THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

FOR OFFICIAL USE ONLY

Report No: PAD5221

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROGRAM APPRAISAL DOCUMENT

ON PROPOSED LOANS

IN THE TOTAL AMOUNT OF US$345 MILLION EQUIVALENT

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

CHINA GREEN AGRICULTURAL AND RURAL REVITALIZATION PROGRAM FOR RESULTS (HUBEI AND HUNAN)

April 6, 2023

Agriculture and Food Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

Exchange Rate Effective October 3, 2022

Currency Unit =	Chinese Yuan (CNY)
CNY 1 =	US$0.14
US$1	CNY 7.14

FISCAL YEAR
January 1 - December 31

ABBREVIATIONS AND ACRONYMS

ARAB	Agriculture and Rural Affairs Bureau
BOD	Biological Oxygen Demand
CCDR	Country Climate and Development Report
CNAO	China National Audit Office
COD	Chemical Oxygen Demand
CPF	Country Partnership Framework
CPMO	County Program Management Office
CSA	Climate-Smart Agriculture
DARA	Department of Agriculture and Rural Affairs
DEE	Department of Ecology and Environment
DLI	Disbursement-Linked Indicator
DLR	Disbursement-Linked Result
DNR	Department of Natural Resources
DOF	Department of Finance
DRC	Development and Reform Commission
DWR	Department of Water Resources
E&S	Environmental and Social
EEB	Ecology and Environment Bureau
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment
EMB	Emergency Management Bureau
EPI	Environmental Performance Index
ERR	Economic Rate of Return
ESSA	Environmental and Social Systems Assessment
EU	European Union
E&S	Environmental and Social
EX-ACT	Ex Ante Carbon-balance Tool
FA	Farmer Association
FAO	Food and Agriculture Organization of the United Nations
FC	Farmer Cooperative
FIRR	Financial Internal Rate of Return
FM	Financial Management
FSA	Fiduciary Systems Assessment

FYP	Five-Year Plan
GAP	Good Agricultural Practices
GARR PforR	Green Agricultural and Rural Revitalization Program for Results
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GI	Geographical Indication
GIIP	Good International Industry Practice
GPG	Global Public Good
GPL	Government Procurement Law
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
HC	Health Commission
HURD	Housing and Urban-Rural Development
HURDB	Housing and Urban-Rural Development Bureaus
IBMS	Integrated Budget Management System
ICR	Implementation Completion and Results Report
IPF	Investment Project Financing
IPM	Integrated Pest Management
IPRCC	International Poverty Reduction Center of China
IT	Information Technology
IVDP	Integrated Village Development Plan
LGOPAD	Leading Group Office of Poverty Alleviation and Development
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
MOHURD	Ministry of Housing and Urban-Rural Development
MRV	Measurement, Reporting, and Verification
$MtCO_2e$	Metric Ton of Carbon Dioxide Equivalent
NBS	National Bureau of Statistics
NDC	Nationally Determined Contribution
NDRC	National Development and Reform Commission
NFGA	National Forestry and Grassland Administration
NPS	Nonpoint Source
NRB	Natural Resources Bureau
NRRA	National Rural Revitalization Administration
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
OPRC	Operational Procurement Review Committee
PAD	Program Appraisal Document
PAO	Provincial Audit Office
PAP	Program Action Plan
PASA	Programmatic Advisory Services and Analytics
PDO	Program Development Objective
PDOF	Provincial Department of Finance
PDRC	Provincial Development and Reform Commission

PFM	Public Financial Management
PforR	Program for Results
PIP	Program Implementation Plan
PIU	Program Implementation Unit
PPMO	Provincial Program Management Office
PSC	Program Steering Committee
RA	Results Area
RRB	Rural Revitalization Bureau
RRP	Rural Revitalization Program
RRPL	Rural Revitalization Promotion Law
RRSP	Rural Revitalization Strategic Plan
RSWS	Rural Solid Waste Management Station
SOC	Soil Organic Carbon
SP	Subprogram
SWMS	Solid Waste Management System(s)
TBL	Tendering and Bidding Law
TN	Total Nitrogen
TOR	Terms of Reference
TP	Total Phosphorus
TSWTS	Township Solid Waste Transfer Station(s)
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction Secretariat
VA	Verification Agency
VDAP	Village Development Action Plan
WBG	World Bank Group
WRB	Water Resources Bureau
WUA	Water User Association
WWTF	Wastewater Treatment Facility
ZBB	Zero-Based Budgeting

Regional Vice President:	Manuela V. Ferro
Regional Director:	Benoit Bosquet
Country Director:	Mara K. Warwick
Practice Manager:	Dina Umali-Deininger
Task Team Leader(s):	Ladisy Komba Chengula, Wendao Cao

TABLE OF CONTENTS

DATASHEET I
I. STRATEGIC CONTEXT 1
A. Country Context 1
B. Sectoral (or Multisectoral) and Institutional Context 2
C. Relationship to the CPS/CPF and Rationale for Use of Instrument 9
II. PROGRAM DESCRIPTION 11
A. Government Program 11
B. Theory of Change 11
C. PforR Program Scope 15
D. Program Development Objective(s) (PDO) and PDO Level Results Indicators 17
E. Disbursement Linked Indicators and Verification Protocols 18
III. PROGRAM IMPLEMENTATION 26
A. Institutional and Implementation Arrangements 26
B. Results Monitoring and Evaluation 27
C. Disbursement Arrangements 28
D. Capacity Building 28
IV. ASSESSMENT SUMMARY 29
A. Technical (including program economic evaluation) 29
B. Fiduciary 34
C. Environmental and Social 35
V. RISK 36
ANNEX 1. RESULTS FRAMEWORK MATRIX 39
ANNEX 2. DISBURSEMENT LINKED INDICATORS, DISBURSEMENT ARRANGEMENTS AND VERIFICATION PROTOCOLS 60
ANNEX 3. (SUMMARY) TECHNICAL ASSESSMENT 84
ANNEX 4. (SUMMARY) FIDUCIARY SYSTEMS ASSESSMENT 104
ANNEX 5. SUMMARY ENVIRONMENTAL AND SOCIAL SYSTEMS ASSESSMENT 111
ANNEX 6. PROGRAM ACTION PLAN 115
ANNEX 7. IMPLEMENTATION SUPPORT PLAN 118
ANNEX 8: COMPLEMENTARITY OF IBRD-FUNDED POLLUTION ABATEMENT PROJECTS 120
ANNEX 9: TASK TEAM LIST 121
ANNEX 10: MAP 122

DATASHEET

BASIC INFORMATION

Country(ies)	Project Name
China	China Green Agricultural and Rural Revitalization Program for Results (Hubei and Hunan)

Project ID	Financing Instrument	Does this operation have an IPF component?
P178907	Program-for-Results Financing	No

Financing & Implementation Modalities

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

Expected Project Approval Date	Expected Closing Date
27-Apr-2023	29-Jun-2029

Bank/IFC Collaboration

No

Proposed Program Development Objective(s)

To enhance adoption of environmentally-sustainable agricultural and rural infrastructure development practices in selected areas of Hubei and Hunan.

Organizations

Borrower :	People's Republic of China
Implementing Agency :	Hubei Provincial Rural Revitalization Administration

Contact:	Xinghua Jiang
Title:	Director General
Telephone No:	13907158845
Email:	hbfpfz@163.com
Implementing Agency :	Hunan Provincial Department of Agriculture and Rural Affairs
Contact:	Keyun Chen
Title:	Head of Center for Foreign Economic Cooperation in Agricultu
Telephone No:	13607448992
Email:	hunanpmo@163.com
Implementing Agency :	National Rural Revitalization Administration
Contact:	Weiping Tan
Title:	Deputy Director General
Telephone No:	13910803163
Email:	tanweiping@iprcc.org.cn

COST & FINANCING

SUMMARY

Government program Cost	4,445.00
Total Operation Cost	4,445.00
Total Program Cost	4,445.00
Total Financing	4,445.00
Financing Gap	0.00

Financing (USD Millions)

Counterpart Funding	**4,100.00**
Borrower/Recipient	4,100.00
International Bank for Reconstruction and Development (IBRD)	**345.00**

Expected Disbursements (USD Millions)

Fiscal Year	2023	2024	2025	2026	2027	2028	2029
Absolute	0.00	39.25	70.42	84.41	75.16	58.81	16.94
Cumulative	0.00	39.25	109.68	194.09	269.25	328.06	345.00

INSTITUTIONAL DATA

Practice Area (Lead)

Agriculture and Food

Contributing Practice Areas

Environment, Natural Resources & the Blue Economy, Governance, Social Protection & Jobs, Water

Climate Change and Disaster Screening

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

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

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

COMPLIANCE

Policy

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

[ ] Yes [✓] No

Does the program require any waivers of Bank policies?

[ ] Yes [✓] No

Legal Operational Policies

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

Legal Covenants

Sections and Description

Program Institutions (national level)

Loan Agreement (LA), Schedule 2, Section I.B.1: The Borrower shall, through NRRA, maintain, and cause to be maintained the following entity with composition, powers, functions, staffing, facilities and other resources acceptable to the Bank: (a) the Central Program Coordination Office; and (b) the National Program Steering Group.

Sections and Description

Program Institutions (provincial level)

Program Agreements (PAs), Schedule, Section I.B.1: Each of the Program Implementing Entities shall maintain, and cause to be maintained, the following entities, with composition, powers, functions, staffing, facilities and other resources acceptable to the Bank: (a) at provincial level: (i) the Provincial Program Steering Committee; (ii) the Provincial Program Management Office; (iii) the Provincial Program Implementation Unit; and (iv) an expert advisory panel; and (b) at county level: (i) a steering committee in each of the Program Counties; and (ii) a management office in each of the Program Counties.

Sections and Description

Program Action Plan

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

Sections and Description
Program Implementation Plan

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

Sections and Description
Annual Work Plans and Budget Allocations

PAs, Schedule, Section I.B.4: Each of the Program Implementing Entities shall: (a) carry out activities under the Program during each fiscal year in accordance with Annual Work Plans and Budget Allocations; (b) prepare and furnish to the Bank by December 31 in each year, beginning in 2023, the Annual Work Plan and Budget Allocations, summarizing the Program activities to be undertaken and projected targets for the following calendar year, including the proposed overall annual budget allocations for the Program; and (c) thereafter, ensure the implementation of the Program during the following calendar year in accordance with the Annual Work Plan and Budget Allocation, in a manner satisfactory to the Bank.

Sections and Description
Mid-term Review

LA, Schedule 2, Section III.2; PAs, Schedule, Section III.2 : The Borrower, through NRRA, and each of the Program Implementing Entities, shall prepare, under terms of reference acceptable to the Bank, and furnish to the Bank no later than June 30, 2026, a consolidated mid-term review report for the Program, summarizing the results of the monitoring and evaluation activities carried out from the inception of the Program, and setting out the measures recommended to ensure the efficient completion of the Program and to further the objectives thereof.

Sections and Description
Verification Agencies

LA, Schedule 2, Section III.3; PA, Schedule, Section III.4: The Borrower, through NRRA, and each of the Program

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

Conditions

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

I. STRATEGIC CONTEXT

A. Country Context

1. **After 40 years of unprecedented economic growth, China eradicated absolute poverty in 2020, 10 years ahead of the United Nations' Sustainable Development Goal target of 2030.** Currently, the share of people living below the extreme international poverty line of US$1.90 per day is below 1 percent. Despite this remarkable achievement, about 250 million Chinese remain below the poverty line of US$5.50 per day recommended for upper-middle-income countries, of which two-thirds reside in rural areas. Approximately 40 percent of China's population (or 570 million people) still live in rural areas, and many are vulnerable to falling back into poverty in case of an economic shock or natural disasters such as floods and droughts, some due to climate change.

2. **China's past rapid agricultural growth has come at increasing environmental costs.** It is estimated that the cost of environmental pollution and resource (especially land and water) degradation in China amounts to 9 percent of its gross domestic product (GDP), 10 times higher than corresponding levels in the Republic of Korea and Japan.[1] The 2022 Environmental Performance Index (EPI)[2] report ranked China 160 out of 180 countries for environmental performance across 24 indicators in 10 categories: air quality, water and sanitation, heavy metals, biodiversity and habitat, forests, fisheries, climate, energy, water resources, and agriculture. The EPI shows that China lags behind many other upper-middle-income countries with comparable per capita income, such as Brazil, Mexico, the Russian Federation, and Türkiye.

3. **China's transition from its current resource-intensive economy to a green economy started with a greener growth strategy in its 13th Five-Year Plan (FYP, 2015–2020),** emphasizing quality over quantity of growth and the need for green development. This greener growth strategy is being pursued in a range of sectors through actions to slow growth of greenhouse gas (GHG) emissions, reduce air and water pollution, improve resource efficiency of the economy, and enhance land management. But more needs to be done, including in the agriculture and rural development sector that is highly vulnerable to climate change and dependent on natural resources, especially land and water.

4. **To promote green growth and sustainably address the above agricultural and rural development challenges, China adopted the National Rural Revitalization Program (RRP, 2018–2035) in 2017.** The 'No. 1 Central Documents' in 2018, 2019, 2020, 2021, and 2022 focused on rural revitalization framed around the three rural dimensions: agriculture, rural areas, and farmers. The RRP is being implemented through a series of five-year Rural Revitalization Strategic Plans (RRSPs), and these serve as the basis of the Green Agricultural and Rural Revitalization Program for Results (Hubei and Hunan) (henceforth referred to as GARR PforR). The RRP objectives and milestones have been further elaborated in annual policy documents[3] and in the 14th FYP (2021–2025) for the National Green Development of Agriculture[4] and the 14th FYP on Municipal Solid Waste Separation and Treatment Facilities Development Plan (2021–2025).[5] The Rural Revitalization Promotion Law (RRPL) of April 29, 2021, provides the legal framework for implementing the RRP through phased five-year

[1] World Bank Group. 2010. *Cost of Pollution in China: Economic Estimates of Physical Damages (English).* Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/782171468027560055/Cost-of-pollution-in-China-economic-estimates-of-physical-damages. World Bank and Development Research Center of the State Council, People's Republic of China. 2013. *China 2030: Building a Modern, Harmonious, and Creative Society*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/12925.

[2] The 2018 EPI ranks 180 countries on 24 performance indicators across 10 issue categories covering environmental health and ecosystem vitality. These metrics provide a gauge at a national scale of how close countries are to established environmental policy goals.

[3] The No. 1 Document issued by the Central Committee of the Communist Party of China and the State Council in 2018, 2019, 2020, 2021, and 2022 focused on green agricultural development, market reforms, and modernization of the rural economy.

[4] A joint notice of the Ministry of Agriculture and Rural Affairs (MARA), National Development and Reform Commission (NDRC), Ministry of Science and Technology (MOST), Ministry of Natural Resources (MNR), Ministry of Ecology and Environment (MEE), and National Forestry and Grassland Administration (NFGA) (Nong Gui Fa [2021] No. 8) issued in August 2021.

[5] Issued jointly by the Ministry of Housing and Urban-Rural Development (MOHURD) and the NDRC.

RRSPs, aimed at promoting the overall upgrading of agriculture, the professional development of farmers, the modernization of agriculture and rural areas, and the revitalization of the countryside.

5. **Despite the prominence given to green economic development in the RRP, in practice, the Government's rural revitalization and greening objectives are not fully aligned.** Central and provincial government transfers targeting rural revitalization do not consider green, low-carbon, and sustainable agriculture and rural development as their primary objectives. Instead, the bulk of agricultural support policy measures (for example, input subsidies, guaranteed purchase schemes, and subsidized credit) are still tied to farmland area, production volumes, and yields without considering their environmental costs and benefits. Funding gaps remain for some rural infrastructure and public services, especially rural wastewater and solid waste management, and the sustainable management of the natural capital, such as agricultural landscapes and ecosystems. While 40 percent of agricultural support policies in the European Union (EU) are now related to green agricultural development, in China, this proportion is estimated to be only 5 percent.[6]

6. **To achieve the specific targets for green, low-carbon, and sustainable agriculture and rural development objectives, there is an urgent need to develop new governance frameworks for mobilizing fiscal resources that can be transferred to counties.** Incentives are needed for strengthening the central and provincial levels' institutional delivery mechanisms, so that they focus on the delivery of results related to green, low-carbon, and sustainable development of agriculture; managing agricultural ecosystems; and delivering climate-resilient rural infrastructure and public services while keeping the focus on poor and vulnerable households in Hubei and Hunan provinces.

7. **The GARR PforR complements the Green Agricultural and Rural Revitalization Program for Results for the Guangxi Zhuang Autonomous Region and Guizhou province (GARR PforR, Guangxi and Guizhou) approved by the World Bank in March 2022 to support implementation of the national RRP.** Building on the GARR PforR (Guangxi and Guizhou), the GARR PforR adds a central component supporting the National Rural Revitalization Administration (NRRA) to enhance the overall central governance framework toward a greener agriculture and rural development. Established on February 25, 2021, the NRRA is an agency within MARA. It supersedes the former State Council Leading Group Office of Poverty Alleviation and Development (LGOPAD), which was mandated to coordinate the eradication of extreme rural poverty. The NRRA's mandates include coordinating the transition from China's Poverty Reduction Program into the RRP (2018–2035). Given its institutional mandate, the NRRA is expected to remain engaged with the GARR PforR (Guangxi and Guizhou) despite not implementing specific activities or receiving financing by the World Bank loan. Therefore, the NRRA is expected to coordinate the implementation of the two GARR PforRs and facilitate national and global knowledge exchange and the sharing and scale-up of good practices developed under the two GARR PforRs. In addition, the GARR PforR expands the geographic coverage to Hubei and Hunan provinces in the middle reaches of the Yangtze River, which share subtropical monsoon climatic conditions, to apply green agricultural and rural revitalization approaches under different agro-ecological and socioeconomic conditions, compared to the mountainous Guangxi and Guizhou settings.

B. Sectoral (or Multisectoral) and Institutional Context

Green Agricultural Development

8. **China's agriculture sector is one of the largest in the world.** In 2021, the country's agricultural GDP amounted to US$1.37 trillion (constant 2010 US$), equivalent to 7.3 percent of the national GDP (US$17.7 trillion). Over the past 40 years, China's inflation-adjusted average annual growth rate of agricultural output value and agricultural GDP was 5.3 percent and 4.5 percent, respectively, driven mainly by the growth in total factor productivity; introduction of new technologies; and large producer subsidies, mostly for rice, wheat, and maize production. China has now surpassed the

[6] World Bank. 2022. *Toward a Greener China: A Review of Recent Agricultural Support Policies and Public Expenditures*. Washington, DC: World Bank.

EU and the United States in total agricultural support,[7] which has also led to the excessive use of chemical fertilizers, resulting in significant GHG emissions, pollution, and environmental degradation. Currently, the Chinese Government is implementing major policy and regulatory adjustments to reduce the agriculture sector's environmental footprint and market distortions. Accompanying these policy and regulatory shifts are broad changes in the purpose and targeting of subsidies—now decoupled from commodity production and aiming to incentivize the adoption of low-carbon, green, and sustainable agricultural practices—as well as significantly increased expenditures on agricultural ecosystem and landscape restoration and protection programs.

9. **China is the largest emitter of GHGs, both as a country and from the agriculture sector, accounting for 27 percent of global emissions and 13 percent of total agriculture emissions.**[8] While agricultural GHG emissions are overshadowed by those of other sectors,[9] China's agriculture sector emits about as much as the entire economy of Canada. China's agriculture sector (that is, including agriculture, land use, land use change, and forestry) accounted for 6 percent of China's GHG emissions or about 667 million tons of carbon dioxide equivalent (CO_2e) in 2019.[10] This footprint excludes indirect emissions, such as those related to fertilizer and pesticide production and on-farm energy-related emissions. It is also based on what China produces domestically, not what it imports. The sector's footprint would be larger if it included the impacts of feed, meat, and dairy imports on the emissions of exporting countries, especially those experiencing tropical deforestation and landscape degradation such as Brazil.

10. **Overall, livestock, synthetic chemical fertilizer use, and rice farming are the largest sources of agricultural GHG emissions in China, in that order.** On-farm energy use comes next if its emissions are counted in the sector's total. Breaking down agriculture sector emissions by type, methane (CH_4) accounts for the highest share at 46 percent, followed by nitrous oxide (N_2O) at 39 percent and carbon dioxide (CO_2) at 15 percent. CH_4 is 81 times more potent and N_2O is 273 more potent than CO_2 in trapping heat in the atmosphere. After increasing for several decades, China's farm-related GHGs declined between 2016 and 2019, consistent with the decline in chemical fertilizer use. According to the Food and Agriculture Organization of the United Nations (FAO) statistics (2021), China's GHG emissions from agricultural land peaked at 842 million tons of CO_2e in 2016. Between then and 2019, they declined by 6 percent per year, returning approximately to their 2007 levels. However, climate models estimate that without serious national mitigation efforts, agricultural GHG emissions in China will rise to 1,350 million metric tons of carbon dioxide equivalent ($MtCO_2e$) per year by 2050, driven mainly by increased livestock production in response to the growing demand for animal-based protein (due to increasing incomes)—especially beef, pork, and poultry. Going forward, mitigating China's agricultural GHG emissions requires deploying a food system approach (that is, reducing GHG emissions along the value chains) and adopting climate-smart agricultural practices, which increase productivity, build resilience to climate change, and reduce GHG emissions.

11. **China's reductions of potent CH_4 and N_2O are considered as critical for mitigating near-term warming, while structural changes to reduce fossil fuel dependence are undertaken.**[11] At the 27th Conference of the Parties of the UNFCCC[12] (COP27) in November 2022, the Chinese Government announced its commitment to curb CH_4 emissions from

[7] The Ministry of Finance (MOF) and MARA consolidated three subsidies—the direct subsidy for grain growers, purchasing improved crop varieties, and the general subsidies for agricultural inputs—into an agricultural support and protection subsidy.
[8] The main agricultural and land use change GHG emissions are CO_2, CH_4, and N_2O.
[9] China's agriculture GHG emissions are ranked fourth after electricity and heating, industry, and transportation.
[10] FAO (Food and Agriculture Organization of the United Nations). 2021. "FAOSTAT Statistical Database." https://www.fao.org/faostat/en/. Climate Watch. 2020. "Historical GHG Emissions." https://www.climatewatchdata.org/ghg-emissions?breakBy=sector&chartType=percentage&end_year=2018&gases=ch4&regions=CHN&sectors=total-excluding-lucf&source=CAIT&start_year=1990.
[11] In that respect, one noteworthy trend is that if agricultural emissions have long been dominated by CH_4 (and continue to be), N_2O emissions have risen faster and fallen more slowly in recent years.
[12] United Nations Framework Convention on Climate Change.

energy, agriculture, and waste.[13] The commitment is inclusive of livestock and rice production systems, as well as chemical fertilizers, which are major contributors to CH_4 emissions. China also committed to moving toward using the highest tier of the IPCC[14] good practice GHG inventory methodologies (for example, measurement, reporting, and verification [MRV]).[15] But it reported that MRV methodologies to track mitigation measures in agriculture are either not planned or not yet fully established. This presents an opportunity for the GARR PforR to support China to develop its MRV methodologies for the livestock and rice production systems and synthetic chemical fertilizer.

12. **Agriculture is China's main nonpoint source (NPS) of water pollution.** As of 2020, the Government deemed over 86 percent of China's monitored groundwater sources unfit for human contact.[16] In comparison, China's surface waters are in far better condition and generally improving. Agriculture remains the leading source of nutrient pollution. In 2017, the national pollution census showed that a decade after the first survey, agriculture remained responsible for more nitrogen and phosphorus pollution than other sources such as industry. The sector accounted for nearly half (47 percent) of national nitrogen pollution and over two-thirds (67 percent) of phosphorus pollution.[17] Agricultural sources of excess nutrients are primarily farmed animals' feces (including those generated by aquaculture), chemical fertilizer, and to a lesser extent, aquaculture feed and detritus.

13. **China's agriculture is also highly vulnerable to climate change.** The country faces significant climate change-related disaster risks and is ranked 87 out of 193 countries by the 2023 Inform Risk Index.[18] This ranking is driven strongly by the exposure component of risk, including to flooding (riverine, flash, and coastal—ranked jointly 13) and tropical cyclones and their associated hazards (ranked 6). Projected precipitation trends show a likely reduction in rainfall across the central regions, such as in Hubei and Hunan provinces, but an increase in intensity of extreme rainfall events. In China, flooding is the largest driver of average annual losses to disaster; the United Nations International Strategy for Disaster Reduction Secretariat (UNISDR) estimates flood impacts at US$19 billion per year. Storm surge impacts also represent a major risk, costing an estimated US$5 billion per year.[19] These risks vary by region, but Hubei and Hunan experience the highest risk in terms of vulnerable populations and agricultural vulnerability.[20]

14. **The increasing severity and frequency of extreme weather events (especially floods and droughts), rising sea levels, destruction of ecosystems, and loss of biodiversity will significantly weaken China's agricultural productive capacity.** While all of China will experience warming trends, temperature increases in China are expected to be most severe in its central (including Hubei and Hunan) and northern regions. An increase in the frequency and intensity of heatwaves has already been documented in recent decades, and this trend is expected to continue and lead to more frequent droughts. As a result, climate change will influence food production through direct and indirect effects on crop growth processes. Direct effects include alterations to CO_2 availability, precipitation, and temperatures. Indirect effects include impacts on water resource availability and seasonality, soil organic matter transformation, soil erosion, changes in pest and disease profiles, the arrival of invasive species, and a decline in arable areas due to the submergence of coastal lands and desertification. Across China, seasonal droughts driven by climate change could lead to substantial crop yield

[13] https://www.reuters.com/business/cop/china-announces-plan-curb-rising-methane-emissions-challenges-await-2022-11-09/.
[14] Intergovernmental Panel on Climate Change.
[15] MRV refers to the multistep process to measure the amount of GHG emissions reduced by a specific mitigation activity, such as reducing emissions from deforestation, rice fields, manure, and chemical fertilizer over a period of time, and report these findings to an accredited third party. The third party then verifies the report, so that the results can be certified and carbon credits can be issued.
[16] MEE (Ministry of Ecology and Environment). 2021. *Report on the State of the Ecology and Environment in China 2020*. Beijing: MEE.
[17] Gao, Shangbin. 2021. *Green Agricultural Development in China*. Unpublished background report prepared for the World Bank.
[18] European Commission. 2023. "INFORM Index for Risk Management." China Country Profile. https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Country-Risk-Profile.
[19] UNISDR. 2014. "Basic Country Statistics and Indicators: China." https://www.preventionweb.net/countries/chn/data/.
[20] Huang, D., R. Zhang, Z. Huo, F. Mao, E. Youhao, and W. Zheng. 2012. "An Assessment of Multidimensional Flood Vulnerability at the Provincial Scale in China Based on the DEA Method." *Natural Hazards* 64 (2): 1575–1586. https://link.springer.com/article/10.1007/s11069-012-0323-1.

losses of nearly 8 percent by 2030 for its three primary crops: rice, wheat, and corn. Corn yields are likely to suffer the greatest losses with a projected drop of nearly 20 percent of total production, followed by wheat with a 4 percent decline and rice decreasing by 1.5 percent.[21]

15. **In China, the adoption of green technologies and practices by farmers and cooperatives is hampered by perverse incentives, commercial risks, and insufficient technical and advisory services.** Chinese farmers face these key challenges: (a) input-oriented subsidies encourage the overuse of more harmful chemical agricultural inputs, especially fertilizer and pesticide, in crop production; (b) climate-smart agricultural technologies and practices, including the use of formula fertilizer, fertigation, organic and green manure, and livestock and poultry manure treatment and recycling facilities require up-front costly investments, hence risk-averse and credit-constrained farmers are reluctant to adopt them; (c) farmers need extensive technical training and capacity building to fully master the details of good agricultural practices (GAP),[22] but local institutional capacity to deliver them is limited; and (d) farmers find it difficult to recoup the costs of producing green agricultural products unless these are certified as green or organic, or registered as geographical indication (GI), and are sold in niche markets, where consumers are willing to pay premium prices.

16. **The design of the GARR PforR is grounded on the recently completed studies undertaken as part of the World Bank's Programmatic Advisory Services and Analytics (PASA) on Transforming Rural China: Greening of Chinese Agriculture.** The PASA concludes that over the past four decades, China has made enormous strides in raising agricultural productivity, advancing national food security, and tackling rural poverty, but this expansion and intensification came with a high environmental cost, both locally and beyond. Over the past decade, these adverse environmental impacts have been increasingly recognized and a broad range of policy and regulatory initiatives have been adopted to promote the development and adoption of green agricultural technologies, restore and protect agricultural ecosystems, and incentivize more sustainable natural resource use, especially land and water. While there have been notable achievements in each of these areas, there remains a large unfinished business pertaining to the greening of Chinese agriculture—unfinished in terms of policy, fiscal support, institutional strengthening, and adoption of greener agricultural technologies and practices. For example, major obstacles to the implementation of green subsidies still exist due to the lack of clear indicators of policy objectives and a well-rounded monitoring and evaluation (M&E) system. In addition, the widely recognized environmental protection and treatment standards are still insufficient; and there is currently neither specific objective for carbon emissions in the agriculture sector nor MRV methodologies for calculating GHG emission reduction. Furthermore, most of the current eco-environmental fiscal support policies for agriculture are not accurately targeted at smallholder farmers. Only a few existing fiscal subsidies are actually dedicated to transforming farmers' production practices and incentivizing them to adopt green agricultural technologies.

Rural Revitalization

17. **After achieving its goal of eliminating extreme poverty in 2020, China is transitioning from its Poverty Reduction Program into the RRP.** Under the Poverty Reduction Program, China achieved its goal of universal coverage of paved rural roads, drinking water supply, and rural housing—dubbed the three guarantees. The RRP focuses on increasing access to other rural infrastructure and public services, especially solid waste and wastewater services, to improve the rural living environment. Following the guidelines issued by the State Council in 2019, improving these types of rural infrastructure at the village level is being promoted through the development of spatial integrated village development plans (IVDPs), which represent rural service delivery compacts and once approved by the relevant authorities, they are binding. In May 2022, the State Council released a Village Development Action Plan (VDAP), which sets out main principles for the

[21] Tebaldi, C., and D. Lobell. 2018. "Differences, or Lack Thereof, in Wheat and Maize Yields under Three Low-Warming Scenarios." *Environmental Research Letters* 13: 065001. https://iopscience.iop.org/article/10.1088/1748-9326/aaba48.

[22] GAP is a set of standards for the safe and sustainable production of crops and livestock, which is verified through voluntary audit. It aims to help farm owners maximize yields and optimize business operations while also minimizing production costs and environmental impact.

development of rural infrastructure under the RRP. The VDAP requires spatial IVDPs, which are viewed as 'village masterplans' and developed based on the approved 'county masterplan' to guide all future investment decisions and operation and maintenance (O&M) of rural infrastructure. The VDAP also calls for performance evaluation of provincial and county RRP implementation.

18. **The NRRA, as a central agency mandated to coordinate the implementation of the RRP, needs accurate data and information to monitor and evaluate the performance of RRP implementation at the subnational level and to inform policy decision-making.** The NRRA will provide technical guidance and financial incentives to subnational governments to promote the adoption of green agriculture practices, deliver low-carbon and climate-resilient rural infrastructure and public services, and facilitate peer learning among provinces, as well as scale up good practices. The existing national information technology (IT)-based monitoring platform that was developed by the State Council's LGOPAD, the predecessor of the NRRA in 2014, for managing the Poverty Reduction Program is deemed insufficient to support the RRP implementation in sectoral scope and geographic coverage. Thus, under the GARR PforR, the national IT-based monitoring platform will be expanded to include all types of rural infrastructure and public services in its database as well as IVDPs.

19. **China's rural solid waste collection, transfer, and treatment levels are much below those in urban areas.** In 2019, waste generation was estimated at 0.76 kilograms per capita per day (kg/capita/day) in rural areas. While urban waste collection and treatment standards are almost universal, in 2017, it was estimated that only 47 percent of rural waste was disposed of according to the existing national standards.[23] In 2018, MARA reported that rural solid waste was not properly managed in at least one-quarter of China's administrative villages, where open dumping was normal and littering was ubiquitous.[24] China is currently piloting the separation of rural solid waste at source into four categories: organics, recyclables, hazardous, and residuals. In rural areas, kitchen (organic) waste is mostly used by households as animal feed and recyclables are partially collected outside the public service (for example, by the informal and private sectors) due to low profit margins and long transportation distances. But residual and hazardous wastes often remain uncollected, littered into the environment, placed at informal dumpsites, or burned. Sorting rural solid waste at source protects the environment, as it cuts pollution and reduces public health risks. These positive effects also translate into economic advantages: savings on disposal costs, enhanced efficiency during waste collection operations, and greater use of recycled materials. The World Bank is financing a series of operations aimed at abating domestic wastewater, solid waste and plastic waste pollution in China (see Annex 8). However, these operations do not focus on physical investment in decentralized facilities in rural traditional villages.

20. **Inadequate rural wastewater collection, treatment, and recycling infrastructure and services in rural traditional villages, a focus of the GARR PforR, are also major concerns in China.** In 2018, China had 2.45 million villages with a total population of 580 million.[25] Simple pit latrines and flush toilets connected to septic tanks are still commonly used in rural areas. But many villagers continue to face poor sanitation and hygiene conditions because of inadequate, outdated, and/or faulty sanitary facilities. The sewage generated in these villages daily is approximately 17.6 million cubic meters (m^3), but the daily treatment capacity is only about 494,700 m^3, so only 2.8 percent of wastewater is treated. The untreated wastewater discharged into the environment contributes to GHG emissions (CH_4,N_2O, and CO_2) and causes various health

[23] China Association of Urban Environmental Sanitation. 2017. *The China Municipal Waste Development Report*. Beijing: China Association of Urban Environmental Sanitation.
[24] http://www.xinhuanet.com/gongyi/2018-09/30/c_129964054.htm.
[25] Ministry of Housing and Urban-Rural Development of the People's Republic of China. 2018. *Chinese Urban-Rural Construction Statistical Yearbook (2018)*. Beijing: China Planning Press (in Chinese).

risks because of the higher content of chemical oxygen demand (COD), total nitrogen (TN), total phosphorus (TP), and ammoniacal nitrogen (NH_3-N)[26] in the drinking water sources.

21. **Most of the rural infrastructure are vulnerable to climate change-related disasters, especially floods and storm surges.** Technical standards would need to be strengthened for critical rural infrastructure, particularly in areas expected to be most severely affected by rising temperatures, changing precipitation patterns, or flooding. Thus, the GARR PforR will support the planning and development of climate-resilient rural infrastructure (as a package of both solid waste systems and wastewater treatment facilities [WWTFs])[27] in the demonstration traditional villages in the program counties.

GARR PforR Provinces

22. **The GARR PforR will support the adoption of green agricultural and rural infrastructure development practices in Hubei and Hunan provinces, which are located in the central region of China.** These provinces were competitively selected based on technical proposals submitted to the NDRC and criteria agreed with the World Bank.The two provinces have adequate fiscal space (sustainable debt ratio) to borrow from the World Bank. The two provincial governments believe that adopting GAP and climate-smart agriculture (CSA) to achieve the triple wins of increasing productivity, building resilience, and reducing GHG emission; restoring and protecting degraded agricultural ecosystems; and increasing access to low-carbon, energy efficient, and climate-resilient rural infrastructure and public services are imperatives to achieving the harmonious coexistence of man and nature.

Hubei Province

23. **Hubei is among the top 10 economies and is a major agricultural province in China.**[28] Hubei is an important grain-producing province, including summer grains: rice, corn, sorghum, millet, and soybean. Hubei also produces several industrial crops such as tea, fruit, cotton, oilseeds, hemp, sugar, tobacco, and medicinal plants. In addition, Hubei is a large livestock producer of pigs, cattle, sheep, and poultry. Given its abundant water resources, Hubei is also one of the largest producers of aquaculture products in China, comprising mainly freshwater fish, shrimp, crab, and shellfish, some integrated into the rice-fish production systems.

24. **Being a major agricultural producer, Hubei is one of the largest users of agricultural inputs, with major implications on its environmental footprint.** In 2020, 2.67 million tons of chemical fertilizers were used in the province, with an average application intensity considerably higher than the national average. Commercial pesticide use was about 52,000 tons. Long-term excessive and improper application of chemical fertilizers has resulted in acidification, compaction, and a decrease in soil fertility, which, in turn, have increased agricultural production costs and lowered the yield and quality of crops. The livestock and poultry industry uses large areas of pasture and consumes large quantities of fodder and animal feed. In 2021, the livestock and poultry sector produced over 100 million tons of manure, of which only about 80 percent is properly treated. In addition, Hubei generates large quantities of crop straw residues (often burned in the fields) and aquaculture wastewater, causing air and water pollution, as they are not properly managed.

25. **In recent years, the supply of basic public services in rural areas in Hubei has continued to increase, but the solid waste and wastewater infrastructure are still below par.** Since 2018, Hubei has taken the lead in promulgating local standards for rural toilet improvement in China and has built and renovated about 3.76 million household toilets and

[26] NH_3-N is a measure of the amount of NH_3 (ammonia), a toxic pollutant often found in landfill leachate and in waste products, such as sewage, liquid manure, and other liquid organic waste products.
[27] 'Climate-resilient infrastructure' refers to how well infrastructure withstands, and how quickly it recovers from, natural hazards made worse by climate change. As climate change causes disasters such as floods, hurricanes, heatwaves, and wildfires to become more severe or frequent, much of rural infrastructure will need to be redesigned and rebuilt for climate resilience.
[28] According to the China's National Bureau of Statistics (NBS), Hubei's GDP in 2021 was CNY 5,001.29 billion (US$781.45 billion), ranking seventh in the country, with a per capita income of CNY 86,600 (US$13,531.25), ranking ninth in the country. The total output value of agriculture, forestry, animal husbandry, and fishery in 2021 was CNY 668.19 billion (US$104.40 billion or about 13.35 percent of the total GDP of the province).

29,000 public toilets in rural areas, achieving a penetration rate of 90.15 percent of rural sanitary toilets. By the end of 2020, 150 rural waste treatment facilities were built in Hubei province. In addition, 897 township domestic sewage treatment plants were built increasing the province's sewage treatment capacity from 1.14 million tons/day to 1.7 million tons/day. Despite these efforts the rural sewage treatment rate remains less than 25 percent. These basic public services, especially in rural traditional villages, need to be improved to close the urban-rural gap.

Hunan Province

26. **Hunan is also among the top 10 economies and one of the major agricultural production areas in China.**[29] The province is an important producer of grains (for example, ranks first in rice, and major producer of wheat and corn), tea, and citrus (ranks second) and a major producer of livestock (ranks second in pigs) and poultry. Hunan's intensive agricultural production systems also use large quantities of agricultural inputs, resulting in a significant environmental footprint. In 2021, the province's total chemical fertilizer use amounted to 2.24 million tons (ranking 11th in the country). In addition, the province used 101,450 tons of pesticides, ranking third in the country. In the same year, about 25.18 million tons of livestock and poultry manure generated, of which only 83 percent was treated and recycled. Hunan also generates large quantities of crop straw residues (with significant amounts burned in the field) and aquaculture wastewater which are not properly managed, causing air and water pollution.

27. **The greening of agricultural value chains faces significant challenges.** Awareness of and skills in green and modern agricultural management practices are low. Agricultural landscapes and ecosystems are highly degraded in Hunan. Agricultural production areas in Hunan have been affected by heavy metal contamination (about 13 percent of arable land), mainly caused by industrial discharges of flue gas, wastewater and waste residue, and metal mine tailings. Agricultural soil quality is further affected by the overuse of agrochemicals and poor farming practices.

28. **Despite the increase in public investments in agricultural and rural infrastructure in Hunan, there is still a large deficit to be addressed.** For example, Hunan has increased the number of solid waste and sewage treatment facilities in rural areas, promoted the classification of rural domestic waste, increased capacity for rural domestic waste and sewage treatment, promoted improvements in rural toilets, and improved the rural living environment. However, access to rural wastewater management services is only 20–25 percent.

29. **The GARR PforR draws lessons and experiences from the ongoing and recently closed NPS pollution control, value chains, and sustainable agriculture development projects and poverty alleviation/reduction projects financed by the World Bank in China.** These include Guangdong Agricultural Pollution Control Project (P127775, TF018176), Hunan Integrated Management of Agricultural Land Project (P153115), Hubei Smart and Sustainable Agriculture Project (P168061), Jiangxi Farm Produce Distribution System Development Project (P147009), Henan Green Agriculture Finance Project (P169758), and the Climate Smart Staple Crop Production Project (P144531). The key lessons from these projects are that adoption of green and sustainable agricultural practices requires a balanced mix of technical services (for example, effective extension and advisory services, animal health, and regulations and standards), enabling environment (for example, public investment in productive infrastructure such as irrigation, cold storage, value addition and so on), and incentives (for example, matching grants to family farms and cooperatives, and output-based subsidies to agro-enterprises). The GARR PforR's design also draws lessons and experiences from the poverty alleviation/reduction projects/program, including the Guangxi Poverty Alleviation Pilot Project (P153892), Shaanxi Poor Rural Areas Community Development Project (P153541), Guizhou Rural Development Project (P133261), Guangxi Poverty Reduction PforR (P163138), and the Poverty Alleviation and Agriculture-Based Industry Pilot and Demonstration in Poor Areas Project' (P133326)—supporting the International Poverty Reduction Center in China (IPRCC) (Sichuan, Gansu, and Guizhou

[29] Based on China's NBS statistics, Hunan's total GDP in 2021 was CNY 4,606.31 billion (US$719.74 billion), ranking ninth in the country, with a per capita income of CNY 69,300 (US$10,828), ranking 14th in the country. In 2021, the total output value of agriculture, forestry, animal husbandry, and fisheries was CNY 751.20 billion (US$117.38 billion or about 16.31 percent of the province's GDP).

provinces). The key lessons learned from these projects/program are that targeting central and provincial budget transfers to poverty counties, pooling funds locally from various earmarked budget lines, and putting in place robust M&E and verification systems achieved greater impact on poverty reduction.

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

30. **The GARR PforR is aligned with the World Bank Group's Country Partnership Framework for China (FY 2020–2025) (Report No. 117875-CN), which was discussed by the World Bank Board of Executive Directors on December 5, 2019**[30]. The CPF focuses on closing the remaining institutional gaps and supporting interventions that generate significant global public goods (GPGs), which include (a) reducing GHG emissions, (b) increasing carbon sequestration in agricultural ecosystems, and (c) improving biodiversity protection and restoration, all of which GARR PforR supports (see Box 1). The GARR PforR is linked to Engagement Area 2 of the CPF—Promoting Greener Growth, which aims to support the Government's efforts to (a) reduce air, soil, water, and marine plastics pollution; (b) demonstrate sustainable agricultural practices and improve agro-food product quality and safety; and (c) strengthen institutional capacity for sustainable natural resource management, especially the efficient use of scarce arable land and water. The GARR PforR also aligns with the WBG's Green, Inclusive, and Resilient Development (GRID) framework and the Climate Change Action Plan (2021–2025). By focusing on green value chains development the operation contributes to the World Bank Group's Twin Goals of Ending Extreme Poverty and Promoting Shared Prosperity. Also, by supporting institutional capacity strengthening, climate change resilience, and future pandemics prevention the operation aligns itself with the Global Crises Response Framework (GCRF). In addition, GARR PforR supports the implementation of China's Nationally Determined Contribution (NDC),[31] updated in October 2021, and is consistent with a range of recent climate policy commitments made by the country, including the Glasgow Leaders' Declaration on Forests and Land Use and a joint declaration signed by China and the US in the margins of the 26th UN Climate Change Conference of the Parties (COP26) in November 2021, providing for incentives and programs to reduce CH_4 emissions from the agriculture sector.

Box 1. Contribution of the GARR PforR to GPGs

The GARR PforR contributes to the following GPGs: (a) reducing GHG emissions, (b) increasing carbon sequestration in agricultural ecosystems, and (c) reducing agriculture pollution to improve biodiversity protection and restoration.

Reducing GHG emissions. The GARR PforR is expected to generate substantial climate co-benefits by implementing mitigation and adaptation measures. The climate co-benefits from mitigation measures are expected to be generated in several ways. First, by reducing GHG emissions (CO_2, CH_4, and N_2O measured in CO_2 equivalent) from crop production systems through minimizing chemical fertilizer use and increasing the use of organic fertilizer, such as green manure, treated sludge, and compost material, as substitutes for chemical fertilizer. Second, by reducing GHG emissions (removal of COD, CH_4, and NH_3-N) from livestock and poultry production systems through the collection, treatment, and recycling of manure. Third, reducing GHG emissions (CO_2, N_2O and CH_4) from the rice-fish/shrimp co-culture crop production systems. The carbon climate co-benefits from adaptation measures are expected to be generated through the adoption of CSA practices, including (a) increasing efficiency of irrigation water use, such as through fertigation; (b) improving water management in rice to reduce CH_4 emissions; (c) adopting integrated pest management (IPM) technologies and practices to reduce N_2O; and (d) reducing food loss and waste from more efficient agricultural value chains (for example, improved postharvest management such as cold storage and primary processing).

[30] World Bank Group. 2021. *China - Country Partnership Framework for the Period FY2020–2025* (Report No. 117875-CN). Washington, DC: World Bank Group. https://documents1.worldbank.org/curated/en/902781575573489712/pdf/China-Country-Partnership-Framework-for-the-Period-FY2020-2025.pdf.

[31] China updated its NDC targets to include the following: (a) CO_2 emissions will peak by 2030 and achieve carbon neutrality by 2060; (b) by 2030, China's CO_2 emissions per unit of GDP will drop by more than 65 percent compared with 2005; (c) the proportion of non-fossil energy in primary energy consumption will reach about 25 percent; (d) the forest volume will increase by 6 billion m^3 compared with 2005; and (e) the total installed capacity of solar power generation will reach more than 1.2 billion kilowatts.

Increasing carbon sequestration in agricultural ecosystems. Adopting agroforestry practices, improving the management of pasture and grasslands, and returning crop straw residues to the farmland will significantly increase carbon sequestration above ground and below ground and reduce GHG emissions by not burning the crop straw residues in the fields. It will also increase soil organic carbon (SOC); improve soil health (for example, higher water retention, cation exchange, and nutrient absorption capacity); and promote a rural circular economy, such as better utilization of crop residues, which would, in turn, help reduce emissions intensity.

Reducing agriculture pollution to improve biodiversity protection and restoration. Hubei and Hunan are part of the Yangtze River Basin, a globally significant biodiversity hotspot, as its waterways, floodplains, and wetland systems provide habitat to various endangered species. The GARR PforR will indirectly contribute to the protection and restoration of biodiversity, through the reduction of point and nonpoint source pollution (especially from treatment of high toxicity and high residue pesticides and recycling of livestock and poultry manure as well as domestic wastewater); promotion of IPM technologies and practices (for example, use of pest lamps and insect glue boards, biological pesticides, and low-residue, high-efficiency pesticides); and management and recycling of tail water from intensive aquaculture systems and rice-fish production systems.

The activities under the GARR PforR also contribute to other GPGs such as improving food safety and reducing health risks related to China's large food exports, through improved market infrastructure and livestock rearing and handling practices helping reduce the risk of zoonotic diseases, and by widely sharing globally knowledge such as methodologies for MRV of GHG emissions reduction.

31. **The GARR PforR is consistent with the China Country Climate and Development Report (CCDR).** Under Policy Package 3: Enhance climate resilience and low-carbon development in rural landscapes and urban areas, the CCDR underscores that climate change will affect China's agricultural production potential and the availability of ecosystem services. In turn, changes in crop yields and the availability of arable land will adversely affect agricultural output and exacerbate food and nutrition security risks. The GARR PforR will leverage public expenditures to support green agricultural technologies and practices that mitigate GHG emissions, alleviate soil and water pollution, enhance climate adaptation and climate-related disaster resilience, and increase the efficiency of natural resource use.

32. **The PforR instrument is the most appropriate for the GARR PforR because it will help the Government improve the effectiveness and results-orientation of its RRSP toward supporting green agricultural and rural development.** The PforR instrument allows for a greater focus on results in the substantial public investments being made by the governments in agriculture and rural infrastructure and incentivizes greater coherence of activities across the multiple agencies involved in implementing the RRSP. National and provincial policy frameworks for fiscal transfers are already becoming more results based (for example, eco-compensation)[32] and the PforR instrument capitalizes on this trend by tying high-level government (central and provincial) transfers to a verifiable range of environmental outcomes (for example, GHG emissions and pollutant loads reduction). In leveraging budget resources under the RRSPs, the PforR instrument provides geographic coverage beyond that possible under the standard Investment Project Financing (IPF) instrument. The PforR instrument would also help the Government repurpose its agricultural input subsidies toward achieving green and sustainable agricultural development objectives and the Rural Revitalization Transition Fund toward climate-resilient wastewater facilities and solid waste management systems.

[32] Eco-compensation is a system of payments for ecosystem services. It aims to incentivize local governments, private and state-owned enterprises, and farmers to adopt better environmental management practices to protect ecosystems. The Sloping Land Conversion Program (SLCP), or the 'Green for Grain' scheme in China, is one of the largest payments for ecosystem services in the developing world, with a total investment of more than US$69 billion. Its initial goal was to decrease soil erosion, deforestation, and flood risk by restoring forests and grasslands. The scheme operates through cash transfers to farmers in return for reforesting marginal agricultural land. Payments are made only after verification that the trees planted have at least an 85 percent survival rate.

II. PROGRAM DESCRIPTION

A. Government Program

33. **The Chinese Government has been implementing the RRP since 2017 in phases of five-year RRSPs.** The national RRSP provides the overarching rural development vision and broadly defined actions. The RRSP is framed around the three rural dimensions: agriculture, rural areas, and farmers. The main objectives of the RRSPs are to sustainably increase rural income, increase access to rural infrastructure and public services, and improve the living environment in rural areas. The national RRSP Phase 1 (2018–2022) focuses on consolidating and sustaining the poverty eradication gains; and has four pillars: (1) green agricultural development; (2) agricultural modernization; (3) rural infrastructure and public services; and (4) rural governance. The national RRSP Phase 1 overlaps with the transition period (2021–2025),[33] coinciding with the 14th FYP (2021–2025), which sets out the national targets. The Chinese RRPL[34] provides a legal framework for implementing the phased national RRSPs.

34. **The green agricultural development pillar of RRSP Phase 1 has seven subprograms (SPs), further elaborated in the 14th FYP for the National Green Development of Agriculture Plan.**[35] These are (1) strengthening the protection and utilization of agricultural resources; (2) preventing and controlling agricultural NPS pollution; (3) strengthening agricultural ecological protection and restoration; (4) building green and low-carbon agricultural industry chains as well as promoting green, organic, and GI agricultural products; (5) improving the innovation system for green agricultural technology development; (6) improving the governance systems and mechanisms for enhancing green development of agriculture; and (7) planning and implementing green agricultural development. The GARR PforR will support the implementation of a subset of activities in all these SPs (see table 1).

35. **The rural infrastructure and public services pillar of RRSP Phase 1 has six SPs.** These are (1) building an ecologically livable beautiful village, (2) improving rural habitat environment,[36] (3) improving the appearance of the village, (4) improving the rural water infrastructure network, (5) strengthening rural transport infrastructure, and (6) building a modern energy system in rural areas. The GARR PforR will also support the implementation of a subset of these SPs and related activities (see table 1).

B. Theory of Change

36. **While China has demonstrated strong central and provincial institutional capacity and experience in implementing the Government's Poverty Reduction Program, the green growth objective enshrined under the RRP is new to Chinese authorities.** Thus, it is critical to enhance the institutional capacity for governance of green agriculture and rural revitalization. The GARR PforR will support this transition and focus on improving the effectiveness and impact of the RRP implementation and enhancing its contribution to climate change mitigation and adaptation while delivering on other policy objectives, such as increasing access to rural infrastructure and public services and improving the living environment in rural areas. The Program Development Objective (PDO) is to enhance adoption of environmentally sustainable agricultural and rural infrastructure development practices in selected areas of Hubei and Hunan. Considering the sheer size of China and the multilayered governance system, the institutional capacity for governance of green agriculture and rural revitalization needs to be strengthened at both the central and provincial levels.

[33] Transition from the Poverty Reduction Program to the RRP, with the RRSP Phase 1 (2018–2022) focusing on consolidating and sustaining extreme poverty alleviation gains, tackling pollution, and greening the economy.
[34] Adopted by the National People's Congress on April 29, 2021.
[35] A joint notice of MARA, NDRC, MOST, MNR, MEE, and NFGA (Nong Gui Fa [2021] No. 8) issued in August 2021.
[36] Further elaborated in the 14th FYP on Municipal Solid Waste Separation and Treatment Facilities Development (2021–2025).

37. **Environmentally-sustainable agricultural practices are defined as practices that:** (a) avoid further deterioration of the environment and natural resource base and reverse this trend by reducing agriculture's environmental footprint, such as through restoration of natural habitats, soil carbon sequestration, and preservation of fresh water; (b) minimize the use of harmful or synthetic inputs by integrating natural biological cycles and controls, including crop rotation and IPM technologies; (c) reduce GHG emissions, and agricultural pollution in the air, water, and soil while enhancing the resilience of agri-food systems to pests, diseases, climate, and other exogenous shocks;[37] (d) minimize further expansion of agricultural land into other ecosystems and/or further environmental degradation caused by agriculture, including deforestation, land degradation, and desertification; (e) contribute to greater food and nutrition security, in part through the production of affordable, nutritious, sustainable agro-products available to food and nutrition insecure populations; and (f) ensure the generation of better economic livelihoods and incomes for farmers and rural communities, contributing in turn to poverty alleviation, food and nutrition security, resilience, and livelihood security.

38. **Environmentally-sustainable rural infrastructure development practices are defined as practices that promote** (a) low-carbon technologies for waste treatment facilities (for example, recovering and recycling organic waste in villages to reduce GHG emissions from transport to transfer stations); (b) energy efficiency (for example, renewable sources such as solar, wind, and biogas to energy in irrigation systems and livestock and poultry manure treatment operations); and (c) nature-based solutions for treating wastewater (for example, discharging treated effluents into wetlands to meet environmental standards). Figure 1 shows the Theory of Change with the results chain (results areas [RAs], planned activities, and expected outputs and outcomes) of the GARR PforR.

39. **The key assumptions for the GARR PforR to satisfactorily achieve its expected outcomes and PDO are the following:** (a) central-level governance frameworks, such as an IT-based platform for mapping and M&E of rural infrastructure and public services, and methodology for MRV of GHG emissions are developed on schedule to facilitate the adoption by provinces and use by program counties; (b) effective cross-sectoral coordination and inter-jurisdictional cooperation at the central, provincial, and county government levels exist throughout the program implementation period; (c) efficient provincial green budgeting and expenditure tracking systems are established on schedule and resources are mobilized to finance RAs' activities to achieve the expected results; (d) requisite GAP and CSA practices and technical assistance are readily available to help provinces and counties implement activities to achieve the expected results; and (e) effective M&E systems are in place and competent third-party verification agencies (VAs) are hired to verify the results.

40. **The World Bank's GARR PforR support focuses on four interlinked RAs.** The four RAs are chosen to address the main challenges facing agriculture and rural infrastructure development under the RRP: (a) filling the remaining gaps in institutional capacity for governance (RA1), (b) reducing agricultural GHG emissions and NPS pollution (RA2), (c) reducing wastewater and solid waste pollution (RA3), and (d) restoring degraded natural capital—especially land and water (RA4). RA1 is a key platform for monitoring progress and supporting the implementation of RA2, RA3, and RA4, while RA4 complements the implementation and achievement of results under RA2. The rationale and activities under each RA and the expected outcomes are described in detail in the section 'PforR Program Scope'.

41. **RA1 - Strengthening institutional capacity for governance.** This RA aims to improve the implementation performance (efficiency and impact) of the results-based green agriculture and climate-resilient rural infrastructure development (wastewater and solid waste management systems) activities. At the national level, it will support the NRRA in (a) developing a national IT-based monitoring platform for mapping and M&E of the delivery of rural infrastructure and public services and (b) developing the MRV methodologies for measuring the GHG emissions reduction from three main agriculture sources: livestock and poultry manure, chemical fertilizer, and rice. At the provincial level, it will support Hubei

[37] These may include nature-based solutions and alternative methods of land management such as agroforestry, grazing pressure management, and silvo-pastoral management.

and Hunan provinces in (a) developing or adopting regulations, standards, and guidelines for good agricultural practices and the delivery of climate-resilient rural infrastructure and public services; (b) mainstreaming the national IT-based monitoring system (developed by the NRRA) for mapping, and monitoring and evaluation of rural infrastructure and public services at provincial level; and (c) establishing frameworks for nurturing green skills and talents. These governance frameworks will contribute to climate co-benefits by helping program counties incorporate GAP and CSA in their agricultural plans and climate resilience measures in rural infrastructure development designs.

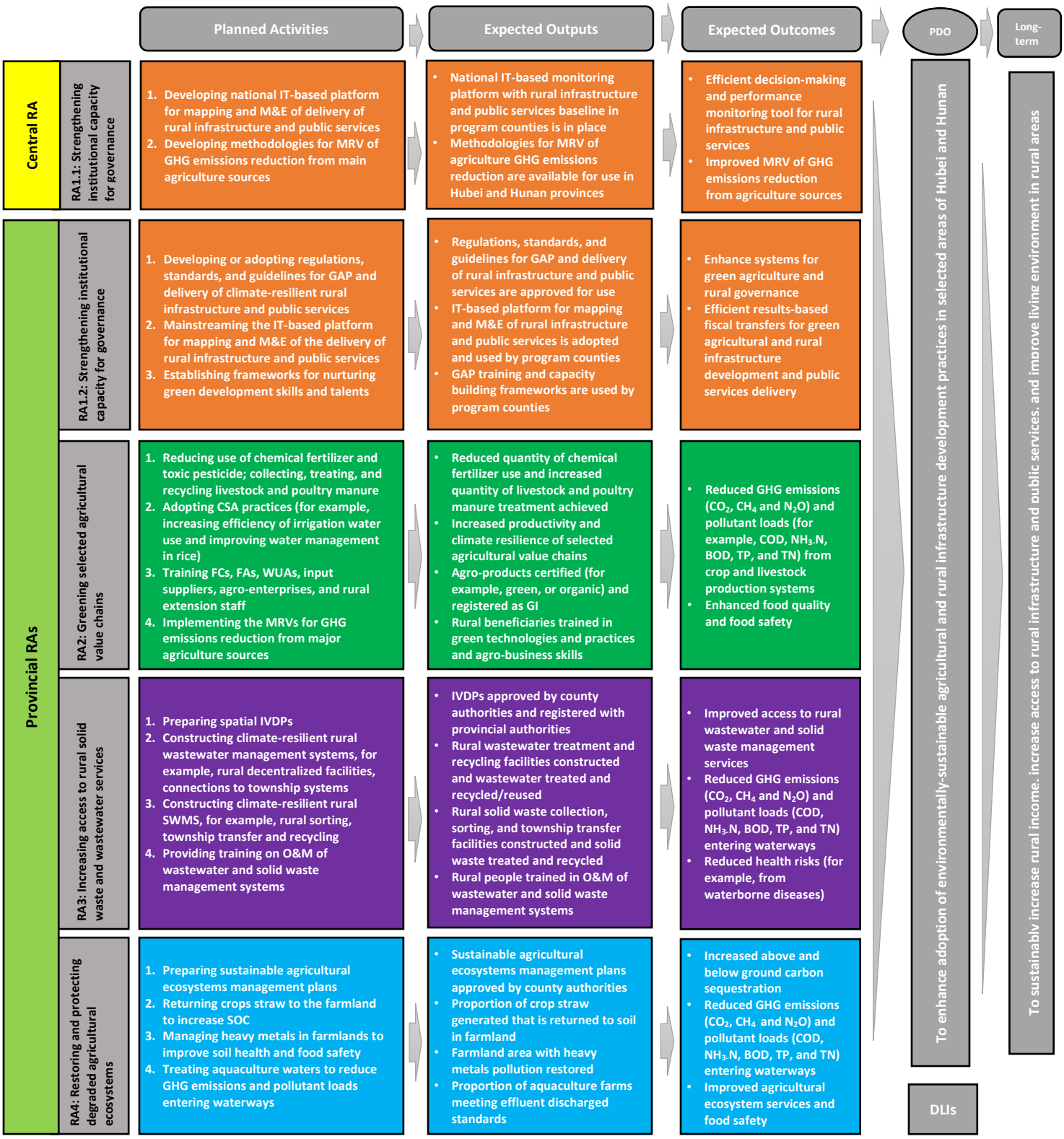
42. **RA2 - Greening selected agricultural value chains.** This RA aims to reduce the agricultural environmental footprint through the adoption of CSA and GAP to reduce GHG emissions, especially CH_4 and N_2O from livestock and poultry manure, chemical fertilizer, and rice; and reduce point and NPS pollution. Activities under this RA will include (a) reducing the use of chemical fertilizers and toxic pesticides and treating and recycling livestock and poultry wastes; (b) adopting CSA practices (for example, increasing the efficiency of irrigation water use and improving nutrient and water management for rice); (c) training farmer cooperatives (FCs), farmer associations (FAs), water user associations (WUAs), input suppliers, agro-enterprises, and rural extension staff on green technologies; and (d) implementing the MRVs to measure the GHG emissions reduction from manure, chemical fertilizer, and rice. Additional support will be provided for investments that address the gaps in agricultural production and value addition infrastructure, including efficient irrigation systems, cold storage, and cold chain logistics. Other public services, such as agricultural extension and advisory services, animal health and veterinary services, business development services, and marketing services will also be financed. To incentivize the adoption of GAP and CSA; and compensate for generating GPGs from the reduction in GHG emissions, matching grants will be provided to smallholder farmers and FCs, and output-based or performance-based subsidies will be provided to enterprises.

43. **RA3 - Increasing access to rural solid waste and wastewater services.** This RA aims to reduce GHG emissions (especially CH_4 and N_2O from wastewater and solid waste leachates) and pollutant loads (COD, biological oxygen demand [BOD], TP, TN) and improve the rural living environment. It will also help the two provinces close the urban-rural infrastructure and public service delivery gap. Activities to be supported include (a) preparing spatial IVDPs, which are mandatory and binding instruments for guiding all future private and public rural investments; (b) constructing rural wastewater management systems (for example, rural decentralized facilities, connections to township systems to reduce GHG emissions and pollutant loads entering waterways); (c) constructing rural solid waste management system (SWMS) (for example, rural sorting, township transfer, and recycling); and (d) providing training on O&M of wastewater and solid waste management systems. While the wastewater management facilities and SWMS will contribute to GHG emissions reduction, the spatial IVDPs will help program counties incorporate climate resilience planning in their designs.

44. **RA4 - Restoring and protecting degraded agricultural ecosystems.** This RA aims to improve soil health and food safety, sequester carbon (above and below ground), and reduce GHG emissions. It will support the integrated management of natural capital (especially land and water) and increase their use efficiency. The main activities will include (a) preparing sustainable agricultural ecosystem management plans, (b) returning crop straw to the farmland to increase SOC, (c) managing heavy metals[38] in farmlands to improve soil health and food safety, and (d) treating aquaculture wastewater to reduce GHG emissions and pollutant loads entering waterways. Matching grants and eco-compensation mechanisms to participating famers and FCs will provide incentives for adopting these measures. In addition to complementing the activities under RA2, the integrated management of natural resources (land and water) under RA4 will contribute to increasing climate resilience in the sector.

[38] As heavy metals are nonbiodegradable, they persist in the environment, have potential to enter the food chain through crop plants, and eventually may accumulate in the human body through biomagnification. Owing to their toxic nature, heavy metal contamination has posed a serious threat to human health and the ecosystem.

Figure 1. The GARR PforR Results Chain



45. **The expected outcomes of implementing activities vary based on each RA.** For RA1, these are efficient decision-making and performance monitoring systems for climate-resilient rural infrastructure and public services, improved MRV of GHG emissions reduction from main agriculture sources, enhanced green agriculture and rural governance systems, and efficient results-based fiscal transfers for green agricultural and rural revitalization. For RA2, these are reduced GHG emissions (CO_2, CH_4, and N_2O) and pollutant loads (for example, COD, NH_3-N, BOD, TP, and TN) from crop and livestock and poultry production systems and enhanced food quality and food safety. For RA3, these are improved access to rural wastewater and solid waste management services, reduced GHG emissions (CO_2, CH_4 and N_2O) and pollutant loads (COD, NH_3-N, BOD, TP, and TN) entering waterways, and reduced health risks (for example, waterborne diseases). For RA4, these are increased aboveground and belowground carbon sequestration, reduced GHG emissions (CO_2, CH_4 and N_2O, especially from reduced burning of crop residues and integrated fish-rice systems) and pollutant loads (COD, NH_3-N, BOD, TP, and TN from intensive aquaculture and integrated fish-rice production systems entering waterways), and improved agricultural ecosystem services and food safety.

C. PforR Program Scope

46. **The GARR PforR will support two of the four pillars of the national RRSP Phase 1 (2018–2022) under the 14th FYP in China: Pillar 1 (Green agricultural development) and Pillar 3 (Rural infrastructure and public services).** Under Pillar 1, it will support a subset of activities in all seven RRSP SPs, while under Pillar 3, it will support another subset of activities in three (out of six) RRSP SPs (see Table 1). The scope of the GARR PforR is very similar to the Guangxi and Guizhou PforR—the main differences are that (a) the GARR PforR will support the NRRA as a central component, and (b) it includes a new results area, RA4 - Restoring and protecting degraded agricultural ecosystems. The RA4 will focus on three main activities: (a) increasing comprehensive utilization of crop straw, (b) controlling heavy metals, and (c) managing aquaculture wastewater. Thus, three disbursement-linked indicators (DLIs) corresponding to these activities, along with associated intermediate indicators have been added under the GARR PforR to track implementation performance and achievement of intended results. In addition, unlike the GARR PforR (Guangxi and Guizhou), the GARR PforR does not include the reduction in agricultural plastics pollution activity and its related DLI, mainly because it is being supported through other Bank-funded programs.

47. **The NRRA will be responsible for delivering RA1.1, mainly developing the governance frameworks.** These will include (a) expanding the national IT-based monitoring platform to include mapping and M&E of rural infrastructure and public services, which builds on the existing Poverty Reduction Program M&E system, and (b) developing the methodology for MRV of agriculture GHG emissions reduction from the main agriculture sources: livestock and poultry manure, chemical fertilizer, and rice. In addition, the NRRA will be responsible for providing strategic direction and technical assistance to the provincial implementing agencies, coordinating with central ministries on policy matters related to phased RRSP implementation, developing a communication strategy for the RRSP program, sharing knowledge and lessons learned from implementation of the two GARR PforRs, and mainstreaming and upscaling nationwide the approaches and methodologies developed in Hubei and Hunan.

48. **Hubei and Hunan will be responsible for delivering results under RA1.2, RA2, RA3, and RA4.** The GARR PforR will support 10 demonstration counties (out of 103 counties) in Hubei province: Honghu, Chongyang, Xishui, Yangxin, Yunxi, Shishou, Suixian, Xiantao, Danjiangkou, and Xianfeng. Similarly, the GARR PforR will support 13 demonstration counties (out of 122 counties) in Hunan province: Hengyang, Lixian, Taojiang, Cili, Suining, Yueyang, Huayuan, Liling, Jiangyong, Yongding, Linxiang, Hengnan, and Yongshun. These demonstration counties were selected based on the following criteria: (a) geographic distribution (that is, demonstration counties from different municipalities/cities); (b) large users of chemical fertilizer and pesticide (to maximize impacts of GHG emissions reduction , and NPS pollution reduction); (c) large producers of livestock and poultry to maximize the impacts of better management of livestock and poultry manure and other waste (dead animals and byproducts); (d) lack of/inadequate SWMS (for example, for collecting, sorting, treating, and converting

to organic fertilizer or biogas/energy generation); and (e) lack of/inadequate WWMS (for example, for collecting, treating, and recycling water for irrigation and/or construction of wetlands). The links between the RAs of GARR PforR and the Government's RRSP Phase 1 are summarized in table 1.

Table 1. GARR PforR Program Boundary

Description	Government Rural Revitalization Program/RRSP Phase 1 (under the 14th FYP 2021–2025)	Program Supported by the World Bank's GARR PforR
Objectives	To sustainably increase rural income, increase access to rural infrastructure and public services, and improve the living environment in rural areas[39]	To enhance adoption of environmentally-sustainable agricultural and rural infrastructure development practices in selected areas of Hubei and Hunan
Duration	Rural Revitalization Program (RRP) (2018–2035) RRSP Phase 1 (2018–2022) or 14th FYP (2021–2025)	FY2024–2029
Geographic coverage	Mainland China: 22 provinces, 4 municipalities, and 5 autonomous regions	Central: NRRA Provinces: Hubei (10 counties) and Hunan (13 counties)
SPs/RAs	**A. Green agricultural development Pillar 1** • Strengthening the protection and utilization of agricultural resources • Strengthening the prevention and control of agricultural NPS pollution • Strengthening agricultural ecological protection and restoration • Building green and low-carbon agricultural industry chains • Improving the innovation system for green agricultural technology development • Improving the governance systems and mechanisms for enhancing the green development of agriculture • Planning and implementing green agricultural development **B. Rural infrastructure and public services Pillar 3** • Building an ecologically livable beautiful village • Improving rural habitat environment[40] • Improving the appearance of the village • Improving rural water infrastructure network • Strengthening rural transportation infrastructure • Building a modern energy system in rural areas	GARR PforR RAs • RA1: Strengthening institutional capacity for governance (RRSP SP 6) • RA2: Greening agricultural value chains (RRSP SPs 1, 2, 4, 5, and 7) • RA3: Increasing access to rural solid waste and wastewater services (RRSP SPs 9, 10, and 11) • RA4: Restoring and protecting degraded agricultural ecosystems (RRSP SP 3)
Overall financing	• National RRP: Total financing of US$960 billion (22 provinces, 4 municipalities, and 5 autonomous regions, 2022–2025)	• IBRD loan of US$345.00 million • Government financing of US$4,100 million for Hubei and Hunan (23 program counties) • Total program financing is US$4,445.00 million

[39] Aims to revitalize rural areas on all fronts: industries, human resources, culture, ecosystems, and institutions.
[40] Further elaborated in the 14th FYP on Municipal Solid Waste Separation and Treatment Facilities Development (2021–2025).

49. **Both the GARR PforR and the Yangtze River Protection and Ecological Restoration PforR (Hubei) (P178338) include Honghu as a program county.** Both are supporting improvements in (a) the treatment and utilization of livestock and poultry manure and (b) the collection, transfer, and treatment of domestic wastewater and solid waste in Honghu. To foster synergies and avoid duplication of efforts, the GARR PforR will support only the public investment in the centralized livestock and poultry manure treatment facilities to cater to small and medium farms, while the Yangtze River PforR (Hubei) will focus on monitoring livestock and poultry manure treatment and recycling in the privately owned large-scale livestock and poultry farms in the county. The DLI for livestock and poultry manure treated and meeting effluent standards has distinct targets for the large-scale and small and medium farms. Similarly, the GARR PforR will support the construction or rehabilitation of rural traditional villages' WWTFs and SWMS, while the Yangtze River PforR (Hubei) will focus on integrating administrative villages' domestic waste systems with the treatment facilities of towns or urban areas. The rural solid waste sorting and transfer under the GARR PforR will complement the agricultural plastic pollution reduction under the Yangtze PforR (Hubei).

Program Financing

50. **The total GARR PforR financing is estimated at US$4,445 million, of which US$4,100 million (CNY 29.3 billion) will be financed by the Chinese Government and US$345 million will be financed by the IBRD loan.** Of the US$4,100 million Chinese Government financing, it is estimated that US$2,464 million will come from Hubei, US$1,605 million from Hunan, and US$31 million from the NRRA (see table 2).

Table 2. Program Financing Plan (FY2024–2029) (US$, millions)

Source	NRRA		Hubei Province		Hunan Province		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
Government budget	31.00	86.11	2,464.00	93.5	1,605.00	90.40	4,100.00	92.23
IBRD loan	5.00	13.89	170.00	6.5	170.00	9.60	345.00	7.77
Total	**36.00**	**100.0**	**2,634.00**	**100.0**	**1,775.00**	**100.00**	**4,445.00**	**100.00**

51. **The public financing of the GARR PforR from the central and provincial government budgets and the IBRD loan proceeds will leverage significant private financing under RA2 and RA4.** While RA1 and RA3 will be wholly financed through public expenditures, RA2 and RA4 financing will primarily come from own resources of farmers, cooperatives, and agro-enterprises. The public financing under RA2 and RA4 will be limited to output-based subsidies and matching grants to agro-enterprises and farmers adopting GAP and CSA technologies, respectively.

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

52. **The PDO is to enhance adoption of environmentally-sustainable agricultural and rural infrastructure development practices in selected areas of Hubei and Hunan.** Institutional capacity for governance will be strengthened at the central (at NRRA) and provincial levels. To incentivize program counties to promote environmentally sustainable practices, the higher-level governments (central and provincial) fiscal transfers will be made against achieving specific verifiable environmental results. These will be monitored and evaluated through tagging of program budgets and expenditure tracking; and the IT-based monitoring platform for mapping and M&E of the rural infrastructure and public services. Farmers and agro-enterprises will be incentivized to adopt GAP and CSA practices through targeted green matching grants and output-based green subsidies, respectively.

53. **The GARR PforR's PDO-level indicators** are (1) reduction in pollutant loads from agricultural production systems and rural domestic wastewater treatment facilities (COD, NH_3-N])[41] achieved in the Program Counties (RA2, RA3, and RA4) (metric tons/year), (2) Greenhouse gas emissions reduction achieved in the Program Counties (RA2, RA3, and RA4) (metric tons/year CO_2 equivalent), and (3) beneficiaries reached by assets or public services in the Program Counties (disaggregated by gender) (RA1, RA2, RA3, and RA4) (Number).

54. **The GARR PforR's contribution to GHG emission reductions derive from both mitigation and adaptation measures being promoted.** The metric tons of CO_2 equivalent reduced from the mitigation measures will be calculated using M&E data on quantities of nutrient load reduction and pollutant load reduction achieved under PDO/outcome indicators (1) above. This will be done at the mid-term and the end of the program (compared with the 2021 baseline values), which would give the third-party verification agency sufficient time to verify the results using the agreed protocols and MRV methodologies developed under the GARR PforR.

55. **The Ex Ante Carbon-balance Tool (EX-ACT) estimated net emissions reduction by RA, which are presented in table 3.** Preliminary assessment shows that the GARR PforR will reduce approximately 397,520 tCO_2e/year or about 1,987,600 $MtCO_2e$ over its five-year implementation period. The assessment does not include the mitigation climate co-benefits generated from carbon storage or improved institutional policies, regulations, and plans. In addition, the estimated GHG emission reductions presented herein are restricted to activities under the 23 program counties. Thus, these estimates could be considered to be conservative, especially given that there is huge potential for scaling up the GARR PforR activities beyond the program counties.

Table 3. Estimated Ex Ante Net Emissions Reductions by RA and DLI ($MtCO_2e$/year)

RA	DLIs	Project Interventions	GHG Reduction per Year
RA2 - Greening selected agricultural value chains	DLI2.1	Fertilizer reduction	66,276
	DLI2.2	Livestock and poultry manure treatment	197,626
RA3 - Increasing access to rural solid waste and wastewater services	DLI3.2	Wastewater treatment	66,461
RA4 - Restoring and protecting degraded agricultural ecosystems	DLI4.2	Crop straw utilization	67,157
Total			**397,520**

E. Disbursement Linked Indicators and Verification Protocols

56. **The GARR PforR's DLIs quantify the parameters and values that need to be achieved to trigger disbursements (table 3).** Each province is responsible for measuring the 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 RA, (b) are within the control of the Government, (c) are achievable in the Program period, and (d) are verifiable. The GARR PforR prioritizes the use of existing indicators and reporting mechanisms within the government system and the GARR PforR (Guangxi and Guizhou) to help aggregation and ensure sustainability.

57. **The GARR PforR (Guangxi and Guizhou) and the GARR PforR are similar and complementary in various ways.** First, they support three similar RAs: RA1 - Strengthening institutional capacity for governance, RA2 - Greening selected agricultural value chains, and RA3 - Increasing access to rural solid waste and wastewater services. Second, they have five

[41] These two key pollutants have been selected because they are priorities set since the 12th FYP, under which specific reduction targets and detailed monitoring and verification arrangements have been spelled out.

similar DLIs: DLI1.2, DLI2.1, DLI2.2, DLI3.1, and DLI3.2 (see table 4). By retaining some common RAs and DLIs, it will be possible to aggregate results achieved under the two operations and assess the overall performance and contribution of the World Bank's programs to the RRP.

Table 4. DLIs and Allocations

DLI	Allocated Amount (US$)	% of Total	Rationale for Selection
RA1: Strengthening institutional capacity for governance			
DLI1.1: Development and use of a comprehensive national IT-based monitoring platform for mapping and M&E of the delivery of rural infrastructure, public services and spatial Integrated Village Development Plans of rural villages	5,000,000	1.45	The purpose of this DLI is to enable the NRRA to expand the functions of the existing National Poverty Reduction Monitoring Platform developed by the State Council LGOPAD, the predecessor of the NRRA, which was developed about 10 years ago to facilitate accurate targeting of government support to the poor villages and extreme poverty households. Currently, the upgraded IT-based platform is used to monitor vulnerable rural households and facilitate timely access to support policies to avoid their falling back into extreme poverty. Since the government program is transitioning from eliminating extreme rural poverty to rural revitalization, the NRRA will expand the coverage of the platform from poverty-stricken villages to all villages in China and the functions from basic infrastructure and social services to all rural infrastructure and public services, including SWMS and WWTF. Thus, the IT-based monitoring platform will function as a decision support tool to manage the RRP implementation, regularly evaluate its performance, and ensure that newly developed rural infrastructure is climate resilient (for example, can withstand climate-induced floods and wildfires). This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience" and Pillar 4 of the GCRF "Strengthening Policies, Institutions and Investments for Rebuilding Better".
DLI1.2: Adoption of regulations, standards, and guidelines on green agricultural development and the number of agro-products produced in the Program Counties that are certified and/or registered as green, organic, or GI pursuant to said regulations, standards, and guidelines (provincial level)	13,615,160	3.95	This DLI aims to enable Hubei and Hunan provincial governments to adopt MARA's national regulations, standards, and guidelines for green agricultural development and customize or tailor them to fit and meet provincial/local conditions and requirements. County governments will use the approved provincial regulations, standards, and guidelines to certify agro-products as green and organic and register as GI. The standards and guidelines are critical for ensuring that agro-products meet the targets for GHG emissions and nutrient and pollutant loads reduction before being certified as green and organic or registered as GI agro-products. The regulations, standards, and guidelines will also promote GAP (that is, a set of standards for the safe and sustainable production of crops and livestock, verified through voluntary audit. GAP aims to help farm owners maximize yields and optimize business operations, while also minimizing production costs and environmental impact, and adoption of CSA technologies (for example, increased irrigation efficiency, improved water management in paddy rice, and improved animal feeds). This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience" and Pillar 4 of the GCRF "Strengthening Policies, Institutions and Investments for Rebuilding Better".
RA2: Greening selected agricultural value chains			
DLI2.1: Tons of chemical fertilizer use	60,984,840	17.68	This DLI aims to enable Hubei and Hunan to achieve a net reduction in quantity and intensity of chemical fertilizer use in selected value chains (for example, rice,

DLI	Allocated Amount (US$)	% of Total	Rationale for Selection
reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties (provincial level)			fruits, and vegetables). The goal is to achieve provincial targets for reducing agricultural NPS water pollution and increasing the fertilizer utilization rates set in the RRSPs under the 14th FYP. The reductions can be achieved partly by increasing the efficiency of chemical fertilizer use (for example, by improving the rate, timing, placement, or precision of application) and partly by using substitutes, including organic, green, and formula (based on soil testing) fertilizers and fertigation technologies. These improved practices have been proven to substantially reduce GHG emissions (CH_4, N_2O, and CO_2) and nutrient loads (NH_3-N, TP, and TN). This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience".
DLI2.2: Percentage increase of treated and recycled livestock and poultry manure from large- and small-scale farms meeting effluent standards in the Program Counties (provincial level)	71,700,000	20.78	This DLI aims to enable Hubei and Hunan to increase the quantities of livestock and poultry manure collected, safely treated, and recycled into organic fertilizer, biogas/energy generation, and irrigation water. The aim is to achieve provincial comprehensive livestock and poultry manure utilization rates and pollutant reduction targets set in the provincial RRSPs under the 14th FYP. Livestock and poultry manure management activities contribute to substantially reducing GHG emission (for example, by removing COD, BOD, and NH_3-N and efficiently using recovered gases [CH_4] and treated effluents from livestock and poultry production systems as organic fertilizer in crop production—circular economy) and nutrient loads (TP and TN) entering waterways and increasing health risks. This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience".
RA3: Increasing access to rural solid waste and wastewater services			
DLI3.1: Number of IVDPs approved by the Program Counties (provincial level)	34,000,000	9.86	This DLI aims to enable the Hubei and Hunan governments to properly plan climate-resilient rural infrastructure development under their phased RRSPs. While the priority under the Poverty Reduction Program had been on investing in rural roads and water supply, the RRP priority is to increase investment in rural wastewater and solid waste management systems which have been lagging. Preparation of spatial IVDPs is mandatory and they will include plans for settlement, farmland, forestry and protected land, recreation, social services, and rural infrastructure. They are binding and will guide all future rural investment to improve the village living environment. Thus, spatial IVDPs are viewed as future investment decision support tools. Spatial planning would help avoid protected land use changes; and guide climate-resilient investment in WWTFs and SWMS to help reduce GHG emissions and pollutant loads (for example, COD, TP, and NH_3-N) entering waterways. This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience" and Pillar 4 of the GCRF "Strengthening Policies, Institutions and Investments for Rebuilding Better".
DLI3.2: Number of demonstration villages with newly constructed or rehabilitated climate-resilient WWTFs and established solid waste collection, sorting, and	105,200,000	30.49	This DLI aims to enable Hubei and Hunan to provide climate-resilient rural WWTFs and SWMS to prevent pollutants (for example, COD, TP, and NH_3-N) from entering waterways and improve living conditions in the demonstration villages. Solid waste will be sorted at source into organics, recyclables/reuse, hazardous, and residuals. Treating and recycling solid waste and wastewater would contribute to a substantial reduction in GHG emissions. This will also contribute to the achievement of a rural circular economy, including through the efficient use of treated wastewater (for example, reuse for irrigation to build

DLI	Allocated Amount (US$)	% of Total	Rationale for Selection
transfer systems meeting effluent standards in the Program Counties (provincial level)			resilience to drought), use of compost material (for example, as a substitute for chemical fertilizer), and use of nature-based solutions (for example, retention ponds or constructed wetlands to filter pollutants). Climate-resilient infrastructure will contribute to climate change adaptation. This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience".
RA 4: Restoring and protecting degraded agricultural ecosystems			
DLI4.1: Percentage increase in comprehensive crop straw (rice, wheat, rapeseed, and corn) utilization in the Program Counties (provincial level)	24,500,000	7.10	This DLI aims to enable Hubei and Hunan to increase the use of large quantities of crop straw generated as a resource rather than waste. In general, crop straw has three uses: as an animal feed, as a source of biomass energy, or as SOC—when returned to the soil in the farmlands. This DLI will primarily focus on increasing the quantities of crop straw returned to the soil in farmland to increase carbon sequestration below ground and reduce GHG emissions (for example, CO_2) by avoiding burning. This activity will also contribute substantially to climate change adaptation. This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience".
DLI4.2: Number of hectares of treated aquaculture ponds meeting effluent discharge standards in the Program Counties (Hubei)	15,000,000	4.35	This DLI aims to enable Hubei to reduce GHG emissions (CO_2, CH_4 and N_2O) and pollutant loads (COD, NH_3-N, BOD, TP, and TN) from large-scale aquaculture farms by improving treatment standards of pollutants using climate-resilient infrastructure. The aquaculture pollution results from the industry's use of inputs and its poor management of pond tail water. Inputs into aquaculture ponds include feed, drugs, and a variety of chemicals. Most inland aquaculture ponds regularly release large volumes of tail water, which pollutes downstream water bodies affecting other aquaculture operations and farmlands. Aquaculture pond water will be treated using existing ecological models as well as rotation between aquaculture and crop (especially rice and lotus roots) farming. This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience".
DLI4.3: Number of hectares of treated farmlands with a safe utilization rate in the Program Counties (Hunan)	15,000,000	4.35	This DLI aims to enable Hunan to better manage the heavy metal pollution problem, affecting the food systems and causing human health risks. The primary goals are demonstrating integrated risk-based heavy metal pollution control measures and sustainable natural resources management approaches, promoting GAP (especially agronomic measures) and CSA technologies and improving the agricultural ecosystem environment. Safe utilization rate means both soil quality and food safety must meet minimum provincial standards. This DLI will contribute to GHG emissions reduction due to sustainable agriculture practices. It will also contribute to the reduction of pollutant loads entering waterways and human health risks emanating from contaminated agro-products. This DLI will contribute to Pillar 3 of the GCRF "Strengthening Resilience".
Total IBRD loan	**345,000,000**	**100**	

Verification of DLIs

58. **The achievement of the above DLIs will be verified by a VA based on agreed protocols.** The provincial governments will prepare consolidated reports on the achievement of results using M&E data and information collected and reported by the county government agencies with help from the third-party M&E firms hired under the program. All M&E data and information collected by these agencies and M&E firms will be uploaded to the management information

system (MIS). The third-party VA hired by each provincial government will use the MIS data and carry out field visits to verify the reported results. The Bank will disburse against the results achieved under each DLI based on agreed unit prices. The two provinces and 23 program counties have established baselines and end targets for each DLI (see Annex 2). Due to different provincial baselines and end targets the unit prices of some DLIs are different. The provincial governments will only disburse the IBRD loan proceeds to county governments based on the results achieved under each DLI. The verification of DLI1.1 (that is, including DLI1.1.1 and DLI1.1.2) will be done at the central level. The NRRA will hire a third-party VA to verify the development and use of the IT-based monitoring platform. The detailed verification protocols for each DLI are presented in the technical assessment report and are summarized in the following paragraphs.

59. **DLI1.1 includes two sub-DLIs.** DLI1.1.1 requires the NRRA as an implementing agency of the central component to develop an IT-based monitoring platform for mapping and M&E of rural infrastructure, public services, and spatial IVDP of rural villages for the provincial and county governments to adopt and use as a decision-making tool to guide investment and O&M activities. DLI1.1.2 requires program counties to connect (that is, install and use) the IT-based monitoring platform developed under DLI1.1.1 to record, analyze, and report on the performance of rural infrastructure (including solid waste and wastewater management facilities), public services, and the spatial IVDPs of rural villages. The data collected, analyzed, and reported through the IT-based monitoring platform will include basic rural household (poor and non-poor) information on access to rural infrastructure and public services, such as wastewater and solid waste in all villages in program counties and village socioeconomic parameters.

60. **Verification protocol for DLI1.1.1.** The third-party VA will verify whether (a) the NRRA has developed and installed the IT-based monitoring platform for mapping and M&E of rural infrastructure and public services and spatial IVDPs of rural villages through on-site review of the system, the official/regular performance evaluation documents, or reports generated; (b) the IT-based monitoring platform meets data security and confidentiality standards; (c) the NRRA has established mechanisms for the protection of personal data; and (d) the NRRA has issued guidelines for installing and using the IT-based monitoring platform at the county level. A single disbursement of 77 percent of the budget allocated for DLI1.1 will be made upon achieving the results.

61. **Verification protocol for DLI1.1.2.** The third-party VA will verify whether (a) the IT-based monitoring platform has been adopted and installed in the program counties; (b) the data and information are being collected and entered in the platform; (c) the platform can regularly generate the required official reports, including on the performance of the solid waste, wastewater facilities, public services, and IVDPs to inform the investment and O&M decision-making; (d) the platform meets data security and confidentiality standards; and (e) the provincial and county Rural Revitalization Bureaus (RRB) have established mechanisms for protecting personal data. The NRRA targets to have all 23 program counties achieve these results by FY2026. The remaining 23 percent of the budget allocated to DLI1.1 is scalable. Disbursements will be made progressively against the number of new program counties that have achieved these results each year based on the agreed unit price.

62. **DLI1.2 also has two sub-DLIs.** DLI1.2.1: Provinces will adopt regulations, standards, and guidelines on green agricultural development issued by MARA, which set the minimum requirements for certifying or registering agro-products as green, organic, or as GI. The focus will be on the fruit, vegetables, tea, and livestock and poultry products. Provinces normally approve regulations, standards and guidelines that are more stringent than MARA's to meet the food safety standards of niche markets. The adopted/customized regulations, standards, and guidelines will be approved by the relevant authorities at the provincial level and the provincial Departments of Agriculture and Rural Affairs (DARAs) will issue official notice to the 23 program counties to use them. DLI1.2.2: Number of agro-products produced in the program counties certified as green or organic or registered as GI using the approved provincial regulations, standards, and guidelines. This sub-DLI aims to provide evidence that farmers in the program counties are adopting GAP and are able to meet environmental and food safety standards. Certified and registered agro-products are fetching premium prices in the

niche domestic (including Hong Kong Special Administrative Region of the People's Republic of China and Macao Special Administrative Region of the People's Republic of China), and international markets, which creates incentive for the two provinces to adopt the national certification and registration systems. Hubei and Hunan are targeting to certify or register 157 and 200 agro-products in the program counties, respectively.

63. **Verification protocol for DLI1.2.1.** The third-party VA will verify the documents approved by the relevant provincial authorities (that is, regulations, standards, and guidelines), and a single disbursement of 20 percent of the allocated budget for DLI1.2 will be made upon achieving the results.

64. **Verification protocol for DLI1.2.2.** The third-party VA will verify the green and organic agro-product certificates issued by the provincial DARAs and the GI agro-products registration documents issued by MARA. Disbursements of the remaining 80 percent of the budget allocated to DLI1.2 are scalable. Disbursements will be made against the number of agro-products certified or registered in each calendar year based on the agreed unit price.

65. **DLI2.1 measures the reduction in net chemical fertilizer use in the program counties.** The cumulative chemical fertilizer use reduction achieved by reducing application intensity (for example, quantity per unit area) or increasing use efficiency will be monitored using MARA's national platform. The cumulative chemical fertilizer use reduction achieved due to the increased use of substitute technologies will be estimated using conversion coefficients approved by MARA. This is because the utilization rates are calculated by combining experimental data on fertilizer absorption by different crops over multiple seasons and data from the substitute technologies or GAP. The experiments use MARA's methodology to monitor fertilizer application rates and crop yields and account for crop nutrient use. Therefore, the program counties will collect data on the quantity and area (hectares) of chemical fertilizer use and substitute green technologies use and prepare annual reports. The net reduction in chemical fertilizer use will be calculated by provincial DARAs from a decrease in application intensity and an increase in substitute green technologies or GAP using the conversion coefficients approved by MARA. Hubei and Hunan are targeting to reduce the chemical fertilizer use in the program counties by 38,361 and 78,176 metric tons, respectively

66. **Verification protocol.** The third-party VA will verify the cumulative quantity of organic and formula fertilizers and area under the green manure and fertigation practices in selected cropping systems, which are monitored by county DARAs and reported to the World Bank by provincial DARAs annually. The third-party VA will also verify whether the provincial DARAs have used appropriate conversion coefficients to calculate the net tons of chemical fertilizers reduced. The third-party VA will randomly sample and review analyses and results of the county DARAs, which are reported to the provincial DARAs to check whether they are consistent with the reduction in chemical fertilizer use due to the adoption of substitute green technologies or GAP. Chemical fertilizer reduction targets and budgets are spread over 2025–2028 period. Disbursements are scalable and are made against the target net metric tons of chemical fertilizer reduction achieved in the program counties each calendar year based on the agreed unit price.

67. **DLI2.2 measures the incremental adoption of good management practices of livestock and poultry manure due to the program interventions.** These include the expansion of on-site livestock and poultry manure treatment capacity at large farms and the construction of centralized treatment facilities to cater to the small and medium farms.[42] The cumulative data on the quantity of livestock and poultry manure collected, treated, and recycled will be obtained from large farms with on-site treatment facilities and centralized treatment facilities for small and medium livestock and poultry farms. MARA has established a national platform for monitoring the quantities of livestock and poultry manure produced, collected, treated, and utilized (for example, as organic fertilizer, conversion to biogas/energy, and crop irrigation) by large farms. Data from this platform enable MARA and provincial DARAs to scientifically calculate the comprehensive utilization

[42] Small and medium animal farms are defined as less than 500 head of pigs, less than 2,000 egg chickens (layers), less than 10,000 meat chicken (broilers), and/or less than 30 head of cattle.

rate of livestock and poultry manure. Supplementary data will be collected from the on-site ledgers of large farms and centralized facilities serving the small and medium livestock and poultry farms and through annual M&E socioeconomic surveys. The county Department of Ecology and Environment (DEE) will monitor the effluents discharged from the livestock and poultry manure treatment facilities to ensure that they meet environmental standards. Hubei is targeting to increase the livestock and poultry manure treatment rate by 6 percent (baseline 84 percent) and 11 percent (baseline 74 percent) in large-scale and small-scale farms, respectively. Similarly, Hunan aims to increase the livestock and poultry manure treatment rate by 5 percent (baseline 89 percent) and 10 percent (baseline 74 percent) in large-scale and small-scale farms, respectively, over the five-year implementation period.

68. **Verification protocol.** Cumulative quantities of livestock and poultry manure collected, treated, and recycled that are reported by the provincial DARAs will be verified by the third-party VA based on a random sampling of large farms and centralized facilities serving the small and medium farms and by reviewing other supporting documents, such as inspection reports from county DARAs and annual M&E socioeconomic survey reports. Disbursements will be made when at least 1 percent increase in the quantity of livestock and poultry manure treated and meeting provincial effluent discharge standards is achieved in the program counties based on the agreed unit price.

69. **DLI3.1 measures the number of professionally developed spatial IVDPs,** which include settlement, farmland, forestry/protected land, recreation, social services, and infrastructure areas in rural villages. As village masterplans, the spatial IVDPs would guide future rural village development, including climate-resilient infrastructure, and improve living environment. The county RRB will collect data on the number of spatial IVDPs prepared by professional spatial planning firms. The spatial IVDPs will be approved by the relevant county authorities for implementation at the county level to ensure that they meet the required technical, environmental, and social standards specified in the Program Implementation Plan (PIP). The target is to develop 200 and 213 spatial IVDPs in Hubei and Hunan, respectively.

70. **Verification protocol.** The third-party VA will verify the achievements reported by provincial RRBs by reviewing the minutes of meetings approving the spatial IVDPs and the final documents provided by the county RRBs on a random sampling basis. Disbursements will be made against the number of spatial IVDPs approved by the relevant county authorities each year based on the agreed unit price.

71. **DLI3.2 measures the number of demonstration villages with solid waste and wastewater management facilities that meet effluent discharge standards.** The aim is to track the improvement in the waste management systems to prevent pollutants (for example, COD, TP, and NH_3-N) from entering waterways and increasing health risks. The main objective is to meet the provincial effluent discharge standards. Data on the number of newly constructed or rehabilitated and operational WWTFs and SWMS will be collected by the relevant departments at the county level during the handover of the facilities/systems. The provincial RRBs will consolidate data from the program counties into a provincial report. Hubei and Hunan aim to construct or rehabilitate 49 and 59 centralized WWTFs/SWMS in the program counties, respectively.

72. **Verification protocol.** The third-party VA will verify whether the WWTFs and SWMS are fully operational by randomly sampling batches of facilities and systems completed and accepted each year. Using data from county DEEs and own sample-based analyses, the third-party VA will also verify whether the waste management facilities and systems meet provincial effluent discharge standards. Disbursement will be made against the number of demonstration villages with waste management facilities and systems that meet the provincial effluent discharge standards in the program counties each year based on the unit price.

73. **DLI4.1 measures the residual crop straw that is returned (plowed in) to the soil in farmlands.** The program will focus on returning residual crop straw to the soil to increase SOC (through carbon sequestration), improve soil health (for higher water retention, cation exchange, and nutrient absorption capacity), and reduce GHG emissions (by avoiding burning or decomposition). The program counties' DARAs will collect data on the quantities of residual crop straw (left in

the field) that are returned to the soil in farmlands. The provincial DARAs will prepare consolidated reports based on the data collected in the program counties and uploaded on MARA's platform for crop straw utilization. Hubei and Hunan are targeting to increase their comprehensive crop straw utilization rate in the program counties by 3 percent (baseline 93 percent) and 6 percent (baseline 85 percent), respectively.

74. **Verification protocol.** The third-party VA will verify the quantities of residual crop straw reported by the provincial DARAs by randomly sampling 23 program counties and carrying out on-site checks or spot-checks. To estimate their uptake, the third-party VA will also verify the quantities of straw used as feed by large animal farms and biomass-to-energy generation firms. Using all three data and information sources, the third-party VA will verify the comprehensive crop straw utilization rates. Disbursements will be made when at least 1 percent increase in comprehensive crop utilization rate is achieved in the 23 program counties based on the agreed unit price.

75. **DLI4.2 measures the reduction in pollutant loads from large-scale aquaculture farms in Hubei province.** Inland aquaculture is a booming industry in Hubei province. The intensive use of inputs and poor management of aquaculture pond wastewater are increasingly causing environmental pollution. This is primarily because many aquaculture operations regularly release large volumes of untreated pond wastewater into waterways. In the 10 program counties, aquaculture pond wastewater will be treated using the existing ecological models as well as rotation between aquaculture and crop (especially rice and lotus roots) farming. The tail water from the aquaculture ponds will be monitored by county DARA and MEE to ensure that it meets provincial effluent discharge standards. Hubei targets to implement ecological aquaculture wastewater treatment models in 10,938 ha of the 10 program counties.

76. **Verification protocol.** The third-party VA will review the provincial DARA and MEE aquaculture wastewater treatment monitoring reports to establish the number and area of ponds with treated tail water meeting effluent discharge standards. The third-party VA will also randomly collect and analyze samples from large-scale aquaculture farms that have installed pond water treatment facilities to check whether tail water meets provincial effluent discharge standards. The third-party VA will verify the results by comparing the data from monitoring reports with own results. Disbursement will be made against the number of hectares of aquaculture ponds meeting effluents discharge standards in the 10 program counties in each calendar year based on the agreed unit price.

77. **DLI4.3 measures the area of agricultural farmland degraded by heavy metals that have been treated and brought back to safe crop production in Hunan province.** Technical measures for risk-based heavy metal pollution management will be implemented, including (a) source control measures, such as increasing the flooding irrigation regime to reduce uptake of cadmium, removing rice straw from contaminated fields, and growing hyperaccumulator[43] plants in the winter season; (b) agronomic management measures to help reduce active heavy metals in crops, such as cultivating rice varieties that do not accumulate heavy metals, increasing soil pH by applying lime, and applying organic fertilizers and soil immobilization agents; (c) switching crops by growing non-metal accumulating species, such as oil crops or fodder crops; and (d) phytoremediation,[44] especially for high-risk farmlands, where growing highly accumulating plant species such as Sedum (*Pteris vittata*), water onion, and grain amaranth can help reduce heavy metals from the farmland. Hunan targets to treat 8,029 ha of heavy metal polluted farmlands in the 13 program counties.

[43] A hyperaccumulator is a plant capable of growing in soil or water with high concentrations of metals, absorbing these metals through their roots, and concentrating extremely high levels of metals in their tissues. https://en.wikipedia.org/wiki/Hyperaccumulator.

[44] Phytoremediation is a plant-based approach, which involves the use of plants to extract and remove elemental pollutants or lower their bioavailability in soil. Using phytoremediation is economically feasible (phytoremediation is an autotrophic system powered by solar energy, therefore, simple to manage and the cost of installation and maintenance is low), environment and eco-friendly (it can reduce exposure of the pollutants to the environment and ecosystem), and applicable (it can be applied over a large-scale field and can easily be disposed). It prevents erosion and metal leaching through stabilizing heavy metals and reducing the risk of spreading of contaminants improves soil fertility by releasing various organic matter to the soil.

78. **Verification protocol.** The third-party VA will review the provincial DARA heavy metals pollution control reports and randomly collect and analyze soil and crop samples from treated farmlands in the 13 program counties. The third-party VA will verify the percentage of crop samples that meet provincial food safety standards. Disbursement will be made against the number of hectares of treated farmland meeting the safe utilization rate (that is, at least 85 percent of the crop samples) in the 13 program counties.

III. PROGRAM IMPLEMENTATION

A. Institutional and Implementation Arrangements

At the Central Level

79. **The NRRA will be the lead implementing agency of the central component of the GARR PforR**. The NRRA will coordinate the implementation of activities under RA1.1. A Central Program Coordination Office has been established by the NRRA at the IPRCC to be responsible for coordinating day-to-day GARR PforR activities at the national level, including (a) delivery of the RA1.1 results; (b) coordinating the preparation of annual program implementation progress reports, semiannual M&E reports, and Implementation Completion and Results Report (ICR); (c) knowledge management and sharing of green agricultural and rural revitalization approaches and methodologies nationally and globally; and (d) dissemination of lessons learned from the implementation of GARR PforR (Guangxi and Guizhou) and this GARR PforR (Hubei and Hunan). A steering group at the national level has been established, comprising representatives from the NDRC, the MOF, NRRA, MARA, and two GARR PforR provinces. The steering group will be responsible for overall strategic direction, oversight, and facilitation of national policy dialogue.

At the Provincial Level

80. **The provincial RRB and DARA will coordinate the implementation of the GARR PforR.** The county-level RRB and DARA will be responsible for implementing GARR PforR activities to achieve the DLIs. In both Hubei and Hunan, a provincial-level Program Steering Committee (PSC) to be chaired by the vice-governor and with members (at Deputy Director General level) from the Development and Reform Commission (DRC), Department of Finance (DOF), RRB, DARA, and other relevant departments has been established to oversee GARR PforR implementation.

81. **Hubei province.** The provincial RRB will be the lead implementing agency and will host the Provincial Program Management Office (PPMO), which will be responsible for the overall day-to-day coordination of the GARR PforR implementation. Under RA1.2, the RRB will be responsible for mainstreaming the IT-based platform for mapping and M&E of the delivery of rural infrastructure and public services. Similarly, under RA3, the RRB will be responsible for coordinating the implementation of the following activities: (a) preparing the spatial IVDPs; (b) constructing rural wastewater management systems (for example, rural decentralized facilities and connections to township systems); (c) constructing rural SWMS (for example, rural sorting, township transfer, and recycling); and (d) providing training on O&M of wastewater and solid waste management systems. The RRB will work with other departments responsible for rural infrastructure development, including DARA, Department of Water Resources (DWR), Housing and Urban-Rural Development (HURD), DEE, Department of Natural Resources (DNR), and Comprehensive Enforcement Bureaus (CEB).

82. **A provincial-level Program Implementation Unit (PIU) has been established under DARA,** which will be responsible for coordinating the implementation of the following activities under RA1.2: (a) developing regulations, standards, and guidelines for green agriculture development, and (b) establishing frameworks for nurturing green development skills and talents. In addition, under RA2, DARA will coordinate the implementation of the following activities: (a) reducing chemical fertilizer and toxic pesticide use from selected crop production systems (for example, rice, fruits, and vegetables) and increasing livestock and poultry manure collection, treatment, and recycling; (b) adopting CSA practices—increasing productivity, building resilience, and reducing GHG emissions; (c) enhancing green skills and talents

through training of FCs, FAs, WUAs, input suppliers, agro-enterprises, and rural extension staff; and (d) implementing the MRVs for GHG emissions. Finally, under RA4, DARA will coordinate the following activities: (a) preparing sustainable agricultural ecosystem management plans, (b) returning crop straw to soil in farmlands to increase SOC, and (c) treating aquaculture ponds wastewater to reduce GHG emissions and pollutant loads entering waterways.

83. **The DARA PIU will coordinate activities of relevant divisions/stations** responsible for crops (chemical fertilizer and pesticide reductions, straw management), livestock and poultry manure (and other waste management), and agricultural ecological ecosystems and training and capacity building. An expert panel will be established to provide technical assistance to the (under RRB) or PIU (under DARA). The provincial-level institutional arrangements will be replicated at the GARR PforR program counties.

84. **Hunan province.** The provincial DARA will be the lead implementing agency and will host the PPMO, which will be responsible for the overall day-to-day coordination of the GARR PforR implementation. DARA will coordinate the implementation of the following activities under RA1.2: (a) developing regulations, standards, and guidelines for green agriculture development, and (b) establishing frameworks for nurturing green development skills and talents. In addition, under RA2, DARA will coordinate the implementation of the following activities: (a) reducing chemical fertilizer and toxic pesticide use from selected crop production systems (for example, rice, fruits, and vegetables) and increasing livestock and poultry manure collection, treatment, and recycling; (b) adopting CSA practices—increasing productivity, building resilience, and reducing GHG emissions; (c) enhancing green skills and talents through training of FCs, FAs, WUAs, input suppliers, agro-enterprises, and rural extension staff; and (d) implementing the MRVs for GHG emissions reduction. Finally, under RA4, DARA will coordinate the following activities: (a) preparing sustainable agricultural ecosystem management plans, (b) returning crop straw to soil in farmlands to increase SOC, and (c) managing heavy metals pollution to improve soil health and food safety.

85. **A provincial-level PIU has been established under the RRB and will coordinate the implementation of the following activities.** Under RA1.2, the RRB will be responsible for mainstreaming the IT-based platform for mapping and M&E of the delivery of rural infrastructure and public services. In addition, under RA3, the RRB will be responsible for coordinating the implementation of the following activities: (a) preparing the spatial IVDPs; (b) constructing rural wastewater management systems (for example, rural decentralized facilities, connections to township systems); (c) constructing rural SWMS (for example, rural sorting, township transfer, and recycling); and (d) providing training on O&M of wastewater and solid waste management systems. The RRB will work with other departments responsible for rural infrastructure development, including DARA, DWR, HURD, DEE, DNR, and CEB. An expert panel will be established to provide technical assistance to the (under RRB) or PIU (under DARA). The provincial-level institutional arrangements will be replicated at the GARR PforR program counties.

B. Results Monitoring and Evaluation

86. **Each province will prepare an M&E plan, specifying the units of measurement, baseline values, targets, data sources for each indicator, methodology, and responsibility for collection and reporting.** The provinces will recruit third-party M&E firms to collect, analyze, and report survey-based data. Administrative data will be collected by the relevant county government departments implementing the GARR PforR activities.[45] The M&E data will be stored in the MIS for the GARR PforR. The M&E of the livestock and poultry manure pollution reduction and wastewater treatment and

[45] The Provincial Development and Reform Commission (PDRCs) are responsible for fund allocations based on an evaluation of county achievements, which relies on data provided by sector departments. The DOFs are responsible for monitoring the management and disbursement of funds. The respective DWRs are responsible for monitoring ecological flow compliance and providing data on water resource management. DNRs are responsible for IVDP preparation. DEEs are responsible for monitoring water and air quality. HURDs are responsible for monitoring wastewater services. DARAs are responsible for agricultural NPS pollution.

recycling will be based on the established monitoring and verification system under the MEE. Similarly, the M&E of the chemical fertilizer use reduction will follow M&E protocols established by MARA. This will provide a solid basis for official recognition and credibility of the GARR PforR's disbursement-linked results (DLRs). The M&E system will be linked to the IT-based monitoring platforms for rural infrastructure management and the green budgeting and expenditure tracking system. This will enable the provinces to evaluate the results and performance of the GARR PforR activities and analyze their cost-effectiveness. The PPMOs will prepare and submit to the World Bank consolidated semiannual progress reports (including findings of third-party M&E reports), a midterm review report, and an ICR. The NRRA and two PPMOs will each hire a third-party VA to verify the results reported in DLRs monitoring reports. The NRRA and PPMOs will periodically submit to the World Bank the third-party VA's verification reports on the achievement of DLR to request IBRD loan disbursement against the achieved DLIs. The third-party VAs will be selected competitively in Hubei and Hunan provinces immediately after the GARR PforR becomes effective using terms of reference (TORs) satisfactory to the World Bank.

C. Disbursement Arrangements

87. **The World Bank would advance to the NRRA and Hubei and Hunan provinces up to 25 percent of their total IBRD loan amounts for the GARR PforR by loan effectiveness.** However, the NRRA, Hubei, and Hunan will be required to provide justification acceptable to the World Bank for this advance. After achieving the DLIs against which the advances have been disbursed, equal amounts will be deducted from the total amount allocated to such DLIs. The World Bank will record any amount of advance as disbursed for an achieved DLR ('recovered') after it has notified the MOF (International Economic and Financial Cooperation Department) of its acceptance of the evidence of achievement of the results for which the advance was provided.

88. **The PPMOs will be responsible for consolidating reports on achieved DLRs from provincial departments and agencies participating in the GARR PforR** and submitting them to the Provincial Department of Finance (PDOF), copying the county PMO (CPMO). The IBRD loan disbursements will be made periodically upon receiving and accepting the third-party VA reports on the DLR for the respective DLIs. The amount of submitted withdrawal application will depend on the verified results. Some annual allocations are scalable and non-fixed, meaning that the World Bank can disburse for overperformance up to the DLIs' total allocation. Overperformance will enable the PDOFs to bring forward disbursements from Years 4 and 5 to Years 3 and 4, respectively. The PDOFs can apply for disbursements as soon as the provinces achieve the results by providing the World Bank the necessary evidence verified by the third-party VAs, and the World Bank will accept the evidence in a formal notice to the MOF specifying the eligible disbursement amounts. The Accounts which will receive advance from the Bank for the NRRA and Hubei will be set up in US dollar, while that for Hunan in euro.

D. Capacity Building

89. **Given that the responsibility for delivering most of the DLIs is with the counties, capacity building for planning, budgeting, implementation, and M&E and reporting will be needed.** Overall, capacity gaps remain on how to design and implement specific activities to achieve the expected results; conduct effective M&E of the results; and strengthen the links (better manage the results chain) between inputs, outputs, and outcomes to achieve the PDO of the GARR PforR. Technical assistance will also be needed to strengthen the capacity for green budgeting and expenditure reporting (including compliance with fiduciary requirements); operations and management of rural infrastructure (wastewater and solid waste management); and handling of environmental and social (E&S) safeguard issues, such as assessing the potential risks and impacts of rural investments and putting in place effective risks mitigation measures and the grievance redress mechanisms (GRMs) at the county level. The GARR PforR also incorporates training and capacity building (nurturing green skills and talents) for the beneficiaries, including members of FCs, FAs, and WUAs; input suppliers; extension workers; and agro-enterprises. The Results Framework includes intermediate indicators to measure the performance of training and capacity-building activities.

IV. ASSESSMENT SUMMARY

A. Technical (including program economic evaluation)

90. **The technical assessment of the GARR PforR was undertaken using data and information from the national, provincial, and county governments.** It focused on five key aspects: strategic relevance, technical soundness, expenditure framework, technical capacity building, and economic rationale. A detailed description of the technical assessment is provided in Annex 3.

Strategic Relevance

91. **Hubei and Hunan provincial leaders are committed to addressing the environmental challenges** related to the overuse of chemical fertilizer, improper management of livestock and poultry manure, and degradation of agricultural ecosystems. The leaders of the two provinces have also expressed their commitment to addressing the challenges related to underdeveloped rural solid waste and wastewater services (see Section 1.B – Sectoral [or Multi-Sectoral] and Institutional Context). These commitments are presented in several of Hubei's and Hunan's policies and strategic plans on comprehensively promoting rural revitalization and accelerating green, sustainable, and modern agricultural development. Their provincial RRS plans are included in the 14th FYP (2021–25). This presents an opportunity for the Bank to support the two provincial governments' efforts to promote green agricultural and rural development activities through a results-based financing instrument.

Technical Soundness

92. **The proposed RA2 and RA4 activities are consistent with China's *National Green Development of Agriculture Plan*.** They will significantly reduce the GHG emissions and pollutant loads entering waterways, hence contributing to the achievement of China's emissions peaking and zero growth targets by 2030 and 2060, respectively. The plan's priority activities include (a) strengthening the protection and use of agricultural resources, including protecting and improving the quality of farmland, improving the efficiency of agricultural irrigation water use, and protecting agricultural biological resources; (b) preventing and controlling agricultural NPS pollution, including promoting a reduction in fertilizer use and increasing the efficiency of fertilizer and pesticide use, and promoting the recycling of livestock and poultry manure and crop straw; (c) strengthening agricultural ecological protection and restoration, including restoring and protecting degraded agricultural ecosystems; (d) building green and low-carbon agricultural industry chains, including promoting green agricultural value chains, industrial agglomeration, and circular economy; and promoting pollution-free, green, organic, and GI agricultural products; and (e) improving the innovation system for green agricultural technology development, including accelerating the adoption of GAP, and nurturing green talents and skills in rural areas. The RA2 and RA4 will contribute to the achievement of China's emissions peaking and zero growth targets by 2030 and 2060, respectively.

93. **The proposed RA3 activities are consistent with the Municipal Solid Waste Separation and Treatment Facilities Development Plan.** They will also contribute to reducing GHG emissions and pollutant loads entering waterways. The main activities include (a) constructing rural solid waste (garbage) and wastewater (sewerage) treatment systems; (b) promoting rural domestic waste classification (sorting) and resource use (recycling), and the "toilet revolution"; and (c) improving village appearance through professionally spatial planning of rural villages and landscapes. The RA3 will improve water quality in the Yangtze River Basin and living conditions in the rural areas.

94. **The GARR PforR is consistent with the World Bank's corporate priorities,** including maximizing finance for development, citizen engagement, climate co-benefits, and gender consideration.

95. **Maximizing finance for development.** The GARR PforR will support the creation of an enabling environment for attracting private investment in greening agricultural value chains. China has an established system of mobilizing private capital to support agricultural development. Under its agricultural industrialization (*Chanye Fupin*) policy, Hubei and

Hunan provincial governments will provide incentives to agro-enterprises (often called dragon head enterprises) through productive partnership/contractual arrangements with FCs to invest in the production, value addition, and marketing of branded (and green or organic certified or GI-registered) agro-products. The GARR PforR will encourage the Hubei and Hunan provincial governments to expand the scope of such support to more private enterprises with incentives for adopting GAP and compensation for generating GPGs due to the reduction in GHG emissions.

96. **Citizen engagement.** The GARR PforR has been promoting citizen engagement through wider stakeholder consultation during the environmental and social systems assessment (ESSA), including with local communities and benefiting farmers and villagers and private enterprise owners. The mechanism for citizen engagement will be expanded during project implementation to include the (a) contact details of persons from provincial and county PMOs receiving feedback and complaints will be made public in all 23 program counties as part of the grievance redress mechanism, and (b) participatory approaches will be used under DLI3.1. Records of people participating in planning and implementing the spatial IVDPs will be kept at the village level. Citizen engagement will be used as a tool for transparency and accountability, including full disclosure of plans, budgets, expenditures, and results. In addition, a comprehensive GARR PforR communication strategy will be developed and implemented to inform the wider public and rural communities of the achievement of results and share lessons learned and approaches and methodologies for upscaling nationwide.

97. **Climate co-benefits.** The GARR PforR will generate climate co-benefits from mitigation and adaptation measures. The mitigation climate co-benefits will be generated by reducing GHG emissions from (a) crop production systems through reducing chemical fertilizer use and increasing the organic fertilizer use (RA2 - DLI2.1); (b) livestock and poultry production systems through the collection, treatment, and recycling of livestock and poultry manure (RA2 - DLI2.2); (c) treatment of rural domestic wastewater and solid waste leachate (RA3 - DLI3.2); (d) treatment of aquaculture wastewater and rice-fish/shrimp co-culture crop production systems (RA4 - DLI4.2); and (e) sequestering carbon through the restoration and protection of agricultural ecosystems (for example, agroforestry and grasslands restoration). Eligible activities will be summarized in PIP. Similarly, the adaptation climate co-benefits will be generate through the adoption of (a) climate-smart agricultural practices (for example, returning crop straw/residues to the farmland to increase soil carbon [RA4 - DLI4.1], increasing efficiency of irrigation water use such as through fertigation, and improving water management in rice to reduce CH_4 emissions); (b) nature-based solutions such as retention ponds or constructed wetlands to manage floods; and (c) circular economy practices, including the efficient use of treated wastewater, such as water reuse for irrigation to build resilience to droughts. Additional mitigation and adaptation climate co-benefits will be derived from creating an enabling environment to mainstream climate change within the governance frameworks of provinces, including (a) development of IT-based mapping and M&E of rural infrastructure and public services (RA1 – DLI1.1); and (b) development of spatial IVDPs (RA3 – DLI3.1), which incorporate climate-resilience infrastructure planning and development considerations. The climate co-benefits will be measured in $MtCO_2e$ of GHG emissions reduced from the GARR PforR supported activities.

98. **Gender.** A gender gap analysis found that although women account for 70 percent of the agricultural labor force, they tend to work upstream of the value chains. Factors such as limited access to educational resources, market information and extension and advisory services, and occupational segregation and bias that encompass gender discrimination in family and labor market together contribute to this gender gap. A gender analysis also found that on average women only account for 37.1 percent of agriculture extension personnel, 39.3 percent of agri-entrepreneurs, 41.7 percent in agro-processing jobs, and less than 35 percent in rural SWMS and WWTFs in program counties (see Annex 3). Opportunities for occupying and retaining technical and managerial positions downstream the agricultural value chains (for example, processing, cold-storage, logistics, and marketing) and rural SWMS and WWTFs are also limited. This is because women are less likely to acquire technical and managerial skills needed for these positions. As a result, the analysis found that women earn significantly less than men and this exacerbates their disadvantaged social-economic status in the process of agricultural and rural transformation. To facilitate the achievement of results under RA2 and RA4, the GARR PforR will nurture women's green skills and talents, through training and capacity-building activities, including exchange visits and internships. Similarly,

the GARR PforR will promote gender balance in technical and managerial positions during recruitment process, and improve retention and advancement of female staff/workers.

Technical Capacity Building

99. **The technical capacity of the provinces in green agriculture and rural infrastructure is generally inadequate.** The provincial and county governments are paying significant attention to the training and capacity building of farmers and extension workers and developing rural talents. During the 13th FYP period, MARA launched a five-year program to develop a new type of professional farmer equipped with a wide range of skills: from soil management and crop and livestock/poultry production to marketing and business planning. In addition, the Department of Human Resources and Social Security is organizing regular short-term training for farmers and returning migrant workers. Under the GARR PforR, technical assistance and an outreach program through training and demonstration in the 23 program counties will be provided by experts from the relevant provincial departments, provincial expert panels, local and international academic and research institutions, and private firms. A needs assessment for the various categories (for example, farmers, input suppliers, enterprises, and extension workers) will be carried out. Development of training modules, delivery of training and technical assistance services, and evaluation of adoption rates will be outsourced.

Expenditure Framework Assessment

100. **The Expenditure Framework Assessment has shown that in 2020, the two GARR PforR provinces spent a total of US$645 million (Hubei US$306 million and Hunan US$339 million)** in 23 program counties to finance activities related to RA2, RA3, and RA4. It is projected that the two provinces will spend about US$4,069 million to support the implementation of these activities over the five-year period (2024–2028) or FY2024–2029. In addition, the NRRA will spend about US$31 million, bringing the governments' total outlay to US$4,100 million. The overall program funding appears to be adequate, predictable, and sustainable. The GARR PforR will leverage the general, earmarked, and poverty budget transfers from the central and provincial governments to program counties to finance green agricultural and rural infrastructure development activities. The GARR PforR will help develop mechanisms for (a) strengthening monitoring and reporting of expenditures on green agricultural development activities, out of the overall expenditures on agriculture; (b) ensuring adequate budget allocation to rural solid waste and wastewater treatment services, out of the overall budget allocated to rural infrastructure; (c) strengthening links between village development plans and budget outlays; and (d) strengthening the breakdown between capital and recurrent budgets.

101. **The GARR PforR is not expected to generate any incremental tax or other revenues for the provincial government.** However, by reducing pollutant loads entering waterways, Hubei and Hunan could save significant water treatment and health care costs. Hubei and Hunan have fully integrated their IBRD loan repayment schedules into their provincial budgets. Thus, the overall fiscal impact is expected to be manageable. The interventions introduced under the GARR PforR will support Hubei and Hunan to (a) enhance the efficiency and effectiveness of public expenditure management; (b) adopt results-based allocation of fiscal resources to the county to finance green agricultural and rural infrastructure development and delivery of public services; and (c) improve budget transparency and accountability through active engagement of citizens and tracking of public expenditures on green agriculture and rural infrastructure and public services, especially solid waste and wastewater services.

Economic Rationale

Rationale for Public Sector Financing

102. **The GARR PforR will strengthen national, provincial, and county level institutional capacity for governance and generate global and local public goods arising from the reduction in GHG emissions and NPS pollution, respectively.** It will also provide basic climate-resilient rural infrastructure and public services. The GARR PforR directly contributes to the following GPGs: (a) reducing GHG emissions, (b) increasing carbon sequestration in agricultural ecosystems, and (c)

reducing agriculture pollution to improve biodiversity protection and restoration. The GARR PforR also indirectly contributes to other GPGs, such as (a) improving food safety and reducing health risks related to China's large food exports, through improved market infrastructure and livestock rearing and handling practices helping reduce the risk of zoonotic diseases, and (b) sharing globally knowledge, such as methodologies for MRV of GHG emissions reduction. Further, the GARR PforR will improve the efficiency and effectiveness of public services delivery through the development of governance frameworks or systems and capacity building at the central and subnational levels. As a result, the high-level governments will adopt results-based fiscal transfers to finance activities aimed at achieving green, low-carbon, and sustainable agricultural and rural development objectives set in their respective 14th FYP and RRSP Phase 1.

Value Added of Bank Support

103. **The World Bank brings in international knowledge and experience of implementing green, low-carbon, and sustainable agricultural and climate-resilient rural public infrastructure development**. In addition, World Bank involvement can incorporate into the Government's RRSP the lessons learned and experience gained from other World Bank-financed agricultural and rural development projects in China and other countries and related knowledge products. The recently completed studies undertaken as part of the World Bank's PASA, the Greening of China's Agriculture, are particularly relevant for informing the GARR PforR design and its implementation (see section IC - Relationship to the CPS/CPF and Rationale for Use of Instrument). The World Bank's involvement will help leverage its vast international experience and good practices in green agricultural development, rural wastewater and solid waste management, NPS water pollution control, and environmental/ecological restoration. This involvement will also help strengthen the governance frameworks for implementing the RRP, using the PforR instrument to leverage greater results-orientation of government transfers and improve cross-agency cooperation.

Economic Assessment Methodology

104. **The economic assessment compares a scenario of 'no government program' with a scenario of a 'government program', including World Bank support.** The estimates from the EX-ACT tool show that overall the program is expected to reduce GHG emissions by approximately 7.95 $MtCO_2e$ over a period of 20 years (including about 1.99 $MtCO_2e$ over five-year GARR PforR implementation). Net GHG emissions are quantified from activities under RA2, RA3, and RA4. Principal sources of quantifiable net GHG emission reductions are (a) reduced chemical fertilizer application and improved use efficiency, (b) treatment and reuse of livestock and poultry manure, (c) treatment of rural domestic wastewater and wastewater from aquaculture ponds, and (d) increased crop straw utilization rate.

RA2 - Greening Selected Agricultural Value Chains

105. **RA2 involves support to farmers, cooperatives, and enterprises in the form of matching grants and performance or output-based subsidies.** The support for developing green value chains generates both private (increased productivity/income) and public (reduced GHG emissions and pollutant loads entering waterways) benefits. Adopting GAP and CSA technologies promoted by the GARR PforR partly depends on the profitability of farm operations and value chains.

106. **Economic analysis.** Cost-benefit analysis has been conducted to assess the economic viability of RA2 by aggregating activities in crop production (value chains) and livestock and poultry manure treatment interventions targets under DLI2.1 and DLI2.2 based on production and livestock and poultry manure treatment models in the financial analysis. Annex 3 provides the detailed incremental costs and benefits used. The following assumptions have been applied for the analysis: (a) carbon shadow prices are set following World Bank guidelines: 'Guidance Note on the Shadow Price of Carbon

in the Economic Analysis' (November 2017);[46] (b) program life is 20 years; (c) the discount rate adopted by the analysis is 6 percent, chosen according to NDRC's guidelines, which is in line with the World Bank's guidance for discount rate; and (d) taxes, duties, and subsidies are not included as they represent transfer payments instead of real costs or benefits to society as a whole. Cash flows of benefits and costs for RA2 are projected over a 20-year period to estimate their economic rate of return (ERR). The ERR with GHG reductions is estimated to be 15 percent (with a low carbon shadow price) and 18 percent (with a high carbon shadow price), while the ERR without GHG reductions is estimated to be 11 percent. Both ERRs are above the discount rate of 6 percent, indicating that RA2 is economically viable.

107. **Financial analysis.** The project's financial benefits are analyzed based on the incremental benefits and costs of the program from the perspective of farmers/cooperatives. Assumptions for this analysis are the same as for the economic analysis except for the following: (a) subsidies for farmers/ livestock and poultry manure treatment facilities are treated as income and (b) the GHG reduction benefits are excluded as they cannot be internalized by farmers/owners of livestock and poultry manure treatment facilities. The major crop production models targeted for fertilizer reduction are selected for the financial analysis, and the results are in table 5.

Table 5. Results of Financial Analysis for Major Crop Value Chains

Technical Packages to Be Adopted	Main Crop	FIRR with Subsidies (%)	FIRR without Subsidies (%)
Formula fertilizer and/or organic fertilizer and/or green manure and/or deep-side placement	Rice	15	11
Fertigation and/or formula fertilizer and/or organic fertilizer	Vegetable	19	16
Fertigation and/or formula fertilizer and/or organic fertilizer	Fruit	18	15

Note: FIRR = financial internal rate of return.

108. **The crop financial analysis shows that green agricultural technologies and practices are financially viable in the long term, even without subsidies.** However, subsidies are justified during the initial years for the following reasons: (a) promoting the adoption of GAP and CSA technologies; (b) compensating farmers for their contribution to public goods generation (for example, GHG emission reductions and pollutant loads reduction); and (c) providing up-front financial incentives to hedge against the risks associated with switching to new technologies and practices. Experience has shown that once the new technical packages are proven to be financially viable, farmers will continue using them even without subsidies.

109. **For manure treatment, the construction of a centralized livestock and poultry manure treatment and recycling facility has been used in the financial analysis.** Given that the privately operated livestock and poultry manure treatment facilities generate substantial public goods by reducing GHG emissions and pollutants entering waterways, there is strong justification for the program to provide subsidies to offset part of their construction costs. The analysis also shows that, with subsidies, the livestock and poultry manure treatment facilities can be operated profitably.

RA3 - Increasing Access to Rural Solid Waste and Wastewater Services

110. **RA3 involves the preparation of spatial IVDPs, which are the planning and decision tools for guiding public investments at the village level.** Spatial IVDPs will contribute to the efficient allocation of resources as one of the

[46] According to the World Bank's 'Guidance Note on the Shadow Price of Carbon in an Economic Analysis' issued on November 12, 2017, projects' economic analysis should use a low and high estimate of the carbon price starting at US$40 and US$80, respectively, in 2020, and increasing to US$50 and US$100 by 2030. The low and high values on carbon prices are extrapolated from 2030 to 2050 using the same growth rate of 2.25 percent per year that is implicit from 2020 to 2030, leading to values of US$78 and US$156 by 2050.

economic benefits. However, the main activities are related to the construction of village-level WWTF and SWMS. Their economic benefits include improved health outcomes (for example, reduced incidences of waterborne diseases) and reduced pollutant loads entering waterways (that is, improving water quality), which are not easily quantifiable. Hubei and Hunan have small natural villages scattered all over; thus, the construction or rehabilitation of decentralized WWTF and SWMS is seen as the most cost-effective way of delivering public services to the underserved rural areas. This is because, over the long term, the cost of transferring waste to the centralized township or urban treatment plants is higher than that of construction or rehabilitation of decentralized rural facilities.

RA4 - Restoring and Protecting Degraded Agricultural Ecosystems

111. **RA4 focuses on the integrated management of natural resources (for example, land and water) to complement the efforts of greening selected agricultural value chains under RA2.** While there is abundant evidence from the literature that returning crop straw residues to soil in the farmlands, controlling heavy metal pollution, and treating aquaculture wastewater contribute to the increase in carbon sequestration and food safety and lead to the reduction in agriculture's environmental footprint (especially because of the reduction in GHG emissions and pollutant loads entering waterways), it is difficult to quantify the costs and benefits. Thus, the analysis acknowledges that the benefits of implementing these activities far outweigh the costs. The main unquantified benefits include increased soil carbon (carbon sequestration), reduced GHG emissions, improved food safety, and reduced human health risks.

B. Fiduciary

112. **Adequacy of the program's fiduciary systems.** The fiduciary systems assessment (FSA) was carried out pursuant to the World Bank's policy and its associated Directive on Program for Results Financing (issued on March 25, 2022, and March 8, 2022, respectively) and the World Bank's Program for Results Fiduciary Systems Assessment Guidance Note (issued on March 8, 2022). Overall, the FSA report concludes that given the fiduciary risks identified and mitigation measures agreed, including actions to strengthen the fiduciary systems reflected in the Program Action Plan (PAP), the Government's fiduciary systems, such as the financial management (FM), procurement, and governance systems, meet the requirements set out in the World Bank's Program for Results Policy and Directive.

113. **FM system.** The FM system provides reasonable assurance that the GARR PforR IBRD loan proceeds will be used for the intended purposes, with due attention to the principles of economy, efficiency, effectiveness, transparency, and accountability. However, the FM system will be reinforced by adopting program budgeting and expenditures tracking; green tagging of the program budgets and expenditures; and supervision of program funds in line with government laws, regulations, and guidelines will be strengthened. Finally, TORs satisfactory to the World Bank will be used for program auditing to ensure that program funds are audited in line with the World Bank's policy (see Annex 6).

114. **Procurement management system.** The Government of China has a robust legal framework for procurement, which includes the Tendering and Bidding Law (TBL) of 1999, revised in 2017; the Government Procurement Law (GPL) of 2002, revised in 2014; and regulations and orders issued at the central, provincial, and county government levels. But the laws can further be revised and aligned with modern principles such as 'value for money' and 'fit for purpose', which offer a fair playing field for bidders and promote transparency and competitiveness. The Government has recently promoted the use of electronic or online bidding. All open competitive bidding processes are conducted through public resource transaction centers, which provide facilities and IT platforms for processing procurement activities electronically (see annex 4). However, challenges might arise from coordinating multiple implementation entities, lack of awareness about debarred and temporarily suspended firms, inadequate reporting to the World Bank about fraud allegations and corruption practices, limited competition among suppliers/service providers, and slow implementation progress of the program which has a negative impact on DLIs. Mitigation measures will include defining clear roles and responsibilities of implementing entities; issuing official notice about debarred and temporarily suspended firms which should also be available on an accessible website and ensuring that the TOR of the annual external auditor includes the task of randomly

sampling contracts and assessing whether they have been awarded to ineligible firms or individuals; requiring reporting to the World Bank credible allegations of fraud and corrupt practices; enhancing competition by maintaining a long list of qualified firms, contractors, suppliers, and service providers and closely monitoring the procurement plan and reviewing packages and methods adopted; and allocating adequate human and financial resources for close monitoring of contracts under implementation to minimize or avoid delays and/or cost overruns.

115. **Procurement exclusions.** Under the GARR PforR, high value contracts exceeding the World Bank's Operational Procurement Review Committee (OPRC) thresholds[47] will not be awarded.

116. **Fiduciary risk rating.** Considering the abovementioned FM and procurement risks and the agreed mitigation measures, the overall fiduciary risk rating is assessed as Substantial.

C. Environmental and Social

117. **An ESSA was carried out to check whether the NRRA and provincial and county governments had adequate E&S management systems for implementing the program.** The ESSA report concludes that China has established comprehensive systems to manage the related E&S risks or impacts at national, provincial, and local levels. The systems consist of legal frameworks (laws, regulations, guidelines, and standards) that are principally consistent with the World Bank's Program for Results Policy and Directive, Environment, Health, and Safety (EHS) guidelines and the Good International Industry Practice (GIIP). They also have corresponding implementation mechanisms and institutional arrangements for enforcing the legal frameworks. A fully financed and well-staffed institutional structure through various government levels is in place and efficiently operates to execute the E&S legal frameworks. The country's track record shows that its management capacity and performance are substantial and that the systems can provide an acceptable basis for addressing the possible E&S issues related to the activities supported under the GARR PforR.

118. **The ESSA report also concludes that overall the GARR PforR is expected to bring E&S benefits.** Its activities are intended to reduce pollution to air, water, and land; increase the efficiency of natural resources (especially land and water) use; and protect the environment and restore degraded agricultural ecosystems in Hubei and Hunan. Nevertheless, an E&S screening conducted on the GARR PforR activities excluded those with a high potential to cause significant adverse impacts on the environment and/or affected people. The excluded activities include those that (a) are domestically classified as Category A (environmental impact assessment [EIA] report category) projects; (b) would be implemented in environmentally sensitive areas (including the legally established protected areas and the regions sensitive to environmental impacts) as defined in the Construction Project EIA Classification Catalogue; (c) would be implemented in areas with significant legacy pollution; (d) involve construction, upgrading, relocation, or shutdown of livestock/poultry farms; (e) involve construction, upgrading, or expansion of domestic solid waste treatment facilities (such as incineration plants and landfill sites); (f) would involve large-scale land acquisition; (g) would involve the acquisition of basic farmland; and (h) would involve restoring lakes/rivers by requisition of water/land/fishing materials or restoring forests by requisition of farmland.

119. **Overall, the E&S risks/impacts associated with the GARR PforR activities are Substantial.** The first risk relates to temporary small-scale construction-related and site-specific risks/impacts, such as dust, wastewater, noise, solid waste, soil erosion, limited land acquisition or use, and occupational health and safety (OHS) issues. The second is its impacts on the local environment, society, and the ecosystem resulting from the operation/implementation of the GARR PforR supported facilities/activities, such as effluent and sludge from rural domestic WWTFs, odor and leachate from domestic solid waste collection and transfer facilities, wastewater and odor from livestock and poultry manure management facilities, wastewater and tail water from aquaculture farms, NPS pollution from fertilizer and pesticide application,

[47] OPRC thresholds for substantial risk projects are US$75 million for works; US$50 million for goods, IT, and non-consulting services; and US$20 million for firm consultants.

removed residues from heavy metal polluted farmland, labor management issues, workers' health and safety risks, impacts on farmers' livelihoods, and potential downstream indirect impacts of technical assistance activities. These adverse E&S impacts are neither significant nor irreversible and can be easily identified and avoided, minimized, and mitigated through known and demonstrated technologies and good management practices. Neither the Operation Policy Manual (OP)/Bank Procedure (BP) 7.50 (Projects on International Waterways) nor OP/BP 7.60 (Projects in Disputed Areas) is triggered for the GARR PforR.

120. **The ESSA report identified some weaknesses in the E&S management practices.** First, OHS awareness and training provided to staff of agro-enterprises and waste treatment facilities is inadequate. Second, odor issues exist in traditional livestock and poultry farms, some domestic solid waste transfer stations, and WWTFs. The ESSA report recommends that these weaknesses should be addressed through two PAPs (see annex 6): (a) implementing mitigation measures to ensure that odor treatment equipment for new or upgraded livestock and poultry manure treatment facilities are installed and domestic solid waste transfer stations are well designed, constructed, and operated and (b) implementing OHS training for employees of agro-enterprises and input dealers; livestock and poultry manure, WWTFs, and solid waste transfer stations; and crop straw storage and processing facilities.

121. **The ESSA report also concludes that a program GRM has been established in both program provinces.** The existing GRM includes community and enterprise levels. In addition, residents can resolve more serious disputes through civil actions at courts. At the enterprise level, workers can seek a solution through the enterprise/factory manager mailbox or the trade union. If any dispute cannot be satisfactorily resolved, workers can go through the government mediation mechanism or seek solution by labor arbitration.

122. **Communities and individuals believing that they are adversely affected as a result of a Bank-supported GARR PforR operation, as defined by the applicable policy and procedures,** may also submit complaints to the existing program grievance mechanism or the Bank's Grievance Redress Service (GRS). The GRS ensures that complaints are promptly reviewed to address pertinent concerns. Project-affected communities and individuals may submit their complaints to the Bank's independent accountability mechanism that houses the inspection panel, which determines whether harm occurred or could occur as a result of Bank non-compliance with its policies and procedures and the dispute resolution service, which provides communities and borrowers with the opportunity to address complaints through dispute resolution. Complaints may be submitted at any time after concerns have been brought directly to the Bank's attention and Bank management has been given an opportunity to respond. For information on how to submit complaints to the Bank's GRS, please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the Bank's accountability mechanism, please visit https://accountability.worldbank.org.

V. RISK

123. **The overall risk rating for the GARR PforR is Substantial.** The GARR PforR aims to support the Government's RRSP Phase 1, which focuses on consolidating and expanding the extreme poverty eradication gains through green agricultural and rural development interventions. The GARR PforR design is informed by the provincial proposals submitted and selected based on criteria set by the MOF and NDRC and agreed by the World Bank. Engagements with MOF, NDRC, MARA, and NRRA at the central government level, and with PDOF, PDRC, PRRA, and DARA at the provincial level, helped further improve the GARR PforR design. However, given the three-tier institutional arrangements (central, provincial, and county levels) and that the E&S and fiduciary risks are assessed to be Substantial, the overall risk is also rated Substantial. This risk will be assessed and revised as appropriate during implementation, especially after the development of governance frameworks and capacity-building activities have been completed.

124. **The political, governance, and macroeconomic risks remain Low.** The GARR PforR is closely aligned with the Government's RRP (2018–2035) and other key national strategies and plans for green agricultural and rural development.

The approval of the RRPL (2021) provides further evidence of high political commitment to implement the RRP through phased RRSPs. There is also high political commitment at the central government level through the MOF, NDRC, and MARA and at the provincial and county/district levels through their respective DOFs, DRCs, and DARAs, as well as other sectors. The Hubei and Hunan provinces and counties also have their respective RRSPs under the 14th FYP and Green Agricultural Development Plans, reaffirming and formalizing these commitments. Following a strong 8 percent cyclical rebound in GDP growth in 2021, China's economic activity slowed in the second quarter of 2022 after growing by 4.8 percent in the first quarter. China's success in containing COVID-19 infections has come at a significant economic expense. For example, China's industrial production shrank by 2.9 percent in April 2022 from a year earlier, the first negative growth in production since March 2020. Going forward, China's output is expected to grow more slowly than the rest of the region in 2022, for the first time since 1990. However, China's macroeconomic conditions are relatively better than many other large economies globally; thus, it remains optimistic that economic growth will rebound in 2023.

125. **The risk related to sector strategies and policies is Moderate.** The GARR PforR is informed by a comprehensive set of sectoral policies, strategies, and programs. Some potential risks are associated with efforts to improve cross-sectoral coordination, but these are internalized into the GARR PforR design. Hubei and Hunan provincial governments will be responsible for the use of the IBRD loan, with the county level sector agencies and/or bureaus (DARA, water resources bureaus [WRBs], RRB, housing and urban-rural development bureaus [HURDBs], DEE, DNR, and so on) responsible for implementing the GARR PfoR's green agricultural and rural revitalization interventions. The PSCs at the provincial and county levels will be responsible for cross-sectoral coordination to ensure quality results are delivered promptly.

126. **The technical design-related risk is Moderate.** The GARR PforR involves two provinces, Hubei and Hunan. Therefore, the risk of inadequate inter-jurisdictional and cross-sectoral coordination remains. However, the provincial PSCs will be key to resolving coordination problems within their jurisdictions. As a central implementing agency, the NRRA will coordinate program implementation at the national level. The GARR PforR financing involves putting in place robust third-party M&E and results/DLI verification mechanisms. Setting up a robust M&E system and recruiting credible VAs will be critical to the success of the GARR PforR. These requirements are included in the PIPs and international experience will be sought whenever possible. In addition, significant efforts will be made to train and build the capacity of provincial and county-level staff to implement the GARR PforR effectively and efficiently. The development of MRV methodologies is another potential technical risk because the science is still evolving. MRVs' development would also require close collaboration between multidisciplinary teams from the central and provincial level research and academic institutions. Approval of MRVs may also take longer than expected due to lengthy internal procedures. To mitigate this risk, MARA's department of science, technology and education, which is mandated to oversee MRVs will provide technical assistance to the multidisciplinary teams. Expert panels will be established at the central and provincial level to oversee and peer review the MRVs' development process and outputs. In addition, the MRVs' development has been included as a PAP, to give it ample time needed to be achieved, at least by the midterm review.

127. **The implementation capacity risk is Moderate.** Despite significant experience and capacity to implement IPF operations, Hubei has limited experience with PforR financing instruments. But Hunan has adequate experience in both IPFs and PforR operations. The GARR PforR presents a good opportunity for Hubei, which has a relatively higher capacity to learn about the results-based financing operations from its neighbor Hunan. Nevertheless, the responsibility for implementing the GARR PforR remains with county governments, which have limited institutional capacity. To mitigate this risk, the number of participating provinces under the GARR PforR is limited to two. The provincial PSCs will provide much-needed policy guidance and strategic direction. Hubei and Hunan will establish PPMOs with full-time staff to manage the day-to-day implementation of the GARR PforR. To enhance the capacity to implement the GARR PforR, technical assistance and training will be provided to PMO staff at the provincial and county levels.

128. **Fiduciary risks are Substantial.** Despite the existence of a generally satisfactory public procurement system within the Government, supported by relatively strong procurement planning and implementation capacity at the provincial level, as well as the FM system for IPFs, the fiduciary assessment report shows lapses in the tendering and bidding processes, which need to be addressed urgently. To mitigate this risk with the PAP, measures are set in place. These include issuing an official notice that no contract shall be awarded to a firm or individual on either a debarred or temporary suspension list. Another is to regularly inform the World Bank of any credible and material allegations of fraud and/or corruption regarding the GARR PforR, which have been included in the program design. Regarding the FM risks, there is a huge financing gap associated with rural wastewater treatment and solid waste collection/sorting, transfer, and treatment. There is also no program budgeting system in China; thus, financial reports cannot be automatically generated from the Government's integrated budget management system (IBMS). Finally, Hubei and Hunan provincial governments do not require county governments to report on program expenditures. To mitigate these FM risks, PAP development of green budgeting and expenditure tracking system and the adoption of templates for program financial reporting and TORs for external audits will be required. In addition, training and capacity building on FM and procurement will be provided during the GARR PforR implementation to address any deficiencies identified. Appropriate audit arrangements will be put in place, and VAs will be hired to verify the achievement of GARR PforR results before IBRD loan disbursement against the respective DLIs.

129. **The environment and social risk is Substantial.** The GARR PforR will have significant and broadly positive E&S impacts in the selected areas of Hubei and Hunan provinces. E&S screening was conducted on the GARR PforR activities, and those that could potentially cause significant adverse impacts on the environment and/or people were excluded. The provincial governments were assessed to have well-established systems for managing potential E&S risks/impacts of the GARR PforR activities, which include (a) temporary small-scale construction-related and site-specific risks/impacts, such as dust, wastewater, noise, solid waste, soil erosion, limited land acquisition or use, and OHS concerns, and (b) impacts on the local environment and ecosystem resulting from the operation/implementation of GARR PforR supported facilities/activities, such as leakage of untreated effluents from rural WWTFs, odor emission from domestic solid waste transfer and livestock and poultry manure management facilities, NPS pollution from chemical fertilizer and pesticide use, labor management issues, workers' health and safety, and impacts on farmers' livelihoods. The large varieties of GARR PforR activities will have diverse adverse E&S impacts covering 23 demonstration counties/cities of the two provinces during the implementation, although these potential adverse E&S impacts are neither significant nor irreversible and can be easily identified and avoided, minimized, and mitigated through known and demonstrated technologies and good management practices. The overall E&S risk is therefore rated Substantial.

130. **The stakeholder risk is Low.** Wide consultations on the GARR PforR activities were held with key stakeholders during the preparation missions and the ESSA's report preparation and disclosure processes. Hubei and Hunan will put in place GRMs to ensure that GARR PforR-affected people have an opportunity to complain and seek redress. Citizen engagement will continue during the GARR PforR implementation period to enhance transparency and accountability in verifying and reporting results under each DLI.

ANNEX 1. RESULTS FRAMEWORK MATRIX

Results Framework
COUNTRY: China
China Green Agricultural and Rural Revitalization Program for Results (Hubei and Hunan)

Program Development Objective(s)

To enhance adoption of environmentally-sustainable agricultural and rural infrastructure development practices in selected areas of Hubei and Hunan.

Program Development Objective Indicators by Objectives/Outcomes

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
To enhance environmentally-sustainable agricultural and rural infrastructure development practices								
Reduction in pollutant loads from agricultural production systems and rural domestic wastewater treatment facilities (COD and NH3-N) achieved in the Program Counties. (Metric tons/year)		0.00	9,317.00	15,076.00	82,434.00	149,793.00	217,166.00	217,166.00
COD (from livestock manure, aquaculture ponds, and demonstration village wastewater treatment) (Metric tons/year)		0.00	8,408.00	13,606.00	79,467.00	145,328.00	211,188.00	211,188.00

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
NH3N (from crop, livestock manure, aquaculture ponds, and demonstration village wastewater treatment) (Metric tons/year)		0.00	909.00	1,470.00	2,968.00	4,465.00	5,977.00	5,977.00
Greenhouse gas (GHG) emissions reduction achieved in the Program Counties (Metric tons/year CO2 equivalent). (Metric tons/year)		0.00			1,192,561.00			1,987,602.00
Beneficiaries reached by assets or public services in the Program Counties (disaggregated by gender). (Number)		0.00	0.00	1,430,163.00	2,860,326.00	4,290,488.00	5,720,651.00	7,150,814.00
Female (Number)		0.00	0.00	697,407.00	1,394,814.00	2,092,220.00	2,789,627.00	3,487,034.00

Intermediate Results Indicator by Results Areas

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
Strengthening institutional capacity for governance								
Number of Program Counties that have adopted		0.00	0.00	10.00	23.00	23.00	23.00	23.00

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
the IT-based platform for mapping and M&E of rural infrastructure and public services. (Number)								
Number of agro-products certified and/or registered in the Program Counties as either green, organic, or GI using the approved provincial regulations, standards and guidelines. (Number)	DLI 2, 3	0.00	0.00	95.00	189.00	278.00	357.00	357.00
Greening of selected agricultural value chains								
Quantity of chemical fertilizers reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties. (Metric tons/year)	DLI 4, 5	0.00	8,107.00	15,994.00	23,560.00	30,880.00	37,995.00	116,537.00
Quantity of organic fertilizer used in the Program Counties. (Metric tons/year)		0.00	200,594.00	392,588.00	575,582.00	754,676.00	929,970.00	929,970.00
Area under crop production using formula fertilizer in the Program Counties. (Hectare(Ha))		0.00	23,567.00	46,993.00	69,148.00	91,192.00	111,592.00	111,592.00
Area under fertigation in the Program Counties. (Hectare(Ha))		0.00	1,964.00	3,975.00	6,081.00	8,115.00	10,059.00	10,059.00

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
Area under green manure in the Program Counties. (Hectare(Ha))		0.00	16,043.00	31,991.00	47,238.00	60,952.00	74,608.00	74,608.00
Beneficiaries in the Program Counties who have been trained in green agricultural technologies and practices (e.g., farmers, input suppliers, enterprises, extension staff), disaggregated by gender. (Number)		0.00	8,657.00	16,327.00	23,932.00	31,734.00	39,521.00	39,521.00
Female (Number)		0.00	3,252.00	6,197.00	9,232.00	12,255.00	15,297.00	15,297.00
Beneficiaries in the Program Counties who have adopted green agricultural technologies and practices (farmers, input suppliers, enterprises, extension staff), disaggregated by gender. (Percentage)		0.00	15.00	30.00	45.00	60.00	70.00	70.00
Female (Percentage)		0.00	15.00	30.00	45.00	60.00	70.00	70.00
Quantity of livestock and poultry manure treated and recycled in the Program Counties. (Metric tons/year)	DLI 6, 7	0.00	411,888.00	1,235,665.00	2,471,330.00	4,118,884.00	6,178,326.00	6,178,327.00
Manure treated by large farms in the Program Counties. (Metric tons/year)		0.00	162,693.00	488,079.00	976,159.00	1,626,932.00	2,440,398.00	2,440,398.00
Manure treated at		0.00	249,195.00	747,586.00	1,495,172.00	2,491,953.00	3,737,929.00	3,737,929.00

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
centralized and small-scale manure treatment facilities constructed to cater for small and medium scale farms in the Program Counties. (Metric tons/year)								
Centralized manure treatment facilities constructed to cater for small- and medium-scale farms in the Program Counties. (Number)		0.00	9.00	21.00	39.00	53.00	59.00	59.00
Increasing access to rural solid waste and wastewater services.								
Spatial Integrated Village Development Plans (IVDPs) approved by the relevant authorities in the Program Counties. (Number)	DLI 8, 9	0.00	0.00	110.00	240.00	355.00	413.00	413.00
Counties implementing the approved guidelines for wastewater and solid waste management in rural villages in the Program Counties. (Number)		0.00	0.00	10.00	23.00	23.00	23.00	23.00
Beneficiaries trained in the operations and maintenance (O&M) of rural wastewater and solid waste management systems in the Program Counties. (Number)		0.00	4,666.00	8,506.00	12,389.00	16,258.00	20,191.00	20,191.00

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
Female (Number)		0.00	1,651.00	3,120.00	4,625.00	6,121.00	7,595.00	7,595.00
Demonstration villages in Program Counties with newly-constructed or rehabilitated climate-resilient wastewater treatment facilities and solid waste collection, sorting and transfer systems. (Number)	DLI 1	0.00	0.00	11.00	50.00	94.00	108.00	108.00
Rural domestic wastewater facilities in demonstration villages in the Program Counties meeting provincial effluent discharge standards. (Percentage)	DLI 10, 11	37.00	37.00	45.00	58.00	68.00	70.00	70.00
Newly created and upgraded jobs held by women in the transformation of agricultural value chain and in the rural waste management and environmental rehabilitation in the Program Counties. (Percentage)		0.00	40.00	41.00	42.00	43.00	44.00	45.00
Restoring and protecting degraded agricultural ecosystems								
Quantity of crop straw returned to the soil in farmlands in the Program	DLI 12, 13	5,964,305.00	6,055,513.00	6,138,067.00	6,213,619.00	6,288,516.00	6,362,050.00	6,362,050.00

Indicator Name	DLI	Baseline	Intermediate Targets					End Target
			1	2	3	4	5	
Counties. (Metric tons/year)								
Regulations, technical guidelines, and standards on treatment of aquaculture tail water issued by provincial authorities and implemented by the Program Counties. (Number)		0.00	0.00	8.00	10.00	10.00	10.00	10.00
Area of large-scale aquaculture farms (ponds) with tail water treatment systems in the Program Counties (Hubei only) (Hectare(Ha))	DLI 14	0.00	2,264.00	4,501.00	6,705.00	8,838.00	10,938.00	10,938.00
Regulations, technical guidelines, and standards on degraded farmland treatment and protection issued by provincial authorities and implemented by the Program Counties. (Number)		0.00	0.00	10.00	13.00	13.00	13.00	13.00
Area of agricultural farmland polluted with heavy metals that is treated and protected in the Program Counties (Hunan only). (Hectare(Ha))	DLI 15	0.00	1,472.00	3,003.00	4,635.00	6,324.00	7,989.00	7,989.00

.

Monitoring & Evaluation Plan: PDO Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Reduction in pollutant loads from agricultural production systems and rural domestic wastewater treatment facilities (COD and NH3-N) achieved in the Program Counties.	Cumulative quantities of the annual reduction of pollutant loads (COD and NH3-N) achieved due to reduced fertilizer use and increased efficiency in selected value chains (e.g., rice, fruits, and vegetables); treatment of livestock and poultry manure, and aquaculture wastewater; and treatment of rural domestic wastewater.	Annual	Annual program monitoring reports	The NH3-N reduction is estimated from annual quantities of fertilizer use reduction and increased use of substitute technologies used based on pollutant discharge coefficients approved by the Ministry of Agriculture and Rural Affairs (MARA) and guidelines issued by provinces. Quantities of fertilizer reduction are obtained through sales records and sample surveys. The NH3-N and COD reductions from improved livestock and poultry manure management are estimated using methodology approved by MARA and guidelines provided by provinces. The NH3-N and COD reduction from the rural wastewater	PPMOs/third-party M&E firms

				treatment is estimated based on the guidelines provided by the Ministry of Housing and Urban-Rural Development (MOHURD).	
COD (from livestock manure, aquaculture ponds, and demonstration village wastewater treatment)					
NH3N (from crop, livestock manure, aquaculture ponds, and demonstration village wastewater treatment)					
Greenhouse gas (GHG) emissions reduction achieved in the Program Counties (Metric tons/year CO2 equivalent).	This indicator measures the net reduction in GHG emissions in metric tons CO2 equivalent, due to chemical fertilizer use reduction; and livestock and poultry manure treatment, wastewater treatment, and increase of crop straw utilization	Baseline, mid-term, end-term	Conversion of quantity reduced to carbon dioxide equivalent (CO2-e) using respective coefficients provided by the MARA and MOHURD.	Socioeconomic surveys, fertilizer sales records, onsite manure and rural domestic wastewater treatment records.	County program management offices (CPMOs) and Provincial PPMOs, with help from third-party M&E firms
Beneficiaries reached by assets or public services in the Program Counties (disaggregated by gender).	This indicator measures the number of farmers provided with agricultural assets or services resulting from World Bank project or program support.	Annual	Semi-annual third-party M&E reports	Records from demonstration villages in the Program Counties and socioeconomic surveys.	PPMOs/third-party M&E firms

	“Agriculture" or “Agricultural" includes: crops, livestock, capture fisheries, aquaculture, agroforestry, timber, and non-timber forest products. Assets include property, biological assets, and farm and processing equipment. Biological assets may include animal agriculture breeds (e.g., livestock, fisheries) and genetic material of livestock, crops, trees, and shrubs (including fiber and fuel crops). Services include research, extension, training, education, ICTs, inputs (e.g., fertilizers, pesticides, labor); production-related services (e.g., soil testing, animal health/veterinary services); phyto-sanitary and food safety services, agricultural marketing support services (e.g., price monitoring, export promotion), access to farm and post-harvest machinery and storage facilities, employment,				

	irrigation and drainage, and finance. Farmers are people engaged in agricultural activities or members of an agriculture-related business targeted by the GARR PforR in Program Counties (disaggregated by men and women).				
Female					

Monitoring & Evaluation Plan: Intermediate Results Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Number of Program Counties that have adopted the IT-based platform for mapping and M&E of rural infrastructure and public services.	The IT-based platform will be developed by the NRRA, piloted in Program Counties, and adopted for use as a decision support and performance evaluation tool.	Annual	Annual reports	Annual progress reports confirming the adoption of the IT platform by the Program Counties and evidence of use, such as regular reports generated from the platform by the Program Counties.	PPMOs/third-party M&E firms.
Number of agro-products certified and/or registered in the Program Counties as either green, organic, or GI using the approved provincial regulations, standards and guidelines.	This indicator measures the number of product certificates and the number of geographical indication (GI) registered by using the approved provincial regulations, standards and guidelines. Product certification is defined as agri-products certified as organic, or green according to national standards set by MARA. GI certificates are done according to national standards set by MARA and are recognized internationally.	Annual	Annual reports	Annual reports confirming certified green and organic, and GI-registered agricultural products under the GARR PforR in the Program Counties.	PPMOs/third-party M&E firms.

Quantity of chemical fertilizers reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties.	Cumulative net quantities of chemical fertilizer use reduced by farmers in various crop production systems due to increased use efficiency and increased use of substitute environmentally-friendly fertilizers.	Annual	Annual reports	Monitored by CPMO in accordance with MARA guidelines and verified by the verification agency (VA).	PPMOs/third-party M&E firms.
Quantity of organic fertilizer used in the Program Counties.	Cumulative quantities of organic fertilizer used by farmers in various crop production systems as a replacement for the chemical fertilizers.	Annual	Monitored by CPMOs in accordance with MARA guidelines and verified by the VA.	Producers and retailers' sales records and socioeconomic surveys.	CPMOs/PPMOs/third-party M&E firms.
Area under crop production using formula fertilizer in the Program Counties.	Cumulative area under crop production using formula fertilizers as substitutes for regular chemical fertilizers.	Annual	Annual reports	Monitored by CPMOs in accordance with MARA guidelines and verified by the VA.	PPMOs/third-party M&E firms.
Area under fertigation in the Program Counties.	Cumulative number of hectares (ha) under fertigation practices. Fertigation is the injection of fertilizers and other water water-soluble products into an irrigation system for soil nutrients and water amendments. Fertigation is related to chemigation, or the	Annual	Annual reports	Monitored by CPMOs in accordance with MARA guidelines and verified by the VA.	PPMOs/third-party M&E firms.

	injection of chemicals into an irrigation system.				
Area under green manure in the Program Counties.	Cumulative number of hectares under green manure (nitrogen-fixing/leguminous crops), including vetch (genus Vicia) will be incorporated into the soil to increase organic matter and nutrients, and improve soil structure.	Annual	Annual reports	Monitored by CPMOs in accordance with MARA guidelines and verified by the VA.	PPMOs/third-party M&E firms.
Beneficiaries in the Program Counties who have been trained in green agricultural technologies and practices (e.g., farmers, input suppliers, enterprises, extension staff), disaggregated by gender.	Cumulative number of people (farmers, input suppliers, enterprises/agri-businesses, extension staff) trained in green agricultural technologies and practices (disaggregated by gender).	Semi-annual	Semi-annual reports	Semi-annual reports prepared using administrative data from the management information system (MIS).	CPMOs.
Female					
Beneficiaries in the Program Counties who have adopted green agricultural technologies and practices (farmers, input suppliers, enterprises, extension staff), disaggregated by gender.	Percentage of the people who have been trained and have adopted green agricultural technologies and practices.	Baseline, mid-term, and end-term.	Baseline, mid-term, and end-term reports.	Three times (baseline, mid-term and end-term) socio-economic surveys carried out by program CPMOs.	CPMOs
Female					
Quantity of livestock and poultry manure treated and recycled in the Program Counties.	Cumulative quantity of livestock and poultry manure treated by small,	Annual	Annual reports	Monitored by CPMOs in accordance with MARA guidelines and verified	PPMOs and third-party M&E firm.

	medium and large farms in Program Counties.			by the VA.	
Manure treated by large farms in the Program Counties.	Cumulative quantity (tons) of livestock and poultry manure that are collected, treated and recycled by large farms into organic fertilizer, biogas/energy generation, and irrigation water in the Program Counties.	Annual	Annual reports	Monitored by CPMOs in accordance with MARA guidelines and verified by the VA.	PPMOs and third-party M&E firm.
Manure treated at centralized and small-scale manure treatment facilities constructed to cater for small and medium scale farms in the Program Counties.	Cumulative quantity (tons) of livestock and poultry manure in the Program Counties that are collected, treated and recycled by centralized and small-scale manure treatment facilities and are meeting provincial effluent discharge standards.	Annual	Annual reports	Monitored by CPMOs in accordance with MARA guidelines and verified by the VA.	PPMOs and third-party M&E firm.
Centralized manure treatment facilities constructed to cater for small- and medium-scale farms in the Program Counties.	Cumulative number of centralized manure treatment facilities newly constructed for small- and medium-scale farms in the Program Counties. Small- and medium-scale animal farms are defined as less than 500 heads of pigs, less than 2,000 egg chickens (layers), less than 10,000	Annual	Annual reports	Annual reports monitored through administrative data provided by CPMOs.	CPMOs.

	meat chickens (broilers), and/or less than 30 heads of cattle.				
Spatial Integrated Village Development Plans (IVDPs) approved by the relevant authorities in the Program Counties.	Cumulative number of IVDPs prepared by professional planning firms using participatory approaches. The IVDPs show the future village development in terms of land use, such as agriculture, public infrastructure and social services, recreation, environmental protection, and residential areas.	Annual	Annual reports	Annual reports prepared using administrative data generated by county natural resources bureaus.	CPMOs.
Counties implementing the approved guidelines for wastewater and solid waste management in rural villages in the Program Counties.	Cumulative number of counties that have developed guidelines for rural solid waste and wastewater management, which have been approved by the relevant provincial authorities and are being used in the Program Counties.	Annual	Annual reports	Annual reports confirming the development of the guidelines by the provincial governments and their approval and use in the Program Counties.	CPMOs/third-party M&E firms.
Beneficiaries trained in the operations and maintenance (O&M) of rural wastewater and solid waste management systems in the Program Counties.	Cumulative number of people trained in O&M of rural villages wastewater and solid waste management systems in the Program Counties.	Semi-annual	Semi-annual reports	Semi-annual reports prepared using administrative data from the MIS.	CPMOs

Female					
Demonstration villages in Program Counties with newly-constructed or rehabilitated climate-resilient wastewater treatment facilities and solid waste collection, sorting and transfer systems.	Cumulative number of demonstration villages with newly-constructed or rehabilitated climate-resilient wastewater treatment facilities and established solid waste collection, sorting and transfer systems in Program Counties that are meeting provincial effluent discharge standards.	Annual	Annual reports	Data will be recorded by County RRBs in the MIS based on the approved investments; sample based onsite verification by third-party M&E firms; and semi-annual reports prepared by the PPMOs based on the CPMO reports.	CPMOs
Rural domestic wastewater facilities in demonstration villages in the Program Counties meeting provincial effluent discharge standards.	Cumulative percentage of wastewater treatment facilities constructed or rehabilitated in the Program Counties with effluent discharge meeting the provincial standards.	Semi-annual	Semi-annual reports	Data will be recorded by county RRBs in the MIS based on automated loggers from demonstration village treatment facilities and onsite records; random onsite verification by third-party M&E firms using a sample of at least 30 percent; and semi-annual reports prepared by the PPMOs based on CPMO reports.	CPMOs.
Newly created and upgraded jobs held by women in the transformation of agricultural value chain and in the rural waste management and environmental	Cumulative percentage of women or female employees in entities that receive GARR PforR	Annual	Annual reports	Annual reports prepared using administrative data generated by county commerce	CPMOs.

rehabilitation in the Program Counties.	support in the transformation of production, processing, packaging, marketing and sales of green agricultural products and in the newly constructed rural wastewater management facilities.			bureaus.	
Quantity of crop straw returned to the soil in farmlands in the Program Counties.	Cumulative amount of crop straw returned into the soil in the Program Counties. In general, crop straws are either used for animal feed and biomass energy (power generation plants), or returned to the soil in farmlands. The latter, also known as residual crop straw will be monitored annually to estimate the carbon sequestration amounts/rates. The aim is to improve soil organic carbon (SOC) and soil structure, and reduce GHG emissions.	Annual	Annual reports	Residual crop straw data collected by county DARA based on the methodology developed by MARA and adopted by the provincial DARA. The VA verifies the data based on the estimation coefficients provided by MARA.	CPMOs.
Regulations, technical guidelines, and standards on treatment of aquaculture tail water issued by provincial authorities and implemented by the Program Counties.	Cumulative number of provincial technical guidelines and standards for treatment of aquaculture tail water	Annual	Annual reports showing the proportion of sampling	Reports issued by the county DARAs and compiled by the provincial DARAs.	CPMOs.

	approved by the relevant provincial authorities, and used by the Program Counties.		points in program counties that have soils meeting quality and crops meeting food safety standards in the Program Counties. The target is to reach 90 percent of the sampling points.		
Area of large-scale aquaculture farms (ponds) with tail water treatment systems in the Program Counties (Hubei only)	Cumulative number of hectares under aquaculture ponds with tail water treatment systems in the Program Counties. The tail water of large-scale aquaculture farms will be monitored with sensors by environmental and third-party monitoring agencies to ensure that they meet environmental standards to reduce GHG emissions and non-point source (NPS) pollution.	Semi-annual	Semi-annual environmental monitoring reports.	Data on large-scale aquaculture farms will be collected by DARAs and stored in the MIS. The county ecology and environmental bureaus will monitor the tail water effluent discharges. The VA will randomly sample , analyze and verify the effluent discharge data from selected large-scale farms.	CPMOs/third-party M&E firms.

Regulations, technical guidelines, and standards on degraded farmland treatment and protection issued by provincial authorities and implemented by the Program Counties.	Cumulative number of provincial technical guidelines and standards for degraded agricultural land treatment and protection developed, approved by the relevant provincial authorities, and used by the Program Counties. Degraded farmland include areas with heavy metals, acidic soils, alkaline soils and other forms of degradation due to unsustainable agriculture practices, land use change, and industrial and mining activities.	Annual	Annual reports	Reports from the provincial DARA compiled based on county DARA reports. The VA verifies the existence of the guidelines and standards and whether they are being used by the Program Counties.	CPMOs/third-party M&E firms.
Area of agricultural farmland polluted with heavy metals that is treated and protected in the Program Counties (Hunan only).	Cumulative number of hectares of agricultural farmlands with heavy metals that have been treated using various technologies and practices, and brought back into safe production in the Program Counties.	Annual	Annual reports	Records from the provincial DARA compiled based on data received from the county DARA and stored in the MIS. Sample-based onsite verification by the VA.	CPMOs.

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

Disbursement Linked Indicators Matrix				
DLI 1	DLI1.1: Development and use of a comprehensive national IT-based monitoring platform for mapping and M&E of the delivery of rural infrastructure, public services and spatial Integrated Village Develop			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Number	5,000,000.00	1.45
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	
2024	1.00		3,850,000.00	US$3,850,000.00 (77%) for NRRA to develop an IT-based platform
2025	6.00		300,000.00	US$50,000 (1%) per county connecting to IT-based platform
2026	17.00		850,000.00	US$50,000 (1%) per county connecting to central IT-based platform
2027	0.00		0.00	US$50,000 (1%) per county connecting to central IT-based platform

2028	0.00	0.00	US$50,000 (1%) per county connecting to central IT-based platform

DLI 2	DLI1.2: Adoption of regulations, standards, and guidelines on green agricultural development and the number of agro-products that are certified and/or registered as green, organic or GI (Hubei)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Number	6,803,800.00	1.97
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	
2024	1.00		1,363,750.00	US$ 1,363,750
2025	40.00		1,386,000.00	US$ 34,650 per agro-product certified and/or registered
2026	40.00		1,386,000.00	US$ 34,650 per agro-product certified and/or registered
2027	40.00		1,386,000.00	US$ 34,650 per agro-product certified and/or registered
2028	37.00		1,282,050.00	US$ 34,650 per agro-product certified and/or registered

DLI 3	DLI1.2: Adoption of regulations, standards, and guidelines on green agricultural development and the number of agro-products that are certified and/or registered as green, organic or GI (Hunan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Number	6,811,360.00	1.97
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	
2024	1.00		1,371,360.00	US$ 1,371360
2025	55.00		1,496,000.00	US$ 27,200 per agro-product certified and/or registered
2026	54.00		1,468,800.00	US$ 27,200 per agro-product certified and/or registered
2027	49.00		1,332,800.00	US$ 27,200 per agro-product certified and/or registered
2028	42.00		1,142,400.00	US$ 27,200 per agro-product certified and/or registered

DLI 4	DLI2.1: Tons of chemical fertilizer reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties (Hubei)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Metric tons/year	30,496,200.00	8.84
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	
2024	2,455.00		1,951,725.00	US$ 795 per ton
2025	4,984.00		3,962,280.00	US$ 795 per ton
2026	7,589.00		6,033,255.00	US$ 795 per ton
2027	10,287.00		8,178,165.00	US$ 795 per ton
2028	13,045.00		10,370,775.00	US$ 795 per ton

DLI 5	DLI2.1: Tons of chemical fertilizer reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties (Hunan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Metric tons/year	30,488,640.00	8.84
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			

Prior Results		0.00	
2024	5,651.00	2,203,890.00	US$ 390 per ton
2025	11,010.00	4,293,900.00	US$ 390 per ton
2026	15,971.00	6,228,690.00	US$ 390 per ton
2027	20,594.00	8,031,660.00	US$ 390 per ton
2028	24,950.00	9,730,500.00	US$ 390 per ton

DLI 6	DLI2.2: Percentage increase of treated and recycled livestock and poultry manure from large- and small-scale farms meeting effluent standards in the Program Counties (Hubei)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Outcome	Yes	Percentage	35,850,000.00	10.39
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	84.00			
Prior Results			0.00	
2024	2.00		6,300,909.09	6% increase from large scale farm (1% =US$2,390,000) and 11% increase from small scale farms (1%=US$1,955,454.5)
2025	2.00		6,300,909.09	6% increase from large scale farm (1% =US$2,390,000) and 11% increase from small scale farms

			(1%=US$1,955,454.5)
2026	2.00	6,300,909.09	6% increase from large scale farm (1% =US$2,390,000) and 11% increase from small scale farms (1%=US$1,955,454.5)
2027	2.00	6,300,909.09	6% increase from large scale farm (1% =US$2,390,000) and 11% increase from small scale farms (1%=US$1,955,454.5)
2028	3.00	10,646,363.64	6% increase from large scale farm (1% =US$2,390,000) and 11% increase from small scale farms (1%=US$1,955,454.5)

DLI 7	DLI2.2: Percentage increase of treated and recycled livestock and poultry manure from large- and small-scale farms meeting effluent standards in the Program Counties (Hunan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Outcome	Yes	Percentage	35,850,000.00	10.39
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	82.00			
Prior Results			0.00	
2024	2.00		7,170,000.00	5% increase from large scale farms (1%=US$2,868,000);10% increase from small scale farms

			(1%=2,151,000)
2025	2.00	7,170,000.00	5% increase from large scale farms (1%=US$2,868,000) ;10% increase from small scale farms (1%=2,151,000)
2026	2.00	7,170,000.00	5% increase from large scale farms (1%=US$2,868,000);10% increase from small scale farms (1%=2,151,000)
2027	2.00	7,170,000.00	5% increase from large scale farms (1%=US$2,868,000);10% increase from small scale farms (1%=2,151,000)
2028	2.00	7,170,000.00	5% increase from large scale farms (1%=US$2,868,000);10% increase from small scale farms (1%=2,151,000)

DLI 8	DLI3.1: Number of spatial Integrated Village Development Plans (IVDPs) approved by the Program Counties (Hubei)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Number	17,000,000.00	4.93
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	

2024	0.00	0.00	US$85,000 per IVDP approved
2025	50.00	4,250,000.00	US$85,000 per IVDP approved
2026	70.00	5,950,000.00	US$85,000 per IVDP approved
2027	60.00	5,100,000.00	US$85,000 per IVDP approved
2028	20.00	1,700,000.00	US$85,000 per IVDP approved

DLI 9	DLI3.1: Number of spatial Integrated Village Development Plans (IVDPs) approved by the Program Counties (Hunan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Number	17,000,000.00	4.93
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	
2024	0.00		0.00	US$79,812.21 per each IVDP approved
2025	60.00		4,788,732.39	US$79,812.21 per each IVDP approved
2026	60.00		4,788,732.39	US$79,812.21 per each IVDP approved
2027	55.00		4,389,671.36	US$79,812.21 per each IVDP approved

2028	38.00		3,032,863.86	US$79,812.21 per each IVDP approved
DLI 10	DLI3.2: Number of demonstration villages with newly constructed or rehabilitated climate-resilient WWTFs and established solid waste collection, sorting, and transfer systems meeting effluent (Hubei)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Number	52,600,000.00	15.25
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results			0.00	
2024	0.00		0.00	US$1,073,469.39 per village
2025	12.00		12,881,632.70	US$1,073,469.39 per village
2026	20.00		21,469,387.80	US$1,073,469.39 per village
2027	17.00		18,248,979.50	US$1,073,469.39 per village
2028	0.00		0.00	US$1,073,469.39 per village
DLI 11	DLI3.2: Number of demonstration villages with newly constructed or rehabilitated climate-resilient WWTFs and established solid waste collection, sorting, and transfer systems meeting effluent (Hunan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Output	Yes	Number	52,600,000.00	15.25
Period	**Value**		**Allocated Amount (USD)**	**Formula**

Baseline	0.00		
Prior Results		0.00	
2024	0.00	0.00	US$ 891,525.42 per village
2025	15.00	13,372,881.40	US$ 891,525.42 per village
2026	25.00	22,288,135.60	US$ 891,525.42 per village
2027	19.00	16,938,983.00	US$ 891,525.42 per village
2028	0.00	0.00	US$ 891,525.42 per village

DLI 12	DLI4.1: Percentage increase in comprehensive crop straw (rice, wheat, rapeseed, and corn) utilization in the Program Counties (Hubei).			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Percentage	12,250,000.00	3.55
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	93.00			
Prior Results			0.00	
2024	0.50		2,041,667.00	1%= US$4,083,333
2025	0.50		2,041,667.00	1%= US$4,083,333
2026	0.50		2,041,667.00	1%= US$4,083,333
2027	0.50		2,041,667.00	1%= US$4,083,333

2028	1.00		4,083,332.00	1%= US$4,083,333
DLI 13	DLI4.1: Percentage increase in comprehensive crop straw (rice, wheat, rapeseed, and corn) utilization in the Program Counties (Hunan).			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Percentage	12,250,000.00	3.55
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	85.00			
Prior Results			0.00	
2024	1.00		2,041,667.00	1%= US$2,041,666.67
2025	1.00		2,041,667.00	1%= US$2,041,666.67
2026	1.00		2,041,667.00	1%= US$2,041,666.67
2027	1.00		2,041,667.00	1%= US$2,041,666.67
2028	2.00		4,083,332.00	1%= US$2,041,666.67
DLI 14	DLI4.2: Number of hectares of treated aquaculture ponds meeting effluent discharge standards in the Program Counties (Hubei)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Hectare(Ha)	15,000,000.00	4.35
Period	**Value**		**Allocated Amount (USD)**	**Formula**

Baseline	0.00		
Prior Results	0.00	0.00	
2024	2,264.00	3,104,772.35	US$ 1371.37 per ha treated
2025	2,237.00	3,067,745.47	US$ 1371.37 per ha treated
2026	2,204.00	3,022,490.76	US$ 1371.37 per ha treated
2027	2,133.00	2,925,123.42	US$ 1371.37 per ha treated
2028	2,100.00	2,879,868.00	US$ 1371.37 per ha treated

DLI 15	DLI4.3: Number of hectares of treated farmlands with a safe utilization rate in the Program Counties (Hunan)			
Type of DLI	**Scalability**	**Unit of Measure**	**Total Allocated Amount (USD)**	**As % of Total Financing Amount**
Intermediate Outcome	Yes	Hectare(Ha)	15,000,000.00	4.35
Period	**Value**		**Allocated Amount (USD)**	**Formula**
Baseline	0.00			
Prior Results	0.00		0.00	0.00
2024	1,472.00		2,763,800.23	US$1,877.58 per ha treated
2025	1,531.00		2,874,577.54	US$1,877.58 per ha treated
2026	1,632.00		3,064,213.29	US$1,877.58 per ha treated
2027	1,689.00		3,171,235.45	US$1,877.58 per ha treated

2028	1,665.00	3,126,173.49	US$1,877.58 per ha treated

Verification Protocol Table: Disbursement Linked Indicators	
DLI 1	DLI1.1: Development and use of a comprehensive national IT-based monitoring platform for mapping and M&E of the delivery of rural infrastructure, public services and spatial Integrated Village Develop
Description	DLI1.1 includes two sub-DLIs. DLI1.1.1 requires the NRRA as an implementing agency of the central component to develop an IT-based platform for mapping and M&E of rural infrastructure and public services for the provincial and county governments to adopt and use as a decision-making tool to guide investment and O&M activities. DLI1.1.2 requires program counties to connect (that is, install and use) the IT-based platform developed under DLI1.1.1 to record, analyze, and report on the performance of rural infrastructure (including solid waste and wastewater management facilities), public services, and the spatial IVDPs of rural villages. The data collected, analyzed, and reported through the IT-based platform will include basic rural household (poor and non-poor) information on access to rural infrastructure and public services, such as wastewater and solid waste in all villages in program counties, and village socioeconomic parameters.
Data source/ Agency	Management Information System (MIS) at Provincial RRBs
Verification Entity	Third-party verification agencies
Procedure	**Verification protocol for DLI1.1.1:** The third-party VA verifies whether: (a) the NRRA has developed and installed the IT-based platform for mapping and M&E of rural infrastructure and public services and spatial IVDPs of rural villages through on-site review of the system, the official/regular performance evaluation documents, or reports generated; (b) the IT-based platform meets data security and confidentiality standards; (c) the NRRA has established mechanisms for the protection of personal data; and (d) the NRRA has issued guidelines for installing and using the IT-based platform at the county level. A single disbursement of 77 percent of the budget allocated for DLI1.1 will be made upon achieving the results. **Verification protocol for DLI1.1.2:** The third-party VA verifies whether: (a) the IT-based platform has been adopted and installed in the Program Counties; (b) the data and information are being collected and entered in the platform; (c) the platform can regularly generate the required official reports, including on the performance of the solid waste, wastewater facilities, public services, and IVDPs to inform the investment and O&M decision-making; (d) the platform meets data security and confidentiality standards; and (e) the provincial and county RRBs have established mechanisms for protecting personal data. The NRRA target to have all 23 program counties achieve these results by FY2026. The remaining 23 percent of the budget allocated to DLI1.1 is scalable. Disbursements will be made progressively against the number of new program counties that have achieved these results in each year based on the agreed unit price.

DLI 2	DLI1.2: Adoption of regulations, standards, and guidelines on green agricultural development and the number of agro-products that are certified and/or registered as green, organic or GI (Hubei)
Description	DLI1.2 has two sub-DLIs: DLI1.2.1: The province will adopt regulations, standards, and guidelines on green agricultural development issued by MARA, which set the minimum requirements for certifying, or registering agro-products as green, organic, or as GI. Depending on target markets, provinces may approve regulations, standards and guidelines that are more stringent, or higher than MARA's. The adopted or customized regulations, standards, and guidelines will be approved by the relevant authorities at the provincial level. The provincial DARA will issue the official notice to the 10 program counties to use them. DLI1.2.2: Number of agro-products produced in the program counties certified as green or organic, or registered as GI using the approved provincial regulations, standards, and guidelines. This sub-DLI aims to provide evidence that farmers in the program counties are adopting GAP and are able to meet environmental and food safety standards. Certified and registered agro-products are fetching premium prices in the niche domestic, regional, and international markets, which creates incentive for the province to adopt the national certification and registration systems. Hubei is targeting to certify or register 157 agro-products in the 10 program counties.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol for DLI1.2.1:** The third-party VA will verify the documents approved by the relevant provincial authorities (that is, regulations, standards, and guidelines), and a single disbursement of 20 percent of the allocated budget for DLI1.2 will be made upon achieving the results. **Verification protocol for DLI1.2.2:** The third-party VA will verify the green and organic agro-product certificates issued by the provincial DARAs and the GI agro-products registration documents issued by MARA. Disbursements of the remaining 80 percent of the budget allocated to DLI1.2 are scalable. Disbursements will be made against the number of agro-products certified or registered in each calendar year based on the agreed unit price.
DLI 3	DLI1.2: Adoption of regulations, standards, and guidelines on green agricultural development and the number of agro-products that are certified and/or registered as green, organic or GI (Hunan)
Description	DLI1.2 has two sub-DLIs: DLI1.2.1:The province will adopt regulations, standards, and guidelines on green agricultural development issued by MARA, which set the minimum requirements for certifying, or registering agro-products as green, organic, or as GI. Depending on target markets, provinces may approve regulations, standards and guidelines that are more stringent, or higher than MARA's. The adopted or customized regulations, standards, and guidelines will be approved by the relevant authorities at the provincial level. The provincial DARA will issue the official notice to the 13 Program Counties to

	use them. DLI1.2.2: Number of agro-products produced in the program counties certified as green or organic, or registered as GI using the approved provincial regulations, standards, and guidelines. This sub-DLI aims to provide evidence that farmers in the program counties are adopting GAP and are able to meet environmental and food safety standards. Certified and registered agro-products are fetching premium prices in the niche domestic, regional, and international markets, which creates incentive for the province to adopt the national certification and registration systems. Hunan is targeting to certify or register 200 agro-products in the 13 program counties.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol for DLI1.2.1:** The third-party VA will verify the documents approved by the relevant provincial authorities (that is, regulations, standards, and guidelines), and a single disbursement of 20 percent of the allocated budget for DLI1.2 will be made upon achieving the results. **Verification protocol for DLI1.2.2:** The third-party VA will verify the green and organic agro-product certificates issued by the provincial DARAs and the GI agro-products registration documents issued by MARA. Disbursements of the remaining 80 percent of the budget allocated to DLI1.2 are scalable. Disbursements will be made against the number of agro-products certified or registered in each calendar year based on the agreed unit price.
DLI 4	DLI2.1: Tons of chemical fertilizer reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties (Hubei)
Description	DLI2.1 measures the reduction in net chemical fertilizer use in the 10 program counties. The cumulative chemical fertilizer use reduction achieved by reducing application intensity (for example, quantity per unit area), or increasing use efficiency will be monitored using MARA's national platform. The cumulative chemical fertilizer use reduction achieved due to increased use of substitute technologies will be estimated using conversion coefficients approved by MARA. This is because the utilization rates are calculated by combining experimental data on fertilizer absorption by different crops over multiple seasons and data from the substitute green technologies. The experiments use MARA's methodology to monitor fertilizer application rates and crop yields and account for crop nutrient use. Therefore, the program counties will collect data on the quantity and area (hectares) of chemical fertilizer use and substitute green technologies use and prepare annual reports. The net reduction in chemical fertilizer use will be calculated by provincial DARA from a decrease in application intensity and an increase in substitute green technologies or GAP using the conversion coefficients approved by MARA. Hubei is targeting to reduce the chemical fertilizer use in the 10 program counties by 38,361 metric tons.

Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify the cumulative quantity of organic and formula fertilizers, and area under the green manure and fertigation practices in selected cropping systems, which are monitored by county DARAs and reported to the World Bank by provincial DARAs annually. The third-party VA will also verify whether the provincial DARAs have used appropriate conversion coefficients to calculate the net tons of chemical fertilizers reduced. The third-party VA will randomly sample and review the analyses and results of county DARAs, which are reported to the provincial DARA to check whether they are consistent with the reduction in chemical fertilizer use due to the adoption of substitute green technologies or GAP. Chemical fertilizer reduction targets and budgets are spread over 2025–2028 period. Disbursements are scalable and are made against the target net metric tons of chemical fertilizer reduction achieved in the 10 program counties each calendar year based on the agreed unit price.
DLI 5	DLI2.1: Tons of chemical fertilizer reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the Program Counties (Hunan)
Description	DLI2.1 measures the reduction in net chemical fertilizer use in the 13 program counties. The cumulative chemical fertilizer use reduction achieved by reducing application intensity (for example, quantity per unit area), or increasing use efficiency will be monitored using MARA's national platform. The cumulative chemical fertilizer use reduction achieved due to increased use of substitute technologies will be estimated using conversion coefficients approved by MARA. This is because the utilization rates are calculated by combining experimental data on fertilizer absorption by different crops over multiple seasons and data from the substitute green technologies or GAPs. The experiments use MARA's methodology to monitor fertilizer application rates and crop yields and account for crop nutrient use. Therefore, the 13 program counties will collect data on the quantity and area (hectares) of chemical fertilizer use and substitute green technologies or GAP use and prepare annual reports. The net reduction in chemical fertilizer use will be calculated by provincial DARA from a decrease in application intensity and an increase in substitute green technologies or GAP using the conversion coefficients approved by MARA. Hunan is targeting to reduce the chemical fertilizer use in the 13 program counties by 78,176 metric tons.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency.
Procedure	**Verification Protocol:** The third-party VA will verify the cumulative quantity of organic and formula fertilizers, and area under the green manure and fertigation practices in selected cropping systems, which are monitored by county DARAs and

	reported to the World Bank by provincial DARAs annually. The third-party VA will also verify whether the provincial DARAs have used appropriate conversion coefficients to calculate the net tons of chemical fertilizers reduced. The third-party VA will randomly sample and review the analyses and results of county DARAs, which are reported to the provincial DARA to check whether they are consistent with the reduction in chemical fertilizer use due to the adoption of substitute green technologies or GAP. Chemical fertilizer reduction targets and budgets are spread over 2025–2028 period. Disbursements are scalable and are made against the target net metric tons of chemical fertilizer reduction achieved in the 13 program counties each calendar year based on the agreed unit price.
DLI 6	DLI2.2: Percentage increase of treated and recycled livestock and poultry manure from large- and small-scale farms meeting effluent standards in the Program Counties (Hubei)
Description	DLI2.2 measures the incremental adoption of good management practices of livestock and poultry manure due to the program interventions. These include the expansion of on-site manure treatment capacity at large farms and the construction of centralized treatment facilities to cater to the small- and medium farms. The cumulative data on the quantity of manure collected, treated, and recycled will be obtained from large farms with on-site treatment facilities and centralized treatment facilities for small – and medium livestock and poultry farms. MARA has established a national platform for monitoring the quantities of livestock and poultry manure produced, collected, treated, and utilized (for example, as organic fertilizer, conversion to biogas/energy, and crop irrigation) by large farms. Data from this platform enables MARA and provincial DARA to scientifically calculate the comprehensive utilization rate of livestock and poultry manure. Supplementary data will be collected from the on-site ledgers of large farms and centralized facilities serving the small- and medium livestock and poultry farms, and through annual M&E socioeconomic surveys. The county DEE will monitor the effluents discharged from the manure treatment facilities to ensure that they meet environmental standards. Hubei aims to increase the manure treatment rate by 6 percent (baseline 84 percent) for large-scale and 11 percent (baseline 74 percent) for small-scale farms in the 10 program counties over the five year implementation period.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** Cumulative quantities of livestock and poultry manure collected, treated, and recycled that are reported by the provincial DARA will be verified by the third-party VA based on a random sampling of large farms and centralized facilities serving the small- and medium farms; and by reviewing other supporting documents, such as inspection reports from county DARAs and annual M&E socioeconomic survey reports. Disbursements will be made when at

	least 1 percent increase in the quantity of livestock and poultry manure treated and meeting provincial effluent discharge standards is achieved in the 10 program counties based on the agreed unit price.
DLI 7	DLI2.2: Percentage increase of treated and recycled livestock and poultry manure from large- and small-scale farms meeting effluent standards in the Program Counties (Hunan)
Description	DLI2.2 measures the incremental adoption of good management practices of livestock and poultry manure due to the program interventions. These include the expansion of on-site manure treatment capacity at large farms and the construction of centralized treatment facilities to cater to the small- and medium farms. The cumulative data on the quantity of manure collected, treated, and recycled will be obtained from large farms with on-site treatment facilities and centralized treatment facilities for small – and medium livestock and poultry farms. MARA has established a national platform for monitoring the quantities of livestock and poultry manure produced, collected, treated, and utilized (for example, as organic fertilizer, conversion to biogas/energy, and crop irrigation) by large farms. Data from this platform enables MARA and provincial DARA to scientifically calculate the comprehensive utilization rate of livestock and poultry manure. Supplementary data will be collected from the on-site ledgers of large farms and centralized facilities serving the small- and medium livestock and poultry farms, and through annual M&E socioeconomic surveys. The county DEE will monitor the effluents discharged from the manure treatment facilities to ensure that they meet environmental standards. Hunan aims to increase the manure treatment rate by 5 percent (baseline 89 percent) for large-scale and 10 percent (baseline 74 percent) for small-scale farms in the 13 program counties over the five year implementation period.
Data source/ Agency	Regional DARA and RRB
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** Cumulative quantities of livestock and poultry manure collected, treated, and recycled that are reported by the provincial DARA will be verified by the third-party VA based on a random sampling of large farms and centralized facilities serving the small- and medium farms; and by reviewing other supporting documents, such as inspection reports from county DARAs and annual M&E socioeconomic survey reports. Disbursements will be made when at least 1 percent increase in the quantity of livestock and poultry manure treated and meeting provincial effluent discharge standards is achieved in the 13 program counties based on the agreed unit price.
DLI 8	DLI3.1: Number of spatial Integrated Village Development Plans (IVDPs) approved by the Program Counties (Hubei)
Description	DLI3.1 measures the number of professionally-developed spatial IVDPs, which include settlement, farmland, forestry/protected land, recreation, social services, and infrastructure areas in rural villages. As village masterplans, the

	spatial IVDPs would guide future rural village development to improve living conditions. The county RRB will collect data on the number of spatial IVDPs prepared by professional spatial planning firms. The spatial IVDPs will be approved by the relevant county authorities for implementation at the county level to ensure that they meet the required technical, environmental, and social standards specified in the program implementation plan (PIP). The target is to develop 200 spatial IVDPs in the 10 program counties in Hubei.
Data source/ Agency	Provincial RRB
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify the achievements reported by provincial RRB by reviewing the minutes of meetings approving the spatial IVDPs and the final documents provided by the county RRBs on a random sampling basis. Disbursements will be made against the number of spatial IVDPs approved by the relevant county authorities and registered by the provincial authorities each year based on the agreed unit price.
DLI 9	DLI3.1: Number of spatial Integrated Village Development Plans (IVDPs) approved by the Program Counties (Hunan)
Description	DLI3.1 measures the number of professionally-developed spatial IVDPs, which include settlement, farmland, forestry/protected land, recreation, social services, and infrastructure areas in rural villages. As village masterplans, the IVDPs would guide future rural village development to improve living conditions. The county RRB will collect data on the number of spatial IVDPs prepared by professional spatial planning firms. The spatial IVDPs will be approved by the relevant county authorities for implementation at the county level to ensure that they meet the required technical, environmental, and social standards specified in the program implementation plan (PIP). The target is to develop 213 spatial IVDPs in the 13 program counties in Hunan.
Data source/ Agency	Provincial RRB
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify the achievements reported by provincial RRB by reviewing the minutes of meetings approving the spatial IVDPs and the final documents provided by the county RRBs on a random sampling basis. Disbursements will be made against the number of spatial IVDPs approved by the relevant county authorities and registered by the provincial authorities each year based on the agreed unit price.

DLI 10	DLI3.2: Number of demonstration villages with newly constructed or rehabilitated climate-resilient WWTFs and established solid waste collection, sorting, and transfer systems meeting effluent (Hubei)
Description	DLI3.2 measures the number of demonstration villages with solid waste and wastewater management facilities that are meeting effluent discharge standards. The aim is to track the improvement in the waste management systems to prevent pollutants (for example, COD, TP, and NH3-N) from entering waterways and increasing health risks. The main objective is to meet the provincial effluent discharge standards. Data on the number of newly-constructed or rehabilitated and operational WWTFs and SWMS will be collected by the relevant departments at the county level during the handover of the facilities/systems. The provincial RRB will consolidate data from the 10 program counties into a provincial report. Hubei aims to construct 49 centralized WWTFs/SWMS in the 10 program counties.
Data source/ Agency	Provincial RRB
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify whether the WWTFs and SWMS are fully operational by randomly sampling batches of facilities and systems completed and accepted each year. Using data from county DEEs and own sample-based analyses, the third-party VA will also verify whether the waste management facilities and systems meet provincial effluent discharge standards. Disbursement will be made against the number of demonstration villages with waste management facilities and systems that meet the provincial effluent discharge standards each year based on the unit price.
DLI 11	DLI3.2: Number of demonstration villages with newly constructed or rehabilitated climate-resilient WWTFs and established solid waste collection, sorting, and transfer systems meeting effluent (Hunan)
Description	DLI3.2 measures the number of demonstration villages with solid waste and wastewater management facilities that are meeting effluent discharge standards. The aim is to track the improvement in the waste management systems to prevent pollutants (for example, COD, TP, and NH3-N) from entering waterways and increasing health risks. The main objective is to meet the provincial effluent discharge standards. Data on the number of newly-constructed or rehabilitated and operational WWTFs and SWMS will be collected by the relevant departments at the county level during the handover of the facilities/systems. The provincial RRB will consolidate data from the 13 program counties into a provincial report. Hunan aims to construct 59 centralized WWTFs/SWMS in the 13 program counties.
Data source/ Agency	Provincial RRB

Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify whether the WWTFs and SWMS are fully operational by randomly sampling batches of facilities and systems completed and accepted each year. Using data from county DEEs and own sample-based analyses, the third-party VA will also verify whether the waste management facilities and systems meet provincial effluent discharge standards. Disbursement will be made against the number of demonstration villages with waste management facilities and systems that meet the provincial effluent discharge standards each year based on the unit price.
DLI 12	DLI4.1: Percentage increase in comprehensive crop straw (rice, wheat, rapeseed, and corn) utilization in the Program Counties (Hubei).
Description	DLI4.1 measures the residual crop straw that is returned (plowed in) to the soil in farmlands. The program will focus on returning residual crop straw into the soil to increase SOC (through carbon sequestration), improve soil health (for higher water retention, cation exchange, and nutrient absorption capacity), and reduce GHG emissions (by avoiding burning or decomposition). The 10 program counties' DARAs will collect data on the quantities of residual crop straw (left in the field) that are returned to the soil in farmlands. The provincial DARA will prepare consolidated reports based on the data collected in the 10 program counties and MARA's platform for crop straw utilization. Hubei is targeting to increase their comprehensive crop straw utilization rate by 3 percent (baseline 93 percent) in the 10 program counties.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify the quantities of residual crop straw reported by the provincial DARA by randomly sampling 10 Program Counties and carrying out on-site checks or spot checks. To estimate their uptake, the third-party VA will also verify the quantities of straw used as feed by large animal farms and biomass-to-energy generation firms. Using all the three data and information sources the third-party VA will estimate the comprehensive crop straw utilization rate. Disbursements will be made when at least 1 percent increase in comprehensive crop utilization rate is achieved in the 10 program counties based on the agreed unit price.

DLI 13	DLI4.1: Percentage increase in comprehensive crop straw (rice, wheat, rapeseed, and corn) utilization in the Program Counties (Hunan).
Description	DLI4.1 measures the residual crop straw that is returned (plowed in) to the soil in farmlands. The program will focus on returning residual crop straw into the soil to increase SOC (through carbon sequestration), improve soil health (for higher water retention, cation exchange, and nutrient absorption capacity), and reduce GHG emissions (by avoiding burning or decomposition). The 13 program counties' DARAs will collect data on the quantities of residual crop straw (left in the field) that are returned to the soil in farmlands. The provincial DARA will prepare consolidated reports based on the data collected in the 13 program counties and MARA's platform for crop straw utilization. Hunan is targeting to increase their comprehensive crop straw utilization rate by 6 percent (baseline 85 percent) in the 13 program counties.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will verify the quantities of residual crop straw reported by the provincial DARA by randomly sampling 13 program counties and carrying out on-site checks or spot checks. To estimate their uptake, the third-party VA will also verify the quantities of straw used as feed by large animal farms and biomass-to-energy generation firms. Using all the three data and information sources the third-party VA will estimate the comprehensive crop straw utilization rate. Disbursements will be made when at least 1 percent increase in comprehensive crop utilization rate is achieved in the 13 program counties based on the agreed unit price.
DLI 14	DLI4.2: Number of hectares of treated aquaculture ponds meeting effluent discharge standards in the Program Counties (Hubei)
Description	DLI4.2 measures the reduction in pollutant loads from large-scale aquaculture farms in Hubei province. Inland aquaculture is a booming industry in Hubei province. The intensive use of inputs and poor management of aquaculture pond wastewater are increasingly causing environmental pollution. This is primarily because many aquaculture operations regularly release large volumes of untreated pond wastewater into waterways. In the 10 program counties, aquaculture pond wastewater will be treated using the existing ecological models, as well as rotation between aquaculture and crop (especially rice and lotus roots) farming. The tail water from the aquaculture ponds will be monitored by county DARAs and MEEs to ensure that it meets provincial effluent discharge standards. Hubei targets to implement ecological aquaculture wastewater treatment models in 10,938 ha in the 10 program counties.
Data source/ Agency	Provincial DARA and MEE

Verification Entity	Third-party Verification Agency
Procedure	**Verification protocol:** The third-party VA will review the provincial DARA and MEE aquaculture wastewater treatment monitoring reports to establish the number and area (in hectares) of ponds with treated tail water meeting effluent discharge standards. The third-party VA will also randomly collect and analyze samples from large-scale aquaculture farms that have installed pond water treatment facilities to check whether tail water meets provincial effluent discharge standards. The third-party VA will verify the results by comparing the data from monitoring reports with own results. Disbursement will be made based on the number of hectares of aquaculture ponds meeting effluents discharge standards in the 10 program counties in each calendar year based on the agreed unit price.
DLI 15	DLI4.3: Number of hectares of treated farmlands with a safe utilization rate in the Program Counties (Hunan)
Description	DLI4.3 measures the area of agricultural farmland degraded by heavy metals that have been treated and brought back to safe crop production in Hunan province. Technical measures for risk-based heavy metal pollution management will be implemented, including: (a) source control measures, such as increasing the flooding irrigation regime to reduce uptake of cadmium, removing rice straw from contaminated fields, and growing hyperaccumulator plants in the winter season; (b) agronomic management measures to help reduce active heavy metals in crops, such as cultivating rice varieties that do not accumulate heavy metals, increasing soil pH by applying lime, and applying organic fertilizers and soil immobilization agents; (c) switching crops by growing non-metal accumulating species, such as oil crops or fodder crops; and (d) phytoremediation, especially for high-risk farmlands, where growing highly accumulating plant species, such as Sedum (Pteris vittata), water onion, and grain amaranth can help reduce heavy metals from the farmland. Hunan targets to treat 8,029 ha of heavy metal polluted farmlands in the 13 program counties.
Data source/ Agency	Provincial DARA
Verification Entity	Third-party verification agency
Procedure	**Verification protocol:** The third-party VA will review the provincial DARA heavy metals pollution control reports; and randomly collect and analyze soil and crop samples from treated farmlands in the 13 program counties. The third-party VA will verify the percentage of crop samples that meet provincial food safety standards. Disbursement will be made against the number of hectares of treated farmland area meeting the safe utilization rate (that is, at least 85 percent of crop samples) in the 13 program counties.

ANNEX 3. (SUMMARY) TECHNICAL ASSESSMENT

Introduction

1. **This annex presents a summary of the Technical Assessment report, which will be disclosed at the same time as the Program Appraisal Document (PAD).** The summary includes the geographic boundary and PDO. This is followed by a brief description of the scope of the China GARR PforR (Hubei and Hunan) and the typology of main activities per RA, its strategic relevance and technical soundness, expenditure framework, gender results chain, and results M&E.

Program Geographic Boundary

2. **The GARR PforR will support the central-level activities to be implemented by the NRRA and the provincial-level activities to be implemented by Hubei and Hunan.** It will support 10 demonstration counties/cities (out of 103 counties) in Hubei province (Honghu, Chongyang, Xishui, Yangxin, Yunxi, Shishou, Suixian, Xiantao, Danjiangkou, and Xianfeng). Similarly, it will support 13 demonstration counties (out of 122 counties) in Hunan province (including Hengyang, Lixian, Taojiang, Cili, Suining, Yueyang, Huayuan, Liling, Jiangyong, Yongding, Linxiang, Hengnan, and Yongshun). These demonstration counties/cities were selected based on the agreed criteria summarized in Section IIC - PforR Program Scope.

Program Development Objective

3. **The PDO of the GARR PforR is to enhance adoption of environmentally-sustainable agricultural and rural infrastructure development practices in selected areas of Hubei and Hunan.** The PDO-level indicators are (1) reduction in pollutant loads from agricultural production systems and rural domestic wastewater treatment facilities (COD, NH_3-N]) achieved in the Program Counties (RA2, RA3, and RA4) (metric tons/year), (2) Greenhouse gas emissions reduction achieved in the Program Counties (RA2, RA3, and RA4) (metric tons/year CO_2equivalent), and (3) beneficiaries reached by assets or public services in the Program Counties (disaggregated by gender) (RA1, RA2, RA3, and RA4) (Number). The annual targets are presented in Annex 1 - Results Framework Matrix.

Program RAs and Activities

4. **The World Bank's GARR PforR support focuses on four RAs.** RA1 is on strengthening central- and provincial-level institutional capacity for governance, aimed at improving the implementation performance (efficiency and impact) of the results-based green agriculture and rural infrastructure development (wastewater and solid waste management systems) activities. RA2 is on greening selected agricultural value chains by adopting CSA and GAP and reducing NPS and GHG emissions. RA3 is on increasing access to rural solid waste and wastewater services, reducing pollutant loads (point and nonpoint source) and GHG emissions, and improving the rural living environment. RA4 is on restoring and protecting degraded agricultural ecosystems to improve soil health, sequester carbon, ensure food safety, and reduce GHG emissions.

5. **The expected outcomes of implementing activities under the four RAs are varied.** For RA1, these include an efficient decision support and performance monitoring tool for rural infrastructure and public services, improved MRV of GHG emissions reduction from main agriculture sources, enhanced systems for green agriculture and rural governance, and efficient results-based fiscal transfers for green agricultural and rural revitalization. For RA2, the outcomes are reduced GHG emissions (CO_2, CH_4, and N_2O) and pollutant loads (for example, COD, NH_3-N, BOD, TP, and TN) from crop and livestock production systems and enhanced food quality and food safety. For RA3, the outcomes are improved access to rural wastewater and solid waste management services and reduced GHG emissions (CO_2, CH_4 and N_2O) and pollutant loads (COD, NH_3-N, BOD, TP and TN) entering waterways. For RA4, the outcomes are increased aboveground and

belowground carbon sequestration, reduced GHG emissions (CO_2, CH_4 and N_2O) and pollutant loads (COD, NH_3-N, BOD, TP and TN) entering waterways, and improved agricultural ecosystem services and food safety.

Strategic Relevance

6. **Hubei and Hunan provincial leaders are committed to addressing the environmental challenges** related to the overuse of chemical fertilizer, improper management of livestock and poultry manure, and degradation of the agricultural ecosystems presented in the sector context (see Section IB - Sectoral [or Multisectoral] Institutional Context). The leaders of the two provinces have also expressed their commitment to addressing the challenges related to underdeveloped rural solid waste and wastewater services. The main activities to be implemented are presented in the Hubei Green Agriculture and Rural Revitalization Demonstration Project and the Hunan Green Agriculture and Rural Revitalization Result-Oriented Demonstration Project proposals approved by the MOF and the NDRC. These activities are also included in Hubei's and Hunan's provincial 14th FYP (2021–2025). This presents an opportunity for the World Bank to support the two provincial governments' efforts to promote green agricultural and rural development activities through its results-based financing instrument.

7. **Hubei and Hunan are among the large agricultural producers, large users of chemical inputs, and major polluters in China.** In 2021, Hubei and Hunan provinces used 2.67 million and 2.24 million metric tons (ranking 11 in the country) of chemical fertilizers, with application intensity of 26.8 kg/mu (4.9 kg higher than the national average) and 16.37 kg/mu, respectively. Hubei and Hunan also used 52,000 tons and 101,450 tons (ranking third in the country) of pesticides. In the same year, the combined COD, NH_3-N, TN, and TP was about 1,426,171 metric tons, 36,673 metric tons, 196,650 metric tons, and 30,170 metric tons, respectively (table 3.1). The two provinces also generate large quantities of GHG emissions from crops, especially rice, livestock, and aquaculture production systems. The GARR PforR presents a great opportunity for helping Hubei and Hunan reduce these GHG emissions and pollutant loads.

Table 3.1. Agricultural Pollution in 2021 (metric tons)

Province	Agricultural Subsectors	COD	NH_3-N	TN	TP
Hubei	Crops	—	5,589.30	54,019.05	6,209.61
	Livestock	719,427.59	9,700.88	41,358.45	9,680.65
	Aquaculture	93,643.50	1,455.00	4,441.50	313.50
	Sub-total	**813,071.09**	**16,745.18**	**99,819.00**	**16,203.76**
Hunan	Crops	—	11,716.00	56,055.00	5,151.00
	Livestock	584,210.00	6,862.00	36,096.00	8,366.00
	Aquaculture	28,890.00	1,350.00	4,680.00	450.00
	Sub-total	**613,100.00**	**19,928.00**	**96,831.00**	**13,967.00**
Total		**1,426,171.09**	**36,673.18**	**196,650.00**	**30,170.76**

8. The GARR PforR aims to finance green agricultural and rural infrastructure and public services that generate substantial climate co-benefits through mitigation and adaptation measures. It will generate climate co-benefits from mitigation measures in several ways. First, by reducing GHG emissions (CO_2, CH_4, and N_2O measured in CO_2 equivalent [$mtCO_2e$) from crop production systems through the reduction of chemical fertilizer use. Second, by reducing GHG emissions (e.g., removal of COD, CH_4, and NH_3-N) from the livestock and poultry production systems through the collection, treatment, and recycling of manure. Third, by reducing GHG emissions (e.g., removal of COD, BOD, or COD5 and NH_3-N) through the collection, transfer, and treatment of solid waste and the treatment and recycling of domestic wastewater. Fourth, by enhancing carbon sequestration (SOC) through returning crop straw residues into the farmland soil and applying organic fertilizer as a substitute for chemical fertilizer. The GARR PforR will also generate climate co-benefits from adaptation measures. These include (a) adopting GAP and CSA technologies, (b) reducing food loss and

waste, (c) increasing energy use efficiency, and (d) adopting IPM technologies. The climate co-benefits will be measured in $MtCO_2e$ of GHG emissions reduced from PforR supported activities.

9. **The GARR PforR will indirectly contribute to the protection of biodiversity on farmland**. Experience from the Guangdong Agricultural Pollution Control Project shows significant improvement in biodiversity in farmland ecosystem due to the reduction of agricultural pollutants and the promotion of IPM technologies. The GARR PforR will also support the restoration and protection of degraded and/or polluted agricultural ecosystems to enhance soil health and improve biodiversity. Using experience from the Guangdong Agricultural Pollution Control Project, the GARR PforR's impacts on biodiversity protection and restoration will be monitored through a third-party technical agency and the results included in the annual E&S monitoring reports.

10. **The reduction of pollutant loads entering waterways will also generate local environmental benefits.** These will mainly arise from the reduction of the point and nonpoint source water pollution through the reduction and efficient use of chemical fertilizer; increased use of formula and organic fertilizer; and treatment and recycling of livestock and poultry manure, tail water of aquaculture and fish-rice systems, and rural wastewater. One of the key local environmental benefits would be the improvement of water quality, with the associated improvement of health outcomes, such as reducing waterborne diseases in rural areas.

Technical Soundness

RA1 - Strengthening Institutional Capacity for Governance

11. **RA1 aims to put in place governance and training and capacity-building frameworks needed to enhance the effectiveness of the Government's RRSPs.** At the central level, the NRRA will be responsible for implementing activities under RA1.1. These include (a) expanding the national IT-based platform for mapping and M&E of delivery of rural infrastructure and public services and (b) developing methodologies for MRV of GHG emissions reduction from the main agriculture sources. The IT-based monitoring platform was developed about 10 years ago to accurately target government support for poor villages and extreme poverty households. It will be important for the IT-based monitoring platform to be aligned with the evolving strategy, policy objectives, and implementation measures of rural revitalization; cost-effective in the data collection, analyses, and reporting processes; cognizant of the institutional capacity-building needs of the county governments; and an opportunity for integrating and streamlining the Government's business processes, such as IBMS by the DOFs, the investment project management system by DRCs, and the digital mapping and integrated planning system by ecology and environment bureaus (EEBs) and natural resources bureaus (NRBs).

12. **Since the government program is transitioning from eliminating extreme rural poverty to rural revitalization, the NRRA plans to further upgrade the IT-based monitoring platform.** The NRRA will do the following: (a) expand the village data to cover non-poverty villages and non-poverty households; (b) add data and information on the spatial IVDPs; (c) add modules on rural infrastructure (especially solid waste and wastewater services) and living environment based on the needs identified in the IVDP approved by county/city authorities (with data inputs done at village or county levels); (d) pilot the IT-based monitoring platform under the GARR PforR in administrative and traditional villages of the 25 participating counties/cities and some villages in the eastern and western provinces under the government program; (e) ensure smooth data and information exchange between the IT-based monitoring platform and other central government agencies (MARA, MOHURD, MEE, MWR, MNR, and so on); (f) ensure adequate mechanisms for household and sensitive data security and protection and confidentiality, including for the processing of household and sensitive data and any personal data; and (g) ensure that the system is generating regular automated reports and it is used for decision-making on rural infrastructure investment and O&M activities.

13. **At the central level, the NRRA will also coordinate the development of methodologies for MRV of GHG emissions reduction from three main agriculture sources**: livestock and poultry manure, chemical fertilizer, and rice.

These MRV methodologies are critical for the success of the GARR PforR because these will be used to measure the PDO-level indicator on GHG emissions reduction at the midterm and end of the program; and may facilitate agricultural carbon trading in the two provinces in the future if the necessary Government's requirements are fully met. The NRRA will be responsible for hiring a reputable research and/or academic institution to develop and pilot the MRV methodologies in the 23 program counties. The NRRA will set up a panel of experts to provide technical guidance and quality control of the MRVs development process. The World Bank team will provide much-needed technical assistance by bringing in international experts. Once the MRV methodologies are developed, Hubei and Hunan provinces will ensure that they are used in the 23 program counties. Hunan will also use the MRV methodologies developed under GARR PforR to pilot carbon trading in two counties under the Water Saving and Low-carbon Paddy Rice Program for Results (P178796). MARA and the two program provinces (Hubei and Hunan) will have the option to roll out or upscale the MRV methodologies nationwide or province-wide, respectively.

14. **The IT-based platform for mapping and M&E of the rural infrastructure and public services is a decision support tool for future investment and O&M of the facilities**. Its successful development by the NRRA and adoption for implementation by program provinces and counties/cities will become a DLI. Similarly, the MRV methodologies for agricultural GHG emissions reduction will help accurately measure and report the sector's contribution to achieving China's carbon peaking goals by 2030 and net zero by 2060. The successful development of MRV methodologies at most two years after the GARR PforR effectiveness and adoption by program provinces and counties/cities will become a PAP. The NRRA will be solely responsible for hiring a third-party VA to verify the achievement of results under DLI1.1.1 and DLI1.1.2 and the PAP under RA1.1 (that is, the MRV methodologies) reported by the 23 program counties.

15. **At the provincial level, the relevant departments will be responsible for implementing three main activities (RA1.2):** (a) developing or adopting regulations, standards, and guidelines for good agricultural practices; (b) implementing the IT-based platform for mapping and M&E of rural infrastructure and public services delivery; and (c) establishing frameworks for nurturing green skills and talents.

16. **The program budgeting and expenditure tracking frameworks are tools for the transparent allocation of fiscal resources based on delivering verifiable results** and for enhancement of the accountability of public expenditures. The provincial regulations, standards, and guidelines will strengthen the legal framework for green agricultural technologies and innovations and the mechanisms for regulating agricultural inputs and livestock and poultry waste management. Similarly, developing green skills and talents is key to accelerating the adoption of GAP and CSA technologies to reduce environmental footprint. The adoption and use of regulations, standards, and guidelines for green agricultural development is a DLI under RA1.2.

17. **RA1 will strengthen institutional capacity at all levels and enhance the efficiency, effectiveness, and impact of public expenditures** by linking the disbursement of funds to the achievement of specific results. Through the PforR instrument, the fiscal transfers from the central and provincial governments to counties and rural areas will directly be linked to monitorable and verifiable results, including the amount or proportion of (a) reduced use of chemical fertilizer; (b) increased treatment and recycling of livestock and poultry manure; (c) increased safety utilization rate of polluted farmland; and (d) increased collection, treatment, and recycling of solid waste and wastewater in rural areas. The PforR instrument capitalizes on the evolving national and provincial policy frameworks (for example, eco-compensation) for results-based fiscal transfers related to point and nonpoint source water pollution control, GHG reduction, increased water use efficiency, improved soil health and food safety, and improved landscape and ecosystem management, among others.

18. **Similarly, capacity building for administrating rural infrastructure and public services is integral to strengthening governance for rural revitalization.** The central and provincial governments have significantly increased investment in rural infrastructure and public services. However, the capacity for investment planning, implementation, and O&M of rural

infrastructure and public services, especially concerning wastewater and solid waste systems, is relatively weak. This includes inadequate qualified and experienced staff, poor incentive mechanisms, insufficient budget allocations, and a lack of performance evaluation systems. The GARR PforR will help the provincial and county/city governments strengthen their capacity through training local technical and administration officials, especially in areas that enhance the solid waste and wastewater services' delivery and management systems, to improve the living environment and reduce pollution in rural areas.

RA2 - Greening Selected Agricultural Value Chains

19. **The main objective of RA2 is to promote environment-friendly agricultural production practices.** RA2 will promote GAP and CSA practices in selected value chains (for example, rice, rapeseed, vegetable, and fruit). The aim is to further increase productivity and food quality and safety, build resilience to climate change, and reduce pollutant loads and GHG emissions. Activities under RA2 are summarized in the 'Program RAs and Activities' section.

Reducing Chemical Fertilizer Use

20. **In Hubei and Hunan, chemical fertilizer intensity is significantly above the national average.** In 2020, the pure amount of agricultural chemical fertilizers used in Hubei and Hunan was 2.673 million metric tons and 2.237 million metric tons, respectively. The chemical fertilizer application intensity for major crops in Hubei was about 319 kg/ha for rice, 270 kg/ha for rapeseed, 302 kg/ha for wheat, 391 kg/ha for fruit, and 547 kg/ha for vegetables. Similarly, the chemical fertilizer application intensity for major crops in Hunan was about 282 kg/ha for rice, 224 kg/ha for rapeseed, 645 kg/ha for fruit, and 742 kg/ha for vegetables. These high chemical fertilizer application rates cause significant NPS pollution in waterways and contribute to GHG emissions and climate change. In addition, the high fertilizer application intensity is a major concern to food quality and safety. The reported combined NH_3-N, TN, and TP was about 17,610 metric tons, 113,585 metric tons, and 11,778 metric tons, respectively. The two provinces also generate large quantities of GHG emissions from the crop production systems. Thus, the GARR PforR presents a great opportunity for helping Hubei and Hunan reduce these GHG emissions and pollutant loads.

21. **China has put in place national and provincial policies, regulations, standards, and guidelines for chemical fertilizer reduction and efficiency enhancement.** Zero growth in chemical fertilizer use was adopted under China's 13th FYP, whose goal was to promote the green development of agriculture. The central government also issued a series of policy documents to promote reduction in chemical fertilizer use and increase in efficiency or utilization rate. At the subnational level, Hubei and Hunan have also issued a series of provincial policies, strategic plans, regulations, standards, and guidelines, emphasizing fertilizer use reduction.

22. **China has also developed technical approaches and practices for fertilizer use reduction and efficiency enhancement.** Four technical approaches are commonly used to achieve these goals. The first is to promote precise fertilization. Based on the different agroecological soil conditions, crop yield potential, and comprehensive nutrient management requirements, the fertilization rates (kg/area) for each region/agroecological zone and crop type are established to reduce the overuse of chemical fertilizers. The second is to adjust the composition of fertilizer use. The ratio of nitrogen (N), phosphorus (P), and potassium (K) is optimized to promote the interaction of macro, medium, and trace elements. The optimization and upgrading of fertilizer products are complemented by using high-efficiency chemical fertilizers. The third is to improve the fertilization method. This includes soil testing and developing formula fertilizers, ensuring mechanical deep placing of chemical fertilizer, integrating irrigation water and soluble chemical fertilizer (fertigation), using slow-release and high-efficiency fertilizers, and applying foliar fertilizer. The fourth is to replace chemical fertilizers with organic fertilizers. This includes utilizing organic nutrient resources and replacing some chemical fertilizers with organic fertilizers. The soil fertility and structure are improved by returning crop straws to the soil, planting green manure, and using biogas and organic fertilizer from treated livestock and poultry manure.

23. **The levels of chemical fertilizer use reduction and efficiency enhancement estimates at the national and provincial levels are mainly based on field experiments.** By soil testing and applying formula fertilizer in experimental fields, the fertilizer utilization rate of main crops can be estimated by monitoring fertilization rates and crop yields and accounting for crop nutrient utilization. In addition, the amounts of chemical fertilizer reduction due to the use of substitute green technologies, including formula fertilizer, organic fertilizer, fertigation, and green manure, are estimated using established coefficients (see table 3.2). Tons of chemical fertilizer use reduced due to the adoption of green technologies and sustainable practices in selected crop production systems in the program counties is a DLI.

Table 3.2. Reduction in Chemical Fertilizer by Substitute Technologies

Technical Approach	Reduced Chemical Fertilizer Use in Hubei Province (pure tons)	Reduced Chemical Fertilizer Use in Hunan Province (pure tons)
Formula fertilizer (ha)	0.063	0.050
Organic fertilizer (tons)	0.025	0.025
Fertigation (ha)	0.190	0.280
Green manure (ha)	0.090	0.080

Improving Management of Livestock and Poultry Manure

24. **In 2021, MARA issued the 14th FYP for the Combined Construction of National Livestock and Poultry Manure Utilization, Planting, and Breeding.** The plan focuses on returning and using livestock and poultry manure in the field or farmland, improving the efficiency and number of facilities and equipment, and strengthening extension services. The plan aims to integrate crop production and animal breeding—and promote a circular economy. By 2025, the plan targets to (a) support more than 250 pilot counties to construct livestock and poultry manure treatment facilities, (b) establish demonstration bases for returning manure to fields (including five in Hubei and four in Hunan), and (c) promote the use of composted manure and liquid manure in accordance with local conditions. The plan also intends to support the construction of manure storage facilities, promote the biogas fertilizer return to the field, and construct manure and sewage transportation pipeline networks. MARA strives to reach more than 80 percent nationwide comprehensive utilization rate of livestock and poultry manure by 2025 from the current 76 percent.

25. **Technologies for livestock and poultry manure resource utilization are in place.** They are based on the Typical Model of Resource Utilization of Livestock and Poultry Manure issued by the Department of Animal Husbandry of MARA on March 22, 2017. It mainly includes the following models: full collection and return of manure, specialized energy utilization of manure, solid livestock and poultry manure composting, ectopic fermentation bed, fecal bedding reuse, and sewage standard discharge models. Hubei is currently using solid livestock and poultry manure composting, sewage standard discharge, and full collection and return of livestock and poultry manure to the farmland models as its main technologies for the resource utilization of livestock and poultry manure. Hunan uses sewage standard discharge, solid livestock and poultry manure composting, specialized energy utilization, and full collection and return of livestock and poultry manure to the field (water and fertilizer integration model) models.

26. **Hubei has clear baseline and target values for treating and recycling livestock and poultry manure.** In 2021, the total livestock and poultry manure generation in the program counties was 10.30 million tons, of which 9.44 million tons was treated and reused, with a comprehensive utilization rate reaching 89 percent for manure. Of the total amount of livestock and poultry manure generated, about 6.99 million tons came from large-scale livestock and poultry farms, of which about 6.54 million tons was treated and reused, with a comprehensive utilization rate reaching 94 percent. By 2027, overall, Hubei is targeting to generate 14.1 million tons of livestock and poultry manure, treat and recycle 13.5 million tons, and achieve a comprehensive utilization rate of livestock and poultry manure of more than 96 percent. Of this total

amount, the quantity of livestock and poultry manure generated by large-scale farms is projected to reach 8.91 million tons, the treated and reused amount is expected to reach 8.61 million tons, and the comprehensive utilization rate to reach 97 percent. Similarly, the amount of livestock and poultry manure generated from small farms is projected to reach 5.16 million tons, the treated and reused quantity to be 4.87 million tons, and the comprehensive utilization rate of livestock and poultry manure to reach approximately 94 percent.

27. **Similarly, Hunan has a clear baseline and target values for treating and recycling livestock and poultry manure.** In 2020, the total amount of livestock and poultry manure generated in the program counties was 15.84 million tons, of which 13.14 million tons was treated and reused, achieving a comprehensive livestock and poultry manure utilization rate of 83 percent. Of the total amount, the quantity of livestock and poultry manure from large-scale farms was 8.87 million tons, the treated and recycled quantity was 7.98 million tons, and the comprehensive utilization rate was 90 percent. The quantity of livestock and poultry manure from the small farms (households) was 6.97 million tons, the treated and reused amount was 5.30 million tons, and the comprehensive utilization rate was 76 percent. By 2027, Hunan projects the total output of livestock poultry manure in the project counties to reach 15.83 million tons, the treated and reused livestock and poultry manure to be 13.93 million tons, and the comprehensive utilization rate to reach 88 percent. Of the total amount, livestock and poultry manure from large-scale farms will be about 8.86 million tons, the treated and reused livestock and poultry manure will be 8.42 million tons, and the comprehensive utilization rate will reach 95 percent. Hunan will make efforts to further increase the utilization of livestock and poultry manure resources by constructing additional organic fertilizer processing plants. Percentage increase of treated and recycled livestock and poultry manure from large-scale and small-scale farms meeting effluent standards in the program counties is a DLI.

28. **The greening of selected agricultural value chains will lead to the certification and registration of its agro-products.** According to Hunan, in 2021 certification and registration processes were ongoing for 3,098 green food products, 245 organic agricultural products, and 126 GI agricultural products, covering grains, vegetables, fruits, mushrooms, tea, fish, and so on.[48] Similarly, in Hubei, there were 2,177 green, 166 organic; and 180 GI agricultural products in 2020.[49] The certification of agro-products as green and organic or registered as GI agro-products will be a DLI under RA1.2. To support green agricultural development, nurturing green agricultural skills and talents will be critical. The high-competency farmer training program has been introduced by the Government for years, but it faces challenges in terms of its relevance, quality, adequacy, and effectiveness. Training needs assessments on green agricultural skills are not systematically carried out to inform the design of training plans and the selection of competent training agencies. The format, substance, and organization of training activities do not consider the profile of rural farmers, who are mostly older and less educated, with a large proportion being female. The number of beneficiaries is relatively small because of inadequate budget resources. The training program for rural extension staff is not well coordinated with the high-competency farmer training program. The M&E activities largely focus on the training process instead of the adoption of green agricultural technologies and practices. The GARR PforR will help strengthen the existing government programs to meet the increasing demand for green agricultural skills. It will support a series of training and capacity-building activities for farmers, FCs, inputs suppliers, agri-businesses, and rural extension workers. The training sessions will be organized, managed systematically, and coordinated along the green agricultural value chain to increase their relevance, quality, adequacy, and effectiveness.

29. **To complement the provincial governments' efforts to reduce GHG emissions and pollutant loads in program counties, the GARR PforR will support innovations.** Specifically, fertilizer use reduction will be complemented by (a) improving soil nutrient management through the deep placement of formula fertilizers, (b) using formula and slow-release fertilizers, (c) investing in fertigation facilities for vegetables and fruit orchards, (d) using mechanized fertilization, (e)

[48] *Source*: http://www.gxzf.gov.cn/gxyw/t6154130.shtml.
[49] *Source*: http://gz.people.com.cn/n2/2021/0713/c222152-34818683.html.

replacing chemical with organic fertilizer from treated livestock and poultry manure and green manure, (f) using crop rotation with green manure/leguminous plants, and (g) using livestock-crop integrated systems. Similarly, livestock waste management will be improved through more efficient aerobic composting, bedding preparation, and matrix transformation for solid feces; field incorporation upon storage or upon storage and anaerobic treatment of liquid livestock and poultry manure to recover CH_4 gas; and better livestock and poultry manure transport vehicles and storage facilities.

RA3 - Increasing Access to Rural Solid Waste and Wastewater Services

30. **RA3 aims to reduce GHG emissions and point and nonpoint source pollution and improve rural living conditions.** RA3 will also promote the rural circular economy (for example, efficient use of treated wastewater for reuse in irrigation and compost material as a substitute for chemical fertilizer) and use nature-based solutions to reduce pollution, including constructing retention ponds and wetlands to filter pollutants. RA3 activities include supporting activities aimed at developing spatial IVDPs, constructing and/or rehabilitating rural wastewater management systems (for example, rural decentralized facilities and connections to township systems), constructing rural SWMS (for example, household sorting, township transfer, and recycling), and providing training on O&M of wastewater and solid waste management systems. These activities will be implemented by the relevant provincial and county/city government departments.

Developing Spatial IVDPs

31. **The State Council issued a VDAP in May 2022, which sets out the main principles and implementation measures for developing rural infrastructure and highlights key types of infrastructure to be covered under the RRP.** The GARR PforR focuses on activities covered under the VDAP, including developing the spatial IVDPs and constructing WWTFs and solid waste collection and transfer systems. The VDAP calls for making IVDPs binding, establishing a pipeline project management system, and improving the mechanisms for the O&M of rural infrastructure assets. The VDAP also emphasizes enhancing the performance evaluation of the implementation of RRP activities.

32. **The spatial IVDP is a multidimensional planning tool for the rural areas of natural or administrative villages.** This is a detailed plan forming a statutory basis for carrying out territorial space development and protection activities, implementing control over the use of territorial space, issuing planning permits for rural construction projects, and carrying out various construction projects at the village level. The spatial IVDPs will specifically (a) define the red lines (boundaries) for ecological protection, arable land, and permanent prime farmland; (b) optimize land use by consolidated planning and spatial layout; (c) promote cultural heritage with distinguished local features; and (d) encourage phased development based on the local context. Hubei and Hunan provinces have already developed provincial guidelines and specifications for preparing spatial IVDPs, which will be done by qualified and competent professional planning agencies in full consultation with and participation of villagers. The respective county NRBs and agriculture and rural affairs bureaus (ARABs) will jointly oversee the preparation of the spatial IVDPs. The respective county DRCs, county DOFs, and other relevant agencies will approve the spatial IVDPs. The spatial IVDPs will guide future village-level investments and public services delivery financed by the Government and the private sector. The development of spatial IVDPs is a DLI under RA3.

Constructing and/or Rehabilitating Rural WWTFs

33. **In China, with the rural 'toilet revolution' gaining momentum in the last decade, the generation of rural wastewater increased from 16.7 billion tons in 2013 to 23 billion tons in 2018.** However, the average rural wastewater treatment ratio was only 11 percent in 2015, while the average urban wastewater treatment ratio was over 95 percent in 2019. Both central-level and provincial-level governments underscore the importance of investing in rural WWTFs. Under the 14th FYP, Hubei and Hunan provincial governments have targeted increasing rural wastewater treatment from 25 percent to 35 percent. Both provinces are committed to formulating and/or updating their rural wastewater policy to

support, guide, and leverage the central government's funds to develop WWTFs. In addition, technical guidelines for managing WWTFs will be developed and/or updated by the two provinces and adopted by the program counties.

34. **The GARR PforR will support selected demonstration traditional and administrative villages with approved spatial IVDPs in each program county to build and/or rehabilitate rural WWTFs for proper wastewater treatment** to avoid direct discharge into the environment resulting in water, soil, and air pollution and increased health risks. To embrace nature-based solutions, Hubei and Hunan will use wetlands and ecological ponds to remove physical, chemical, and biological pollutants and meet provincial effluent discharge standards. To ensure the stability of the constructed wetland ecosystem and increase the life and processing capacity of the wetland treatment system, Hunan and Hubei will ensure that the sewage is properly treated before it is discharged into the constructed wetlands or ecological ponds. The pretreatment of wastewater will help prevent odor or blockage of sewage during storage and transportation, prevent untreated sewage from polluting soil and groundwater, reduce sewage treatment load, and ensure the quality of effluent from constructed wetlands.

35. **Hubei and Hunan rural wastewater treatment processes** will include (a) wetland processes, (b) combined process of anaerobic ponds and wetlands, (c) combined process of hydrolysis acidification ponds and wetlands, (d) hydrolysis acidification/contact oxidation/constructed wetland treatment process, (e) combined process of artificial wetlands and ecological ponds, (f) combined process of an ecological pond with artificial wetland, and (g) treatment process of combined ecological ponds. Under the GARR PforR, centralized WWTFs will be built for those villages with larger populations. But for small villages with smaller populations, ecological treatment technologies without (or low) power such as three-cell septic tanks plus anaerobic tanks or/and small-scale wetlands (where the effluent can be used for fertigation) will be used.

36. **Hubei and Hunan will ensure that effluents discharged from WWTFs meet provincial environmental standards** based on the process adopted and the condition of the receiving environment (for example, water bodies, farmland, wetlands, ecological ponds). Rural domestic wastewater is categorized into black water and gray water. Black water refers to high-concentration domestic wastewater used for flushing feces in toilets. Gray water refers to low-concentration domestic wastewater such as kitchen water, laundry, and bathing water. Black water can be used for irrigation in agricultural production systems after composting in three-grid septic tanks, purification biogas tanks, and other treatments to meet crop production standards. Gray water can be used for farmland irrigation or reuse after technical treatment, such as in artificial wetlands, stabilization ponds, and land treatment.

Rural Solid Waste Management

37. **The GARR PforR will also support a selected demonstration of traditional and administrative villages with approved spatial IVDPs in each program county to build and/or rehabilitate rural solid waste management stations (RSWS)** for proper solid waste collection, sorting, and transfer to avoid open dumping into the environment. Hubei and Hunan are committed to closing all existing solid waste dumpsites by the end of the 14th FYP. In addition, Hubei and Hunan have stopped issuing permits for new dumpsites. So far, solid waste collection is ongoing in all natural and administrative villages. However, sorting domestic waste at source, particularly into organics, recyclables, hazardous, and residuals, is rarely done. This is partly because the rural communities are not properly trained in solid waste sorting or separation techniques.

38. **Hubei and Hunan have developed provincial technical specifications for RSWS.** These include (a) principles for the selection of solid waste collection sites; (b) facilities and equipment (for example, sorting bins, carts) required at each site to serve 500–600 residents, such as fencing, parking space, solid waste containers, and leachate collection ditches; (c) building code for the solid waste transfer stations; and (d) standards for safety, sanitation, and hygiene, including regular cleaning and disinfection. The two provinces are planning to construct and/or rehabilitate at least one domestic solid waste collection station for each demonstration village, and its size would depend on the estimated quantity of waste

generated and the frequency of collection and transfer to township facilities. The spatial IVDPs will determine the site for the RSWS. The RSWS will be properly designed based on local conditions using cost-effective technology and materials. The size of the RSWS will be determined by the estimated quantity of domestic waste generated in the village. The service radius of a small RSWS that uses manpower to collect garbage will not exceed 0.5 km; the service radius of a small RSWS that uses small motor vehicles to collect garbage will not exceed 2.0 km. For garbage transportation distances exceeding 20 km, medium and large RSWS will be set up.

39. **The two provinces also plan to construct and/or rehabilitate township solid waste transfer stations (TSWTS), which will be designed according to local specifications and conditions.** The layout of the buildings and structures shall comply with provincial fire protection, hygienic regulations, and safety requirements. Depending on the geographic and economic conditions, the TSWTS will use different methods and equipment to load the garbage onto the transport vehicles. The equipment at the TSWTS will be determined by the solid waste transfer volume. To simultaneously maximize the efficiency of the TSWTS and solid waste transfer vehicles, garbage storage tanks will be set up in distant locations. To meet hygiene and safety standards, the TSWTS will be fitted with auxiliary rooms for workers on duty to change clothes or store tools and materials.

40. **The construction of WWTFs and RSWSs in the selected demonstration villages is a second DLI under RA3.** The DLI will only be met when a full range of solid waste collection, sorting, and transfer services are provided for all natural villages within an administrative village. The county/city governments will be responsible for O&M arrangement, including designating operations staff and providing sufficient budget.

O&M Plan and Capacity Building

41. **The overall training plan for the O&M of the TSWTS, rural WWTF, and RSWS for the duration of the program will be developed and will form part of the PIP.** This will become a PAP under the GARR PforR. In addition, annual training plans and budgets will be prepared each year. The trainees will include the facilities management staff and formal and/or informal operations staff (villagers), with at least 50 percent being female.

RA4 - Restoring and Protecting Degraded Agricultural Ecosystems

42. **RA4 supports integrated management of the natural resources to complement activities under RA2.** The main activities under RA4 include (a) preparing sustainable agricultural ecosystems management plans, (b) managing heavy metals to improve soil health and food safety, (c) returning crops straw to the farmland to increase SOC, and (d) treating aquaculture wastewater to reduce GHG emissions and pollutant loads entering waterways.

Preparing Sustainable Agricultural Ecosystems Management Plans

43. **The sustainable agricultural ecosystems management plans would be prepared through participatory approaches.** The aim is to map degraded farmlands, identify the sources and severity of degradation in the participating counties/cities, and develop appropriate integrated risk-based land restoration measures. The plans will include interventions to increase the rate of returning crop straw to farmland (Hubei and Hunan), treating aquaculture wastewater (Hubei), and managing heavy metal pollution (Hunan). Both Hubei and Hunan are familiar with participatory planning methodologies and approaches. However, heavy metal pollution management is technically complex. And one key lesson learned from the national programs for heavy metal pollution prevention and control is that the application of lime, water management, and low metal accumulating variety substitution requires careful planning and strict and effective implementation and supervision, which implies that professional services will be needed for demonstration planning, implementation, and supervision to allow the accurate evaluation of demonstration results.

Returning Crop Straw to the Farmland

44. **Hubei and Hunan provinces produce large quantities of crop straw, especially from rice, wheat, corn, and rapeseed.** The comprehensive use of crop straw (to avoid burning) includes animal feed, biomass energy generation, and return to soil in farmlands. But the GARR PforR will focus on returning crop straw to the soil to increase soil carbon (carbon sequestration) and improve soil health (for example, water retention, cation exchange, and nutrient absorption capacity). Although open burning is gradually being smothered, burning agricultural residues after harvest remains a major seasonal polluting event in some parts of China, including in Hubei and Hunan. According to FAO statistics, mainland China accounted for 17 percent of global open burning of agricultural residues (mainly maize, rice, wheat, and sugarcane) in 2019, burning 23 percent more biomass than all of Africa and 40 percent more than India. The open burning of straw creates a complex mix of air pollutants, including ones that can seriously endanger human health. These include fine particulates such as $PM_{2.5}$, dioxins, polycyclic aromatic hydrocarbons, carbon monoxide, arsenic, mercury, lead, hydrochloric acid, and volatile organic compounds. The implication is that biomass burning is a major driver of particulate pollution alongside traffic and coal combustion—at least seasonally. Straw burning is indeed an important contributor to secondary pollutants associated with air quality impairment and climate pollution. The major sources of climate pollution from straw burning are organic aerosols—black and brown carbon—and, indirectly, tropospheric ozone.

45. **Straw burning has been difficult to bring to a full stop in part because many farmers continue to view it as beneficial.** Some farmers believe straw burning can quickly improve soil fertility, kill pests, eliminate weeds and grass seeds, and block the inter-year or inter-season spread of pests and weeds. While these agronomic benefits are debatable, the economic benefits are clear: straw burning is a time and cost saver for farmers. Available alternatives are generally more costly. For example, incorporating straw residues into agricultural fields takes more time and effort and requires farmers to buy or rent costly machinery. Thus, under the GARR PforR, subsidies will be provided as incentives to offset the cost of field incorporation and increase carbon sequestration below ground. The percentage increase in comprehensive crop straw (rice, wheat, rapeseed, and corn) utilization in the program counties is a DLI under RA4.

Treating Aquaculture Wastewater in Hubei

46. **Aquaculture is a major contributor to surface water pollution downstream of areas where the industry is highly developed in some parts of Hubei province.** Aquaculture pollution results from the industry's use of inputs and its management of wastewater. Inputs into aquaculture include feed, drugs, and a variety of chemicals. Most inland aquaculture operations regularly release large volumes of wastewater. While these contribute to the endogenous pollution of aquaculture water, their discharge also pollutes downstream bodies of water, potentially affecting other aquaculture operations and farmlands.

47. **Overall, China's aquaculture industry has scaled and moved in directions that have tested or exceeded environmental carrying capacity.** Between 1978 and 2019, aquaculture production in China increased 40-fold, growing about 3.5 times larger than capture fisheries' output. By 2019, the industry produced nearly 51 million tons of seafood, over 60 percent of the world's total. While this scale-up has expanded the industry's environmental footprint, the latter has also been widened by the development (including in Hubei) of large-scale, high-density production systems that are more reliant on inputs. As a result, China's expansive and crowded fish farms have seriously overloaded water bodies by releasing large amounts of residual feed, fertilizer, feces, dead fish, metabolites, drugs, and other chemical wastes. Aquaculture operations have contributed to widespread water quality degradation and eutrophication by overwhelming many water bodies' capacity to self-purify, including some rivers and streams in Hubei. China's water conservation efforts have not kept pace with the development of its aquaculture industry.

48. **Freshwater aquaculture, especially eel and shrimp production, is an important value chain in Hubei.** The integrated fish (eel and shrimp)–rice production system is also expanding rapidly. In both production systems, there are great concerns over the GHG emissions from the fishponds and rice fields and pollution loads from the tail water (or fishponds' effluent discharges) entering waterways. The aquaculture subsector accounts for 6.2 percent, 10.3 percent, 7.0

percent, and 7.6 percent of COD, NH_3-N, TN, and TP, respectively, of the agricultural pollution sources. On the other hand, properly treating aquaculture wastewater can help improve water biodiversity in wetlands, lakes, and rivers. In addition, no specific institution is responsible for monitoring and enforcing effluent standards for aquaculture tail water. The number of hectares of treated aquaculture ponds meeting effluent discharge standards in the program counties is a DLI under RA4.

Managing Heavy Metals[50] in Hunan

49. **Hunan, the largest rice producer in China, produces about 10 percent of the nation's rice, making a significant contribution to food security in China.** It is estimated that heavy metals affect 13 percent of the farmlands in Hunan, which is well known as a home to nonferrous metal, nonferrous metallurgy, chemical, and mining industries that account for more than 80 percent of the province's industry. Heavy metal contamination is mainly caused by industrial discharges of flue gas, wastewater and waste residue, and metal mine tailings. Agricultural soil quality is further affected by the overuse of agrochemicals and poor farming practices. In addition, severe air pollution (for example, sulfur dioxide emission from fossil fuel combustion at power plants and other industrial facilities) increases the frequency of acid rain in Hunan, causing soil acidity, which in turn increases the availability of heavy metals to be absorbed by plants.

50. **Hunan's provincial DARA has been monitoring heavy metals in soil in the mining and industrial areas, irrigation areas, and suburbs, especially in the Xiang River Basin.** It is estimated that 58 percent of sample points exceed the maximum threshold of safe heavy metals in the soil. In Hunan, this contamination imposes enormous economic and financial costs (that is, discounted prices to farmers and millers, accumulated public sector stocks disposed of at a loss, reduced trade and tourism) and increased health risks. In response, the central and provincial governments have invested large amounts to help manage heavy metal pollution in agricultural lands. The DEE has inspected and monitored all industries discharging heavy metals. Some enterprises have been ordered to close or improve their waste treatment to meet the emission and effluent discharge standards, and some contaminated sites have been treated.

51. **Technical measures for risk-based heavy metal pollution management will continue to be implemented.** The first type is source control measures (for example, increased flood irrigation regime to reduce uptake of cadmium—but this may increase CH_4 emissions in rice fields, rice straw removal from fields, and growing heavy metal high-accumulated plants in the winter season). Another type is agronomic management measures to reduce active heavy metals in crops (for example, cultivating rice varieties that do not accumulate heavy metals, optimizing water management in the rice fields, increasing soil pH by applying lime or other soil amendments, and applying organic fertilizers and soil immobilization agents). Adjusting the crop planting structure or switching to non-metal accumulating food crops, oil crops, or fodder crops can also be done. The last type is phytoremediation, especially for high-risk farmlands, where agronomic and switching crops measures are not suitable (for example, growing hyperaccumulative plant species, such as Sedum - *Pteris vittata*, water onion, and grain amaranth). The number of hectares of treated farmlands with a safe utilization rate in the program counties is a DLI under RA4.

The GARR PforR activities will substantially contribute to the GHG emissions reduction. This would lead to the generation of both GPGs and local public goods. The eligible activities are summarized in technical assessment report and will be included in the Hubei and Hunan PIPs.

Expenditure Framework

52. **The total GARR PforR financing is estimated at US$4,445 million.** Of these, an equivalent of US$4,100 million (CNY 29.3 billion) will be financed by the Chinese Government and US$345 million will be financed by the IBRD loan (see

[50] Heavy metals are naturally occurring elements that have a high atomic weight and a density, at least five times greater than that of water. Examples of heavy metals include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb).

table 3.3). Of the US$4,100 million Chinese Government financing, it is estimated that US$2,464 million will come from Hubei, US$1,605 million from Hunan, and US$31 million from NRRA.

Table 3.3. Program Financing (FY2024–2029)

Source	NRRA		Hubei Province		Hunan Province		Total	
	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total	Amount (US$, millions)	% of Total
Government budget	31.00	86.11	2,464.00	93.5	1,605.00	90.40	4,100.00	92.23
IBRD loans	5.00	13.89	170.00	6.5	170.00	9.60	345.00	7.77
Total	**36.00**	**100.0**	**2,634.00**	**100.0**	**1,775.00**	**100.00**	**4,445.00**	**100.00**

Note: The exchange rate is US$1 = CNY 7.14.

Expenditure Scope

53. **The GARR PforR expenditures by RAs and provinces are presented in table 3.4.** Of the total GARR PforR government financing of US$4,100 million equivalent, RA1 accounts for only 0.8 percent, RA2 for 36.6 percent, RA3 for 53.0 percent, and RA4 for 9.6 percent. RA2, RA3, and RA4 involve massive public investment. RA1 puts more emphasis on institutional strengthening and innovation, including the improvement of program governance frameworks and/or systems, for which the public expenditure is relatively small.

Table 3.4. Government's Program Financing by Result Areas (FY2024–2029)

Result Areas	2018–2021 actual (US$, millions)			FY2024–2029 estimated (US$, millions)				
	NRRA	Hubei	Hunan	NRRA	Hubei	Hunan	Sub-total	Share (%)
RA1	25.0	0.0	0.0	31.3	0.0	0.0	31.3	**0.8**
RA2	0.0	733.4	466.4	0.0	916.7	583.0	1,499.7	**36.6**
RA3	0.0	1,125.0	614.6	0.0	1,406.3	768.3	2,174.6	**53.0**
RA4	0.0	112.7	202.7	0.0	140.9	253.3	394.2	**9.6**
Sub-total	**25.0**	**1,971.2**	**1,283.7**	**31.3**	**2,463.9**	**1,604.6**	**4,099.8**	**100.0**

Note: The simple average number of the program financing from 2018 to 2021 is used to forecast the program financing from FY2024 to FY2029. The data source for actual expenditures from 2018 to 2021 is shown in table 3.3.

54. **The GARR PforR will support a subset of activities under the government's RRP and Green Agricultural Development Plan program in the NRRA and the selected counties in Hubei and Hunan.** The RA1 activities are implemented centrally by the NRRA and locally by two provinces. The RA1 activities implemented by the NRRA involve mainly development and maintenance of the IT system, for which the public expenditure is recorded on budget report of the NRRA under the special fund allocated to its information center (IT center). The RA1 activities implemented by two provinces involve mainly institutional strengthening and innovation and adoption of the IT platform, for which the public expenditure is estimated to be negligible. The RA2, RA3, and RA4 activities are implemented by the two provinces and include greening selected agricultural value chains, increasing access to rural solid waste and wastewater services, and restoring and protecting degraded agricultural ecosystems. The provincial governments in China adopt uniform budget classification codes and report public expenditures based on formats provided or established by the central MOF. Hubei and Hunan use an IBMS to allocate budgets and track public expenditures. Based on the budget data for 2018–2021, the overall public expenditure on the government program was US$7,171.5 million, while the GARR PforR related activities were estimated to be US$3,928.7 million (45.5 percent of the government program). The government program's

expenditures in Hubei and Hunan were US$3,653.5 million and US$3,493.0 million, respectively. At the same time, the GARR PforR related expenditures in Hubei and Hunan were estimated to be US$1,971.2 million (54 percent of government program) and US$1,283.7 million (36.7 percent of the government program), respectively. Under the NRRA, the US$25 million government program's expenditures were 100 percent of the GARR PforR related activities.

Program Financing

55. **Program financing seems to be predictable.** Expenditures of the NRRA are fully financed from the central government's general budget. County governments will implement activities of RA2, RA3 and RA4 and the corresponding expenditures will be recorded under the county government's budget and will heavily rely on the central and provincial governments' transfers to finance these activities.

56. **There are three mechanisms used by the higher-level governments to transfer funds to county governments**: (a) transfer for central-local shared functions on agriculture, forestry, and water affairs; (b) transfer for poor areas; and (c) special transfers for agricultural, forestry, and water affairs, of which the third item is an earmarked transfer, while the other two are general transfers. The earmarked transfer incentivizes counties to implement the GARR PforR activities, while general transfers help fill the financing gaps as needed. Given that the bulk of GARR PforR expenditures would come from higher-level government transfers, it can be concluded that the program financing is overall adequate and largely predictable (see table 3.5).

Table 3.5. Program Funding Sources during 2018–2021 (US$, millions)

Source of Funds	10 Counties of Hubei					13 Counties of Hunan					Total
	2018	2019	2020	2021	Sub-Total	2018	2019	2020	2021	Sub-Total	
General transfers											
Transfer for central-local common functions on agriculture, forestry and water affairs	3.6	416.4	450.6	491.8	1,362.4	12.5	520.7	549.2	621.0	1,703.4	3,065.8
Transfer for poor areas	95.9	135.4	152.8	147.7	531.8	152.7	182.4	202.0	206.9	744.0	1,275.9
Earmarked transfers											
Special transfer for agricultural, forestry and water affairs	552.5	206.2	206.6	296.4	1,261.8	780.5	418.3	312.0	239.6	1,750.4	3,012.1
Total	**652.1**	**758.0**	**810.0**	**936.0**	**3,156.0**	**945.7**	**1,121.4**	**1,063.2**	**1,067.5**	**4,197.8**	**7,353.8**
Share of earmarked transfers	**84.7**	**27.2**	**25.5**	**31.7**	**40.0**	**82.5**	**37.3**	**29.3**	**22.4**	**41.7**	**41.0**

57. **Nevertheless, the review of the county governments' expenditures revealed the prevailing presence of unfunded mandate for rural solid waste and wastewater services, the focus of RA3.** Fiscal transfers from the central and provincial governments in this area are limited, only accounting for a small share of the counties' total expenditures on these items. And Hunan and Hubei provinces do not envision collecting users' fees. The IBRD loan proceeds will complement the county governments' own budget to finance the activities of RA3.

Financial Sustainability

58. **Financial sustainability is not deemed a concern for this operation.** While both Hubei and Hunan were affected by the COVID pandemic and witnessed unstable budget revenue and expenditure in the past three years, both provinces have maintained a relatively sound finance stance with debt-to-regional GDP ratio much below the threshold. Moreover, the total program expenditure is small, accounting for only 1.3 percent of general government budgetary expenditure in Hubei and 1.1 percent in Hunan.

Expenditure Performance

59. **The quality of program expenditure management will be critical to achieving the GARR PforR objectives.** While the county governments are responsible for implementing the program activities and delivering the results, the central and provincial governments provide incentives to the program counties through (a) earmarked transfers that mandate program counties to use the funds for implementing activities that are critical to the achievement of expected results, (b) expenditure performance evaluation and rewards, and (c) technical guidance and close supervision. A thorough review of the mechanism of earmarked transfer programs in areas of green agriculture and rural revitalization suggests most earmarked transfers clearly define eligible activities and have adopted performance evaluation for budget expenditures. Indicators are widely used in assessing the performance and the performance results are used to inform the allocation of funds among counties. The budget outlay in program counties is generally in compliance with the policies and instruction of the high-level government. However, most indicators are for measuring inputs. Outcome of the program is generally not measured. No province evaluates the program's direct impact on environment or carbon emission.

60. **Overall, the expenditure framework presents a strong basis for the governments of Hubei and Hunan to finance green agriculture development and delivery of rural infrastructure and public services.** Budgets appear largely adequate relative to the GARR PforR's expected results, and aggregated fiscal sustainability issues were not identified as a core concern associated with the public expenditures. The transfers that the project counties received from the central and provincial governments are stable and predictable. However, the following points need to be addressed during the GARR PforR implementation. First, the central and provincial governments should consider (a) developing a green agriculture expenditure taxonomy and monitor the expenditures accordingly and (b) allocating the agriculture-related transfers among counties based on the achievement of green agricultural development results, to enhance the incentives and performance. The green budget developed under this PforR will help Hunan and Hubei to enhance the contribution of the RRP to climate mitigation. Second, the county governments need to reallocate adequate funds to finance the solid waste and wastewater management services. Hubei and Hunan should make recourse to a 25 percent PforR advance disbursement to accelerate the program implementation.

Economic and Financial Assessment

61. **Economic analysis.** Cost-benefit analysis has been conducted to assess the economic viability of RA2 by aggregating activities in crop production (value chains) and livestock and poultry manure treatment interventions based on the physical targets contained in DLI2.1 and DLI2.2 and based on crop production and livestock and poultry manure treatment models in the financial analysis. The incremental economic costs include investment costs for technical package adoption, operational costs for agricultural production, and training and capacity-building costs. The major benefits included in the analysis are incremental crop production and price premiums from quality improvement; savings from reduced agricultural input costs, including fertilizer, agrochemicals, diesel, and irrigation water; income from biogas, electricity, and organic fertilizer generated from livestock and poultry manure treatment; and benefits from GHG emission reductions. Other substantial positive externalities such as reduced water pollution and improved soil biodiversity are not included in the analysis as they are not easily quantifiable. The following assumptions have been applied for the analysis: (a) carbon shadow prices are set following the World Bank Guidance Note on Shadow Price of Carbon in Economic Analysis (November 2017);[51] (b) program life of 20 years; (c) the discount rate adopted by the analysis is 6 percent, chosen according to guidelines from the NDRC, which is in line with the World Bank's guidance for discount rate;[52] and (d) taxes,

[51] According to the World Bank's Guidance Note on Shadow Price of Carbon in Economic Analysis issued on November 12, 2017, projects' economic analysis should use a low and high estimate of the carbon price starting at US$40 and US$80 in 2020 and increasing to US$50 and US$100 by 2030. The low and high values on carbon prices are extrapolated from 2030 to 2050 using the same growth rate of 2.25 percent per year that is implicit from 2020 to 2030, leading to values of US$78 and US$156 by 2050.

[52] 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 E&S benefits.

duties, and subsidies are not included as they represent transfer payments instead of real costs or benefits to the society as a whole. Cash flows of benefits and costs for RA2 are projected over 20 years to estimate their ERR. The ERR with GHG reductions is estimated at 15 percent (at a low carbon shadow price), 18 percent (at a high carbon shadow price), and ERR without GHG reductions at 11 percent. These are all above the discount rate of 6 percent, indicating that RA2 is economically viable.

62. **Financial analysis.** The project's financial benefits were analyzed based on the program's incremental benefits and costs from the perspective of farmers/cooperatives. Assumptions for the financial analysis are the same as for the economic analysis except that subsidies for farmers/ livestock and poultry manure treatment facilities are treated as income and the GHG reduction benefits are excluded as they cannot be internalized by farmers/owners of livestock and poultry manure treatment facilities. The crop financial analysis shows that green agricultural technologies and practices are financially viable in the long run, even without government subsidies. However, the subsidies are justified during the initial years for the following reasons: (a) promoting the adoption of new technologies and practices, (b) compensating farmers for their contribution to the generation of public goods (for example, GHG emission reductions and nutrient and pollutant reductions), and (c) providing up-front financial incentives to hedge against the risks associated with switching to new technologies and practices. In China, experience has shown that once the new technical packages are proven financially viable, farmers will continue using them even without subsidies.

63. **For manure treatment, the construction of a centralized livestock and poultry manure treatment and recycling facility has been adopted for analysis.** The facility will adopt the odorous fermentation bed technology with an annual treatment capacity of at least 6,600 metric tons of livestock and poultry manure (for roughly 9,000 standing pigs annually). Based on the estimated capital investment, operational cost, and revenues, the facility will have an internal FIRR of 5 percent without subsidies and 12 percent with subsidies. The financial analysis of the livestock and poultry manure treatment facility shows that it is not financially viable without subsidies.[53] Because the centralized facilities will provide livestock and poultry manure treatment services to small-scale livestock and poultry farms and generate substantial public goods by reducing the quantity of pollutant loads entering waterways, there is strong justification for the program to provide subsidies for their construction. The analysis also shows that, with subsidies, the facilities could run profitably. No sensitivity test is warranted because conservative values of outputs and income are used in the analysis throughout the program's life and significant unquantifiable positive externalities (for example, water, soil quality, and biodiversity improvement) are not included in the financial analysis.

RA3: Increasing Access to Rural Solid Waste and Wastewater Services

64. **RA3 involves the preparation of spatial IVDPs, which are the planning and future decision tools for the rural infrastructure and public service investments at the village level.** The spatial IVDPs will contribute to the efficient allocation of resources as one of the economic benefits. However, the main activities are related to the construction of village-level wastewater and solid waste treatment and recycling facilities. Their economic benefits include improved health outcomes (for example, reduced incidences of waterborne diseases) and reduced pollutants entering waterways (that is, improving water quality), which are not easily quantifiable. Given the geographically scattered small natural villages, the construction and/or rehabilitation of decentralized rural wastewater and solid waste management facilities are seen as the most cost-effective way of delivering public services. This is obviously true because, in the long run, the cost of transferring rural waste to centralized township treatment plants is higher than the construction and/or rehabilitation of decentralized rural facilities.

[53] This is supported by the analysis in the government ICR for the Guangdong Agricultural Pollution Control Project, in which, out of 21 pig farms, only three high-rise facilities were financially viable without subsidies.

RA4: Restoring and Protecting Degraded Agricultural Ecosystems

65. **RA4 focuses on the integrated management of natural resources (for example, land and water) to complement the efforts of greening selected agricultural value chains under RA2.** While there is abundant evidence from the literature that returning crop straw residues into the soil in farmlands, controlling heavy metal pollution, and treating aquaculture wastewater contribute to the increase in carbon sequestration and food safety and lead to reduction in environmental footprint, especially from reduction in GHG emissions and pollutant loads entering waterways, it is difficult to quantify the costs and benefits. However, the qualitative analysis concludes that the benefits of implementing these activities far outweigh the costs. The main unquantified benefits include increased soil carbon, reduced GHG emissions, improved food safety, and reduced human health risks.

Gender Result Chain

Gap Analysis

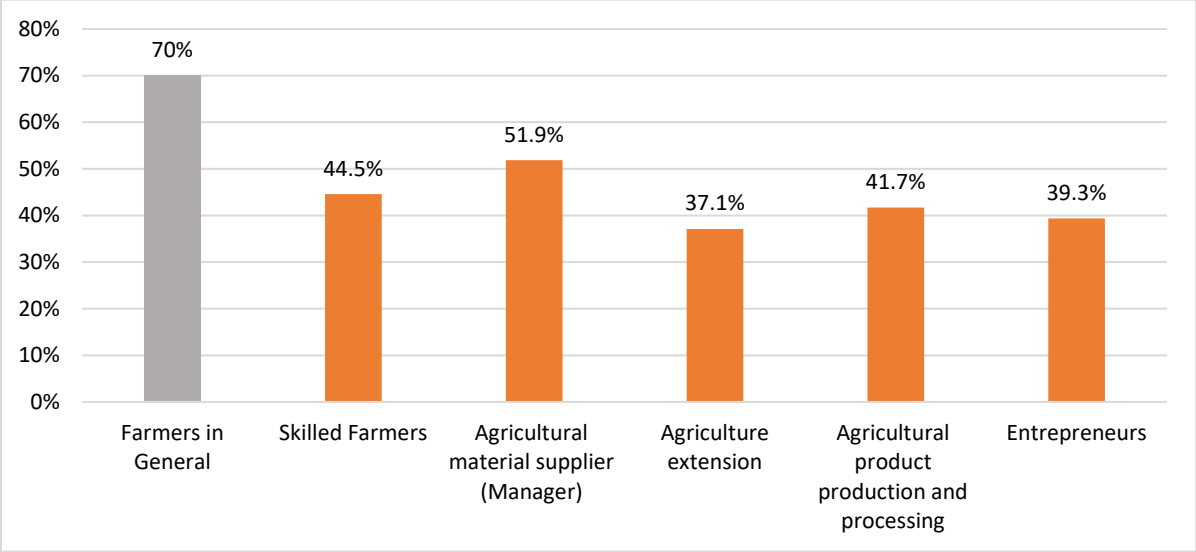
66. **Overall, Chinese women are more engaged in farming activities than men, but due to skill and information gaps they are mainly engaged in upstream activities of agricultural value chains.** According to the White Paper 'Gender Equality and Women's Development in China', in 2015, women account for about 70 percent of the agricultural labor force. However, the GARR PforR gender analysis found that on average women only account for 37.1 percent of agriculture extension personnel, 39.3 percent of agri-entrepreneurs, and 41.7 percent of agro-processing jobs in program counties (see figure3.1). In the last four decades, a significant number of rural people migrated to urban areas in search for better paying jobs, and the majority of them were men. Women, especially those between the age of 36 and 50, remained in the rural communities, spending more hours on the farm.[54] Notwithstanding the higher participation of women, men continue to make major production decisions and play the role of experts and managers in the agriculture sector. This is mainly because of their better access to agricultural technologies, knowledge, and information.

67. **Factors such as limited access to educational resources, market information and extension and advisory services, and occupational segregation and bias** that encompass gender discrimination in family and labor market, together affect women's uptake of green agricultural technologies and contribution to the development of green and sustainable agricultural value chains. Due to lower education level and exposure to extension and advisory services, women are lagging when they compete in emerging economic opportunities in the rapidly transforming agriculture sector.

68. **Women earn significantly less than men due to their limited participation in downstream agricultural value chains activities.** This exacerbates their disadvantaged social-economic status in the process of agricultural transformation. The gender analysis found that the gender annual income gap in rural areas is much wider than that in urban areas. For example, rural women earn 11.2 percent to 38.9 percent less than their male counterparts in the program counties, while the gap in urban areas ranges from 5.8 percent to 33 percent. This is because women are less likely to acquire technical and managerial positions in the agricultural value chains. Positions such as agri-technicians and advisers at the agricultural technical service stations and agri-business leads and decision-makers at the rural cooperatives usually require diplomas or technical certificates qualifications. In addition, they depend on the ability to access the job market and engage with local elites in a male-dominated rural community. As a reverse flow of labor (from cities to countryside) emerged after the outbreak of COVID-19 pandemic, majority of female returnees reengaged in farming activities. Because of their limited technical skills and knowledge and low social capital, they tend to converge into upstream of the agricultural value chains.

[54] International Food Policy Research Institute. 2012. "The Feminization of Agriculture with Chinese Characteristics. Discussion Paper." http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/126960/filename/127171.pdf

Figure 3.1. Share of Women in Agricultural Value Chains



69. **The gender analysis also found that women's share of technical and managerial positions in rural SWMS and WWTFs was smaller relative to men.** Data from Hunan show that although there is no huge gender gap in total number of staff working in general positions in rural WWTFs, the gap was significant for technical and managerial positions (see figure 3.2). And this is also true for SWMS (see figure 3.3). The largest gap exists in technical roles in rural SWMS, where only 27.5 percent of employees are female, despite having more women than men working in general positions. Once again this is a clear indication that gender-based knowledge, skills, and technical gaps hinder women from accessing and retaining technical and managerial jobs and this may exacerbate the rural women-men income disparity.

Figure 3.2. Proportion of Women Working in WWTFs (Hunan)

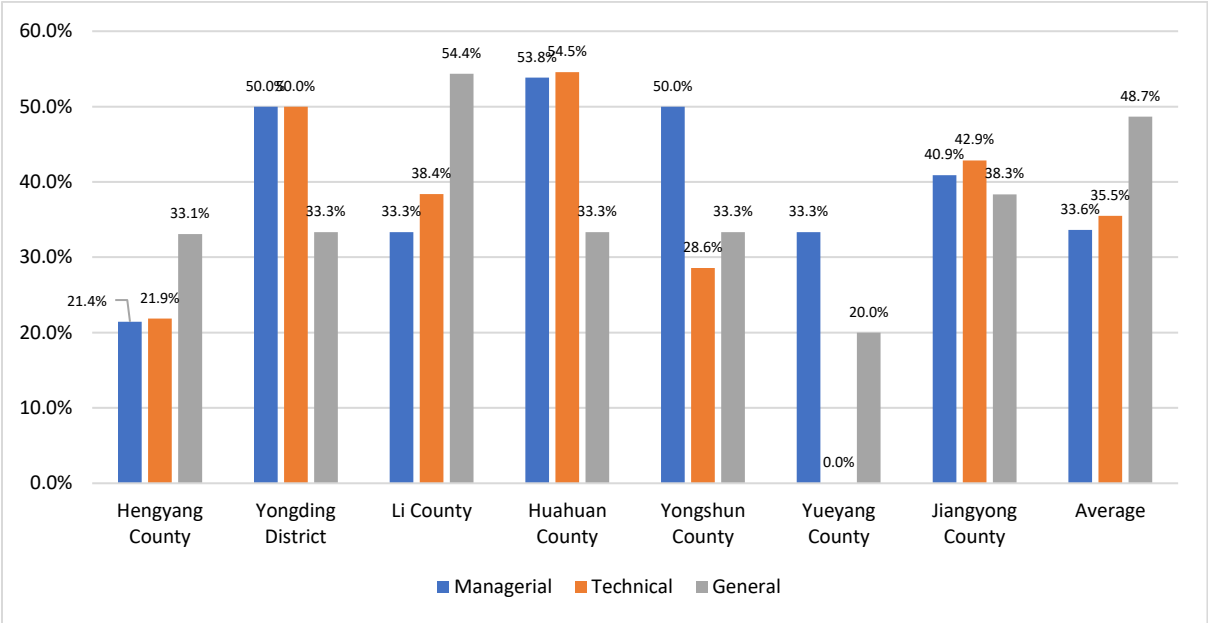
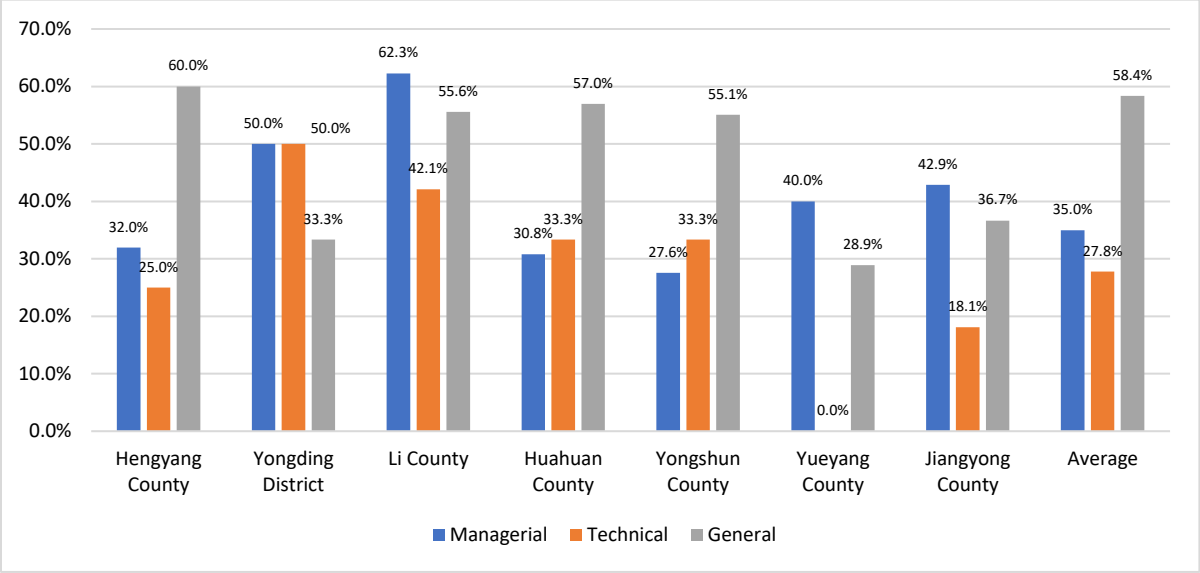


Figure 3.3. Proportion of Women Working in SWMS (Hunan)



Gender Actions

70. **To address the gender gap, targeted trainings and capacity-building activities will be provided to women in the program counties.** This will help them better prepare for the emerging employment opportunities downstream the agricultural value chains, including in processing, cold storage, logistics, and marketing. To facilitate the achievement of results under RA2 and RA4, the GARR PforR will nurture women's green skills and talents through training and capacity-building activities, including exchange visits and internships. The knowledge and skills acquired will help women apply green technologies and practices to reduce chemical fertilizer use, improve management of livestock and poultry manure, use digital tools and services (for example, online learning, live streaming, and other e-commerce methods for marketing certified green and organic or registered GI agricultural products), and use mobile-based payment and billing services. The GARR PforR will encourage Hubei and Hunan to improve their human resource systems by adopting gender-balanced international practices to provide equal job opportunities for both men and women. Gender awareness trainings will be conducted to provide up-to-date perspectives on international good practices of gender equity in job markets. Further, these employers will be encouraged to better link up with the local talent pool, including by selecting trainees from technical schools and colleges, while ensuring that female and male students have equal chance of being recruited based on their capacity and level of skills.

Gender Indicator

71. The indicator is 'Newly created and upgraded jobs held by women in the transformation of agricultural value chain and in the rural waste management and environmental rehabilitation (Percentage)'.

Results Monitoring and Evaluation

72. **M&E capacity will need to be strengthened during the GARR PforR implementation.** Each province will prepare an M&E plan, specifying the units of measurement, baseline values, targets, data sources for each indicator, methodology, and responsibility for collection and reporting. The provinces will recruit third-party M&E agencies to collect, analyze, and report survey-based data. Administrative data will be collected by the relevant county government departments implementing the GARR PforR activities. The M&E data will be stored in the MIS for the GARR PforR. The M&E of livestock and poultry manure pollution reduction and wastewater treatment and recycling will be based on the established

monitoring and verification system under the MEE. Similarly, the M&E of chemical fertilizer reduction will follow protocols established by MARA. This will provide a solid basis for the official recognition and credibility of the PfoR's DLRs. The M&E system will be linked to the IT-based monitoring platforms for rural infrastructure management and the IT-based program for budgeting and expenditure reporting. This will enable the provinces to evaluate the results and performance of the GARR PforR activities and analyze the cost-effectiveness of various activities implemented to generate the results. The PPMOs will prepare and submit to the World Bank consolidated semiannual progress reports (including findings of third-party M&E reports), a midterm review report, and an ICR. The PPMOs will periodically submit to the World Bank the VA's verification reports on the achievement of DLRs to enable IBRD loan disbursements against the DLIs.

73. **The PPMOs will be responsible for consolidating reports from provincial agencies participating in the GARR PforR and submitting them to the PDOFs, copying the CPMOs.** The NRRA and Hubei and Hunan provinces will each hire a third-party VA to verify DLRs reported by the central PMO and PPMOs. IBRD loan disbursements will be made periodically upon receiving and accepting the third-party VA reports on the DLRs for the respective DLIs. The amount in the submitted withdrawal applications will depend on the verified results. Some annual allocations are scalable and non-fixed, meaning the World Bank can disburse for overperformance up to the DLIs' total allocation. Overperformance will enable the PDOFs to bring forward disbursements from Years 4 and 5 to Years 3 and 4, respectively. The PDOFs can apply for disbursements as soon as the provinces achieve the results, provide the necessary evidence verified by the VA to the World Bank, and the World Bank accepts the evidence in a formal notice to the MOF specifying the eligible disbursement amounts.

ANNEX 4. (SUMMARY) FIDUCIARY SYSTEMS ASSESSMENT

Introduction

1. **The China GARR PforR (Hubei and Hunan) will support a subset of activities from the Government's national RRP to be implemented in Hubei and Hunan.** GARR PforR implementation will follow the existing national, provincial, and sectoral legal framework and practices for fulfilling public financial management (PFM), public procurement, and governance responsibilities. The FSA provides a comprehensive review and analysis of the current systems, identifies risks, and recommends mitigation measures for implementation to enhance the performance of the current systems in meeting the GARR PforR objectives. This annex summarizes the main findings and conclusions of the FSA report.

2. **The scope of the FSA is based on the defined program boundary and expenditure framework.** The fiduciary systems of the key implementing agencies at the provincial and county levels, including the PDOF, PDRC, Rural Revitalization Administration, DARA, Department of Housing and Urban-Rural Construction, DEE, and Audit Office, were assessed. During the preparation mission, fiduciary assessments were carried out in GARR PforR counties (10 in Hubei and 13 in Hunan). In addition, during the preparation mission, three program counties were visited in each participating province and senior officials of corresponding line bureaus were interviewed. The FSA report concluded that the Government's fiduciary systems are adequate for meeting the requirements of the World Bank's Program for Results Policy and Directive. The systems can reasonably ensure that the GARR PforR's financing proceeds will be used for the intended purposes, with due attention to the principles of economy, efficiency, effectiveness, transparency, and accountability.

A. Public Financial Management System

3. **The Budget Law of the People's Republic of China, issued in 2015 and revised in 2018, sets the budget management framework for China's central and local governments.** Budgets are prepared at each level of government, and each level follows the standardized PFM processes. At the county level, where the physical GARR PforR activities will be carried out, each year, sector entities prepare and submit their budget proposals to the corresponding technical division of the county finance bureau for review in early September. Both operating and capital budgets are reviewed for consistency and alignment with higher-level government priorities and policies. A 'two-up, two-down process' is followed to arrive at the final budget proposal, which is presented to the county's People's Congress, usually in February of the following calendar year. Since the county sector entities prepared their budget in line with the pre-notice quota, there were no big gaps in most counties between the proposed and approved budget in the two provinces in the past three years.

4. **A nationwide IBMS is being used in China.** Beginning January 1, 2022, a web-based nationwide IBMS has been rolled out and implemented throughout China. The IBMS is used from the central to the county level, connecting all the financial departments and government budget execution entities. The IBMS targets all types of government budget funds and covers budget preparation, appropriation, execution, payments, accounting, and reporting. It also includes the M&E function with standardized budget classification, accounts/codes, payment review, process procedures, and reporting templates. All the budget information could be reflected in the system in real time. The budget management's coherence, consistency, and efficiency are significantly improved. In this regard, the government budget systems in the Hubei and Hunan provinces also follow the same policies, processes, and procedures.

5. **Although the 14th FYP has been prepared for green agriculture and rural revitalization, no budget has been allocated.** Some government officials expressed their concerns about the shortage of funds for implementing the activities in their RRSPs. Significant financing gaps are associated with toilet improvement; rural wastewater treatment; and solid waste collection, sorting, and transfer. Since these activities are a local government responsibility, the transfers from the

upper-level governments (central and provincial) are quite limited. County governments are responsible for exploring other financing sources by themselves. However, the financial capacity of most counties is quite weak. The main financing source is non-tax revenue (land sales), but it is not stable and has decreased in recent years. The data on fund allocation of rural revitalization cohesion funds, one of the main financing sources for these activities, were collected and analyzed. The rural revitalization cohesion funds are mainly used in three areas: industrial development, rural infrastructure, and social development, with about half of the funds allocated to industrial development. The funds allocated by counties for rural infrastructure and public services, such as toilet renovation and wastewater and solid waste management, are less than 3 percent.

6. **From January 1, 2019, all budgetary entities must prepare accrual-based financial reports.** However, accrual-based financial reports are neither submitted to the People's Congress nor audited by external auditors. The primary financial report at each level of government is the budget execution report, which is prepared on a cash basis. Several budget items that capture the program expenditures were selected, and their data were analyzed to review the execution rates. The budget completion rate in program counties is satisfactory.

7. **Upper-level government transfers are mostly distributed to counties through advanced budget quotas.** To avoid late budget availability, most central and provincial governments' transfers for the following year are advanced to counties toward the end of the current year or early the next year. The county finance bureau logs the allocated budget quota in the budget system, which enables program/project implementing agencies to apply for payment following the central government's established procedures.

8. **Since 2018, the zero-based budgeting (ZBB) approach has been fully implemented in Hubei and Hunan to optimize budget allocation annually.** It has broken the stereotyped principle of making budget allocation and evaluation based on predetermined amounts and expenditure areas, which may remain unchanged for years. The ZBB is a flexible, needs-driven approach to restore the budget base numbers back to zero on an annual basis so that the budget entities can revisit the budget utilization and indicators for M&E on budget execution, which is aimed at optimizing the allocation of budget resources to higher priority areas. The ZBB would be a useful mechanism for channeling the program's budgeted funds to finance activities needed for achieving the intended results (DLIs) and the PDO indicators.

9. **Budget payments are processed through the IBMS.** The budget quotas for the activities approved by the People's Congress are documented under each budget line in the IBMS and used to monitor and control the nature and amount of the payment requested within the approved budget plan. Preauthorized payments under each budget entity with approved thresholds are entered into the IBMS by the local finance bureau. Budget entities retain all the original documents. Based on interviews with some counties, the average payment period is one month.

10. **Each county maintains a treasury single account and makes payments through a network of commercial banks.** The IBMS is linked to each budget entity's ZBB account opened at a commercial bank acceptable to finance bureaus. Payments are made by the budget user through its commercial bank, which eventually makes settlement/reimbursement with the central bank overnight. The provincial-level treasury can either transfer funds to counties at the time of budget quota allocation through monthly transfers or monitor payment plans in the system and transfer sufficient funds for counties to cover payments. Counties participating in the FSA indicated that they had not experienced cash shortages. Indicators to measure cash flow availability were not available. However, the absence of such indicators is not considered a weakness, given the RRP's large budget and the availability of cash when needed.

11. **Since 'program' is not a budget classification element, program-based financial reports cannot be automatically generated from the government treasury system.** Therefore, the World Bank recommended a green budgeting and expenditure tagging mechanism to easily trace the GARR PforR expenditures in the Government's existing IBMS. The green tagging mechanism will first be piloted in the GARR PforR counties and then rolled out to all counties in the two provinces. This will enable the GARR PforR program counties to generate accurate and relevant financial reports and to analyze the

program's budget allocation and execution. The mechanism for green tagging the program's budgets and tracking and reporting their expenditures will be developed by Hubei's and Hunan's PDOFs. A detailed description of the green budgeting and expenditure tagging mechanism is provided in the FSA report, which received positive feedback from Hubei's and Hunan's PDOFs, including that (a) green tagging is technically doable within the existing IBMS, (b) detailed green tagging technical modalities and implementing plan will be developed during GARR PforR implementation, and (c) green tagging mechanism will be included in the PIPs of the two provinces. To further enhance the FM system, the GARR PforR includes two PAPs: (a) finalizing the template of the program financial reporting, including budget codes and lines based on program-related sources of funds and budgeted expenditures and (b) finalizing the program external audit TORs drafted by the World Bank, which elaborate the program background, audit objective, audit scope, applicable audit standard, description of financial statement, and requirements on the audit report.

12. **There is adequate control over stewardship of program funds, with a well-defined delegation of authority.** Following the national policy and regulations issued by the MOF and the NDRC, the provincial governments have issued a series of regulations regarding fund management, implementation measures, and result verification procedures, among others. For example, related government decrees have been issued for some earmarked funds, which are the main financing sources of program activities, to regulate the usage of these funds and ensure that the budget will only be used for its intended purposes. Provincial sector departments have also established regulations/decrees toward their responsible earmarked funds and have conducted regular supervision or spot checks on these funds. Almost all program counties prepared detailed practical guidance on these upper-level regulations/decrees.

13. **The county finance bureaus must report their budget execution monthly using the data generated from the IBMS,** so budget execution can be closely monitored. Some county line bureaus also submit monthly fund use reports to upper-level administrative bureaus/departments. Meanwhile, provincial sector departments carry out budget performance evaluations annually to assess whether the public funds are used properly and whether the predetermined performance indicators are achieved.

14. **Internal audit practice complies with the Audit Law and the related regulations as issued by the China National Audit Office (CNAO).** Article 3 of CNAO Decree No. 11 of 2018 defines five types of internal audit: financial revenue and expenditure audit, accountability audit, performance audit, audit of the implementation of key policies, and internal control and risk audit. Based on the interviews with provincial entities, counties visited, and data collected, it is noted that the internal audit function has not been widely established in the two provinces. No internal audit function has been set up at the provincial level in related departments. But the supervision and performance evaluation bureaus (the unit responsible for internal audit) within the PDOFs are carrying out their inspection on the usage of program funds. At the county level, besides the supervision and performance evaluation unit established within each county finance bureau, several county line bureaus are equipped with an internal audit unit responsible for inspection/internal audit-related tasks.

15. **Both IPRCC, provinces and the counties, received various external audits and inspections throughout the year, primarily focusing on the proper usage of public funds.** The annual external audit findings on budget execution by the provincial audit offices (PAOs) are included in their annual report to the provincial People's Congress, and the full audit report is published on the PAO's official website. However, not every budgetary unit is audited yearly because of personnel shortages in the audit offices. The audit strategy for government auditors is to conduct audits on a rolling basis and for audits to cover multiple years.

16. **County audit bureaus carry out audits on budget execution and have access to the necessary data without restrictions.** Several material issues and systemic and control risks are usually detected and disclosed in the audit reports, and remedial actions are taken by the audited units effectively and on time. The audit bureaus submit their audit reports to the legislature promptly after receiving the financial reports. The standing committees of the county People's Congress

provide timely approval of the audit reports and call for in-depth hearings on the main findings of these reports once a year.

17. **No specific audit was carried out by the CNAO, PAOs, and audit offices on the usage of program funds in the past years.** To mitigate this risk, an annual program audit is required, and the audit of the program will be conducted by the CNAO for central component and the PAOs. Besides auditing budget execution and other provincial-level entities, the CNAO and PAOs have been the auditors of World Bank-financed projects in the two provinces for about three decades. The CNAO and PAOs also have experience with auditing PforR projects. The first year's audit report issued by the PAOs is subject to a quality review by the CNAO.

18. **To gain reasonable assurance on the proper usage of program funds, the CNAO and PAOs will agree with the World Bank on auditing TOR for conducting annual program financial statement audits that will be publicly disclosed.** The CNAO and the PAOs will adopt the audit approach and coordination mechanisms used in other World Bank-financed PforR operations. The PAOs will coordinate internally to minimize the chances of duplicate audits conducted by different auditors and to maximize reliance on each other's findings. The auditors will conduct the financial audit on the GARR PforR financial statements in accordance with the audit TOR to meet the World Bank's audit requirements. The audit report will be submitted to the World Bank within nine months of the end of the calendar year. Each PAO will issue an audit report separately for its own part. It has been agreed that the program audit would focus on the following aspects: (a) whether the transfers from central and provincial governments have been delivered to the counties completely and on time; (b) whether the program funds are used properly and in line with the applying regulations and procedures, by sampling program counties; (c) whether the World Bank's procurement and safeguard policies and requirements have been fully complied with by all counties; (d) whether the domestic regulations and requirements have been strictly adhered to; and (e) whether the program financial reporting fairly presents the sources and use of program funds.

B. Public Procurement System

19. **The TBL and the GPL are the primary laws governing public procurement in China.** The TBL focuses on construction-related works, goods, and consulting services, while the GPL focuses on fiscal budget funds that finance purchasing activities carried out by government departments, institutions, and organizations. The demarcation line was unclear between the two until the issuance of a monetary threshold[55] for tendering and bidding activities by the NDRC and guidance documents by the MOF, NDRC, and the respective line ministries. Each province and line ministry issues procurement-related guidance and orders to regulate procurement in its respective administrative jurisdiction or sector. Anti-corruption policies and measures are available in laws and regulations to prevent, report, detect, investigate, prosecute, and sanction fraud and corruption.

20. **The FSA analyzed data and interviewed and discussed in person with procuring entities and public transaction centers** (mandated by the Government to provide service and supervision for purchasing activities through open and selective bidding) the procurement legal framework and implementation in practice. The FSA did not identify deviations from the legal requirements. The key procurement stakeholders under the GARR PforR are line government agencies, procuring entities, procurement agents, design institutes, supervisors, transaction centers, and the selected suppliers/contractors/consultants. The line government agencies plan and obtain approval for the procurement activities to be carried out under the program. Procurement agents assist the procuring entity (the government agency itself or its delegated agencies) in preparing procurement documents and facilitating the procurement processes. Design institutes make a technical contribution to the procurement processes. Supervisors monitor the contracts' implementation. Transaction centers provide service to the procurement processes and oversee the processes simultaneously. The selected suppliers/contractors/consultants implement the contracts agreed upon with the employer/purchaser/client.

[55] https://www.ndrc.gov.cn/xxgk/zcfb/fzggwl/201803/W020190905495130858389.pdf.

21. **A complaint mechanism is provided in both the TBL and GPL.** The complainant has the right to file a complaint with the procuring entity or supervising authority. The GPL further allows administrative reconsideration or administrative proceedings in the People's Court if the complainant is unsatisfied with the resolution or if any delay occurs in handling the case by the supervising authority of the procuring entity.

22. **The GARR PforR will cover all kinds of procurement (that is, works, goods, non-consulting, and consulting services).** The procurement activities will comprise development of the IT-based monitoring platform; construction, rehabilitation, and upgrading of rural wastewater and solid waste management systems; construction of treatment and recycling facilities for livestock and poultry manure; acquisition of organic fertilizer; consulting services for engineering design; construction supervision services; development or adoption of regulations, standards, and guidelines for green agriculture practices and infrastructure; development of mechanisms for budgeting, expenditure tracking, and reporting; development of mechanisms for M&E of rural infrastructure and public services; training in operation and monitoring of wastewater and solid waste systems; and training of FCs, FAs, WUAs, input suppliers, agro-enterprises, and rural extension staff. The program-related provincial-level policies and guidelines will be developed by relevant provincial-level government agencies. Some of the activities related to reducing fertilizer use; collecting, sorting, and recycling rural solid waste; and enhanced protection and conservation of agricultural ecosystems would be financed through matching grants and output- or performance-based subsidies.

23. **Procurement is usually efficient because the time from publication of the procurement notice to the deadline for bid submission and opening is normally 20 calendar days.** Bid evaluation is usually completed in one day. Once the evaluation is completed, the contract award recommendation is disclosed to all bidders for three days on the official website of the Government and the website of the public resource transaction center. If no complaint is received within the standstill period, the contract is awarded promptly and signed within 30 calendar days from the contract award. The bidding process is usually competitive. The data provided by the selected program counties show that competition is adequate. Since most of the contract value is below the threshold of open competitive bidding, competitive negotiation and dialogue are often used, with a minimum of three bidders as required by the regulations. In some counties, direct contracting is also allowed when the contract cost estimate is below the threshold of open competitive bidding. The contractor/supplier/service provider is selected from a long list prepared by the county finance bureau through competitive selection. A specific discount rate from the offered price by the contractor/supplier/service provider is also specified in the list of contractors/suppliers/service providers, depending on the category/type of the work/services. During the FSA, data on the cancellation and rebidding of procurements were also collected. Cancellation and rebidding rarely occur.

Conclusions and Recommendations

FM Systems

24. **Overall, a comprehensive PFM framework has been established**, including government regulations, decrees, standards, and procedures to ensure that program funds are used for their intended purposes. However, enforcement varies from one county to another, and the World Bank's support would be needed to strengthen the institutional capacity of the Government's implementing entities. During the FSA, potential FM risks were identified, and appropriate mitigation measures were recommended.

25. **The main FM risks identified include the following.** First, although the 14th FYP has been prepared for green agriculture and rural revitalization, no budget is allocated for it. Second, there is huge financing gap associated with toilet improvement and rural solid waste and wastewater collection, transfer, and treatment. Third, there is no program budgeting in China; thus, financial reports cannot be automatically generated from the Government's IBMS. Fourth, Hubei and Hunan provincial governments do not require county governments to report on program expenditures. Fifth, there is

insufficient supervision of county governments, which may result in a potential risk of improper use of program funds at the county level. Finally, the government auditors do not audit the program funds and prepare the program audit reports.

26. **Mitigation measures for the major FM risks have been agreed.** First, program-based budgeting will be adopted to ensure that adequate funds are available. And the relevant government departments will revise their investment plans and allocate more resources to finance activities under the GARR PforR. Second, a green tagging mechanism that can trace program budgets and expenditures from existing government IBMS will be adopted and piloted in the GARR PforR program counties before it is rolled out to other counties in the two provinces. This will form the basis for generating the program's financial reporting from the Government's IBMS. Several budget line items have already been identified to capture program expenditures, and a tailored program financial reporting template has been designed. Third, the provincial-level entities involved in the GARR PforR implementation will strengthen the supervision of program funds in line with government laws regulations and guidelines. Finally, the TORs satisfactory to the World Bank will be used for program auditing to ensure that program funds are audited in line with the World Bank's policy (see Annex 6).

Procurement Management Systems

27. **The Government also has a robust legal framework for procurement management,** which includes the TBL of 1999, revised in 2017, the GPL of 2002, revised in 2014, and regulations and orders issued at national, provincial, and county levels. Although the laws could be revised and aligned with modern principles, such as 'value for money' and 'fit for purpose', both offer a fair playing field for bidders and promote transparency and competitiveness. The Government has recently encouraged the use of electronic bidding. All open bidding competitive processes are now carried out by public resource transaction centers, which use IT platforms for processing procurement activities electronically.

28. **Procurement risks are as follow.** First, the absence of a coordination framework for multiple implementing entities, such as DOFs, development and reform, agricultural and rural affairs, rural revitalization, housing and rural-urban development, natural resources, ecological and environmental, water resources and city administration bureaus (comprehensive administrative law enhancement bureaus), is likely to be among the major constraints to the GARR PforR implementation. Second, multiple implementation entities involved in procurement activities may not be aware of the lists of debarred and temporarily suspended firms issued by the World Bank and other multilateral development banks. This is despite the fact that most of the contracts will be of small size, and it is unlikely that they would be awarded to firms debarred or under temporary suspension by the World Bank or other multilateral development banks. Third, the World Bank may not be informed of fraud allegations and corruption practices during the GARR PforR implementation. Fourth, the GARR PforR will be implemented at the county level, where most of its procurement activities will comprise small works for the construction and/or rehabilitation of rural infrastructure and small-value consulting and non-consulting services. As a result, there will be limited competition among contractors, suppliers, consultants, or design institutes interested in bidding for small-value contracts. Fifth, works may not be completed within the time specified in the contracts, and the contract completion audit may not be finished in time, affecting the achievement of results under the DLIs.

29. **Several mitigation measures have been agreed.** First, the PPMOs and the county PSC will oversee and supervise the GARR PforR implementation, respectively. The roles and responsibilities of each entity will be clearly defined to eliminate functional repetition or overlap, set up a distinct decision-making and approval structure, and avoid undesirable delays. Second, Hubei and Hunan PPMOs will, upon GARR PforR's IBRD loan effectiveness, issue an official instruction (see Annex 6) to ensure that the implementation agencies at the county/city level will not award contract to a firm or individual that is on the debarred list or under temporary suspension. The website access to the lists of the debarred and temporarily suspended firms and individuals issued by the World Bank will be provided to the agencies in charge of procurement in county/city governments. The TOR for the annual external audit shall also randomly sample contracts and assess whether they have been awarded to an ineligible firm or individual. Third, the PAP shall also require Hubei and Hunan to inform

the World Bank of any credible and material allegations of fraud and corruption issues as part of the GARR PforR progress reports. Fourth, to enhance competition, the county/city governments will maintain a long list of qualified firms, contractors, suppliers, and service providers to widen the range of prospective firms. The county/city governments will also closely monitor the procurement implementation plan and review the procurement packaging and methods to be adopted. Finally, adequate human and financial resources will be allocated for close monitoring of contract implementation progress to minimize or avoid implementation delays and/or cost overruns under the GARR PforR.

30. **Procurement exclusions.** Under the GARR PforR, contracts exceeding (or high-value) the World Bank's OPRC thresholds[56] will not be awarded.

31. **Fiduciary supervision.** Procurement and FM are subject to annual audits by government audit offices. Procurement following the procedures of the TBL is subject to regular supervision and oversight by DRCs at various levels and relevant sector authorities. The DOF or bureaus at various levels exercise regular supervision and oversight for procurement following the procedures of the GPL.

32. **Fraud and corruption risks.** The Government has institutions in place to combat fraud and corruption. These institutions are designed to prevent, report, detect, investigate, prosecute, and sanction fraud and corruption. These institutions include the discipline inspection commissions within all implementation agencies, supervision bureaus, anti-corruption bureaus under People's Procuratorates and audit offices at all central, provincial, prefectural, and county levels. These agencies are mandated to combat fraud and corruption. Any bidder or party can report fraud and corruption concerns to these government agencies. The World Bank reserves the right to inquire into such allegations or other indications, independently or in collaboration with the Chinese Government, regarding activities and expenditures supported by the GARR PforR and its right to access the required persons, information, and documents. This will be observed in accordance with the standard arrangements for this purpose between the Chinese Government and the World Bank. The program's loan and program agreements will also oblige the clients to fully comply with obligations under the World Bank's anti-corruption guidelines for PforR operations.

[56] OPRC thresholds for substantial risk projects are US$75 million for works; US$50 million for goods, IT, and non-consulting services; and US$20 million for firm consultants.

ANNEX 5. SUMMARY ENVIRONMENTAL AND SOCIAL SYSTEMS ASSESSMENT

1. **An ESSA was carried out to check whether the NRRA and the provincial and county governments had adequate E&S management systems for implementing the program.** The ESSA report concludes that China has established comprehensive systems to manage the related E&S risks or impacts at national, provincial, and local levels. The systems consist of legal frameworks (laws, regulations, guidelines, standards, and so on) that are principally consistent with the World Bank's Program for Results Policy and Directive, EHS guidelines, and the GIIP. They also have corresponding implementation mechanisms and institutional arrangements for enforcing the legal frameworks. A fully financed and well-staffed institutional structure through various government levels is in place and efficiently operates to execute the E&S legal frameworks. The country's track record shows that its management capacity and performance are substantial and that the systems can provide an acceptable basis for addressing the possible E&S issues related to the activities supported under the GARR PforR.

E&S Exclusion

2. **An E&S screening was carried out on the GARR PforR activities to exclude those with a high potential to cause significant adverse impacts on the environment and/or affected people.** The excluded activities include those that (a) are domestically classified as Category A (an EIA report category) projects; (b) would be implemented in environmentally sensitive areas (including the legally established protected areas and the regions sensitive to environmental impacts) as defined in the Construction Project EIA Classification Catalogue; (c) would be implemented in areas with significant legacy pollution; (d) would involve construction, upgrading, relocation, or shutdown of livestock/poultry farms; those that would involve construction, upgrading, or expansion of domestic solid waste treatment facilities (such as incineration plants and landfill sites); (e) would involve large-scale land acquisition; those that would involve the acquisition of basic farmland; and (f) would involve restoring lakes/rivers by requisition of water/land/fishing materials or restoring forests by requisition of farmland, among others.

E&S Impacts Assessment and Risk Rating

3. **Overall E&S risks/impacts associated with the GARR PforR activities are Substantial.** The first risk relates to temporary small-scale construction-related and site-specific risks/impacts, such as dust, wastewater, noise, solid waste, soil erosion, limited land acquisition or use, and OHS issues. The second is impacts on the local environment, society, and the ecosystem resulting from the operation/implementation of the GARR PforR supported facilities/activities, such as effluent and sludge from rural domestic WWTFs, odor and leachate from domestic solid waste collection and transfer facilities, wastewater and odor from livestock and poultry manure management facilities, wastewater and tail water from aquaculture farms, NPS pollution from fertilizer and pesticide application, removed residues from heavy metal polluted farmland, labor management issues, workers' health and safety risks, impacts on farmers' livelihoods, and potential downstream indirect impacts of technical assistance activities. These adverse E&S impacts are neither significant nor irreversible and can be easily identified and avoided, minimized, and mitigated through known and demonstrated technologies and good management practices. Neither OP/BP 7.50 (Projects on International Waterways) nor OP/BP 7.60 (Projects in Disputed Areas) applies to the GARR PforR.

4. **With the E&S exclusion list, the GARR PforR will focus on supporting small-scale physical infrastructure as well as technical assistance activities,** such as reducing chemical fertilizers and toxic pesticides; treating and recycling livestock and poultry wastes (E&S due diligence found that the existing organic fertilizer factories, which also treat livestock and poultry manure had been involved in land acquisition of only about 10–30 mu); constructing rural domestic wastewater management facilities; constructing rural domestic solid waste collection and transfer facilities; returning crop straw to the farmland; managing heavy metals in degraded farmland soils; treating wastewater and tail water from aquaculture

farms; developing regulations, standards, and guidelines for GAP and CSA technologies; preparing spatial IVDPs; and training and capacity building activities.

E&S Systems Assessment

5. **A comprehensive review of the legal and regulatory framework for E&S management relevant to the GARR PforR activities was carried out,** including the legal framework; management procedures; and institutional arrangements, performance, and capacity. Overall, China has established a comprehensive legal framework for the management of E&S issues at both national and provincial levels (including Hubei and Hunan provinces), which consists of laws, regulations, guidelines, and standards that are largely consistent with the World Bank's Program for Results Policy and Directive. The legal framework provides a reasonable basis for addressing the E&S issues related to the GARR PforR activities.

Environmental Management Systems

6. **Since its first Environmental Protection Law promulgated in 1979, China has gradually developed a comprehensive environmental management legal framework.** In recent years, the Chinese Government has made efforts to reform its environmental management systems by enhancing its law enforcement capacity. Various laws, regulations, and guidelines have been or are being issued or updated by national and provincial governments, especially regarding EIA, pollution control (air, water, and soil), natural habitat conservation, and OHS management. The key government stakeholders involved in environmental management under the GARR PforR include various levels of the EEBs, WRBs, HURDBs, ARABs, NRBs, health commissions (HCs), and emergency management bureaus (EMBs), among others. EEB reviews and approves domestic EIA instruments; supervises the environmental compliance of construction, operation, and production activities; and manages rural domestic wastewater collection and treatment. WRB reviews and approves subprojects' soil and water conservation documents. HURDB is the sector authority for rural domestic solid waste management. ARAB supervises the activities involving livestock/poultry farming and livestock and poultry manure treatment, aquaculture farming and tailwater treatment, fertilizer and pesticide reduction, crop straw reuse, heavy metal polluted farmland restoration, and so on. EMB and HC take overall responsibility for OHS management.

7. **Consultations with government stakeholders at provincial and county/city levels and site visits to typical activities in the sample counties/cities of Hubei and Hunan have demonstrated that the environmental management systems**—in terms of the legal framework, implementation procedures, institutional arrangements, and management performance related to the GARR PforR activities—are consistent with the World Bank's Program for Result Policy and Directive as well as the EHS guidelines and can provide an acceptable basis for addressing the possible environmental issues related to the GARR PforR activities. The assessment also identified some gaps in the environmental management systems, such as inadequate odor management at livestock/poultry farms and domestic solid waste transfer stations and insufficient discharge standards to guide regular monitoring of tail water from aquaculture farms.

Social Management Systems

8. **The E&S assessment concluded that China has formulated a series of laws and policies at the national and provincial levels and has established appropriate management agencies and mechanisms to govern social risks in the GARR PforR activities.** The social systems assessment focused on the social impacts and risk assessment and management system, cultural heritage protection, occupational health and community safety, land acquisition and resettlement, public participation, ethnic minorities, and vulnerable groups. The social systems are deemed comprehensive and consistent with the World Bank's Program for Results Policy and Directive.

9. **Hubei and Hunan have established management agencies with clear responsibilities and qualified staff for managing corresponding social risks and impacts at the provincial, municipal, and county levels.** Under the social systems assessment, the World Bank team reviewed the organizational setup of the relevant agencies against the principles and elements set out in the World Bank guidance. For example, China has established a functioning mechanism

of social stability risk assessment, which is used by project implementation agencies and managed through the committees of provincial and county political and legislative affairs. The labor authorities have established a tripartite mechanism on labor relations with trade unions and enterprises to solve relevant labor issues. The cultural departments are responsible for managing adverse impacts on physical cultural heritage. The NRBs enforce land acquisition, compensation, and resettlement with support from and coordination with township governments and village committees. The ethnic and religious affairs bureaus develop the related development plans as required by the jurisdictional governments, protecting the lawful rights and interests of minority residents. Other line bureaus, such as social security bureaus and women's federations, are also involved in livelihood restoration for project-affected persons. China has also established various competent authorities to manage and support vulnerable groups. For example, poverty reduction offices or county-level revitalization bureaus are mainly responsible for poverty reduction, the disabled person federation for assistance to disabled people, civil affairs bureaus for support to left-behind older people and children, and women's federations for assistance to women.

10. **Following the engagement with various stakeholders from both provincial and county levels and the due diligence of poverty and agriculture programs and projects,** it was concluded that the social management systems are well functioning. However, the social systems assessment also identified some minor gaps that need to be addressed to minimize adverse social impacts, which relate mainly to some of the planned GARR PforR facilities, especially scattered small facilities, such as livestock and poultry manure disposal facilities, crop straw storage and processing facilities, small WWTFs,[57] and small rural waste collection and transfer facilities. During the preparation stage of the GARR PforR, due diligence on the past and existing social impact management system of related government programs indicated that social risk or impact assessment and monitoring is not adequately performed in some associated projects and poor record keeping and documentation of the public participation and grievance redress activities were also noted. These activities and the OHS awareness and management of associated facilities need further improvement. These issues will need to be addressed during the GARR PforR implementation.

Stakeholder Engagement

11. **Robust engagement was carried out with relevant stakeholders during the ESSA process,** including with the government departments at the national, provincial, county/city, and township levels; local communities; and relevant enterprises by means of meetings, field visits, and online interviews. The draft ESSA report was shared with the NRRA, Hubei and Hunan provincial and county PMOs, relevant provincial government departments, and all demonstration counties/cities on October 11, 2022. Consultation meetings on the draft ESSA report were carried out with the key stakeholders on October 26, 2022 (Hunan) and October 27, 2022 (Hubei). During the preparation of the ESSA report, the stakeholders consulted voiced their support for the GARR PforR. Both Hubei and Hunan leaders acknowledged that the ESSA report's findings and recommendations were relevant and invaluable in strengthening their implementation capacity of the E&S management systems. Some participants provided substantive feedback on how to improve the accuracy of the ESSA report, which have been reflected in the revised ESSA report. The revised ESSA report were disclosed on the respective governments' websites in Hubei on November 25, 2022, and in Hunan and at the NRRA on November 29, 2022. The final ESSA report will be disclosed at the World Bank's website after negotiations.

Grievance Redress Mechanism

12. **The ESSA report also concludes that a program GRM has been established in both program provinces.** The existing GRM includes community and enterprise levels. The community GRM consists of four levels. First, grievances are reported directly to the relevant PIUs to seek a solution. Second, if the PIU cannot resolve, the grievances are reported to the village or community committee. Third, if the village or community committee cannot resolve, the grievances are

[57] Typically, these WWTFs have a maximum capacity of treating 500 m^3 per day with an average of 50–100 m3 per day.

reported to the township government or sub-district office. Fourth, if the township government or sub-district office cannot resolve, the grievances are reported to the county public complaints and proposals bureaus or the county head's hotline/mailbox, which includes a mechanism for collecting complaints, hearing within seven days, and resolving within two months. In addition, residents can resolve more serious disputes through civil actions at courts. The enterprise GRM has two aspects. First, workers' grievances that are handled through a three-tier labor dispute resolution mechanism: the enterprise labor disputes and redressing mechanism, the township government's labor dispute mediation center, and the county government's labor mediation center. At the enterprise level, workers can seek a solution through the enterprise/factory manager mailbox or the trade union. If any dispute cannot be satisfactorily resolved, workers can go through the government mediation mechanism or seek solution by labor arbitration. Second, the enterprise sets up an external relations department and assigns a contact and a telephone number to collect complaints and suggestions from the public.

Key Conclusions and Recommendations

13. **The ESSA report identified some weaknesses in the E&S management practices.** First, there is inadequate OHS awareness and training provided to staff of agro-enterprises and waste treatment facilities, such as those dealing with livestock and poultry manure recycling, crop straw storage and processing, solid waste collection and transfer facilities, rural and township sewage treatment facilities, and the management and supervision staff of the local authorities. Second, odor issues exist in traditional livestock and poultry farms, some domestic solid waste transfer stations, and WWTFs. The ESSA report recommends that these weaknesses should be addressed by implementing the following actions that have been included in the PAP (see annex 6): (a) implementing mitigation measures to ensure that odor treatment equipment for new or upgraded livestock and poultry manure treatment facilities are installed and domestic solid waste transfer stations are well designed, constructed, and operated and (2) preparing and implementing OHS training for employees of agro-enterprises and input dealers, livestock and poultry manure, WWTFs and solid waste transfer stations, and crop straw storage and processing facilities.

ANNEX 6. PROGRAM ACTION PLAN

Action Description	Source	DLI#	Responsibility	Timing		Completion Measurement
Develop of the measurement, reporting and verification (MRV) methodologies for calculating greenhouse gas emissions (GHG) reduction due to improved management of the livestock and poultry manure, chemical fertilizer, and rice.	Other		NRRA/IPRCC	Due Date	30-Jun-2025	The three MRVs are prepared by experts hired by the NRRA for use in the two program provinces.
Issue an official notification that no contract will be awarded to either a firm or an individual appearing on either the World Bank's debarred list or under temporary suspension list.	Fiduciary Systems		NRRA/Hubei RRA/Hunan DARA	Other	No later than loan effectiveness	NRRA and provincial official notifications to affiliations/counties are issued and copies are shared with the World Bank. The notice is also included in the PIP.
Regularly inform the World Bank of any credible and material allegations of fraud and/or corruption regarding the GARR PforR's activities as part of the overall program's reporting requirements.	Fiduciary Systems		IPRCC/PPMO	Recurrent	Semi-Annually	Reflected in the PforR's quarterly/annual progress reports.
Finalize template of the Program financial reporting,	Fiduciary Systems		IPRCC, PDOF and PPMO	Other	By effectivenes	A formal response through email by IPRCC and PPMO with looping in the provincial DOF.

including budget codes and lines based on the Program related sources of funds and budgeted expenditures.					s	Final templates shared with the Bank for review and records. The final templates are also included in the PIP.
Finalize the Program external audit TOR drafted by the Bank, which elaborates the Program background, audit objective, audit scope, applicable audit standards, description of financial statements, and requirements on the audit report.	Fiduciary Systems		CNAO, PAO and PPMO	Other	By effectiveness	The auditor's formal response for concurrence through email with the PPMO being informed. Final TOR shared with the Bank for review and records. Ensure that final TOR are included in the PIP.
Implement mitigation measures to ensure that the odor treatment equipment for new or upgraded livestock and poultry manure treatment facilities, and domestic solid waste transfer stations are well designed, constructed, and operated.	Environmental and Social Systems		County and Provincial PMOs.	Recurrent	Yearly	Third-party Verification Agents confirm that new or upgraded facilities are free of odor.
Prepare and implement occupational health and safety (OHS) trainings for the employees of agro-enterprises; livestock and poultry manure, and wastewater treatment facilities; solid waste transfer stations; and crop straw storage and	Environmental and Social Systems		PPMOs and county PMOs	Recurrent	Yearly	The training and capacity building plans are prepared by PPMOs and cleared by the World Bank. Records of the people trained in various enterprises and facilities.

processing.						
Prepare and implement two detailed training and capacity building plans: a green agricultural skills training plan; and a capacity building plan for the O&M of the rural solid waste and wastewater facilities.	Other		Provincial/County PMOs	Recurrent	Yearly	The two training and capacity building plans are prepared and shared with the World Bank. Records of the people trained in various categories of skills development are kept in the MIS.

ANNEX 7. IMPLEMENTATION SUPPORT PLAN

Main Focus of Implementation Support

Time	Focus	Skills Needed	Resources Estimate
First 12 months	Support for startup activities	Task Team Leaders	4 SW and 2 trips/staff (a total of 8 SW)
	Support for the establishment of IT-based systems for budgeting/expenditure tracking and O&M of infrastructure	Financial Management Specialist Economist Municipal Engineer	4 SW and 2 trips/staff (a total of 12 SW)
	Support for the establishment of the M&E system and complete baseline surveys	M&E Expert	4 SW and 2 trips/staff
	Support for the hiring of third-party VAs	M&E Expert Agriculture Economist Municipal Engineer	4 SW and 2 trips/staff (a total of 12 SW)
	Training and capacity building in the fiduciary (FM and procurement) system	Financial Management Specialist Procurement Specialist	4 SW and 2 trips/staff (a total of 8 SW)
	Training and capacity building in E&S safeguards	Environmental Management Specialist Social Development Specialist	4 SW and 2 trips/staff (a total of 8 SW)
12–48 months	Program implementation support	—	—
	Review of implementation progress toward achieving the PDO of the China GARR PforR (Hubei and Hunan)	Task team Leaders	1 SW/2 staff/year
	Conduct two implementation support missions for each region/province per year	Core PforR task team	4 SW/staff/twice a year (for a total of 120 SW/year)
	Review the semi-annual third-party monitoring and third-party VA reports	Task Team Leaders and Technical Experts for each DLI	4 SW/year
	Review the annual audit reports	Fiduciary teams	1 SW/year
	Review the semi-annual E&S safeguards reports	Safeguards team	2 SW/year
	Provide training and capacity building in fiduciary and E&S safeguards	Fiduciary and Safeguards teams	2 SW/PforR life
	Conduct midterm review mission	Core PforR task team	4 SW/staff/once (for a total of 60 SW)
	Prepare Program Completion Report	Core PforR task team	4 SW/staff (for a total of 8 SW)

Note: SW = Staff Weeks.

Task Team Skills Mix Requirements for Implementation Support

Skills Needed	Number of Staff Weeks (per year)	Number of Trips (per year)
Task Team Leader	10	3
Co-Task Team Leader	10	3
Economist	4	2
Financial Management Specialist	6	2
Procurement Specialist	4	2
Environmental Management Specialist	4	2
Social Management Specialist	4	2
Municipal Engineer	4	2
Water Resources Engineer	4	2
Gender Specialists	2	2
Livestock Management Specialist	4	2
Agribusiness Specialist	4	2

ANNEX 8: COMPLEMENTARITY OF IBRD-FUNDED POLLUTION ABATEMENT PROJECTS

1. Point source pollution control in China has improved through significant investment in the collection and treatment of domestic wastewater. But most of these improvements have occurred in urban areas where the wastewater treatment rate increased from 15 percent in 1991 to more than 95 percent in 2020. By contrast, in rural areas, especially in traditional villages, challenges remain in point source and agricultural NPS pollution (for example, livestock and poultry manure and chemical fertilizer), giving rise to persistent pollutants driving non-compliance with water quality standards—primarily organic matter (COD), nitrogen, and phosphorus. Plastic pollution, which is at the origin of the global marine plastics problem, follows similar patterns, with plastic collection and recycling improving in cities, but lagging far behind in small towns and rural areas.

2. The following paragraphs list the recently approved IBRD operations helping the Chinese Government and provincial and county authorities enhance solid and plastic waste management and wastewater treatment policies and institutions and invest in physical pollution abatement, including in the rural space. Together, these programs and project are helping China mitigate pollution and generate climate co-benefits, which are GPGs.

3. The Hubei Smart and Sustainable Agriculture Project (P168061) approved in FY20 promotes integrated environmentally sustainable and climate-smart agriculture and agri-food quality and safety in targeted value chains and landscapes in the Hubei province. This includes preventing and mitigating pollution from livestock and poultry manure, heavy metals, and agricultural plastics.

4. The Plastic Waste Reduction Project (Chongqing and Ningbo municipalities) (P174267) approved in FY21 improves plastic waste management nationally and subnationally and reduces plastics pollution from municipal solid waste. This project will be followed by the China Plastic Waste Reduction Project (Shaanxi) (P176989) in FY23 that would improve the policy framework by developing the urban-rural integrated model for municipal solid waste service, while also investing in plastic pollution in selected underserved rural areas, and drawing lessons on plastic waste management relevant at the national level.

5. The Food Safety Improvement Project (Guangdong and Shandong) (P162178) approved in FY21 supports food safety management at national and targeted subnational levels and reduces food safety risks in selected value chains, including due to contamination of soil and water through a range of contaminants, including domestic wastewater, livestock and poultry manure, agricultural NPS pollutants, and plastics.

6. The Yangtze River Protection and Ecological Restoration Program (Hunan and Jiangxi) (P171644) approved in FY22 improves institutional coordination, enhances ecological protection, and reduces water pollution loads in select regions of the Yangtze River Basin, including from untreated livestock and poultry manure and domestic wastewater and uncollected or mishandled rural waste such as livestock and poultry manure and agricultural plastics. This program is followed by the Yangtze River Protection and Ecological Restoration Program for Results (Hubei) (P178338) to be approved in FY23.

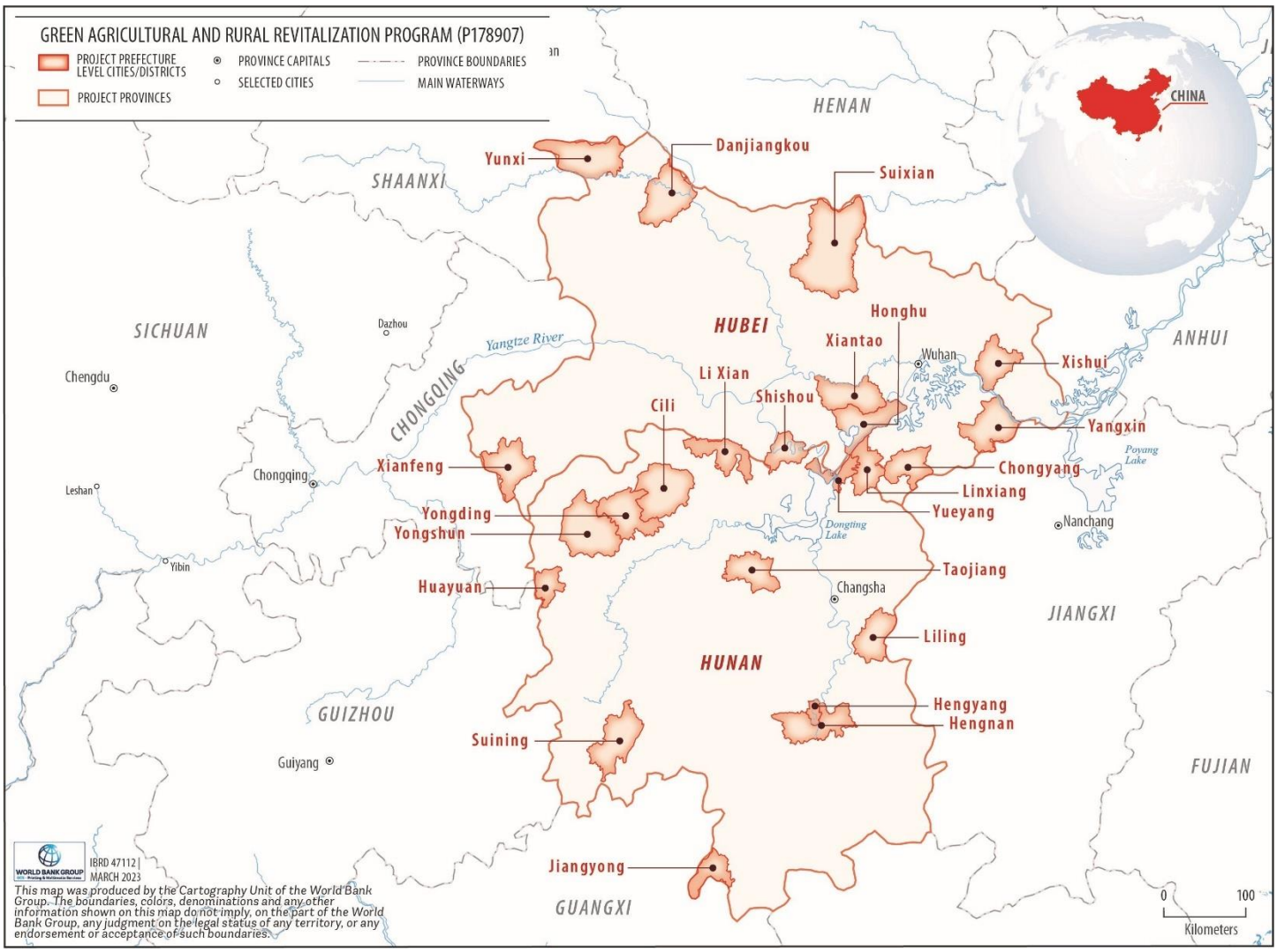
7. The Yellow River Basin Ecological Protection and Pollution Control Program (Henan and Shaanxi) (P172806) approved in FY22 supports activities that improve institutional coordination, enhance ecological protection, and reduce water pollution loads in select regions of the Yellow River Basin. This includes reducing marine plastics pollution through improved collection and treatment of solid waste and improved agricultural practices. The Yellow River Basin Ecological Protection and Environmental Pollution Control Program (Gansu and Shandong) (P178401) to be approved in FY24 promotes improved watershed management and water use efficiency to enhance ecosystem services and restore biodiversity.

8. The GAPP PforR (Guangxi and Guizhou) (P177590) also approved in FY22 supports greening of selected value chains and reduction of agricultural point and NPS pollutants, especially from overuse of chemical fertilizers and pesticides, untreated livestock and poultry manure, untreated domestic wastewater, and mismanaged solid waste, including agricultural plastics. This entails reducing agricultural plastics pollution through improved collection, sorting, and transfer of rural solid waste and improved agricultural practices.

ANNEX 9: TASK TEAM LIST

No.	Name	Title	Unit
1	Mr. Ladisy Komba Chengula	Lead Agriculture Economist	SEAAG
2	Mr. Wendao Cao	Senior Agricultural Economist	SEAAG
3	Mr. Xueming Liu	Agricultural Economists	FAO
4	Mr. Liu Zheng	Senior Procurement Specialist	EEAR1
5	Ms. Zhang Fang	Senior Financial Management Specialist	EEAG1
6	Ms. Min Zhao	Senior Economist	EEAG1
7	Mr. Paul Jonathan Martin	Lead Natural Resource Management Specialist/Peer Reviewer	SLCEN
8	Mr. Paavo Eliste	Lead Agriculture Economist/Peer Reviewer	SAEA3
9	Mr. William Sutton	Lead Agriculture Economist/Peer Reviewer	SLCAG
10	Mr. Kai Kaiser	Senior Governance and Public Sector Specialist/Peer Reviewer	EECG1
11	Mr. Bin Xu	Environmental Engineer	SEAE1
12	Mr. Alejandro Alcala Gerez	Operations Manager	EACCF
13	Mr. Yiren Feng	Senior Environmental Specialist	SEAE1
14	Ms. Minghe Zheng	Finance Officer	WFACS
15	Mr. Aristeidis Panou	Senior Counsel	LEGAS
16	Mr. Minghe Tao	Senior Municipal Engineer	SEAU2
17	Ms. Fang Yang	Gender Specialist Consultant	EACCF
18	Mr. Guoxin Zhou	Social Specialist Consultant	SEAS1
19	Ms. Chunyan Hou	Environmental Specialist Consultant	SEAE1
20	Ms. Li Du	Senior Financial Consultant	SEAW1
21	Mr. Yun Ma	Financial Consultant	SEAW1
22	Mr. Zhang Weijian	Senior Agriculture Specialist, Consultant	SEAAG
23	Mr. Dong Baocheng	Senior Livestock Specialist, Consultant	SEAAG
24	Ms. Xuan Peng	Senior Program Assistant	EACCF
25	Ms. Yunqing Tian	Program Assistant	EACCF
26	Mr. Dewen Wang	Senior Social Protection Economist	HEASP

ANNEX 10: MAP


GREEN AGRICULTURAL AND RURAL REVITALIZATION PROGRAM (P178907)
PROJECT PREFECTURE LEVEL CITIES/DISTRICTS
PROJECT PROVINCES
PROVINCE CAPITALS
SELECTED CITIES
PROVINCE BOUNDARIES
MAIN WATERWAYS
CHINA
HENAN
SHAANXI
SICHUAN
CHONGQING
HUBEI
ANHUI
JIANGXI
HUNAN
GUIZHOU
GUANGXI
FUJIAN
Yangtze River
Poyang Lake
Dongting Lake
Yunxi
Danjiangkou
Suixian
Honghu
Xiantao
Wuhan
Xishui
Li Xian
Shishou
Cili
Yangxin
Xianfeng
Chongyang
Linxiang
Yueyang
Yongding
Yongshun
Huayuan
Taojiang
Liling
Hengyang
Hengnan
Suining
Jiangyong
Dazhou
Chengdu
Chongqing
Leshan
Yibin
Guiyang
Changsha
Nanchang
IBRD 47112 | MARCH 2023
This map was produced by the Cartography Unit of the World Bank Group. The boundaries, colors, denominations and any other information shown on this map do not imply, on the part of the World Bank Group, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries.
0
100
Kilometers