 percent) will be financed by the Government and US$400 million (6.13 percent) by the proposed IBRD loan (**Error! Reference source not found.**). Of the US$6,126 million Government financing, it is estimated that US$2,519 million will come from Jiangxi Province and US$3,607 million will come from Hunan Province.

165. **Program benefits.** Expected benefits from the Program will accrue at both local and global levels. At the local level, increases in biodiversity and vegetative cover can be expected, together with a decrease in pollutants in major waterways and thus periods of eutrophication, which can be expected to improve the amenity value of rivers and lakes, recreation opportunities, real estate values, fishery productivity, shipping services, tourism, and reduced costs of water treatment. Global benefits will result from improved biodiversity, such as benefits to internationally migratory birds (Dongting and Poyang Lake are important migratory bird habitats), reduced coastal eutrophication, and reduced marine plastic debris. Climate benefits (GHG mitigation) will be mainly derived from reduced eutrophication[97] of lakes and waterways caused by discharges of livestock waste and wastewater.

166. To estimate the Program's economic benefits, benefit transfer from available environmental valuation research in China was used. The economic values of water quality and ecological improvement are challenging to quantify due to the dispersed spatial extent of benefits across the basin, the wide range (and indirect nature) of benefit types, and data limitations. However, a number of studies provide benefit estimations that can be adapted to the parameters of this program to indicate likely economic values.

[97] Eutrophication, caused by excessive richness of nutrients, increases the emission of methane, which is more than 25 times as potent as carbon dioxide at trapping heat in the atmosphere.

These studies utilize the contingent valuation method[98] (CVM) to capture the broad range of benefits (both use and non-use economic values) that are expected.

167. Economic assessment at the lake basin level considers the benefits from the program as a whole (that is, as a package of activities) within its basin areas, thus capturing the bulk of provincial-level and county-level activities. The Program's geographic focus within Jiangxi is Poyang Lake Basin, which covers 94 percent of the province. The Program's geographic focus within Hunan is Dongting Lake Basin, which covers 97 percent of the province. Water pollution and associated ecological degradation in both basins are mainly caused by industrial and municipal wastewater discharges and from chemical runoff from cropping due to overapplication and improper application of fertilizers and discharges from intensive livestock farms.

168. A survey of relevant literature found four studies of relevance to comprehensively valuing water environment improvements in China (Table 25). A lower bound of 0.55 percent and an upper bound of 2.9 percent for WTP as a percentage of gross household income was found across studies for comprehensive impacts of water pollution, including water treatment and health values, amenity values, recreational values, and ecological values (existence value to people). While they are broad, these attributes are similar to those expected from the present program and thus provide rough indications of the population's comprehensive valuation (that is, including both use and non-use values) of the outcomes of the program.

Table 25: **Summary of Water Quality-related WTP Studies in China**

Water Body and Reference	Study Objective/Content	WTP (percentage of household income)
Cha Bai and Nan Sha He rivers, Beijing (Day and Mourato 1998)[99]	Aimed to determine the value of maintaining river water quality in all rivers in the Beijing region	0.8–1.3
Yangtze River, Jiangsu Province (Lu and Guo 2003)[100]	Aimed to determine the value of drinking water without pollution from chemical fertilizers	2.0
Lake Puzhehei, Yunnan Province (Wang et al. 2011)[101]	Aimed to determine the total value of a project to improve the water quality of Lake Puzhehei by one grade level (Grade III to Grade II)	2.9
Hongze Lake, Jiangsu Province (Lei et al. 2013)[102]	Aimed to determine value of amenity provided by the lake (fourth largest freshwater lake and one of the most polluted in China)	0.55

[98] Contingent valuation method uses questionnaires targeted to impacted populations to elicit their WTP for non-market environmental goods, such as avoidance or reduction of pollution impacts. It has been applied extensively to water pollution issues.

[99] Day, B. and Mourato, S. (1998). Willingness to pay for water quality maintenance in Chinese rivers. The Centre for Social and Economic Research on the Global Environment Working Paper. (*link*)

[100]

[101] Wang et al. (2013). Valuing Water Quality Improvement in China: A Case Study of Lake Puzhehei in Yunnan Province. Ecological Economics 94. (link)

[102] Huang, et al. (2013). Public demand for remediating a local ecosystem: comparing WTP and WTA at Hongze Lake, China, Lake and Reservoir Management, 29:1, 23-32. (link)

5.7.4 Assessment Results

169. The lower identified estimate was used for a conservative approximation (0.55 percent of household income) of the values Jiangxi and Huanan residents place on improving water quality in these two basins. Adjustment for these provinces' population and per capita income levels were made and estimates compared to the total program cost (Table 26).

Table 26: Estimation of Annual WTP Value and Program Cost[103]

	Provincial Population (Million)	Annual Per Capita Gross Income (US$)	WTP (0.55% of income) (US$, millions, annual)	Government program Cost (US$, millions, total)
Jiangxi (Poyang Lake Basin)	40.90	5,172	1,163	2,714
Hunan (Dongting Lake Basin)	67.10	5,700	2,104	3,802

170. Economic benefits have been projected with the assumptions that (a) investment will be completed within the Program life (5 years); (b) benefits will accrue starting from year 5 for a total of 15 years, with full benefits being reached from year 7 onward; (c) operating and maintenance costs of infrastructure and other recurrent costs will be 10 percent of the total program investment cost; and (d) discount rates are 6 and 12 percent[104] (Table 27).

Table 27: ERR and NPV of Water and Ecology Improvements in Program Sub-basins Based on Benefit-Transfer (US$, millions)

	ERR (%)	NPV @ 6%	NPV @ 12%
Poyang Lake Basin (lower estimate)	15.7	1,957	1,590
Dongting Lake Basin (lower estimate)	18.3	3,684	752

5.8 Greenhouse Gas Emissions Mitigation

171. A quantification of GHG net emissions is made here focused on activities that contribute to DLIs 3.1, 3.2 and 3.3. Quantifiication does not include emissions reductions through institutional, policy and planning measures (DLIs 1 and 2).[105] There are three sources of quantifiable emissions benefits, which are assessed over the 5 years of Program implementation

- **DLI 3.1:** 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 1,500,000 people in the 11 demonstration counties. Most of the counties use A2O technology, and no methane capturing technology is currently being applied. The improvements are expected to result in reduced fugitive methane emissions, leading to an estimated net mitigation of 16,759 tons CO_2-e.
- **DLI 3.2:** Proper disposal of agricultural mulch film in managed landfill is expected for an additional 14,136 tons of plastics over five years due to Program activities.

[103] World Bank team's calculation based on 2020 data available from official statistics.
[104] See: World Bank. 2015. *Technical Note on Discounting Costs and Benefits in Economic Analysis of World Bank Projects*. The discount rate is recommended to be 6 percent for investments with long-term unquantified social and environmental benefits. See: NDRC. 2006. *Economic Analysis of Construction Projects: Methods and Parameters*. China Planning Press, Beijing.
[105] See: Downing, J. A., et al. 2021. "Protecting Local Water Quality Has Global Benefits." *Nature Communications* 12: 2709 (link).

- **DLI 3.3:** treatment and reuse of livestock/poutry manure (through on-farm treatment facilities, biogas generation, and organic fertilizer reuse). Additional manure use is expected to be 1,048,300 tons (Hunan) and 473,100 tons (Jangxi) due to Program activities, expected to lead to a total of 778,235 tons (Hunan) and 351,235 tons (Jiangxi) CO_2-e mitigation over the five years.

172. In total, the program is expected to realize at least 1.15 million tons CO2-e in emissions mitigation over the Project period. This represents a subset of the total expected benefits that are attributable to the World Bank's financing. The calculations are limited to the 11 demonstration counties that are the target of World Bank financing. Equivalent achievements under the wider Government program in around 200 counties would lead to emissions mitigation of around 23 milllion tons CO_2-e over 5 years.

173. Other elements of the Program, specifically institutional, policy and planning measures under DLIs 1 and 2 can be expected to have GHG mitigation benefits that add substantially to those calculated here. 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. Policy and management changes are likely to lead to longer-term water quality improvement through reduced nutrient pollution and thus reduced eutrophication. Eutrophication causes methane emissions due to anaerobic decomposition and has been an issue within the Program's sub-basins. Notably, Poyang and Dongting Lakes have experienced instances of eutrophication, and more broadly, nutrient pollution may contribute to downstream and offshore eutrophication in the East China Sea.[106]

6 IMPLEMENTATION SUPPORT PLAN

174. Support for implementation of the PforR will require close attention and continuous support from the World Bank team. The PforR instrument is new to some government teams involved in the Program (Hunan). This annex outlines the key activities to address risks identified by the risk assessment and provides the TA 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 that of the PAP) 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.

175. The strategy and approach for implementation support includes an emphasis on the technical, fiduciary, and E&S support needed during implementation. The World Bank team provided technical expertise during preparation and will continue to provide technical support 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 TA to address shortcomings identified during the assessment, most notably around audits and the reporting expenditures.

176. Given the multi-provincial, cross-sectoral characteristics of the Program significant resources above the regional norms will be needed during implementation. The integration of the PforR and the IPF also requires expertise and assistance with both instruments during implementation. This support will be

[106] A recent study calcuted the present value of the global social cost of eutrophication-driven methane emissions from lakes at an annual amount of US$0.21–2.31 trillion (US$ 2015). See Downing, J. A., et al. 2021. "Protecting Local Water Quality Has Global Benefits." *Nature Communications* 12: 2709 (link).

ensured through leadership and close contributions from team members in the China Country Office, located 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. Table 28 and Table 29 outline the estimated inputs from different specialists and resources required at different stages of Program implementation.

Table 28: Main Focus of Implementation Support

Time	Focus	Skills Needed	Resources Estimate (Staff Weeks)
First 12 months	• Implementation of program management systems • Setting up cross administrative-level coordination mechanism • Staff capacity building, on-the-job training on E&S and fiduciary • Procurement process and training • E&S training, support to implementation of policy requirements • Technical support to activities and implementation • Financial management and disbursement training and capacity building	• Core team, particularly technical, FM, procurement, E&S experts • Integrated water and environment management expert	72
12–48 months	• Technical support to implementation • Conduct policy and technical research • Review of environmental, social, and financial performance of central components • Continued improvements in project management systems including fiduciary and safeguards • Program Midterm Review	• Core team, particularly technical, FM, procurement, E&S experts • Integrated water and environment management expert	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, Environment & Social experts • Integrated water and environment management	56

Table 29: Task Team Skills Mix Requirements for Implementation Support

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Task team leader/program management	10 annually	Three in the first year, two thereafter	Internationally based staff
Task team leader(s)/program management	14 annually	Three in the first year, two thereafter	Country office-based staff

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Procurement specialist	3-6 annually	Two per year	Country office-based staff
Financial management specialist	3-4 annually	Two per year	Country office-based staff
Operations specialist	4-6 annually	Two per year	Country office-based staff
Environmental specialist	3-4 annually	Two per year	Country office-based staff
Social specialist	3-4 annually	Two per year	Country office-based staff
Monitoring and evaluation specialist	4-6 annually	Two per year	Country office-based staff
Integrated water environment expert	2–4 annually	Two per year	Consultant (national)
Solid waste management expert	2–4 annually	Two per year	Consultant (national)
Big data and AI expert	2 annually	One per year	Consultant (national)

Note: AI = Artificial Intelligence.

7 PROGRAM ACTION PLAN

The technical, fiduciary, and environmental and social systems assessments have identified areas where capacity building is necessary or would support more effective implementation. The Program Action Plan (PAP) details those actions that must be undertaken for disbursement. The PAP focuses on fiduciary and environmental and social issues. A range of technical issues were also identified, as described throughout the technical assessment. These have been included in elements of program design rather than the PAP for a more targeted approach. These include the inclusion of gender considerations in DLI3.1, inclusion of strategic plans for township wastewater services in DLI3.1, and development of a public engagement manuals for the river chief system (intermediate indicator). The PAP thus focuses on the critical fiduciary and environmental and social needs ((Table 30).

Table 30: Program Action Plan

Action Description	Category	Responsibility	Timing		Completion Measurement
Provide training on chemical fertilizer use and agricultural waste management to farmers.	Environmental and Social Systems	PDARA and CDARAs	Other	Throughout Program implementation stage	Hunan and Jiangxi PPMOs will submit semiannual progress reports to the World Bank, including a training program for chemical fertilizer use and agricultural waste management, and relevant records.
Provide occupational health and safety (OHS) training and carry out health checkups for all in-service workers, including temporary workers.	Environmental and Social Systems	Project Implementation Agencies	Other	Throughout Program implementation stage	Hunan and Jiangxi PPMOs will submit semiannual progress reports to the World Bank, including OHS training and health checkup records.

Establish a social impacts and risks screening, public participation, monitoring, and reporting mechanism, and strengthen information and record management in social risk management.	Environmental and Social Systems	Project Implementation Agencies	Other	Throughout Program implementation stage	Hunan and Jiangxi PPMOs will submit semiannual progress reports to the WB, including records of social impacts and risks screening and mitigation, information disclosure, public participation, grievance redress and supports to vulnerable groups.
The TOR for annual external audit includes the task of randomly selecting awarded contracts to check whether they have been awarded to firms or individuals debarred or suspended by the World Bank.	Fiduciary Systems	PPMO	Recurrent	Yearly	A copy of the TOR is sent to the Bank
The PDRC shall, upon program loan effectiveness, issue an official letter or official instruction to implementation agencies to ensure that no contract will be awarded to debarred and temporarily suspended firms and individuals.	Fiduciary Systems	PPMO	Recurrent	Continuous	Agencies report to the Bank each occurrence of F+C within 1 month.
The ToR of the Procurement Staff includes responsibility to check the Bank list of debarred and temporarily suspended firms and individuals on a daily basis; share with all implementation agencies and inform the Bank promptly of fraud and corruption.	Fiduciary Systems	PPMO	Recurrent	Continuous	Agencies report to the Bank each occurrence of F+C within 1 month.
Issue procedures or a guidance note defining the contract administration responsibilities in line with the regulatory framework	Fiduciary Systems	PPMO	Recurrent	Semi-Annually	Provincial notification is issued and provided to the Bank as part of the PIP
Establish a cost estimating process for regularly updating the unit price used in procured contracts.	Fiduciary Systems	PPMO	Recurrent	Continuous	Reflect the status in the Program progress report