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Report No: PAD3443

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF EURO 267.2 MILLION  
(US\$300 MILLION EQUIVALENT)

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

HENAN GREEN AGRICULTURE FUND PROJECT

March 3, 2020

Agriculture and Food Global Practice  
East Asia And Pacific Region

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**CURRENCY EQUIVALENTS**

(Exchange Rate Effective January 17, 2020)

**Currency Unit = CNY**

**CNY 6.88 = US\$1**

**US\$ = SDR 1**

**FISCAL YEAR**

**January 1–December 31**

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## ABBREVIATIONS AND ACRONYMS

ACG	Anticorruption Guidelines
AMAC	Asset Management Association of China
CIO	Chief Investment Officer
CNAO	China National Audit Office
COD	Chemical Oxygen Demand
CPF	Country Partnership Framework
DA	Designated Account
DFIL	Disbursement and Financial Information Letter
E&S	Environmental and Social
EHS	Environmental, Health, and Safety
ERR	Economic Rate of Return
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESMS	Environmental and Social Management System
ESS	Environmental and Social Standard
EX-ACT	Ex-Ante Carbon-balance Tool
FAO	Food and Agriculture Organization of the United Nations
FIRR	Financial Internal Rate of Return
FLW	Food Loss and Waste
FM	Financial Management
FNPV	Financial Net Present Value
GAF	Henan Green Agriculture Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLEAM	Global Livestock Environment Assessment Model
GP	General Partner
GPIDC	General Partner Investment Decision Committee
GRS	Grievance Redress Service
GTI	Green Technology Inventory
HADFC	Henan Agriculture Development Fund Investment Corporation
HAIGC	Henan Agriculture Investment Group Co. Ltd
HDF	Henan Department of Finance
HPAO	Henan Provincial Audit Office
IDC	Investment Decision Committee
IFC	International Finance Corporation
IOC	Incremental Operating Costs
IPM	Integrated Pest Management
IRR	Internal Rate of Return
ISM	Implementation Support Mission
IT	Information Technology

LLC	Limited Liability Company
M&E	Monitoring and Evaluation
MARA	Ministry of Agriculture and Rural Affairs
MFD	Maximizing Finance for Development
MOF	Ministry of Finance
MRV	Monitoring, Reporting, and Verification
N	Nitrogen
NBS	National Bureau of Statistics
NPV	Net Present Value
PAR	Portfolio at Risk
PDO	Project Development Objective
RAI	Responsible Agriculture Investments
SDC	Swiss Agency for Development and Cooperation
SEP	Stakeholder Engagement Plan
SIFs	Strategic Investment Funds
SMEs	Small and Medium Enterprises
TA	Technical Assistance
TN	Total Nitrogen
TOR	Terms of Reference
TP	Total Phosphorus
VC	Venture Capital

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## DATASHEET

### BASIC INFORMATION

Country(ies)	Project Name	
China	Henan Green Agriculture Fund Project	
Project ID	Financing Instrument	Environmental and Social Risk Classification
P169758	Investment Project Financing	Substantial

### Financing & Implementation Modalities

<input type="checkbox"/> Multiphase Programmatic Approach (MPA)	<input type="checkbox"/> Contingent Emergency Response Component (CERC)
<input type="checkbox"/> Series of Projects (SOP)	<input type="checkbox"/> Fragile State(s)
<input type="checkbox"/> Disbursement-linked Indicators (DLIs)	<input type="checkbox"/> Small State(s)
<input checked="" type="checkbox"/> Financial Intermediaries (FI)	<input type="checkbox"/> Fragile within a non-fragile Country
<input type="checkbox"/> Project-Based Guarantee	<input type="checkbox"/> Conflict
<input type="checkbox"/> Deferred Drawdown	<input type="checkbox"/> Responding to Natural or Man-made Disaster
<input type="checkbox"/> Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
26-Mar-2020	31-Dec-2026
Bank/IFC Collaboration	Joint Level
Yes	Joint Project - involving co financing with IFC (loan, equity, budget, other) or staffing

### Proposed Development Objective(s)

The proposed objective is to demonstrate the viability of financing green agriculture investments, and foster the innovation and adoption of green agriculture standards and technologies in Henan.

### Components

Component Name	Cost (US\$, millions)



Component 1: Green Agriculture Fund	285.00
Component 2: Technical Assistance and Innovation Challenge	15.00

## Organizations

Borrower: People's Republic of China

Implementing Agency: Henan Agriculture Development Fund Investment Corporation

## PROJECT FINANCING DATA (US\$, Millions)

### SUMMARY

Total Project Cost	300.00
Total Financing	300.00
of which IBRD/IDA	300.00
Financing Gap	0.00

### DETAILS

#### World Bank Group Financing

International Bank for Reconstruction and Development (IBRD)	300.00
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## Expected Disbursements (in US\$, Millions)

WB Fiscal Year	2020	2021	2022	2023	2024	2025	2026	2027
Annual	0.00	6.00	24.00	45.00	50.00	55.00	60.00	60.00
Cumulative	0.00	6.00	30.00	75.00	125.00	180.00	240.00	300.00

## INSTITUTIONAL DATA

#### Practice Area (Lead)

Agriculture and Food

#### Contributing Practice Areas

Finance, Competitiveness and Innovation



### 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	● Moderate
3. Sector Strategies and Policies	● Moderate
4. Technical Design of Project or Program	● Substantial
5. Institutional Capacity for Implementation and Sustainability	● Moderate
6. Fiduciary	● Substantial
7. Environment and Social	● Substantial
8. Stakeholders	● Moderate
9. Other	
10. Overall	● Substantial

### COMPLIANCE

#### Policy

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

[ ] Yes    [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes    [✓] No

**Environmental and Social Standards Relevance Given its Context at the Time of Appraisal**

E & S Standards	Relevance
Assessment and Management of Environmental and Social Risks and Impacts	Relevant
Stakeholder Engagement and Information Disclosure	Relevant
Labor and Working Conditions	Relevant
Resource Efficiency and Pollution Prevention and Management	Relevant
Community Health and Safety	Relevant
Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Relevant
Biodiversity Conservation and Sustainable Management of Living Natural Resources	Relevant
Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Relevant
Cultural Heritage	Relevant
Financial Intermediaries	Relevant

**NOTE:** For further information regarding the World Bank's due diligence assessment of the Project's potential environmental and social risks and impacts, please refer to the Project's Appraisal Environmental and Social Review Summary (ESRS).

**Legal Covenants**

## Sections and Description

Institutional Arrangements (Section I.A.1 of the Schedule to the Project Agreement): HADFIC shall maintain throughout the period of implementation of the Project an organizational structure under the direction of qualified management provided with sufficient resources, and staffed with competent personnel in adequate numbers including dedicated departments focusing on the management of the Loan proceeds (including environmental and social safeguards), financial management, investment business, compliance and risk management, and integrated management, in each case with qualifications, experience and under terms of reference acceptable to the Bank.

## Sections and Description

Subsidiary Loan Agreement (Section I.B of the Schedule to the Project Agreement): Henan shall make the proceeds of the Loan available to HAIGC under a subsidiary agreement between Henan and HAIGC, under terms and conditions acceptable to the Bank.



#### Sections and Description

Contribution Agreement (Section I.C of the Schedule to the Project Agreement): HAIGC shall make the proceeds of the Loan available to HADFIC under a contribution agreement between HAIGC and HADFIC, under terms and conditions acceptable to the Bank.

#### Sections and Description

Business Plan and Project Operations Manual (Section I.D of the Schedule to the Project Agreement): HADFIC shall apply the Business Plan and the Project Operations Manual in a timely and efficient manner acceptable to the Bank.

#### Sections and Description

Green Agriculture Sub-projects and Innovation Sub-projects (Section I.F of the Schedule to the Project Agreement): HADFIC shall: (a) select and approve Investee Enterprise in accordance with the eligibility criteria and the procedures set forth in the Business Plan and the Project Operations Manual; (b) appraise, review, approve, and supervise the Green Agriculture Sub-projects and the Innovation Sub-project, as the case may be, in accordance with the criteria, conditions and procedures set out in the Business Plan and the Project Operations Manual; and (d) make Capital Investments or Innovation Investments to Investee Enterprises in accordance with eligibility criteria and procedures acceptable to the Bank as set out in the Business Plan and the Project Operations Manual, and shall only make the proceeds of the Capital Investments or the Innovation Investments available to such Investee Enterprises after HADFIC have entered into a Capital Investment Agreement or an Innovation Investment Agreement with the Investee Enterprise on terms and conditions acceptable to the Bank.

#### Sections and Description

Environmental and Social Standards (Section I.E of the Schedule to the Project Agreement): HADFIC shall: (a) ensure that: (i) that the Project is carried out in accordance with the Environmental and Social Standards, in a manner acceptable to the Bank; (ii) the Project is implemented in accordance with the Environmental and Social Commitment Plan ("ESCP"), in a manner acceptable to the Bank; (iii) the ESMS is: (1) maintained and operated; (2) applied to all Sub-borrowers under the Project; and (3) updated and/or revised as necessary, all in a manner satisfactory to the Bank; (iv) take all measures necessary on its part to collect, compile, and furnish to the Bank through regular reports, with the frequency specified in the ESCP, and promptly in a separate report or reports, if so requested by the Bank, information on the status of compliance with the ESCP, the ESMS and the management tools and instruments referred to therein, all such reports in form and substance acceptable to the Bank; (v) promptly notify the Bank of any incident or accident related to or having an impact on the Project which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers, in accordance with the ESCP, the ESMS, the instruments referenced therein and the Environmental and Social Standards; and (vi) maintain and publicize the availability of a grievance mechanism, in form and substance satisfactory to the Bank, to hear and determine fairly and in good faith all complaints raised in relation to the Project, and take all measures necessary to implement the determinations made by such mechanism in a manner satisfactory to the Bank.

#### Sections and Description

Annual Financial Review (Section II.2 of the Schedule to the Project Agreement): HADFIC shall: (a) undertake an annual financial portfolio review and audit of the GAF in a manner and methodology acceptable to the Bank and set forth in the Project Operations Manual; and (b) furnish to the Bank corresponding annual portfolio review and audit report, in form and substance acceptable to the Bank, by not later than six (6) months after the end of each fiscal year.



### Sections and Description

Mid-term Review (Section II.3 of the Schedule to the Project Agreement): HADFIC shall prepare, under terms of reference acceptable to the Bank, and furnish to the Bank no later than July 1, 2024, a consolidated mid-term review report for the Project, summarizing the results of the monitoring and evaluation activities carried out from the inception of the Project, setting out the measures recommended to ensure the efficient completion of the Project to further the objectives thereof, and containing a plan for the sustainability of the GAF.

### Conditions

Type	Description
Effectiveness	Section 5.01 of Article V of the Loan Agreement: (a) the Subsidiary Loan Agreement has been executed on behalf of Henan and HAIGC; (b) the Contribution Agreement has been executed on behalf of HAIGC and HADFIC; and (c) HADFIC has: (i) duly established an investment fund under Part 1 of the Project, in form and substance acceptable to the Bank, and pursuant to the laws of the Borrower; (ii) furnished to the Bank all the Constituent Instruments; and (iii) adopted the Business Plan and the Project Operations Manual in form and substance acceptable to the Bank.



## I. STRATEGIC CONTEXT

### A. Country Context

1. **China is one of the largest agricultural economies in the world.** Its agricultural gross domestic product (GDP) was US\$770 billion in 2018 (constant 2010 US\$), and agricultural GDP growth has averaged 4.3 percent a year from 1978 to 2018. The country is home to 19 percent of the world's population but has only 8 percent of the global arable land and 13 percent of irrigation water resources. In per capita terms, this amounts to 40 percent and 25 percent respectively of the global average. Despite these limitations, China produces 18 percent of the world's cereal grains, 29 percent of the world's meat, and 50 percent of the world's vegetables.
2. **While past agriculture policies in China have been driven by the quest for grain self-sufficiency, future food systems will be shaped by urbanization and income growth.** China has already seen a rapid decline of its rural population since around 1995, due to massive rural–urban migration (about 200 million people). It is expected that China will reach an urbanization rate of 70 percent by 2030 up from 55 percent now. Urbanization will increase aggregate demand for food as changing dietary patterns and increased income levels of the urban population lead to increased demand for higher-value products, especially meat, dairy, horticulture products, and processed food. The consumption growth projections by the World Bank show that China will be consuming 14 percent more pork, 10 percent more milk, and 97 percent more high-value dairy products by 2030. On the other hand, China's increasingly affluent urban consumers are demanding safer, healthier, and greener food. For example, while the aggregate consumption of horticulture products is expected to increase only slightly, there is a marked shift toward green and organic products, which are produced using agriculture technologies that increase the utilization efficiency of natural resources, reduce pollution and greenhouse gas (GHG) emissions, or improve the health of the ecological environment.
3. **Meeting the challenge of changing consumption patterns could impose great strains on Chinese food production systems against the background of a legacy of pollution and increasing natural capital constraints.** China's already limited arable land and water resources are dwindling rapidly due to urbanization (estimated loss of arable land due to urbanization is 5.0–6.1 percent by 2030) and are increasingly degraded due to industrial pollution. Some 7 percent of irrigated land is contaminated with polluted water and 19 percent of farmland has excessive levels of heavy metals. Farming on 3.3 million ha of land is banned indefinitely.
4. **Current agricultural practices are also contributing to environmental pollution, resource depletion, and public health risks.** China is the world's largest producer and user of chemical nitrogenous (N) fertilizers, both on an absolute and per hectare basis. Consumption of fertilizers in China was 58 million tons in 2017. Grain production is the leading user of fertilizers, although the highest fertilizer application rates occur in fruit and vegetable production. It has been estimated that only about 25 percent of N is taken up by crops in China compared to 50 percent in Europe and almost 70 percent in the United States and Canada, with the remainder running off into water sources or entering the air as nitrous oxide. Ammonia emissions from N fertilizer use contribute around 10 percent of the air pollution ( $PM_{2.5}$ ) in the North China Plain and Pearl and Yangtze River Deltas. According to the first census on national pollution sources in 2010, Chemical Oxygen Demand (COD), Total Nitrogen (TN), and Total Phosphorus (TP) are the major sources of pollutants from agriculture sector. While COD mainly comes from the livestock sector, accounting for 96 percent of its total emissions, TN and TP are primarily attributable to overuse of fertilizers in the crop sector, with 38 percent and 59 percent of total emissions,



respectively. Consumption of pesticides in China was 1.8 million tons per year in 2015, and about 30 percent of it was utilized by crops. Overuse of pesticides affects about 10 million ha of farmland.

**5. The extensive use of plastic micro-film in Chinese agriculture to retain soil moisture is an important source of micro-plastics pollution, an issue of growing global concern.** It has been estimated that there are about 20 million ha of agricultural land under plastic mulch in China using nearly 1.2 million tons of plastic film. The area under agricultural plastic mulch application has expanded especially rapidly in northern arid and semiarid regions (including Henan), and the high mountain cold regions of South China.

**6. China's agricultural sector heavily contributes to the country's and global GHG emissions.** It accounts for about 14 percent of global agriculture-related GHG emissions (about 730 Mt in 2016) and is a major source of two highly potent GHGs: methane (from livestock manure and rice) and nitrous oxide (from manure and use of nitrogen fertilizers). Nitrogen fertilization makes accounts for 30 percent of all total agriculture GHG emissions in China, followed by livestock production (27 percent), energy use (20 percent), and rice production (13 percent). By one estimate, China is on a path to emit more than 500 million tons of emissions by 2050 from various parts of N fertilizer production and use.

**7. Food Loss and Waste (FLW) is another area which has important implications on agriculture related GHG emissions and resource use efficiency in general.** Food that is either lost or wasted generates significant GHGs (estimated at 8 percent of annual global GHG emissions), which occurs through decomposing organic matter, fertilizer use (interference with the global nitrogen and phosphorus cycles), and the overall process of producing and processing food that is not consumed. According to data from China's State Administration of Grain, in 2014, 35 percent of China's annual food produced was lost or wasted, mostly at the consumption stage. Even without a reduction in FLW, a smaller carbon footprint of agriculture production and processed foods would contribute to lower levels of FLW-related GHG emissions and pollution. More efficient production and/or processing of food would reduce the need for land conversion for additional food production and slow the rate of increase in fertilizer applications.

**8. Over the last five years, China has taken some policy and reform steps toward the transformation of its agriculture and food sector from high-input/high environmental footprint practices toward more sustainable intensification.** Efforts have been made to curb the use of fertilizer and pesticide overuse, and there are initial steps to restructure China's massive agricultural subsidy system to encourage more efficient utilization of natural resources, and environmental protection. In 2018, China issued for the first time technical guidance notes for green agriculture development. However, the guidelines do not provide technology-specific green standards and protocols. Nor do they provide a unified definition of green agriculture, which limits the knowledge and awareness of existing green agriculture technology solutions among potential investors. The existing standards which come closest to green agriculture are related mostly to agricultural product quality and food safety, such as green and organic food labeling.

**9. The transformation of Chinese agri-food systems toward a more sustainable development path requires massive financing.** Increasing demand for high-quality, nutritious, and safe food in China has created renewed private sector interest to invest in agri-food sector, which provides scope to harness green agriculture finance. Furthermore, the emerging green agriculture regulatory framework, as described above, creates additional incentives and opportunities for financial institutions and others to invest in green agriculture.



10. **In order to encourage financial institutions to offer green credit for environmental protection, emission reduction, and energy conservation projects, China introduced the Green Credit Policy in 2007.** The aggregate national-level green finance portfolio is currently about US\$1.2 trillion of green credit and US\$89 billion in green bonds. Most of it has gone to the energy, urban water, transport, and industrial sectors where commercial investment options and technologies are relatively well defined, although even in these sectors the lack of a consistent definition of what constitutes “green investment” has led to opportunistic investment and diluted market signals.

11. **Within China’s green finance market, there has been lack of attention to green agriculture.** Total green financing for agriculture was only about US\$9 billion or 0.4 percent of the aggregate national green financing. This low level is related to the general reluctance of financial sector institutions in China to finance agriculture investments, which are perceived to be of high risk and low returns. According to the available figures, only about 20 out of 4,000 active registered asset management firms in China engage to some degree in agriculture (and none in green agriculture investments). Most equity and longer-term commercial debt funding available for agriculture goes mainly to larger agribusiness corporates, with agribusiness small and medium enterprises (SMEs) only receiving working capital and short-term finance. On top of the challenges that constrain the financing of agriculture, green agricultural finance is constrained by the limited track record of green agricultural investments, which are not yet well known and understood by financial institutions and fund managers. As such, most of the limited financing for green agriculture in China is carried out by public entities, which consider such investments as fulfilling public policy objectives. Today, green agriculture finance is used primarily to improve the energy efficiency of agribusinesses.

12. **On the demand side, the main constraints facing agribusinesses in the adoption of green technologies are related to the lack of clarity and guidance on the green standards for agriculture in China.** There is also lack of knowledge and awareness of existing green agriculture technology solutions that can be implemented profitably. The incipient nature of many potential new technologies whose profitability and risks cannot yet be assessed conclusively adds to the perceived riskiness of green agricultural finance.

## B. Sectoral and Institutional Context

13. **Henan is a major agricultural and industrial production province in China.** It is located in mid-eastern China, at the lower-middle reaches of the Yellow River, with a land area of 167,000 km<sup>2</sup>. In 2016, its total population was 95.3 million—the third most populous province in China—with the rural population making up 51.5 percent of the total population. In terms of economic development, Henan was the 5th largest provincial economy of China with a GDP of CNY 4,016 billion in 2016 (about US\$620 billion), while agricultural GDP was about CNY 429 billion (about US\$65 billion). At the same time, it is also one of China’s least developed provinces with a per capita GDP of CNY 42,363 (US\$6,378), which ranks it only 20th in China.

14. **The province is one of the largest producers of livestock and grains in China.** It also produces significant quantities of oil crops, fruits, and vegetables. Agriculture has a significant environmental footprint in the province, which has 6.8 million ha of arable land. For example, the total manure discharges from the livestock industry have risen since 1990, reaching about 253 million tons per year by 2010. The increase is attributed to the rapid growth of pig and cattle production since the 1990s as a response to increasing demand for meat. The pork industry accounts for 50 percent of the total manure discharges, followed by cattle (28 percent) and poultry (13 percent). The consumption of pesticides in Henan was 128,700 tons in 2015 (the second largest after Shandong Province), while the consumption of chemical fertilizers reached 7.1 million tons in 2017 (the largest in China). Grains, fruits,



and vegetables are the major users of fertilizers, accounting for 83 percent of total consumption in the crop sector. The crop sector was a major contributor of TN amounting to 93,500 tons and TP discharges of 5,300 tons (NBS, 2017). Henan agriculture has high use intensity of plastic film (about 9 kg/ha/year). It is the fourth largest province in China in COD emissions and the third largest province in ammonia nitrogen emissions. The total amount of COD emissions from agricultural sources was 12 million tons, accounting for 48 percent of the total COD emissions in China (First Census on National Pollution Sources, 2010). Total GHG emissions from agriculture in Henan increased from 16.6 million tons in 1999 to 18 million tons in 2015 (9 percent increase). The main sources of agriculture-related GHG are enteric fermentation (29 percent) and use of synthetic fertilizers (22 percent).

15. **As in the rest of China, agriculture has had an important role in poverty reduction in Henan.** The province has the third largest concentration of rural poor in China (after Guizhou and Yunnan). Using China's rural poverty line of annual per capita net income below CNY 2,300 (at 2010 constant prices and which is slightly above the USD 1.25/day in PPP terms) there were 3.7 million rural poor in Henan in 2016 (8.7 percent of China's total poor). As of end-2014, Henan had 53 designated poor counties (about 50 percent of all counties and county-level cities in the province) and 8,103 designated poor villages. There are roughly 3 million poor in Henan able to work. Various national and provincial level poverty reduction programs aim to assist these groups to find employment in agribusiness and other enterprises.

16. **Henan's agriculture sector is also vulnerable to climate change.** Increasing evidence shows that shifts in China's climate have already occurred and will continue in the coming years. The average surface air temperature across China increased 0.5–0.8°C during the 20th century, and there is evidence that this process is accelerating. Regional warming trends have been more significant in areas north of the Yangtze River, which includes Henan. There is evidence from Henan that increasing temperatures have started to have an impact on grain production due to increased risk of frost damages in spring as the crops start flowering earlier. There are also signs of changing rainfall patterns. Precipitation rates have declined in the North China Plain, which includes Henan. Beginning in the 1950s, rainfall decreased 20–40 mm per decade on average. Specifically, average annual rainfall levels in Henan have dropped from 597 mm to 529 mm between 1997 and 2007. Rainfall patterns in Henan have also become increasingly concentrated with 70 percent of rainfall occurring now in June–September. There is evidence of an increased frequency of early spring droughts (63 percent cases), which have an especially negative impact on winter wheat yields, while summer droughts (35 percent) have negative impacts on maize yields, especially in northern Henan. Based on historic data, on average, grain output in China could decline by about 20–30 percent as a result of droughts and as much as 50–60 percent in severe cases. On the other hand, there is also evidence of increasing frequency of floods and waterlogging in the southern parts of Henan. Climate change in China is also affecting soil quality, with some 40 percent of arable land in China suffering from degradation, such as soil erosion.

17. **Addressing the above environmental issues in agriculture, whilst responding to increasing consumer demand for nutritious, high-quality, and safe food, requires simultaneous attention to the modernization of farming systems and postharvest practices (including processing of agricultural products).** Creating more modern and resource-efficient production structures, while ensuring environmental sustainability and food safety, would require potentially far-reaching adjustments both with respect to on-farm production structures and in the post-farm food value chains. Given its oversized importance in the Chinese food system, and associated large environmental footprint, Henan has the potential to make significant contributions to reduce its agriculture environmental footprint at the national level and globally, as well as to produce safe, high-quality, and nutritious food which meets the changing dietary patterns of Chinese consumers.

**C. Relevance to Higher Level Objectives**

18. **The proposed Henan Green Agriculture Financing Fund project is closely aligned with the World Bank Group (WBG) Country Partnership Framework (CPF) for China (FY 2020 – 2025)(Report No. 117875-CN),** which was discussed by the WBG Board of Directors on December 5, 2019, by addressing some of China's key development and institutional challenges. The proposed project falls under the second pillar of the CPF, which aims to promote greener growth, and contributes specifically to CPF objective 2.3 to demonstrate sustainable agriculture practices and safer and higher quality food systems. The project is in line with several of the CPF's selectivity criteria, namely strengthening policies and institutions, addressing regional and global public goods, fostering the private sector, and strategic piloting of approaches that address key development priorities (see Box 1).

**Box 1. Alignment of the Henan Green Agriculture Fund Project with the selectivity criteria of the China CPF (FY20-25)**

- **Creating institutions for green agriculture finance.** The project will develop institutional capacity, both in the public and private sectors, to identify and manage green agriculture investments and prepare green agriculture financing vehicles at the subnational level, which are operated on a commercial, transparent, and sustainable basis; properly allocate and price risks; and minimize public liabilities. The absence of clear green financing standards in China, including and particularly in the agricultural sector, has been an obstacle to developing the market and attracting bona fide green investment (e.g. through green bonds). The China CPF identified both the improvement of standard setting and verification to enhance the impact of green finance as well as the lack of incentives for private green agriculture investments as key institutional constraints. The project will set-up a transparent institutional mechanism that will bring various innovations to green finance, including:
  - (a) Modeling partnerships between public and commercial funding for green investments;
  - (b) Crowdsourcing activities that would discover promising green agricultural technology start-ups for funding;
  - (c) Preparing green financing facility to mobilize private funding from the green bond markets;
  - (d) Developing standards for green technologies and practices, and establishing credible verification systems;
  - (e) Forging partnerships with technical experts, vendors of technologies, and social capital partners to promote investments in green solutions for agriculture.
- **Delivering regional and global public goods.** The project will deliver significant regional and global public goods (for example, financing climate-smart agriculture, climate change mitigation or adaptation in agriculture, and pollution management) by financing viable green agriculture technology solutions at scale through leveraging social capital from commercial sources and partnering with innovative financial institutions. The project is estimated to generate around 75 percent climate co-benefits.
- **Fostering the Private Sector.** The project is primarily targeting SMEs in the agricultural sector, which are predominantly privately owned. About 60 SMEs are expected to receive financing through the GAF. The project will have a catalyzing impact and support the direct and indirect mobilization of public and private funds to support green agricultural investments of these SMEs.
- **Strategic piloting of approaches that address key development priorities.** Being the first green agriculture financing project in China, the proposed project will provide useful lessons to other regions in China as well as other countries on scaling up climate-smart agriculture and pollution control activities through identifying, structuring, and financing green agricultural investments. The generated technical and financial knowledge could for instance feed into the established China-Africa partnership in agriculture. The project will support the dissemination of experiences in structuring, executing, and financing green agriculture investments.
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19. **The proposed project will support and accelerate the shift towards high-quality and sustainable green agricultural development, as envisaged in China's own national and Henan's provincial policy documents.** The proposed project emphasizes the need for institutional and financial innovations to demonstrate the commercial viability of green agricultural practices, laying the foundation for a private sector led transformation of the sector in Henan province and potentially beyond.

20. **Climate change.** The proposed project will generate significant climate co-benefits (about 75%) and contribute to China's efforts to reduce its GHG emissions. Today, China is responsible for 14 percent of the global agriculture and land use related GHG emissions. Overall, agriculture accounted for about 6 percent of China's GHG emissions in 2016, but it has been estimated that including the emissions associated with producing fertilizer brings this up to around 10 percent. Given China's significant contribution to GHG emissions globally, the proposed



project supports the scale-up of green financing for agriculture and serves as a model for other provinces. The proposed project will address the impacts of climate change through both mitigation and adaptation measures in Henan, especially as it relates to the management of livestock manure and the reduction of the use of N fertilizers. On the mitigation front, there are several technologies and practices that can help reduce GHG emissions. For example, improving ruminant nutrition through straw ammonization can reduce methane emissions from beef cattle by 15–30 percent; promoting intermittent irrigation of rice field can reduce methane emissions by 30 percent; developing biogas digestors and improving manure storage modes can further reduce methane emissions; promoting slow-release fertilizers can reduce nitrous oxide emission by 50–70 percent; and promoting low protein pig diet can significantly improve feed efficiency, reduce nitrogen and carbon content in pig manure, and achieve GHG emission reduction ( $0.81815 \pm 0.40455 \text{ kgCO}_2\text{e/kg weight grain}$ ). All of these would areas could be supported through investments from the GAF and be covered by the new green agricultural financing standards. On the adaptation front, investments will be made in dry land farming and water-saving irrigation technologies, multi-resistant seed varieties, climate-smart irrigation and drainage infrastructure facilities, irrigation wastewater recycling, integrated pest management (IPM), soil nutrients management, and deep tillage and no tillage technologies, all of which would increase resilience against increasing temperatures, rainfall variability, and increased frequency of extreme weather events.

21. **Gender gap.** According to a recent IFC report<sup>1</sup>, only 9 percent of ventures in China receiving funding across all sectors were woman led. An even lower percentage of agribusiness ventures are women-led or women-owned. Furthermore, globally, venture capital (VC) and private equity funds with gender-balanced teams (teams with a share of partners who are female between 30 percent and 70 percent) perform approximately 20 percent higher than their homogeneous peers (IFC 2019). Companies with gender-diverse leadership teams that received equity funding outperformed others by about 25 percent (IFC 2019). In China, only 15 percent of investment professionals are women (IFC 2019). These findings suggest that gender gaps both in the management of agricultural ventures and asset management companies could have significant negative effects on sector performance. To address the first gap in funding for women-led/owned ventures, the project will (a) encourage subproject investment proposals from women-owned firms or firms with a significant share of female partners through positive biased targeting policy, with a target of at least 9 percent of investee firms being women-owned or women-led, to reflect the national average<sup>2</sup>, and (b) specifically look into investments in companies where women have an important participation in the value chain and where women account for a significant part of the labor force. To address the second gap in representation among investment professionals, the project will put into place a recruitment policy of 50 percent of its green investment team consisting of female investment professionals. Depending on the requirements of the Henan Green Agriculture Fund (GAF), the Henan Agriculture Development Fund Investment Corporation (HADFIC) may require to hire up to 20 investment officers, out of which at least 50 percent would be female staff. All Terms of Reference (TOR) for the GAF team within the HADFIC will explicitly request applications from qualified women and men applicants. The recruitment policy will be updated, if needed, to ensure that a fourth candidate who is the most/next qualified female applicant is added to the short list of the three best qualified candidates. These recruitment policies may eventually be applied to the HADFIC as a whole to increase the number of female staff in the organization, especially in technical and management positions.

<sup>1</sup> International Finance Corporation (IFC), *Moving Towards Gender Balance in Private Equity and Venture Capital*, 2019.

<sup>2</sup> Provincial or national data for agribusiness enterprises is not available, but according to HADFIC the share of women led enterprises among their agribusiness clients is considerably below 9 percent.



22. **Nutrition.** The project would encourage the production of safe, high-quality, and nutritious food. The green investments at the production level encourage enterprises to engage in organic and certified green production of fruits and vegetables, which has a direct impact on the nutrition outcomes of consumers. At the processing level, the project would encourage the production of healthier ingredients in food products and incentivize product reformulation to increase healthy ingredients in the processing stage with additional ‘points’ which could be awarded to proposals that would improve nutritional outcome of food products.

23. **Maximizing Finance for Development (MFD).** The proposed project would make a significant contribution to the MFD agenda by leveraging commercial investments. It is expected that the GAF would leverage commercial financing at a factor of up to 1-to-2 through external investors. As such, the project is considered under the ‘private capital mobilized’ category of the MFD. The project would encourage high-quality investments in agriculture by targeting enterprises that demonstrate positive environmental impacts. Although the principles of Responsible Agriculture Investments (RAI) do not specifically focus on green investments, the project would make an effort to consider elements of the RAI to promote sustainable agriculture investments, to the extent feasible.

## II. PROJECT DESCRIPTION

24. **The proposed project will ramp up the establishment and operationalization of a financial intermediation facility focused on green agricultural investments.** The project will be implemented by the HADFIC, which is a subsidiary of the Henan Agriculture Investment Group Co. Ltd (HAIGC)—a wholly state-owned agricultural investment company. It is a major agriculture investment company in Henan. The HADFIC acts both as the representing entity of the public sector as an investor (typically General Partner) and as the fund manager. At a time when private funds are averse to investing in agriculture, HADFIC has demonstrated its ability to blend policy objectives (in this case the promotion of green agriculture development) with reasonable profitability which makes it a suitable partner.

25. **The project will help Henan to address its GHG emissions and agricultural pollution problems through developing a series of innovations to green agriculture finance, including the development of green agriculture financing standards.** Green agriculture investments are defined as those that contribute toward more resource-efficient, environmentally sustainable, and climate-smart agriculture and increase agri-food safety. The project would foster the development of green agriculture financing standards based on globally accepted green investment principles, good practices and performance benchmarks as applicable to the China’ agriculture sector. These would broadly cover such areas as (i) identification of green agriculture investments, (ii) process of project evaluation and selection based on triple bottom line (financial, social and environmental) considerations, (iii) management of social and environment risks in accordance with EQUATOR principles, (iv) measurement and reporting of environmental benefits based on scientific evidence, transparency and accountability considerations. Currently there are no funds dedicated to finance such green agriculture investments in Henan nor in China in general. Furthermore, the existing agriculture investment funds managed by the HADFIC do not have an explicit focus on green/sustainable investments or demonstrated institutional capacity to manage the green investment cycle. The proposed GAF managed by the HADFIC is expected to serve as a pilot that can be scaled up in Henan and that can serve as a model for the development of similar green agriculture investment funds elsewhere in China. It aims to achieve this by testing and demonstrating the viability of green agriculture financing vehicles, which can be operated on a commercial, transparent, and sustainable basis; properly allocating and pricing risks; and minimizing public liabilities.



26. The key innovations of the proposed GAF are

- (a) Developing standards, and a blueprint of practices as well as of institutional and risk management arrangements for green agriculture financing;
- (b) Preparing a model of partnership between public and commercial funding for green investments;
- (c) Involving technical experts to assess and establish the viability and bankability of green technologies thereby generating evidence that can help mobilize commercial funding;<sup>3</sup>
- (d) Crowdsourcing ideas for promising green agricultural technology start-ups and green agriculture technologies that can be readied for funding;
- (e) Preparing the HADFIC and GAF to mobilize private funding from the green bond market and thus create a sustainable funding model for green agricultural finance in Henan.

## A. Project Development Objective

### PDO Statement

27. The proposed Project Development Objective (PDO) is to demonstrate the viability of financing green agriculture investments and foster the innovation and adoption of green agriculture standards and technologies in Henan.

### PDO Level Indicators

28. The proposed PDO-level results indicators include

- (a) Amount of externally leveraged investments in green finance (Amount (US\$));
- (b) Number of applications of replicable green agriculture technology solutions supported by the project (Number); and
- (c) Reduced GHG emissions from the application of green standards and technologies (MT) (Percentage).

## B. Project Components

29. **The proposed project will contribute to the development of a green agriculture financing mechanism for promoting ‘green agriculture growth’ in Henan Province through commercial sector engagement.** The project aims to build credible institutional systems, which could contribute to green financing beyond the project through standard setting and demonstration effects. The proposed project design brings together a twin strategy that creates an enabling environment for green agriculture growth by establishing dedicated and specialized

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<sup>3</sup> Green agriculture technologies are defined as emerging technologies that increase the utilization efficiency of natural resource, reduce pollution (N, P, COD) and GHG emissions, and improve the health of ecological environment while ensuring the production of high-quality, nutritious and safe food products.



investment vehicles in eligible green agriculture subprojects while providing knowledge-driven technical assistance (TA).

#### **Component 1: Green Agriculture Fund (US\$285 million, IBRD)**

30. **Component 1 of the proposed project would support the establishment of a dedicated investment facility to demonstrate the viability of financing green agriculture investments in Henan by providing financing for equity investments and on-lending to eligible firms.** The GAF will be structured as a fund of funds, and it will make both direct investments and indirect investments by creating sub-funds with co-investments from social capital partners. The facility will lend and invest at market conditions but is expected to provide maturities and equity injections not available for the types of investments targeted by the project. The GAF will finance subprojects that enhance green agriculture impacts by investing in technologies that reduce agriculture-related GHG emissions and pollution (TN, TP, and COD); improve the health of agro-ecological environment; increase the resource use efficiency of energy, water, and other natural resources; or ensure production of high-quality, nutritious, and safe food products. Specifically, the GAF would support the following typology of subprojects by value chain segment (see para 44 below for indicative break-down by segment; Annex 2 for detailed description of green technologies; and Annex 3 for GHG emissions reduction analysis):

- (a) Green inputs and equipment production, such as high-efficiency fertilizers and low toxicity biopesticides.
- (b) Crop production, such as reduction/elimination of chemical (nitrogen) fertilizer use; reduction/elimination of the use of plastic inputs (e.g. plastic mulch); promoting intermittent irrigation promoting slow-release fertilizers for cereal production; improved soil erosion control measures. On the adaptation front, subproject investments could include dry land farming techniques and water-saving irrigation and drainage technologies and infrastructure, multi-resistant seed varieties, integrated pest management (IPM), soil nutrients management, and deep tillage and no tillage technologies.
- (c) Livestock production could include investments in technologies and practices that reduce GHG emissions and nutrients run-off, such as improving ruminant nutrition and low protein animal diets for improved feed efficiency and developing biogas digestors and improving manure storage.
- (d) Processing and logistics, such as investments for improving energy, water (including wastewater management); resource use efficiency of storage, logistics and processing; investments for reducing FLW through more adequate postharvest transportation and better in-situ storage facilities; reduction/elimination of the use of plastic packaging for food products.

31. **These investments have different risk profiles and could range from proven technologies (for example, in energy efficiency) to investments with a perceived higher risk profile and uncertainty in financial returns (for example, investments into climate change mitigation and adaptation or into high-efficiency fertilizer technologies).** Therefore, the GAF will provide ‘patient capital’ for financing green investments. The proposed project will reconcile these investments by ensuring that all subprojects are commercially viable, regardless of their risk profile. Further, each investee enterprise will practice green agriculture standards (such as Good Agriculture Practices, and other relevant certifications) to be agreed upon and undertake efforts to reach a minimum threshold of green impacts.



32. **The GAF will support eligible enterprises with equity and/or debt instruments.** Annex 2 of the Project Appraisal Document presents the details of the eligibility criteria for green investments. The financing mix of equity and/or debt for each investment proposal in the subproject will be tailored depending upon the nature of the technology, stage in the lifecycle of the firm, financial structure of the investee firm, and so on. This approach will ensure threshold returns are met for HADFIC as the owner of the GAF, whilst offering some risk sharing to attract financing from external sources.

33. **The GAF will aim to leverage to the extent possible social capital from commercial and public partners (investment firms, agribusiness firms, and financial institutions as well as county, municipal, and provincial governments) by setting up sub-funds.**<sup>4</sup> Sub-funds are solution funds that allow the abovementioned social capital partners to invest in specific asset classes, in certain technologies or subsectors (for example, livestock manure management solutions and high-efficiency fertilizers distribution solutions)<sup>5</sup>. In other words, these sub-funds serve as: (a) investment vehicles for public and commercial investors, (b) platforms to support adoption of high-impact solutions, and (c) mechanism to significantly scale up green impacts. Each sub-fund would be governed by a separate agreement that defines the objectives of the sub-fund, eligibility criteria for investors, selection norms for investees, investment strategy, exit routes and, if applicable, the rules for distribution of the income. A social capital partner could become a limited partner for a specific sub-fund. While such sub-funds would follow the GAF investment rules and procedures (including the applicable World Bank fiduciary and safeguard policies), the social capital partners and GAF would establish a joint governance structure to take investment decisions and to oversee the implementation of the subprojects.

34. **The GAF will also create a market for parallel financing of green financing opportunities by inviting social capital (including commercial banks) to complement its direct and indirect (sub-fund) investments in the investee companies.** Such parallel financing would be subject to separate arrangements, independent of the investment made by the GAF in the investee enterprises. For lowering barriers to entry and to facilitate risk management, the GAF shall consider signing a Memorandum of Understanding with the social capital investors that provide parallel financing, allowing them to: (a) exchange technical due diligence results, (b) take senior debt position in the investee companies, and (c) coordinate the monitoring and supervision of parallel investments.

35. **The GAF aims to develop subproject investment portfolios, which would maximize the positive environmental impacts, while generating acceptable financial returns.** The eligibility criteria for investee agri-enterprises will specify the types of assets to be covered to achieve wide penetration of the facility and that would support the development of a diversified portfolio of green agricultural investment subprojects in terms of economic activities, types of borrowers, loan sizes, and geographical coverage (see Annex 2 for investment

<sup>4</sup> In China, social capital is defined as funding to be co-invested in the GAF sub-funds following the GAF policies and procedures. Sources of social capital could be (a) commercial (public and private companies operating on commercial principles) and (b) public such as funds from municipalities and cities. In addition to commercial returns, the green investments may entice commercial capital to flow into the GAF because of nonfinancial reasons. For example, Corporate Social Responsibility activities could benefit from investing into green investments as companies get 'credits' from regulators if they show green investments in their portfolio of investments.

<sup>5</sup> Sub-funds are the vehicle for social capital to come into the GAF and create the leverage. The creation of sub-funds would be driven by the demand from social capital partners that would identify specific areas for investments (for example, technologies, subsectors, and regions). In sub-funds, the social capital partner not only contributes funding but also helps build the pipeline of investments and know-how about specific subsectors and technologies, by bringing in partnerships with research institutions and so on. The HADFIC has experience in structuring sub-funds within its funds. On average, its funds have about four sub-funds. The GAF will consider sub-funds to leverage social capital but will keep these sub-funds to a manageable number under the project, most likely 3–4.



eligibility criteria). To foster the participation of women, additional ‘points’ could be awarded to proposals that would tackle gender-related issues.

36. **It is estimated that the average agribusiness investment size under the facility would be about US\$5 million (commensurate with the HADFIC’s current portfolio of investments).** To diversify its portfolio, the size of investments to a single enterprise to be funded by the GAF will be capped at US\$20 million. The GAF design includes the creation of reserve/provision to cover for possible losses of the investment and/or loan portfolios whose size will be determined considering the performance of and risks affecting such portfolios.

#### **Component 2: Technical Assistance and Innovation Challenge (US\$15 million, IBRD)**

37. **This component will support the strengthening of institutional, fiduciary, and safeguards management systems of the HADFIC for achieving institutional performance and governance benchmarks in compliance with China’s green finance system regulations and global best practices (such as Equator Principles).** In addition to the TA activities, this component will also provide funding in the form of risk capital to be invested in higher-risk innovative green projects. The main activities funded under this component are goods and non-consultancy and consultancy services. Goods could include information technology (IT) systems, office equipment, and office furniture for the HADFIC. Non-consulting services may include services for organizing training activities and dissemination conferences. Funding for the risk capital is treated the same way as the GAF financing of subprojects. Experience from the IFC advisory program with the Chinese banks (formerly known as the IFC China Energy Efficiency program) offers good examples for capacity building to identify, promote, and process green investment lending projects. This component has the following three subcomponents.

38. **Subcomponent 2.1: Technical assistance to implement institutional enhancements for the HADFIC (US\$6 million, IBRD).** The proposed project is expected to make institutional enhancements by creating a professional green agriculture investment team within the HADFIC and building its capacity in developing and practicing ‘green agriculture financing standards’ through customized trainings and exposure to globally accepted green investment principles, good practices and performance benchmarks as applicable to the China’ agriculture sector. First, the subcomponent would provide TA to develop required institutional systems at HADFIC level for investment cycle management, including pipeline development, technical due-diligence, investment decision-making, monitoring and supervision and impacts assessment. Secondly, the subcomponent would support systems development, including (a) business processes and related systems (for example, building software updates and knowledge apps); (b) developing new financial instruments such as debt finance and liquidity risk management to widen the current focus on equity investments; (c) institutionalizing the management of environmental and social risks through capacity development; and (d) helping the HADFIC to assess options (including their requirements) for refinancing the GAF portfolio from alternative sources (i.e. capital injection by HADFIC, green bonds, social capital, etc.). Thirdly, the subcomponent would establish rigorous monitoring and evaluation and impact evaluation systems to enable learning from its activities. The M&E system would document and analyze the risk and portfolio returns of the GAF to measure the performance of green agriculture finance in a systematic way. In addition, the subcomponent would finance TA to develop and institutionalize a monitoring, reporting, and verification (MRV) protocol for green investments. For this, the HADFIC will hire an independent/third-party certification agency for validating environmental outcomes of subprojects, including estimates of emission reductions from the project investments on a yearly basis, which is required for the GAF to participate in green bond markets in the future.



**39. Subcomponent 2.2: Technical assistance to promote the discovery and dissemination of green agriculture technologies (US\$3 million, IBRD).** Given the general lack of awareness of green agriculture technologies and uncertainties regarding their commercial returns, this subcomponent would provide TA in the following three key areas. First, the subcomponent would undertake market development efforts through crowdsourcing, and facilitation and dissemination of disruptive and high impact green technologies/solutions. It will then aim to disseminate these technologies through knowledge fairs, solution marketplaces, show case events, and other activities involving local and national research institutions, technology providers, leading enterprises, innovators, with the objective to build a pipeline of investment proposals targeting potential clients. Second, the subcomponent would support awareness raising activities on green agriculture and existing technologies through establishing collaborative research partnerships with agriculture research institutions in Henan and elsewhere. This is expected to contribute to further expansion of the Green Technology Inventory (GTI) and updating technology-specific environmental mitigation coefficients. Currently, there are no international standards for the mitigation coefficients in agriculture and livestock sectors, but the project will contribute to the development of national standards for green cropping systems and green livestock sector consistent with globally accepted protocols following IPCC 2006 Guidelines. The subcomponent would create awareness of existing and tested technologies that are already deployed in China, such as methane biodigester or slow-release fertilizers. Since the financial and economic returns of these technologies are known, this could be an opportunity to identify early adopters of the technologies to create an initial investment portfolio. Thirdly, the subcomponent will create a digital knowledge platform that would provide information and TA on green agriculture technologies for prospective investee enterprises. To address issues related to the gender gap in entrepreneurship, the subcomponent would aim to support female applicants in the application process.

**40. Subcomponent 2.3: Risk-capital Challenge Fund (US\$6 million, IBRD).** The proposed project would pilot an early stage Venture Capital (VC)/angel investment-like product to stimulate the market testing and development of new or emerging green technologies and other high-impact solutions for green agriculture, which will be selected through a process of “innovation competition”. The innovation competition will be conducted as competitive selection of ideas to promote green agricultural technologies, for example through shark-tank events where technology promoters could showcase innovations to investors and interested producers alike. The Challenge Fund would not be managed like a VC fund, but as innovation competition in which the HADFIC investments would accompany the investments from VCs or angel investors<sup>6</sup>. The project would invest in the application of innovative, but high-risk green technologies, during the start-up phase or for early stage financing. The innovation competition will enable the HADFIC to choose investments in enterprises with innovative green agriculture technologies and aims to attract specialized VC or angel investors to invest alongside the HADFIC. Proposals The selection criteria for such investments would imply high risk tolerance. The HADFIC would not manage these investments in the form of a stand-alone fund, as there will be likely only about 5-6 such subprojects given the small size of this subcomponent. These subproject investments would be accounted for separately from the regular GAF operations, thus avoiding that possible failure due to the high-risk nature of these investments contaminates the GAF portfolio. To address the gender gap in the potential investee firms and in firms receiving angel/VC investments, the project would offer a safe space for women to pitch for women funders in shark tank events and challenge innovation competitions to increase the chances that female entrepreneurs will obtain funding.

## C. Project Beneficiaries

<sup>6</sup> There are about 300 investment firms focusing on angel investments in China.



41. The project is primarily targeting SMEs given the cap on the maximum investment size, as well as the maximum average investment size at portfolio level, but will also finance investments by larger enterprises that have the potential to provide technical and market leadership for greening their supply chains. Enterprises participating in the project must be willing to comply with the relevant green policies and standards; demonstrate demand for investments in green technologies, both for scaling up and for new initiatives; and agree to track emissions/pollution flows and share data/information with the HADFIC.

42. The HADFIC has identified a long list of 202 agro-enterprises from various databases and from its own long-term engagement with enterprises, which have already passed financial viability and environmental and social (E&S) compliance screening and are mostly located in the poorest counties. Enterprises from this list which have potential and interest to adopt green agriculture technologies could enter the subproject pipeline, if they pass the preliminary green impact screening process. Majority of the enterprises in the long list are located in the southern counties of Henan (28 percent), followed by northern and central Henan (23 percent and 22 percent, respectively). There are a total of 159 counties in Henan, out of which 53 counties are classified as national- and provincial-level poverty counties. Of the identified enterprises, 81 (40 percent) are located in the poverty counties.

43. The typical beneficiary enterprise under the project is small (for example, less than 300 employees, with up to a maximum of CNY 40 million in total assets and less than CNY 30 million in annual business revenues) or medium in size (for example, 300–2,000 employees, at least CNY 40 million in total assets, and CNY 30–300 million annual business revenues) and is likely to be engaged in the following crop and livestock value chains: wheat, fruits, vegetables, tubers, pork, and dairy. Based on the data from the long list of 202 enterprises identified by the HADFIC, the largest share of these enterprises engages in storage, processing and logistics (55 percent), followed by crop and livestock production (37 percent, of which about 2/3 engage in crop production and 1/3 in livestock production), and the supply of inputs (8 percent).

#### D. Results Chain

44. **Theory of Change.** The proposed project aims to demonstrate the viability of financing green agriculture investments in Henan, fostering adoption of innovative green agriculture standards and replicable green technologies. It would do so through an array of green agriculture technologies adopted by targeted enterprises, the mobilization of social capital finance in green agriculture investments, and reduced carbon intensity of the targeted enterprises. Green agriculture impacts will be achieved by investing in new and existing technologies that reduce agriculture-related GHG emissions and pollution (TN, TP, and COD); improve the health of agro-ecological environment; increase the resource use efficiency of energy, water, and other natural resources; and/or ensure production of high-quality, nutritious, and safe food products.

45. The proposed project is expected to achieve this through the following impact areas:

- (a) Establishing a system for green agriculture finance in Henan, including standards which follow international protocols, verification protocols and a knowledge pool of technological applications, which will serve as the foundation for expanding the sector
- (b) Mobilizing increased green finance for agriculture by leveraging social capital at the sub-fund level or as parallel investors



- (c) Reduced pollution flows and emissions (ground-level impacts) using standard technology-specific coefficients to calculate ultimate environmental impact/benefits

46. The latter is expected to come through the following channels: (a) reducing GHG emissions, (b) mitigating agricultural nonpoint sources of pollution (TN, TP, and COD), and (c) enhancing the efficiency of water and energy use. Green agriculture development will also have impact on the safety of agricultural products through reduced use of pesticides and more sustainable value chain management. Investments into livestock sector are expected to consider improvements of animal welfare, such as improved waste management and feeding practices and reduced use of veterinary drugs, which would contribute to the control of zoonotic diseases.

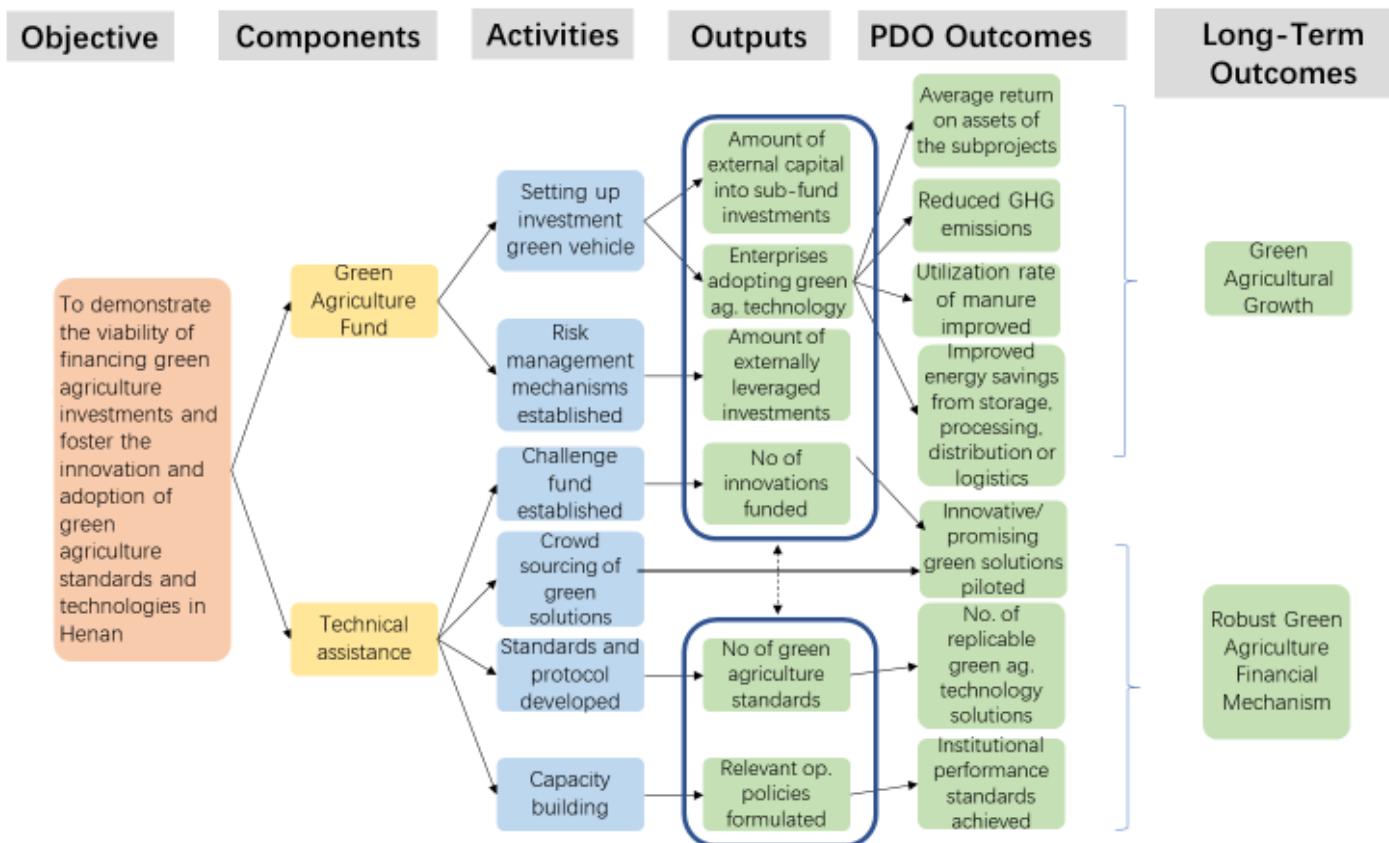
47. **To realize these impacts, six types of green interventions are determined, including and not limited to green crop production expansion, livestock manure management, energy use efficiency, water use efficiency, waste water treatment, and knowledge-based services.** Each intervention is expected to have specific green technology solutions that must be effectively applied by subprojects in a commercially viable manner by various actors in the value chains, such as input producers, technology developers, crop and livestock producers, postharvest and storage service providers, processors, transport/distribution/ logistic service providers, and knowledge service providers.

48. The green solutions in the crop sector cover the whole value chain from inputs to production, postharvest, processing, and distribution. It is expected that most solutions will be related to the application of fertilizers and pesticides at the input and production levels, which is where environmental impacts are the highest. The green solutions at the postharvest stage primarily relate to the crop residue handling. Processing and distribution entities mainly look for green solutions to improve resource efficiency (that is, energy and water). In the livestock sector, the green solutions include the stages of inputs supply, production, manure handling, slaughtering, and distribution; most solutions are centered around manure treatment which has high impact on GHG emission and point and nonpoint sources of agricultural pollution. The green solutions for slaughtering and distribution segments of the value chain are associated with energy and water use efficiency. Given the increasing demand for investments in modern agricultural production equipment and machinery, postharvest practices, and processing, energy efficiency plays an increasing role in generating green impact.

49. The incentives for green agriculture investors are limited not only to direct financial gains but also to indirect benefits such as better market access through compliance with E&S standards, reduced business risks caused by community and customer complaints, and improved corporate branding and improved visibility from the social responsibility perspective.



Figure 1. Results Chain



#### E. Rationale for Bank Involvement and Role of Partners

50. Henan Province aims to transform its agriculture and food systems towards ‘cleaner and greener’, by differentiating itself through the production practices, quality of its products, and the integrity of its institutional arrangements for green investments. However, the financing for green agricultural investments in China is currently held back by the following market failures:

- Lack of clarity of national- or provincial-level green standards;
- Lack of knowledge/awareness of existing green agriculture technology solutions that can be implemented profitably;
- The incipient nature of potential new technologies whose profitability and risks cannot yet be assessed conclusively; and
- Lack of long-term financing for agriculture in general.



51. The proposed project would address these market failures on the demand and supply sides through
- (a) Supporting the establishment of standards for green technologies/investments that can help scale up this business line and attract additional funding (for example, through green bonds);
  - (b) Stimulating the demand for available and commercially viable green agriculture technologies through raising the awareness about them among potential investees;
  - (c) Implementing mechanisms for the generation of financially viable technology solutions that address environmental problems in a cost-effective manner; and
  - (d) Supporting the longer-term loan tenors that are currently not available from commercial banks.
52. **The World Bank has a long track record in setting up facilities to finance agricultural investments, as well as in green finance and in fostering scalable innovations.** It is therefore well positioned to bring knowledge of global best practices in green agriculture financing to Henan together with its expertise and seed capital. In doing this, the World Bank Group is expected to equip the HADFIC with global knowledge on (a) green agriculture finance standards, (b) design of appropriate financing instruments, and (c) development of risk measurement and control systems and providing it with tools to build a pipeline of viable green agricultural investments which, if successful, could be scaled up in the province and across China. The participation of the World Bank Group in this endeavor is expected to provide the GAF much-needed know-how in these areas while at the same time enhancing the capacity of the HADFIC to attract additional resources to finance a cleaner and environmentally more sustainable agriculture. In addition, the participation of the World Bank Group will provide the HADFIC with expertise regarding the promotion and dissemination of innovations through schemes such as road shows, challenge funds, VC arrangements, and so on.
53. **The proposed projects would benefit from a partnership with the Swiss Agency for Development and Cooperation (SDC).** The SDC is in the process of preparing a 10-year facility to be funded with about USD 10.2 million to provide TA to agribusinesses and farms on green technologies and on the monitoring of the ecological impacts of green technologies. It is expected that the SDC activities will provide TA for the targeted enterprises, support applied research and M&E of green technology impacts, and contribute to the further development of the GTI and subsequent green agriculture standards through building partnerships with research institutions. Such TA would be carried out by the entities that have a partnership agreement with the SDC, as well as potential Swiss private sector entities active in China that have a successful track record in the implementation of ecologically sound investments. The SDC facility is expected to complement the activities of the GAF by contributing to stimulate the demand for green financing and enhancing the HADFIC's monitoring capacity for green impacts. The SDC program launch is planned for the first half of 2021, which is aligned with the expected start of the GAF facility.

#### F. Lessons Learned and Reflected in the Project Design

54. **The design of the proposed project has benefitted from extensive international experience and best practice in green agriculture financing, as well as the World Bank's long involvement in green investments and financial intermediary facilities.** International examples include Brazil's Low-Carbon Agriculture program, the Common Agriculture Policy in the European Union, the Sustainable Banking Network by IFC, IFC's Sustainable Energy Finance projects, and particularly the IFC China Energy Efficiency projects in China. In addition, the ongoing work by IFC capital markets and fund team on Strategic Investment Funds (SIFs) shows the tendency of



governments to increasingly consider the use of SIFs to catalyze strategic sectors in the domestic economy. Based on review of these cases, as well as of the experiences of the World Bank with projects involving international financing institutions and green investments, the following lessons can be drawn which have been considered in the GAF design:

- **Ensure appropriate capacity to identify green investments and properly assess their commercial risks.** The GAF should have appropriate expertise and links with technical experts that will help in the identification and appraisal of green investments. The TA will build the capacity of the GAF to identify innovative green technologies and show the financial viability of such investments. Partnerships between the GAF and technical experts, providers of green technologies, and commercial investors, will leverage this capacity for the identification of a strong pipeline of investable green projects.
- **Define a prudent level of leverage.** The GAF must have ready access to funds that can be used to cover debt service payment obligations even if there are shortfalls in payments on the portfolio of loans to its members. This is key to maintain a sufficiently high credit rating of the facility to obtain low-cost long-term financing from the capital market. The GAF will keep adequate liquidity reserves considering the projected cash flows and potential risks of non-recovery.
- **Ensure integrity and independence of the management as well as transparency and accountability of operations.** The ownership structure of the GAF must provide strong incentives for efficient management. The standard tools in corporate management are independent external audits that are publicly released, public reporting of audited accounts, and boards of directors that are independent of day-to-day management and effectively oversee it.
- **Diversify portfolio and asset allocation.** It will be important that the GAF maintains a diversified portfolio in terms of project size and subsector. The GAF will also require credible subproject selection criteria and creditworthiness assessments to ensure a strong portfolio with diversified risks.
- **Provide intensive managerial TA to enhance capacity.** In addition to ensuring up-front technical support for institutional capacity on safeguards management, the GAF may face challenges due to investee firms' low capacity in project packaging, execution, safeguards, and financial management (FM). Hence, there is a need to establish a mechanism to enhance the investee firms' capacity in technical design, project finance, risks assessment, and debt management.
- **Keep the structure flexible for future reform.** International experience shows that it would be better to design a facility structure that is robust to possible regulatory or institutional changes and able to address policy setbacks during its implementation.
- **Make intensive efforts in pipeline assessment and allow sufficient time to roll out subprojects.** Experience indicates that it can be difficult to assess the quality of the subproject pipeline up front due to the lack of detailed information about capacity of the investee firms. Although HADFIC has identified a long list of 202 target enterprises, sufficient time will be needed for detailed technical and commercial risk assessments and a relatively slow ramp up is to be expected in early years of implementation.



55. The GAF objectives and fund structure are consistent with the key features of the SIFs according to a World Bank study from 2016,<sup>7</sup> which concludes that the SIFs, like the proposed GAF, bring implicit commercial advantages, including local knowledge to manage complexities and to unlock a pipeline of important investments, and reduce cost of doing business, particularly in new strategic areas with limited private sector interest. The main features shared by the GAF with the SIFs include the following:

- It is sponsored by and fully/partly capitalized by the government entities.
- It seeks to reconcile market returns while ensuring E&S benefits and additionality.
- It aims to crowd in private capital to sectors where investments are limited (like green agriculture).
- It operates as an expert investor.
- It provides long-term patient capital, in both equity and long-term debt.
- It is established as a pool of assets through suitable legal structures.

### III. IMPLEMENTATION ARRANGEMENTS

#### A. Institutional and Implementation Arrangements

56. **The project will be implemented by the HADFIC.** The Bank concurred with the request of the Government of Henan to assign project implementation to the HADFIC, considering the results of its due diligence (see Annex 4)<sup>8</sup>. There is limited interest of private sector investments funds in agriculture in China. The HADFIC, which is the subsidiary of the HAIGC -- a wholly state-owned agricultural investment company of Henan, is one of the few funds investing in agriculture in China and willing to dedicate resources to finance green agricultural investments<sup>9</sup>. The HADFIC acts both as an investor, typically GP, representing the entity providing fiscal funding, and as fund manager. If there is interest from external fund managers, the HADFIC typically acts as the GP only and hires external fund managers. For funds with a strong policy mandate that may not attract enough external interest as fund managers, the HADFIC typically acts as the fund manager.

57. **The HADFIC's investment objective is to balance the support for government policy objectives with acceptable rates of return.** The HADFIC currently manages 21 funds, 18 of which are funded by fiscal source from the Henan Department of Finance, and 3 are funded by social capital partners. Out of these 21 funds, 3 funds directly focus on modern agriculture development investments and another 4–5 funds have some rural development focus (that is, returning migrants, rural poverty reduction, and so on). As of July 2019, the HADFIC managed total assets of CNY 98 billion (about US\$14 billion) in these 21 funds (mostly through equity

<sup>7</sup> Strategic Investment Funds, Opportunities and Challenges, Policy Research Working Paper #7851, Finance and Markets Global Practice Group, The World Bank, October 2016.

<sup>8</sup> The HADFIC is ranked consistently by third-party ranking companies, such as Zero2IPO and CVINFO, as: (a) top 30 public asset management companies among some 2,000 of such companies in China; (b) top 10 government guided private equity funds; and (c) top 20 limited partners of the private equity investment area.

<sup>9</sup> The HADFIC is one of the 20 asset management firms (among private and public firms), that manages funds for agriculture sector, out of a total of 4,000 such companies in China.



investments). In 2018, the actual operating revenues of the company were CNY 90.8 million (US\$13 million) and its net profit was CNY 33 million (US\$4.7 million).

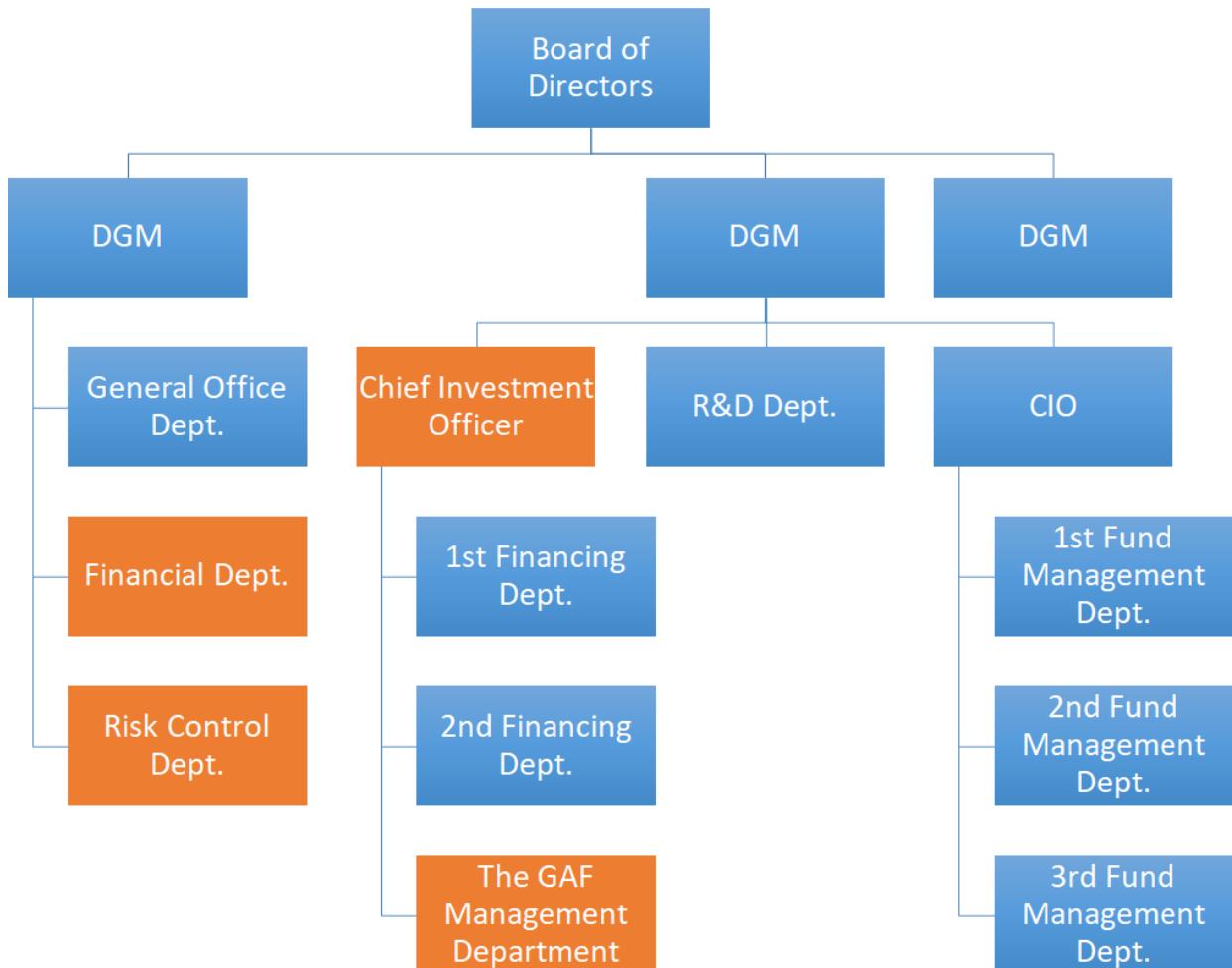
58. The HADFIC currently has 46 employees who work in nine departments: Research and Development Department, two Financing Development Departments, three Fund Management Departments, General Management Department, Risk Control Department, and Financial Management Department. It has a young and well-educated work force. The average age of its employees is 33 years, with 96 percent of them holding at least undergraduate university degree.

59. **Figure 2 presents the institutional structure for project implementation under the HADFIC.** The project implementation draws on the existing institutional structure of the HADFIC. In addition, the HADFIC will establish a new department specifically for the management of the GAF, which will fall under the oversight of the chief investment officer (CIO). The staffing of this department comes from existing departments of the HADFIC, as well as externally recruited contract-based staff with specialized technical skills to address gaps in its current skill profile (both full-time and part-time basis). The GAF management department will receive additional technical support from the existing HADFIC's departments as part of its subproject investment cycle screening, due diligence, and approval process, most notably the Departments of Finance and Risk Control.

60. The main functions of the HADFIC's GAF staff include subproject identification, screening, and evaluation; green agriculture technology research and analysis; risk control, including ensuring compliance with relevant environmental and social standards (ESSs); and fiduciary function (FM and procurement). In addition, the HADFIC will recruit external specialized technical expertise (both full-time and part-time basis), such as green agricultural technology experts, to strengthen its green investment management skills; environment and social experts to strengthen its safeguards management capacity and institutionalize Equator Principles in its operations; an experienced procurement expert to assist with the preparation of procurement documents; and legal and accounting firms to assist the HADFIC with subproject due diligence work.



Figure 2. Institutional Setup of the HADFIC



Note: The orange boxes indicate those HADFIC departments that are directly involved in the implementation of the proposed project. DGM means Deputy General Manager.

61. **The HADFIC follows a '13-step practice' in its investment cycle that includes steps from the scoping of potential investments to HADFIC's exit from such investments.** The investment due diligence focuses on legal and financial issues, and on the enterprise business plan assessment. The HADFIC checks enterprise compliance to relevant laws and regulations, including E&S regulations. However, the HADFIC has limited experience in the identification, assessment (including assessment of social and environmental risks), appraisal, and M&E of green investments that would be consistent with international best practices (for example, Equator Principles). To address this capacity shortcoming, the proposed project would set up institutional arrangements and mobilize adequate internal and externally recruited staff to oversee the implementation of the ESMS and enhance its capacity for the E&S risk management. Building institutional capacity of the HADFIC and related systems for the management of green agriculture investments will be an overarching focus of the proposed project.

62. In the investment process, the HADFIC uses a risk control committee that is independent from its Investment Decision Committee (IDC). A representative from the risk control committee sits in the IDC and opines



when it comes to making investment decisions. Each fund has its own IDC, and this consists usually of five members. In the case of sub-funds, the sub-fund investment committee includes representatives appointed by the social capital partner. Before investments are presented to the IDC, they pass through a quality control process (that is, General Partner Investment Decision Committee [GPIDC]) that recommends investments to the IDC. The IDC and GPIDC can employ specialized technical experts if needed.

63. The HADFIC monitors its investments on a monthly basis and gets monthly progress reports from enterprises. In addition, the HADFIC receives from enterprises quarterly financial statements and annual audited financial statements. The HADFIC provides to the Henan Department of Finance (HDF) monthly circular reports for each fund and shares its quarterly and annual audited reports.

## B. Results Monitoring and Evaluation Arrangements

64. **The Results Framework, based on the Theory of Change, describes the PDO-level indicators and the component-specific intermediate indicators, including unit of measures, respective baselines, cumulative target values, frequency, data source and methodology, and responsibility for data collection.** M&E arrangements and responsibilities will be described in the project operational manual. The proposed project M&E will be the responsibility of the HADFIC. The project progress monitoring, as well as reporting of physical progress, contract-based procurement management, and FM reporting will be also carried by the HADFIC project management team.

65. The GAF invested enterprises are expected to record relevant environmental/natural resource use baselines and track green impacts before and after the GAF investments, according to protocols and technology-specific mitigation coefficients developed under the GTI. The HADFIC will engage with an independent third-party verification agency to verify subproject environmental baselines at the start of investments and carry out impact assessment and E&S safeguards compliance assessment at midterm and at the end of the project. The TOR of the verification agency will be reviewed by the World Bank during the project implementation before the commencement of the specific M&E assignments. The M&E methodology dedicated to green agriculture investment will be practiced, refined, and ultimately sustained by the HADFIC through knowledge sharing and scaling up its green investment portfolio.

66. To measure the intended impacts, each green investment subproject package submitted to the GAF for investment consideration will include a variety of information including expected number of project beneficiaries and environmental impacts arising from the adoption of the proposed green technologies.

## C. Sustainability

67. **The sustainability of the project depends on the commitment of the Henan government, capacity of the HADFIC, and the viability of subprojects.** Whether the building of an institutional framework for green agriculture investments in the project has sustainable impact will depend on whether the project concept is scaled up after full disbursement of the IBRD loan. The GAF will achieve financial sustainability thanks to the initial long-term capital provided under the project and subsequent prudent investment decisions. Repayments or investment exits from underlying projects are expected to be in turn on-lent/invested again. A prudent liquidity management will also help manage the credit risks of the GAF. Once the GAF builds up a track record and a good reputation, it would be able to leverage private capital by tapping the green bond market in a cost-efficient manner.



68. The HADFIC has over a decade of experience in financing investment projects across a range of sectors. Apart from providing financial support to subprojects, the HADFIC and its partners would also provide TA and advisory services to subprojects to overcome potential lack of capacity in technical design, FM, and project implementation.

69. **Furthermore, the project's sustainability will depend crucially on the ability of the proposed project to prove that green agricultural investments are profitable and that the GAF achieves an overall positive economic return.** Demonstrating that green investments in agriculture can be undertaken in a profitable manner would provide incentives for other actors to replicate the GAF's approach and could help attract additional funding to this activity, likely through the issuance of green bonds thus opening an important source of funding. If the GAF proves to operate in a profitable manner, a scenario can also be imagined in which other public and commercial investors can be attracted to participate in the GAF's equity allowing it to operate and grow over time.

#### IV. PROJECT APPRAISAL SUMMARY

##### A. Technical, Economic and Financial Analysis (if applicable)

70. **Green technologies.** The project has prepared the GTI and related protocols, which will be used for the identification, screening, and justification of green investment proposals by the HADFIC. The GTI currently includes 77 green technologies (35 livestock and 42 crop) and over 60 environmental mitigation coefficients (Annex 2). About two-thirds of the technologies in the inventory are used at the production stages. Green technologies applied to processing and distribution segments of the value chain are mainly associated with resource utilization efficiency (that is, water and energy) and waste treatment (that is, wastewater). It is expected that the HADFIC would continue to update, with the support of the TA component, the GTI with new green technologies, their technology-specific impact coefficients, and the related indicators throughout project implementation, using expertise recruited under the TA component during the project implementation.

71. In addition to the GTI, the GAF investments will be subject to the following additional criteria:

- (a) Green investments aim to prioritize, to the extent feasible, high environmental risk/impact areas (that is, crop production, postharvest processing of crops or livestock feeding, manure handling, and slaughtering of livestock).
- (b) Green investment should have direct impact on the reduction of GHG emissions and agricultural pollution (TN, TP, and COD), as well as improve resource use efficiency in Henan.
- (c) Enterprises should be willing to record any environmental/natural resources use baselines and track green impacts before and after the GAF investments according to the protocols and coefficients developed under the GTI.

72. **Cost-benefit analysis.** This analysis was undertaken (see annex 3 for details) based on the three enterprise models that are assumed to be representative of investments financed by the GAF: bean sprout production (example of high-value microgreens), fruit tree orchard (perennial crop), and pig raising (livestock). These investments would produce two types of benefits: (a) increased safe and nutritious food production and (b) environmental benefits from applying green technologies compared to traditional technologies, which leads to



lower environmental pollution (air, soil, and water), reduced GHG emissions by using mitigating technologies, water and electricity savings, and improved public health and safety of food from reduced used of chemical inputs.

73. **GHG benefits.** An ex ante analysis of the impact of investing in the proposed green technologies on reduced GHG emissions, compared to existing practices (the baseline), was undertaken by using Ex-Ante Carbon-balance Tool (EX-ACT) for crops, and Global Livestock Environment Assessment Model (GLEAM) for the livestock, developed by the Food and Agriculture Organization of the United Nations (FAO):

74. The reduced GHG emission benefits would arise from the following activities for which there was available data for the economic analysis: (a) electricity savings in all three models; (b) reduced or no use of chemical inputs (fertilizers and disease control substances); (c) carbon sequestration from fruit tree plantations; (d) lower emissions of nitrogen substances as a result of improved animal feed composition that are lower in proteins; and (e) improved management of animal manure with a 100 percent anaerobic treatment that produces biogas and organic fertilizers.

75. Total GHG emission reduction benefits would reach an estimated 684,000 tons of CO<sub>2</sub>eq per year at full development, corresponding to a total of about 12.1 million tons of CO<sub>2</sub>eq during the project life. Applying economic value of CNY 206 per ton of CO<sub>2</sub>eq (US\$30 per ton) would increase the benefits by some CNY 141.2 million (US\$20.2 million) per year and CNY 2,488 million (US\$355 million) over the project life.

76. **Financial analysis** was undertaken based on the above three models to assess the viability of the proposed investments. Financial inflows and outflows were estimated over a 20-year period, which is the estimated life of the assets financed by the project. The enterprises are assumed to self-finance half of the investment, the remaining half being borrowed at 8.25 percent interest rate corresponding to the lower end of the current market rates for long-term loans. Repayment would start at the end of the second year and be in five instalments. The financial internal rates of return (FIRRs) show that all three models are financially viable: 25.0 percent for bean sprout, 17.2 percent for the fruit orchards, and 18.7 percent for the pig-raising enterprise.

77. **Economic analysis** was performed by aggregating costs and benefits at the project level based on the following phasing of project funding of US\$285 million: 10 percent in Year 1, 20 percent in Year 2, 30 percent in Year 3, and 40 percent in Year 4. The cost of the TA component (US\$15 million) is deducted from the economic benefit stream. A sensitivity analysis was undertaken (a) to test the impact of 20 percent increase in investment costs or 20 percent decrease in annual net revenues and (b) to assess the impact of adding the GHG benefits. The recommended value of US\$30 per ton of CO<sub>2</sub>eq was used as well as a higher figure of US\$100 per ton of CO<sub>2</sub>eq corresponding to a figure recommended by some environmental experts. The results of the sensitivity analysis show good economic performance of the proposed project, its robustness, and the substantial contribution of the GHG benefits, even when valued at US\$30 per ton of CO<sub>2</sub>eq.

Scenario	ERR (%)	NPV (8% Discount Rate) in CNY, millions	NPV (8% Discount Rate) in US\$, millions
Base case scenario	18.8	4,457	637
Investment costs increased by 20%	16.3	3,513	502
Annual benefits decreased by 20%	15.8	2,931	419
GHG benefits valued at US\$30 per ton CO <sub>2</sub> eq	21.1	5,445	778
GHG Benefits valued at US\$100 per ton CO <sub>2</sub> eq	26.5	7,752	1,107



78. **Technical assessment of the HADFIC.** The technical assessment carried out during the project preparation evaluated the HADFIC's technical capacity and current operations based largely on the information of the two existing agriculture funds it manages, as well as considering information provided by reputable fund rating agencies. In all these funds, there is a preference toward equity investments rather than long-term debt. The HADFIC has stringent internal mechanisms for risk management. It has the following strengths that can be leveraged by the project:

- Experience in aligning public mandates with acceptable returns;
- Reasonable investment procedures including organizational structures;
- Profitable with acceptable investment rates of returns (keeping in mind the balancing of policy targets and acceptable returns in its investments, see annex 4); and
- Experience in leveraging social capital from public sources as well as from commercial funding sources.

79. On the downside, the HADFIC has so far had limited experience with the participation of external private sector representatives in decision-making bodies such as the IDC or the Risk Management Committee.

80. On the risk management side, the GAF would need to address the following issues:

- Existing practices of the HADFIC in managing its subproject investment portfolio are rather conservative, ensuring that the value of public funds is maintained over time;
- There is a need for capacity-building measures by the project, especially in the areas of green investments, lending, and risk management in general. In the case of lending, there is a need to develop lending products that are adequate to client-specific characteristics, as well as loan origination and loan portfolio management procedures that are adequate to various types of clients. Capacity building should also concentrate on fostering the use of proven green technologies that can be implemented profitably;
- The project implementation requires a carefully designed investment business flow, which provides for adequate checks and balances in the process of due diligence as well as careful monitoring of the investments after disbursement of the GAF funds;
- The project implementation also requires sound financial business practices regarding liquidity management, portfolio diversification, provisioning and reserves, and so on;
- The separation of investments into new technologies would be managed through challenge fund under the TA component to allow testing of new high-risk green agriculture technologies without contaminating the GAF's main investment portfolio with any losses that may arise.

81. In addition, consideration is being given to the need and viability of using additional risk management instruments such as liquidity reserves.



## B. Fiduciary

### (i) Financial Management

82. An FM assessment has been carried out to assess the FM capacity of the HADFIC and associated risk mitigating measures, to satisfy the World Bank's minimum requirements under the World Bank Policy and World Bank Directive on Investment Project Financing. The project FM arrangements are expected to satisfy the FM requirements.

83. The HADFIC's FM capacity assessment identified the following FM risks: (a) limited experience of identification, assessment (including assessment of social and environmental risks), appraisal, and M&E of green investments that would be consistent with international best practices; (b) no experience with the World Bank-financed projects; and (c) since the HADFIC is a financial intermediary, the traditional expenditure-based disbursement might not satisfy the project's needs.

84. The actions to mitigate these risks include the following: (a) the Bank has provided training to the HADFIC staff and will continue to guide and supervise its operation during project implementation; (b) based on the assessment of the HADFIC's existing FM systems, it is decided that the project will use the HADFIC's existing FM system; (c) the FM manual prepared by the HADFIC and agreed by the Bank will provide guidance on project FM; and (d) the report-based disbursement method will be adopted in the project which could better match the project-specific features.

85. The FM risk of the proposed project is considered between Substantial and Moderate and could be reduced when the proposed mitigating measures are implemented and are shown to be effective.

86. The total project investment is US\$300 million equivalent, which is financed by the IBRD loan. The loan agreement for the IBRD loan will be signed between IBRD and the People's Republic of China through Ministry of Finance (MOF). The on-lending arrangements for the IBRD loan will be signed between the MOF and Henan Finance Department (HFD) on behalf of the Henan Provincial Government, and finally, the loan will be on-lent to the HAIGC through the HFD. The HAIGC will be responsible for repaying the IBRD loan.

87. **Project budgeting.** The majority of the IBRD loan will be invested in the eligible subprojects in the form of equity or debt. The remaining loan amount is allocated to the TA component.

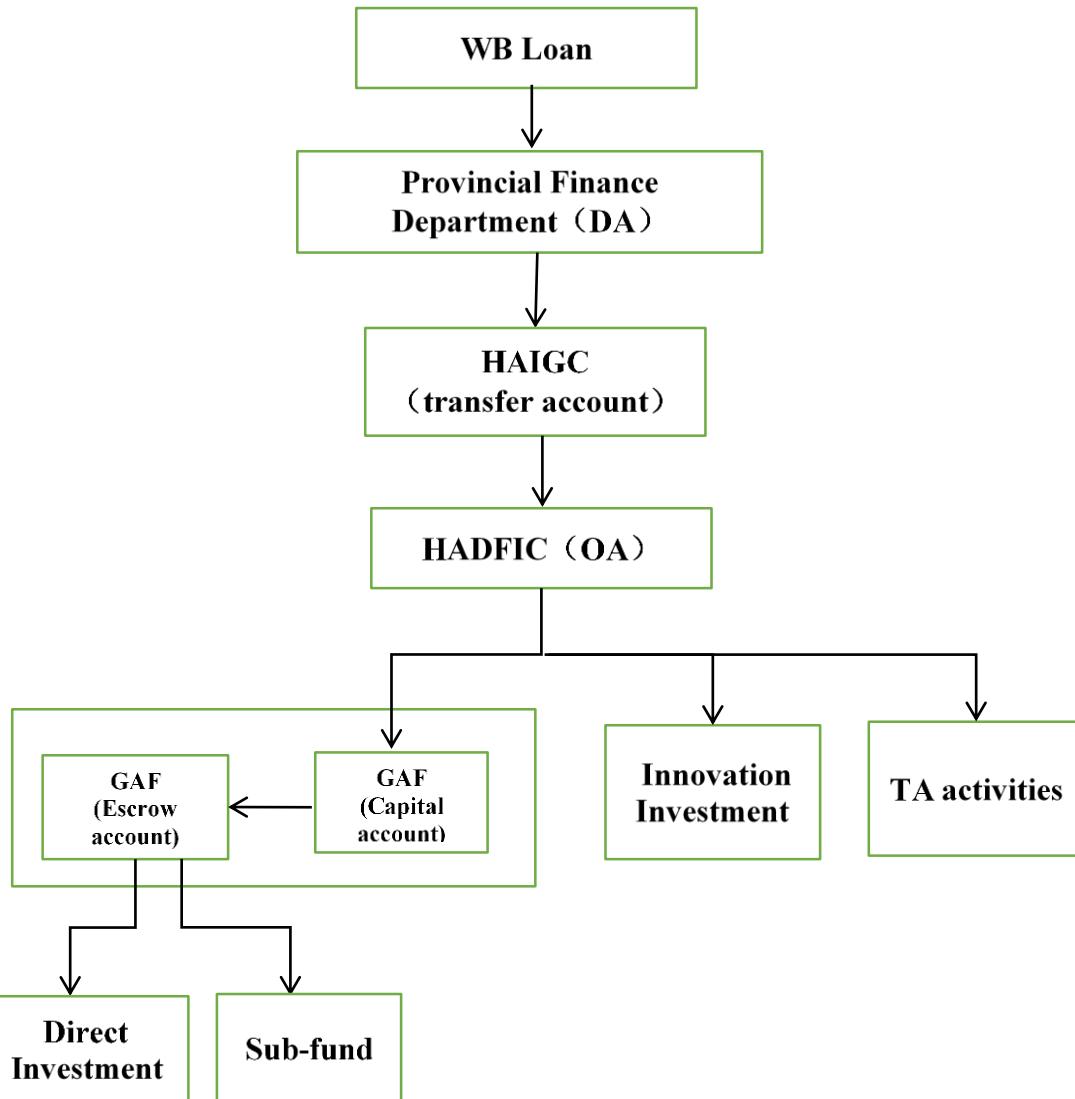
88. The budget cycle of the project would run from January 1 to December 31. As a commercial entity, the HADFIC will conduct the budget versus actual analysis of their activities on a regular basis. Significant variations will be identified, reported, and investigated to ensure the budget is well monitored.

89. **Flow of funds.** The HFD will transfer the loan proceeds from a Designated Account (DA) to the transfer account managed by the HAIGC. From there, the loan proceeds will be transferred to the operating account held by the HADFIC, which will be responsible for (a) making the innovation investments; (b) paying for goods, consulting services, non-consulting services, training, workshop, and Incremental Operating Costs (IOC) technical assistance; and (c) making investments to projects or sub-funds through capital/escrow accounts. End-of-period balance of all subaccounts, including transfer account, operating account, capital/escrow accounts, and so on, will be reflected in the DA balance, which will be reported to the World Bank through the Designated Account Activity Statement in the financial reporting template. Subaccounts, including transfer account, operating account,



capital/ escrow accounts, etc. are arranged to meet the requirements of domestic laws and regulations. The fund flow and account arrangement are shown in Figure 3:

Figure 3. Fund Flow and Account Arrangement



Note: OA = Operating account.

90. **Internal controls.** The HADFIC manages 26 funds and has a 13-step process from identification to exit that appears to be well designed and in line with good fund management practices. Appropriate FM duty segregation, payment, and authorization controls are put in place within the HADFIC. Its audit reports from 2016 to 2018 do not note significant internal control weaknesses. Therefore, the HADFIC's existing internal control process will be used in the proposed project.

91. **Accounting and reporting.** A set of separate bookkeeping arrangements will be established within the HADFIC's computerized accounting system called the 'User Friendly'. The HADFIC will still use the accounting standards for subprojects to record the project expenditures, but the financial reporting will be prepared in the



format stipulated by Circular 13 issued by the MOF, which includes (a) balance sheets of the project; (b) statement of sources and uses of fund by the project components; (c) statement of implementation of the loan agreement; (d) statement of designated account, and (e) notes to the financial statements (required only for annual financial statements).

92. The total project financing is US\$300 million equivalent. Although the HADFIC is expected to mobilize social capital from commercial sources, these funds will not be recorded in the HADFIC's bookkeeping. Only the funds for the GAF would be recorded as project investments and presented in the project financial reports. However, the HADFIC is expected to keep records of the leveraged funding from social capital sources and to present this data in the project progress reports.

93. The project will use the report-based disbursement method. The HADFIC will prepare the project interim financial reports as the disbursement supporting documents and submit to the Bank within 60 days after the end of each calendar semester period. The HADFIC will be responsible for the preparation of the annual project financial statements and get them audited by the entities acceptable to the Bank.

94. **Auditing.** Henan Provincial Audit Office (HPAO) will be assigned by the China National Audit Office (CNAO) as the auditor for the project. The annual audit report will be issued by the HPAO. The HADFIC will submit the audited project financial statements satisfactory to the Bank within six months after the closure of each fiscal year during the entire project life. According to the agreement reached with the MOF and CNAO, the project audit reports will be made public in both the Bank's and the HPAO's websites.

95. **Disbursements.** Disbursements under the project will be carried out in accordance with the provisions of the Disbursement Guidelines (World Bank Disbursement Guidelines for Investment Project Financing, dated February 2017), the Disbursement and Financial Information Letter (DFIL), and the Loan Agreement. The details on the disbursement arrangements are provided in the DFIL and Loan Agreement.

96. The DA managed by the HDF will have a variable ceiling based on the HADFIC's forecasts of its investment schedule (the HADFIC is required to provide details on its forecasting when submitting withdrawal applications for advance). Withdrawal applications will be submitted to the World Bank twice a year within 60 days after the end of each semester. In addition, direct payment would be applicable to the project although the main disbursement method is DA replenishment. The proposed World Bank loan allocation and financing percentage are presented in Table 1:

**Table 1. Loan Allocation and Financing Percentage**

Category	Amount of World Bank Loan Allocated (EURO)	Percentage of Expenditures to Be Financed by World Bank (inclusive of Taxes)
Capital Investments under Component 1; and goods, non-consulting services, and consulting services, Innovation Investments, Training and Incremental Operating Costs under Component 2	266,532,000	100
Front-end fee	668,000	—
<b>Total</b>	<b>267,200,000</b>	—



97. As confirmed with the HADFIC, retroactive financing will be needed for project activities. Therefore, it is agreed that no withdrawals will be made for payments before the signing date, except that withdrawals up to an aggregate amount not to exceed EUR26,720,000 (US\$30,000,000 equivalent) may be made for payments made before the signing date but on or after December 1, 2019, for the eligible expenditures.

#### (ii) Procurement

98. Procurement will be carried out in accordance with the Procurement Regulations for IPF Borrowers, dated July 2016, and revised in November 2017 and August 2018, and according to the provisions stipulated in the Loan Agreement and Project Agreement. Alternative procurement arrangements will not be used in the project.

99. **Procurement arrangements are based on the Project Procurement Strategy for Development.** Works are not anticipated under this project. All procurement will be for goods and non-consultant and consultant services. Goods to be procured may include IT systems, office equipment, and office furniture for the HADFIC. Non-consulting services may include services for organizing training activities and dissemination conferences. All goods and non-consulting services will be procured through open competition by approaching the national market, considering that there are sufficient numbers of local manufacturers or suppliers and that the value of the contracts will be relatively small. Request for proposals may be anticipated for the procurement of IT systems. Request for bids or request for quotations will be adopted for all other procurement depending on the value of the contracts. Direct selection may be used for some non-consultant services in exceptional cases where the service providers have unique qualifications.

100. Most firm consultant services will be procured through open competition by approaching the national market, considering that there are sufficiently qualified local consultants and that the value of the contracts will be relatively small. Quality- and Cost-Based Selection and Selection Based on Consultant's Qualification will be used in most contracts. Direct selection may be used for some consultant services in exceptional cases where the service provider is unique. Most individual consultant services will be procured through open competition. Direct selection may be used in exceptional cases where the individual consultants have unique experience and qualifications to the assignment or where the assignment is with a total expected duration of less than six months.

101. **Procurement risk assessment and mitigation measures.** Procurement and contract implementation will be assumed by the HADFIC. The risks identified from the procurement capacity and risk assessment include the following:

- (a) The HADFIC has no experience in procurement in the World Bank-financed projects.
- (b) The procurement for small-value contracts can follow simple procedures, but in practice, it may become complicated as the domestic practices may have influence on people's behavior even when the World Bank's procurement policies will be used.
- (c) The evaluation committee members normally do not have knowledge and experience in procurement arrangements under the World Bank-financed projects, and the evaluation may not be conducted in accordance with the World Bank's Procurement Regulations for the IPF Borrowers and by the provisions stipulated in the Loan Agreement and Project Agreement.
- (d) The HADFIC has limited knowledge and information about the best qualified and experienced consultants (both firms and individuals) in the market.



- (e) Most probably, the procurement will be conducted through the local public resources transaction center.

102. On the latter, smooth procurement will depend on whether the HADFIC will have a good communication with the center regarding the procurement rules and procedures to be followed, given that most procurement in the center follows domestic rules and procedures, and whether the center's platform allows for issuing the procurement documents used in the World Bank-financed projects. The project procurement risk is rated Substantial.

103. Mitigation actions of the identified risks include the following:

- (a) The World Bank team delivers regular training to the HADFIC staff.
- (b) The procurement agent (either firm or individual consultant) with experience in procurement under the World Bank-financed project is hired by the HADFIC.
- (c) The HADFIC will conduct market analysis and market engagement before the start of procurement to ensure that the best qualified and experienced consultants in the market can be approached and selected.
- (d) The HADFIC will start communication with local public resources transaction center at an earlier stage.

104. **Procurement oversight and monitoring arrangements.** The responsibility for the procurement oversight and monitoring rests with the HADFIC. In addition, the procurement will also be subject to annual government audit.

105. **Procurement documentation references.** The Procurement Plan (PP) for the whole project implementation period has been prepared by the HADFIC. It will be made available on the World Bank's external website. The PP has set forth the thresholds for procurement methods and prior/post review requirements. The PP will be updated annually, or as required to reflect implementation needs and improvements in institutional capacity.

106. **Mitigation for complying with Anticorruption Guidelines (ACG) is as follows:**

- (a) Upon the loan effectiveness, the HADFIC will promulgate a corporate regulation within the company to circulate the ACG to all its departments or divisions.
- (b) The HADFIC will deliver one training of the ACG to its staff and management who are engaged in this project upon the loan effectiveness and will deliver the same training once per year.
- (c) The HADFIC will provide one copy of the ACG to each beneficiary under each subproject and deliver one training of the ACG to the staff and management of such beneficiaries who are engaged in this project upon the signing of the subproject agreement;
- (d) The HADFIC's contract template for all subprojects will include provisions requiring the beneficiary to abide by the ACG and to permit the World Bank to inspect all accounts, records, and other documents relating to the project and to have them audited by or on behalf of the World Bank, providing for early termination or suspension by the HADFIC of the subproject agreement if such



beneficiary is declared ineligible by the World Bank, requiring restitution by such beneficiary of any amount of the loan.

- (e) The HADFIC will remove any staff from all duties and positions in connection with the project if such staff is engaged in any fraud and corruption practice.
- (f) The HADFIC will include one section in each of its semiannual project progress reports particularly for disclosing and reporting any allegation of fraud and corruption issues.
- (g) The HADFIC will ensure that the selected beneficiary: (i) is not in the Bank's debarment/ temporary suspension lists for contractors; and (ii) contracts under the selected sub-projects are not awarded to firms/individuals in the Bank's debarment/temporary suspension lists for contractors.

### C. Legal Operational Policies

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

### D. Environmental and Social

107. Overall, the project would bring about positive E&S benefits in terms of reducing pollution from agricultural production, reducing GHG emissions, and reducing health risk for consumers by improving the food safety and quality. The typology of the activities eligible to be financed by the project generally covers the whole value chains and could include input suppliers, primary production bases, processing facilities, storage facilities, logistics centers, and equipment manufacturing facilities. The size of most subproject enterprises ranges from small to medium, but some livestock farms and cropping bases may be built/expanded to a large size by the project. Investments in expansions would be approved only if they establish more economical and efficient manure management systems, such as innovative pens for feeding efficiency and improved energy and water use efficiency, which can help reduce the waste discharges and GHG emissions more cost effectively. In addition, the policy for livestock waste management in China also supports the intensified and large-scale livestock farms as they are financially stronger and able to comply with increasingly stringent environmental and biosecurity regulations.

108. Based on the typologies of subprojects, the potential environmental impacts have been predicted and analyzed. The potential environmental impacts in the construction phase may include dust, noise, solid waste, wastewater, and social disturbance, such as traffic safety. The potential adverse environmental impacts in the operating stage could typically include noise, dust, nuisance odor, waste gas, solid waste, general wastewater, toxic materials, and other wastes. Specifically, slaughterhouses could generate livestock manure, animal carcasses, and wastewater, and large livestock farms could generate significant amount of wastewater and solid waste, animal carcasses, and odor. Investments into livestock sector are expected to consider improvements of animal welfare, such as improved waste management and feeding practices and reduced use of veterinary drugs, which would contribute to the control of zoonotic diseases. The occupational health concern is related to mechanical damage by operating machines, inhaling fine particles in processing of agro-products, and toxicity of biocides production. The transportation of toxic materials and wastes may cause health and safety risks to



communities. The probability for such risks is very low, and the impacts are small given the size of the proposed subprojects. An exclusion criterion to exclude the genetically modified varieties from the project has been established and incorporated into the ESMS.

109. An ESMS has been prepared by the HADFIC in line with the Environmental and Social Standard (ESS) 9 of the Environmental and Social Framework (ESF). Under the ESMS, highly sensitive areas, that is, critical natural habitats and legally protected cultural heritages, will be excluded from the project, and activities likely to cause cumulative impacts, that is, small-size livestock farms, also will be excluded.

110. China has established a comprehensive system for environmental, health, and safety (EHS), which covers the environmental concerns about all typologies of the subprojects. The environmental assessment instruments will be prepared by the subprojects in line with China's national and provincial requirements, and additionally with EHS guidelines and relevant ESSs of the World Bank for large livestock farms and slaughterhouses. During the implementation, a monitoring and reporting arrangement will be established by the HADFIC. The subproject management cycle will have sufficient resources provided by the HADFIC. The HADFIC has also made a strong commitment for the E&S safeguards risk management, including establishing agreed managerial structure, hiring qualified environmental experts, and allocating required budget resources. A training program for the HADFIC has been developed and will be carried out at the beginning of the implementation stage to ensure that the risk management procedures are robust and staffed with adequate capacity. It is thus expected that the environmental risk of the project is predictable, manageable, measurable, and replicable.

111. **The environmental risk rating of the project is Substantial on a precautionary basis.** The main driver of risk is the nature and magnitude of the potential environmental impacts associated with large livestock farms and slaughterhouses. However, the probability of serious adverse effects to the environment actually occurring is considered moderate. Moreover, there are known and reliable tools and methods available to prevent or minimize such impacts. As the project will be carried out on existing agricultural lands, no land conversion of significant scale is anticipated, nor impacts on natural habitats or ecosystem services. During implementation, the project's environmental management systems, processes and instruments will become operational, and appropriate mitigation measures will be deployed to avoid, minimize or mitigate the identified risks. As part of project supervision a periodic re-evaluation of the environmental risk levels and types will be undertaken. This could likely result in a downgrading to Moderate, once risk management measures are proven effective.

112. The main potential social risks of the proposed subproject activities are related to

- (a) Leasing of land use rights for appropriate-scale farming and for livestock breeding sites;
- (b) Management of labor and working conditions of direct workers, primary supplier workers, and contracted workers;
- (c) Conducting of stakeholder consultations throughout the project lifecycle proportionate to the risks and impacts;
- (d) Land acquisition and resettlement for establishing facilities and structures by targeted enterprises;
- (e) Ethnic minorities; and
- (f) Community health and safety.



113. **Land leasing is generally considered the main social risk given the potential size of rural population that may be interested in participating in this opportunity, potential concerns of inadequate consultation, and possible tomb relocations because of livestock breeding sites.** The HADFIC has reviewed practices for land leasing in Henan and adopted measures to strengthen land leasing under the project to be in conformance with the ESF. Facilities such as input production, processing, and logistics and distribution can either be located at designated industrial areas or would generally involve minor-scale land acquisition. The project's impacts on ethnic minorities are mainly related to land leasing, land acquisition and resettlement, labor and working conditions, special consideration for stakeholder engagement, and so on. Given the low composition of ethnic minorities in Henan, the likelihood of adverse impacts on ethnic minorities is considered low. The project would introduce a few direct workers and will not involve large number of primary supplier workers in the form of seasonal workers on the agricultural bases. Child labor risk is negligible because the primary labor force engaged in the potential subprojects consists of local residents at the age of 40–60 from the local communities. Key labor-related risks are related to possible accidents by the conduct of hazardous works, potential worker lay-off or position transition with the input production and processing facilities, and relatively weak labor law enforcement for seasonal workers at production bases. The potential concerns over the investee enterprises' capacity and experience in managing stakeholder engagement will be readily addressed through on-the-job coaching and implementation support by the HADFIC and the external experts. Therefore, the overall social risk rating of the project is assessed as Substantial, primarily considering the magnitude and spatial extent of the risks and impacts associated with possible land leasing, labor and working conditions, and stakeholder engagement. During implementation, the project's E&S management systems, processes and instruments will become operational, and appropriate mitigation measures will be deployed to avoid, minimize or mitigate the identified risks.

114. An ESMS, Stakeholder Engagement Plan (SEP), and Environmental and Social Commitment Plan (ESCP) have been developed by the HADFIC according to the ESF. The existing policies, procedures for fund management, and E&S risks control systems established in the HADFIC have been assessed and enhanced following the requirements of ESS 9. The E&S management capacity enhancement action plan has been developed, which aims to improve the awareness and capacity of the HADFIC, its investee enterprises, and the external E&S experts who support the implementation of the ESMS. The HADFIC has made a commitment to allocate adequate resources for the implementation of the ESCP and maintain compliance with the ESMS.

115. A set of tools has been developed and annexed to the ESMS to facilitate the ESMS implementation, including the exclusion list, E&S screening sheet, the subproject Environmental and Social Risk Classification guidance and reporting template, indicative outline of environment and social impact assessment and E&S management plan, enhanced procedure for land leasing, a template of subproject labor management procedure, resettlement policy framework, ethnic minority development framework, indicative outline of social due diligence review, subproject SEP template, and an outline of pest management plan.

116. The HADFIC will establish several sub-funds under the proposed project to leverage social capital for specific green agriculture technology solutions. The portfolio of the sub-funds will be exclusively built up for this project and will be managed by the HADFIC. As such, the ESMS will apply to the whole portfolio of sub-funds.

117. All candidate subprojects will be screened against the exclusion criteria and screening checklist, categorized, and assessed for their E&S risks and impacts before financing under the project. All subprojects will be prepared and implemented according to the relevant national and provincial regulations and the ESMS. The E&S documents for subprojects will be prepared by the investee enterprises, disclosed locally, and revised as needed according to the disclosure requirements. The E&S instruments of the subprojects will be reviewed by the



HADFIC's in-house E&S specialists, subject to spot checks by the World Bank. The World Bank will clear the E&S documents of the first three subprojects with E&S risk of Substantial or High representative of the typology of the subprojects. The World Bank review will continue if it is found that the E&S screening quality is low and/or the HADFIC has capacity issues in implementing the ESMS. For the high-risk subprojects, the HADFIC should notify the World Bank before making investment decisions and will apply relevant requirements of ESSs in a manner agreed with the World Bank, as set forth in the ESMS.

118. An overall project SEP, which is consistent with ESS 10, has been prepared by the HADFIC. Following the SEP, key stakeholders were consulted during the project preparation to inform the establishment of the HADFIC's ESMS. A public consultation meeting was held on September 29, 2019, on the draft ESMS. The ESMS was updated, incorporating the feedback from the consultation progress. The SEP documented the stakeholder engagement activities during preparation and will be updated during the project implementation. For subprojects, a template of subproject SEP was developed in the ESMS. If a subproject is screened with environmental and/or social risks, an SEP will be prepared and implemented by the investee enterprises before subproject approval, proportionate to the E&S risks and impacts of the specific investments.

119. The ESCP, ESMS, and SEP were disclosed on the HADFIC's website on September 29, 2019 and November 20, 2019. The ESRS, ESCP, ESMS and SEP were disclosed on the World Bank's website on November 21, 2019. The E&S documents for subprojects will be disclosed locally and on the website of the HADFIC and the World Bank before approval of subprojects by the HADFIC.

## V. GRIEVANCE REDRESS SERVICES

120. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate GRS, please visit <http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service>. For information on how to submit complaints to the World Bank Inspection Panel, please visit [www.inspectionpanel.org](http://www.inspectionpanel.org).

## VI. KEY RISKS

121. **The overall project risk is Substantial.** From a technical design perspective, the main risks are related to lack of clarity about market demand for green finance, limited number of high-impact business models, and low awareness of cost-effective technologies. Misalignment of incentives between the HADFIC, social capital, and other investors could be another source of risk, limiting the project's success in attracting commercial funding. To address this risk, the project would systematically map potential green investments along selected value chains and identify appropriate technology options through the following steps. First, the HADFIC will target a portfolio



of potential enterprises from various databases and from its own long-term engagement of enterprises, which have already passed financial viability and E&S compliance screening. Second, the HADFIC will organize showcase events inviting technology solution providers and potential investee agribusinesses to generate viable green technology leads for pipeline building. Third, the project will put special emphasis on monitoring the specific risk and profitability profiles of the GAF investments, especially as they will also determine the economic success of the project. The project will design a measurement mechanism that would document and analyze the risk and financial return of the GAF in addition to the quantification of the environmental outcomes. The project will give special emphasis to monitoring the specific risk and profitability profiles of the different investment scenarios. The Government has recently issued a technical guidance note for green agriculture investments, which together with more vigorous enforcement of the environmental regulations related to agriculture is expected to expand the pool of potential subprojects. Finally, the project will develop green investment standards for agriculture and support development of technology solutions that could become financially feasible, especially in the context of increasing stringency of enforcement of environmental and pollution control regulations in China. The technical design risk of the proposed project is rated Substantial.

122. **The fiduciary risk is rated Substantial (could be reduced when the proposed mitigating measures are implemented and are shown to be effective) given that the HADFIC has not managed World Bank-financed loan projects before and has therefore no experience with its fiduciary requirements.** On FM arrangements, it was proposed that the project would use report-based disbursement method, which means the replenishment of the DA will be based on the HADFIC's forecast of cash flow requirements and there is no ceiling on the DA. The project will submit the required financial reporting to the World Bank regularly every six months to report the actual expenditures incurred according to the reporting date and the funds estimated to be used in the next two reporting periods. Under this method, the financial reporting rather than traditional disbursement supporting document will be the required document for disbursement. There will be limited procurement under the project, such as procurement of consultant services and office equipment under the TA component.

123. Although it is too early to have the specific information on subprojects, it is expected that prospective subprojects are not expected to be in or near critical or sensitive areas. Given that the project would target SMEs, the average size of subprojects is expected not to be very large. Agro-processing and logistics subprojects are normally located in designated industrial areas, and potential investment on improving sustainability of agriculture practices will happen on existing farmlands, which are away from environmentally and socially sensitive areas.

124. **The environmental risk rating of the project is Substantial on a precautionary basis.** The main driver of risk is the nature and magnitude of the potential environmental impacts associated with large livestock farms and slaughterhouses. Investments into livestock sector are expected to consider improvements of animal welfare, such as improved waste management and feeding practices and reduced use of veterinary drugs, which would contribute to the control of zoonotic diseases. The project would raise the awareness, where applicable, about such practices (such as IFC Good Practice Note on Improving Animal Welfare in Livestock Operations) in animal husbandry techniques and encourage its application where financially and technically feasible. However, the probability of serious adverse effects to the environment actually occurring is considered moderate. Moreover, there are known and reliable tools and methods available to prevent or minimize such impacts. As the project will be carried out on existing agricultural lands, no land conversion of significant scale is anticipated, nor impacts on natural habitats or ecosystem services. During implementation, the project's environmental management systems, processes and instruments will become operational, and appropriate mitigation measures will be deployed to avoid, minimize or mitigate the identified risks. As part of the project supervision a periodic re-



evaluation of the environmental risk levels and types will be undertaken. This could likely result in a downgrading to Moderate, once risk management measures are proven effective.

125. **The main social risks are related to land leasing given the potential size of rural population that may be interested in participating in this opportunity, potential concerns of inadequate consultation, and possible tomb relocations because of livestock breeding sites.** The project's impacts on ethnic minorities are mainly related to land leasing, land acquisition and resettlement, labor and working conditions and special consideration for stakeholder engagement, and so on. Given the low composition of ethnic minorities in Henan, the likelihood of adverse impacts on ethnic minorities is considered low. The project would introduce a few direct workers and will not involve large number of primary supplier workers in the form of seasonal workers on the agricultural bases. Child labor risk is negligible because the primary labor force engaged in the potential subprojects consists of residents from local communities. Key labor-related risks are related to possible accidents by the conduct of hazardous works, potential worker lay-off or position transition with the input production and processing facilities, and relatively weak labor law enforcement for seasonal workers at production bases. The overall social risk rating of the project is assessed as Substantial, primarily considering the magnitude and spatial extent of the risks and impacts associated with possible land leasing, labor and working conditions, and stakeholder engagement. During implementation, the project's E&S management systems, processes and instruments will become operational, and appropriate mitigation measures will be deployed to avoid, minimize or mitigate the identified risks.

**VII. RESULTS FRAMEWORK AND MONITORING****Results Framework**

COUNTRY: China

Henan Green Agriculture Fund Project

**Project Development Objectives(s)**

The proposed objective is to demonstrate the viability of financing green agriculture investments, and foster the innovation and adoption of green agriculture standards and technologies in Henan.

**Project Development Objective Indicators**

Indicator Name	DLI	Baseline	End Target
<b>support the transformation of Henan agricultural sector through financing of green investments</b>			
1. Amount of externally leveraged investments in green finance (Amount(USD))		0.00	300,000,000.00
2. Number of applications of replicable green agriculture technology solutions supported by the project (Number)		0.00	20.00
3. Reduced GHG emissions from the application of green standards and technologies (MT) (Percentage)		0.00	25.00

**Intermediate Results Indicators by Components**

Indicator Name	DLI	Baseline	End Target
<b>Component 1: Green Agriculture Fund</b>			



Indicator Name	DLI	Baseline	End Target
1.1 Enterprises adopting green agricultural technology (Number)	0.00		60.00
1.2 Amount of external capital into sub-fund investments (Amount(USD))	0.00		30,000,000.00
1.3 Average return on assets of the sub-projects weighted by the amount of equity investments (%) (Text)	0.00		>0
1.4 Debt portfolio at risk (PAR) as of 90 days late (%) (Text)	0.00		<5
1.5 Utilization rate of manure (Percentage)	0.00		95.00
1.6 Energy savings from agriculture storage, processing, distribution or logistics (Percentage)	0.00		15.00
1.7 Share of investee firms are women-owned/women-led (Percentage)	0.00		9.00
1.8 Share of investee enterprises that feel sub-project finance reflects their needs (Percentage)	0.00		70.00
<b>Component 2: Technical Assistance and Innovation Challenge</b>			
2.1 HADFIC to formulate relevant operational policies and procedures on the environmental and social risk management (Yes/No)	No		Yes
2.2 HADFIC staff trained in green investment capacity building programs (Number)	0.00		30.00
2.3 Number of innovations funded through challenge fund (Number)	0.00		5.00
2.4 Number of market studies on alternative sources of funding for GAF (Number)	0.00		1.00
2.5 Number of agricultural green agriculture standards (Number)	0.00		5.00
2.6 Share of female investment professionals in the GAF investment team (Percentage)	50.00		50.00



## Monitoring &amp; Evaluation Plan: PDO Indicators

Indicator Name	Definition/Description	Frequency	Datasource	Methodology for Data Collection	Responsibility for Data Collection
1. Amount of externally leveraged investments in green finance	This indicator measures the amount of funding to be co-invested in the GAF investee enterprises from: (i) commercial (public and private companies operating on commercial principles); (ii) public such as funds from municipalities, cities, etc.; and (iii) parallel financing (i.e. commercial banks, etc.).	Annual	Project reporting	Project reporting	GAF
2. Number of applications of replicable green agriculture technology solutions supported by the project	This indicator measures the number green agriculture technologies from the GTI supported under the project. One sub-project may support more than one green technology	Annual	Project reporting	Project reporting	GAF
3. Reduced GHG emissions from the application of green standards and technologies (MT)	This indicator is defined as CO2 equivalent of GHG emissions in MTs.	Annual	Project reporting		GAF



## Monitoring &amp; Evaluation Plan: Intermediate Results Indicators

Indicator Name	Definition/Description	Frequency	Datasource	Methodology for Data Collection	Responsibility for Data Collection
1.1 Enterprises adopting green agricultural technology	This indicator measures the number of enterprise sub-projects funded by the GAF.				
1.2 Amount of external capital into sub-fund investments	This indicator is measured as funding from social capital sources into sub-funds established by the GAF.	Annual	Project reporting and desk reviews	Surveys, reports and desk reviews	GAF
1.3 Average return on assets of the sub-projects weighted by the amount of equity investments (%)	This indicator measures the financial viability of the GAF equity investees. The figure >0 means that investee enterprises are profitable. The weighting by the amounts invested ensures that the calculated average return is not affected by the size of the investee companies but by the level of exposure of the GAF.	Annual	Enterprises annual audited financial statements as reported to the GAF.	Audited financial statements	GAF
1.4 Debt portfolio at risk (PAR) as of 90 days late (%)	This indicator measures the financial viability of debt investments of the GAF. It is expressed as PAR of 90 days less than 5%.	Annual	Project reporting and desk reviews	Financial surveys and annual audit report	GAF
1.5 Utilization rate of manure	This indicator is measured in percentage as comprehensive utilization	Annual	Project reporting, field visits	Surveys, reports and desk reviews	GAF



	rate of livestock and poultry manure as proportion of the amount of livestock and poultry manure used to produce biogas and return the residue of biogas digester to the fields for use as fertilizers, or composting, or liquid fertilizer, or fuel, or commercial organic fertilizer, or bedding materials, or base materials, etc., of the total amount of livestock and poultry manure.		and desk Reviews		
1.6 Energy savings from agriculture storage, processing, distribution or logistics	The energy efficiency target of 15% from the baseline when new technology or new process is used to replace old ones. In addition to energy efficiency, the additional eligibility criteria to meet this target include: (i) Energy efficiency $\geq 15\%$ or annual GHG emissions reduction is higher than 25,000 tons; (ii) Renewable energy utilization is eligible by default; (iii) Water use efficiency improvement is higher than 10%.	Annual	Project reporting, field visits and desk reviews	Surveys, reports and desk reviews	GAF



1.7 Share of investee firms are women-owned/women-led	This indicator measures the progress in reducing gender inequality in the access to the GAF investments. An enterprise qualifies as a woman-owned enterprise if it meets the following criteria: (a) ≥ 51% owned by woman/women; or (b) has ≥ 1 woman as CEO/COO/CFO/CIO/GM/President/Vice President.	Annual	Project reporting	Surveys, reports and desk reviews	GAF
1.8 Share of investee enterprises that feel sub-project finance reflects their needs	This is citizen engagement indicator and will be measured through enterprise surveys.	Mid-term and project end	Project reporting	Simple enterprise survey	GAF
2.1 HADFIC to formulate relevant operational policies and procedures on the environmental and social risk management	This indicator measure the EHS institutional enhancements of the HADFIC.	Annual	Project reporting	Reports	GAF
2.2 HADFIC staff trained in green investment capacity building programs	This indicator measures the number of HADFIC staff trained in green investment capacity building programs under the project. It is measured by person time.	Annual	Project report, field visits and desk reviews	Surveys, reports and desk reviews	GAF
2.3 Number of innovations funded through challenge fund	This indicator measures the total number of innovations funded through challenge fund	Annual	Project reporting, field visits and desk Reviews	Surveys, reports and desk reviews	GAF



2.4 Number of market studies on alternative sources of funding for GAF	Project implementation especially from institutional enhancement would lead towards preparation of entry into green bond markets. It is measured from Year 4 onwards.	Annual from Year 4 onwards	Project reporting	Surveys, reports and desk reviews	GAF
2.5 Number of agricultural green agriculture standards	This indicator measures the number of green standards developed under the project related to inputs quality, green production technologies/solution, evaluation methodology for products food safety and agriculture resource efficiency.	Annual	Project reporting, field visits and desk reviews	Surveys, reports and desk reviews	GAF
2.6 Share of female investment professionals in the GAF investment team	This indicator measures level of gender inequality among HADFIC staff and progress in reducing inequality or maintain current equality.	Annual	Project reporting		GAF

**ANNEX 1: IMPLEMENTATION ARRANGEMENTS AND SUPPORT PLAN****COUNTRY: China  
Henan Green Agriculture Fund**

1. The project will require intensive implementation support and a continuous dialogue with the client. The World Bank's implementation support strategy combines periodic supervision with timely technical support and policy advice as necessary. Implementation support will include (a) an implementation support mission (ISM) every six months, (b) interim technical discussions and field visits by the World Bank, (c) monitoring and reporting by the HADFIC on implementation progress and achievement of results, (d) third-party impact evaluations (baseline, midterm, and final), (e) annual internal and external financial audits and FM reporting, and (f) periodic procurement post review. The ISM will visit randomly selected project sites to assess and physically verify the work financed by the project. These site visits will include interaction with targeted agri-enterprises.

2. It is expected that the early implementation phase could face implementation challenges, which will be addressed through the following actions:

- (a) **Implementation support strategy.** This will be largely built on dialogue and partnership. The implementation support team will have continuous interaction with all stakeholders of the project. This will require consistency in the composition of the core implementation support team, technical expertise, and familiarity with country/local situations.
- (b) **Capacity building of the implementation agencies.** Significant training and hands-on support will be required on a technical level and in terms of fiduciary and safeguards management. This will include supporting the HADFIC in (i) pipeline development and facility ramp-up, (ii) review of important TOR for key consultancies, and (iii) coordination with development partners.
- (c) **M&E and learning.** Coordination of M&E and the capturing of project outcomes and results (including on the green impacts of investments) will need professional guidance from an M&E expert on the implementation support team.
- (d) **Fiduciary assurance support.** The implementation support team will provide hands-on guidance related to review and audit reporting procedures. Similarly, procurement activities will be spread widely among entities, types of procurement, and size of contracts. This will require intensive implementation support.
- (e) **Social and environmental safeguards.** M&E and mitigation of social risks require experienced expertise on the implementation support team with a good understanding of the culture and business process in China. In addition, sufficient staff time and resources will be provided to review subproject-specific E&S management measures during the investment planning process for agri-enterprises. Special emphasis will be placed on the strengthening of the Grievance Redress Mechanism to solicit feedback and grievances from the beneficiaries.

3. **Implementation support plan.** The following implementation support plan reflects the preliminary estimates of skill requirements, timing, and resource requirements over the life of the project. Keeping in mind the need to maintain flexibility over project activities from year to year, the



implementation support plan will be reviewed periodically to ensure that it continues to meet the implementation support needs of the project. Table 1.1 indicates the World Bank team's implementation support plan and the required skill mix.

**Table 1.1. Implementation Support Plan**

Time Needed	Focus	Skills
0–18 months	<ul style="list-style-type: none"><li>• Setting up core team at the GAF, project management systems including fiduciary, safeguards, and M&amp;E</li><li>• Baseline surveys</li><li>• Staff capacity building</li><li>• Pipeline development</li></ul>	<ul style="list-style-type: none"><li>• Core team, particularly FM, procurement, M&amp;E, and so on</li><li>• Financial sector specialists</li><li>• Agribusiness and value chain specialists</li><li>• Green agricultural technology experts</li></ul>
18–36 months	<ul style="list-style-type: none"><li>• Review of environmental and financial performance of subproject investments</li><li>• Review of the solutions fund implementation arrangements</li></ul>	<ul style="list-style-type: none"><li>• Core team, particularly FM, procurement, M&amp;E, and so on</li><li>• Financial sector specialists</li><li>• Agribusiness and value chain specialists</li><li>• Green agricultural technology experts</li></ul>
36–54 months	<ul style="list-style-type: none"><li>• Continued improvements in project management systems including fiduciary, safeguards, and M&amp;E</li><li>• Midterm evaluation of the project</li><li>• Stocktaking of project interventions and design improvements</li></ul>	<ul style="list-style-type: none"><li>• Core team, particularly FM, procurement, M&amp;E, and so on</li><li>• Financial sector specialists</li><li>• Agribusiness and value chain specialists</li><li>• Green agricultural technology experts</li></ul>
54–60 months	<ul style="list-style-type: none"><li>• Completion of activities</li><li>• Understand failure and success parameters in close dialogue with the implementing agencies</li><li>• Facilitate knowledge exchange and events to consolidate project learnings</li><li>• Prepare detailed learning and analysis framework and prepare for end-of-project evaluation</li><li>• Support technical and financial analysis of project investments</li><li>• End-term evaluation and project completion report</li></ul>	<ul style="list-style-type: none"><li>• Core team, particularly FM, procurement, M&amp;E, and so on</li><li>• Financial sector specialists</li><li>• Agribusiness and value chain specialists</li><li>• Green agricultural technology experts</li></ul>



4. **Skill mix.** The skill mix and team composition for supporting project implementation is as proposed in Table 1.2:

**Table 1.2. Skill Mix and Team Composition**

Skills Needed	No. of Staff Weeks	Number of Missions	Comments
Task team leader	12	Two per year but three in the first year	Staff in the country office or Washington, DC
Procurement specialist	3	Two per year including field travel	Staff in the country office
FM specialist	3	Two per year including field travel	Staff in the country office
Social safeguards specialist	3	Two per year including field travel	Staff in the country office
Financial sector specialists	8	Two per year but three in the first year	Staff in Washington, DC
Agribusiness and value chain expert	8	Two per year including field travel	Consultant (national)
Green livestock technology expert	3	Two per year including field travel	Consultant (national)
Green crop production technology expert	3	Two per year including field travel	Consultant (national)

**ANNEX 2: TECHNICAL ANALYSIS**

**COUNTRY: China**  
**Henan Green Agriculture Fund**

**Technical Assessment of the GAF**

1. The technical assessment of the GAF builds largely on the due diligence of the HADFIC, which is responsible for the project implementation (see Annex 4). The project is designed to address the HADFIC's lack of experience in dealing with green investments as well as in managing loan portfolios, while leveraging at the same time the capacity it has built to successfully manage investment funds with a public policy mandate.
2. The technical assessment evaluated the HADFIC's technical capacity and current operations based largely on the information of the two existing agriculture funds managed by the HADFIC. In all these funds, there is a bias toward equity investments rather than long-term debt. The HADFIC has quite stringent internal mechanisms for risk management. It relies on 'investment protection agreements' with investee companies to compensate for significant shortfalls in their valuation, although the implementation of such agreements varies and there is no systematic way to assess their utilization and impact. Furthermore, the HADFIC relies on a process from identification of investments, to due diligence, to internal approvals, to negotiations, and to exit that appears to be quite rigorous.
3. The HADFIC's investment objective is to balance the support for the government policy objectives with acceptable rates of return. The Henan Department of Finance (HDF), oversees the operations of the HADFIC and reviews its performance annually considering (a) the HADFIC's performance in achieving its strategic objectives through its investments, (b) the quality of the HADFIC's corporate governance, (c) its ranking in the industry based on the ratings from independent third-party rating agencies, and (d) its ability to leverage social capital.
4. The HADFIC has some strengths that can be leveraged by the project (see Annex 4). In particular, the following advantages are worth highlighting:
  - Experience in aligning public mandates with acceptable returns;
  - Reasonable risk management practices;
  - Established investment procedures and organizational structures;
  - Profitable with acceptable investment rates of returns (keeping in mind the balancing of policy targets and acceptable returns in its investments); and
  - Experience in leveraging social capital from public sources as well as from commercial funding sources.
5. In addition, the HADFIC operates under the oversight of the Provincial Department of Finance as well as of the Asset Management Association of China (AMAC).



6. On the downside, the HADFIC has limited experience with the participation of external private sector representatives in the decision-making bodies such as the IDC or the Risk Management Committee.

7. **Risk management.** The risk management of the GAF includes:

- Existing HADFIC investment portfolio management practices that are considered rather conservative, ensuring that the value of public funds is maintained over time;<sup>10</sup>
- Additional capacity building measures by the project, especially in the areas of green investments, lending, and risk management in general. In case of lending, TA will include aspects such as the definition of lending products that are adequate to each client's characteristics, as well as loan origination and loan portfolio management procedures adequate to the types of clients it will be serving. In the case of green agricultural technologies, capacity building will concentrate on the fostering of the use of proven technologies that can be implemented profitably. This TA is also expected to help the GAF to relax some of the rather restrictive practices;
- The implementation of a investment business flow (see Figure 2.2), which provides for checks and balances in the process of due diligence as well as careful monitoring of the investments after disbursement of the GAF funds;
- The implementation of sound financial business practices regarding liquidity management, portfolio diversification, provisioning and reserves, and so on;
- The separation of investments into new technologies to be carried out by a separately managed, venture capital/angel investment-like facility under the TA component that will allow the testing of new green agriculture technologies without contaminating the GAF's main investment portfolio with any losses that may arise; and
- Consideration being given to the need and viability of using additional risk management instruments such as liquidity reserves or other instruments.

8. The HADFIC currently acts as (a) the investor of fiscal funds on behalf of the provincial financial department, (b) an investor with its own internal funds, and (c) fund manager of specific-purpose funds (typically funds which support the implementation of specific development policies). As a fund manager, it has on one hand a relatively good fund management capacity, and on the other a mandate to support certain public policy functions.

9. The HADFIC has been ranked by the Zero2IPO (a third-party rating agency) among the 30 best fund management firms in China, out of about 4,000 funds. The HADFIC has also been ranked by CVINFO, another rating firm, as 'Top 10 Best Private Equity Investments Government Guided Funds' and as one of the 'Top 20 Best Private Equity Investing Area Partners'. This gives a certain level of comfort about the

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<sup>10</sup> The HADFIC takes conservative approach with limited risk-taking due to 'capital preservation' principle as the HADFIC aims to preserve capital on each investment and in each year, as opposed to preserving the capital of the whole investment portfolio which would allow for losses in some investments. To ensure the full recovery of every investment, the HADFIC relies on the abovementioned 'investment protection agreements' and 'formulaic' mark-to-market calculations, which limit the attractiveness of the HADFIC funding to potential investees.



HADFIC's capability to implement the GAF, although having a solid pipeline of green agriculture projects is critical to the success of the proposed project.<sup>11</sup>

10. Most of the social capital invested in the two existing agriculture funds is in support of specific public policy objectives. According to the HADFIC, it has mobilized commercial capital (for example, funds from commercial enterprises seeking to establish their presence in agriculture) at the sub-fund level of one of its agricultural funds which it manages on behalf of investors.

11. Given the short-term nature of ongoing government green agriculture support/incentive programs and the fact that the government (provincial, municipal, or cities) does not take a programmatic approach to provide public support for green agriculture, but rather considers each project at a time for public support, it would not be possible for the project to tap into blended financing at the GAF level. Instead, the HADFIC would need to facilitate access of potential subprojects to applicable support programs at the local government levels in an opportunistic way. This means that the project may have blended elements at the sub-fund or at subproject level.

12. The GAF will be structured as a fund of funds, and it will make both direct investments and indirect investments by creating sub-funds with co-investments from social capital partners. The GAF and its sub-funds will invest by acquiring equity and/or debt rights in targeted agriculture enterprises. The investment period for the first tranche of investment financed by the project will have a four-year ramp-up period, and individual exits are expected to start 3–5 years from the start of the project. The fund proceeds recovered from the exits will be reinvested to perpetuate the portfolio.

**Box 2. Green Agriculture Fund**

1. Nature of fund: Fund of Funds
2. Sponsor of fund: HADFIC
3. Initial contribution: US\$285 million
4. Term of fund: ~ 25 years (open-ended type)
5. Investment instruments: Acquiring equity and debt rights in targeted enterprises
6. Ramp-up period: 4 years
7. Tenure of investment in enterprises: 3–5 years
8. Use of exit proceeds: Reinvested in GAF to perpetuate the portfolio
9. Fund manager of GAF: HADFIC
10. Fund manager fee for GAF: 2 percent of invested capital
11. Profit distribution: Dividends/profits will be recognized after adjusting for operational and investment losses of the GAF. Such payments are expected to be reinvested in the GAF.
12. Sub-funds: Initially two types of funds are planned namely regional funds and value chains.
13. Fund manager(s): 2 percent management fee and 20 percent carried interest
14. Fund management of sub-funds: HADFIC
15. Fund manager fee for sub-fund: 2 percent of committed capital and 20 percent carried interest

13. Figure 2.1 provides an overview of the GAF investment instruments. The proposed GAF will have direct investments and sub-fund(s). Social capital will be introduced at the sub-fund and investment level.

<sup>11</sup> The pipeline is currently being prepared.



It is envisioned that the GAF will undertake both equity and debt investments. Given that the HADFIC's experience as a lender is rather limited, the GAF would need to develop market-based debt risk management models and debt products with multiple features (for example, convertible debt, cash flow-based debt financing, and revolving type funds), which carry different risk profiles and require specific risk management strategies.

14. Figure 2.2 describes the intended project investment business flow from promotion to exit. The sourcing process for investable projects foresees two options: first, whereby projects using qualified green technologies would be screened directly for their viability, and second, for technologies that are not yet qualified and that would therefore foresee an additional evaluation by an external pool of experts, before engaging in the appraisal of the investment proposal's other merits. The investment cycle and its procedures will be described in detail in the HADFIC's business plan.



Figure 2.1. GAF – Fund Structure and Business Model

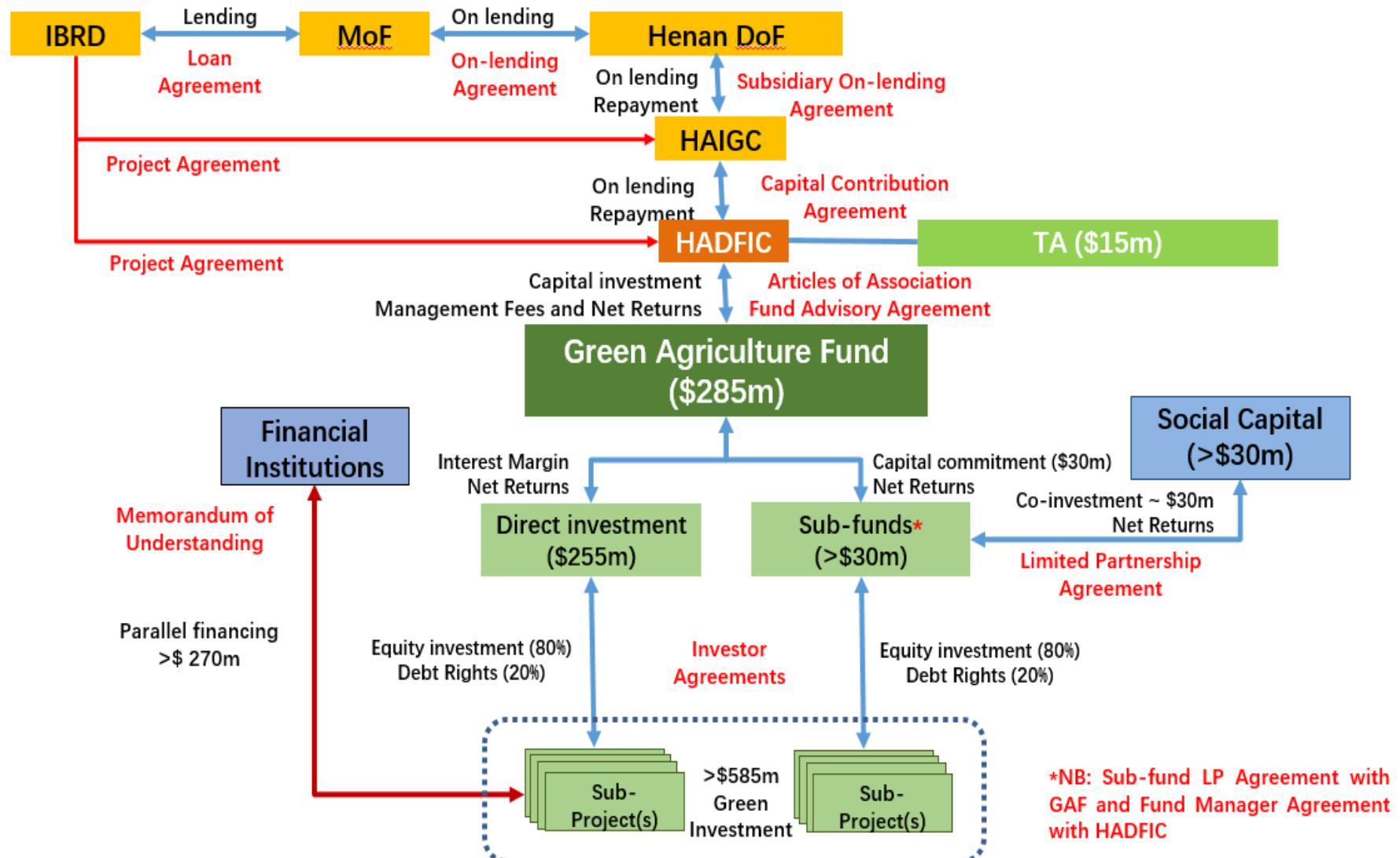
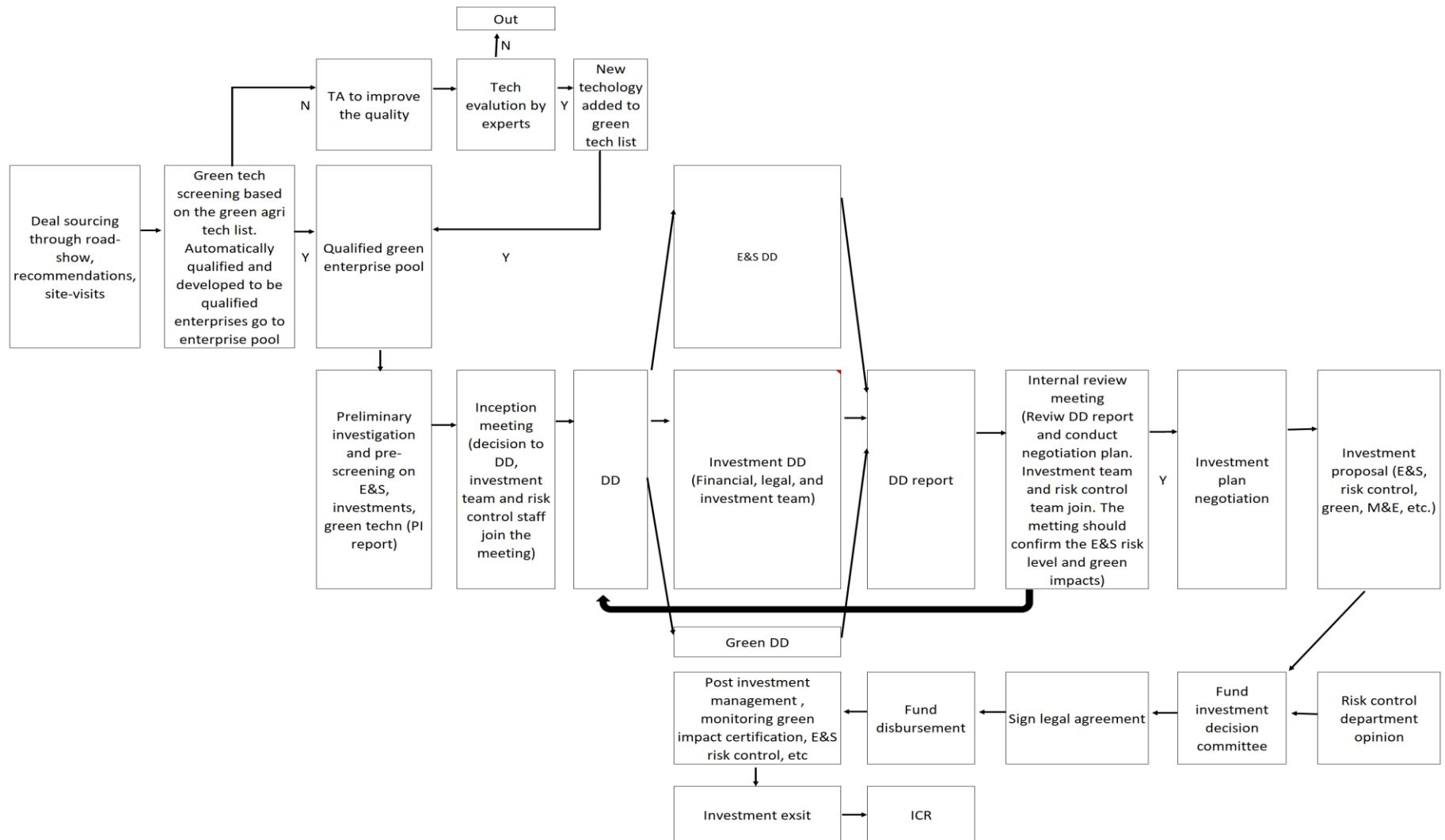




Figure 2.2. GAF Subproject Investments Business Flow





15. **The GAF organizational structure.** The HADFIC has currently 46 employees who work in nine departments: Research and Development Department, two Financing Development Departments, three Fund Management Departments, General Management Department, Risk Control Department, and Financial Management Department. It has a young and well-educated work force. The average age of its employees is 33 years with 96 percent of them holding at least undergraduate university degree.

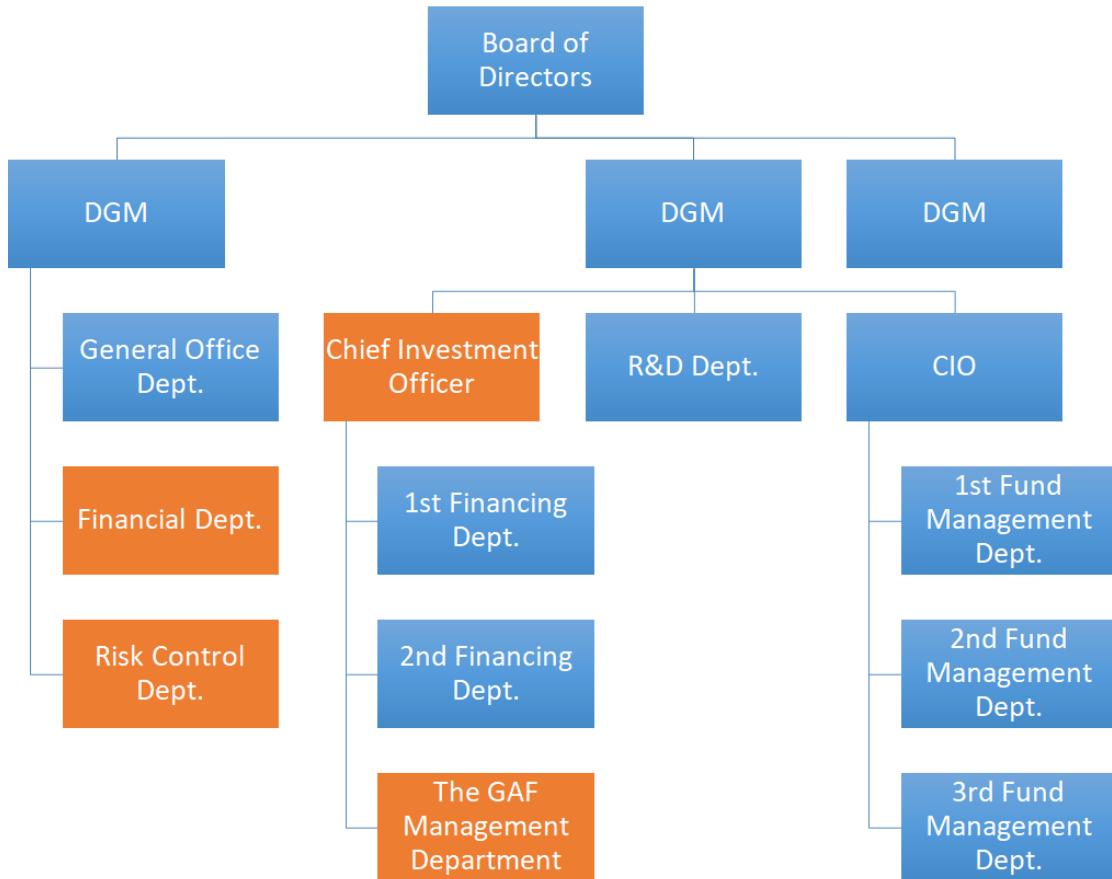
16. Figure 2.3 presents the institutional structure of the project. The project implementation draws on the existing institutional structure of the HADFIC. Figure 2.3 highlights those HADFIC departments that are directly involved in the implementation of the proposed project. In addition to the existing institutional structure, the HADFIC will establish a new department specifically for the management of the GAF, which will fall under the oversight of the CIO. The staffing of this department comes from existing departments of the HADFIC, as well as externally recruited contract-based staff with specialized technical skills to address gaps in its current skill profile (both full-time and part-time basis). The GAF management department will receive additional technical support from the existing HADFIC departments as part of its subproject investment cycle screening, due diligence, and approval process, most notably the Departments of Finance and Risk Control.

17. The HADFIC has assigned 10 of its staff to work on the proposed project preparation on a full-time basis, to ensure early project capacity (50 percent women). By the start of the project implementation and depending on the requirements of the GAF, the HADFIC may increase the GAF staffing to up to 20 officers, out of which at least 50 percent would be female staff. All TOR for the GAF team within the HADFIC will explicitly request applications from qualified women and men applicants. The recruitment policy will be updated, if needed, to ensure that a fourth candidate who is the most/next qualified female applicant is added to the short list of three best qualified candidates of any gender. The main functions of the HADFIC's GAF staff include subproject identification, screening, and evaluation; green agriculture technology research and analysis; risk control, including ensuring compliance with relevant ESSs; and fiduciary function (FM and procurement). In addition, the HADFIC will recruit the external specialized technical expertise (both full-time and part-time basis) such as green agricultural technology experts to strengthen the HADFIC's green investment management skills; environment and social experts to strengthen the HADFIC's safeguards management capacity and institutionalize Equator Principles in its operations; experienced procurement expert to assist with the preparation of procurement documents and strengthen the HADFIC's capacity; and legal and accountant firms to assist the HADFIC with subproject due diligence.

18. The HADFIC's investment objective is to balance the support for the government policy objectives with acceptable rates of return. The HDF, oversees the operations of the HADFIC and reviews its performance annually considering (a) the HADFIC's performance in achieving its strategic objectives through its investments, (b) the quality of the HADFIC's corporate governance, (c) its ranking in the industry based on the ratings from independent third-party rating agencies, and (d) its ability to leverage social capital.



Figure 2.3. Institutional Setup of the GAF



Note: The orange boxes indicate those HADFIC departments that are directly involved in the implementation of the proposed project.

19. The HADFIC is considering establishing the GAF as a limited liability company (LLC) fully owned by the HADFIC to be incorporated pursuant to its Articles of Association. Following the establishment of the company, the HADFIC will create independent team to manage the GAF. The GAF will open an escrow account from which it will make investments for green agriculture subprojects. This option would require that the HADFIC would obtain a business registration for the LLC and comply with applicable domestic regulatory requirements, including obtaining registration number from the AMAC. It is expected that the establishment of the GAF will be completed by the project effectiveness.

20. **The GAF subproject pipeline.** The HADFIC has compiled a long list of 202 potential agriculture subprojects from which it intends to select eligible green agriculture investments. These subprojects span across all geographical regions of Henan. Majority of the targeted enterprises are located in the southern counties of Henan (28 percent), followed by northern and central Henan (23 percent and 22 percent, respectively). Some 66 percent of these enterprises engage in crop production, 30 percent in livestock production, and another 4 percent in integrated crop-livestock production. By value chain segment, the largest share of potential subprojects is expected to come from the processing stage (55 percent), followed by production (37 percent) and input producers/providers (8 percent).



21. **Eligibility criteria for investments.** Green agriculture investments are defined as a broad spectrum of activities ranging from trading, storing, processing, packaging, and related logistical support for both crops and livestock sectors. The eligibility criteria for green investments will specify the types of assets to be covered for green financing eligibility to achieve wide penetration of the GAF which would support a diversified portfolio of agribusiness projects in terms of economic activities, borrowers, loan or equity sizes, and geographical coverage. The primary objective is to develop a portfolio of green agricultural investments that would maximize economic development and green impact of the sector. The GAF could cover a variety of investment types, including equity, equipment financing, working capital, trade financing, or term loans for productive assets, and will be subject to eligibility criteria along the following lines:

- At the origination of an investment, the investee company was in existence for not less than two years, except when investee company has been established by strategic partnerships.
- The maximum amount of an investment would be no more than US\$20 million equivalent to no more than 49 percent of the overall capital of the investee company
- The maximum exposure per investee company as percent of the original capital of GAF does not exceed 10 percent.
- At the origination of the investment, the enterprise was not in default or in violation of any laws and regulations of the country.
- The investee company is an entity where government entities (including national, provincial, and/or city-owned entities) own less than 50 percent of the total capital, directly or indirectly.
- The investee company is a commercial institutional business or enterprise that is not a private individual, and such business or enterprise is duly organized under the laws of China or licensed to do business in China under the relevant laws.
- The investee company is not a subsidiary or controlled by HAIGC or HADFC. In case investee company is related or linked party to HAIGC or HADFC, any conflicts of interest will be resolved following the existing AMAC or relevant regulations;
- The investee company's main activity is agriculture, agribusiness and agriculture related services and is willing to invest in green agriculture technologies with a view to achieve minimum agreed level of green impacts.
- The investee company is not primarily engaged in any of the activities on the Exclusion List.

22. When using loans for financing investments, some additional criteria are as follows:

- Agribusiness loan is not a refinancing of an existing loan.
- Agribusiness loan was underwritten in accordance with commercial underwriting criteria.
- Agribusiness loan is subject to standard commercial documentation.
- Agribusiness loan will be monitored and serviced in accordance with commercial loan servicing criteria.



- Loan is a senior obligation that ranks at least pari passu with all other senior obligations of the borrower.

## Green Technologies

23. **Green agriculture impacts.** Henan is one of the leading agricultural provinces in China. It is the largest producer of wheat in China and one of the largest producers of maize, fruits, vegetables, pork, and dairy, which have a significant environmental footprint. The GAF investments are expected to prioritize the following key value chains: wheat, fruits, vegetables, tubers, pork, and dairy. The major environmental and food safety risks in these value chains are related to agrochemicals use and livestock manure management at the production stage, which is then main source of GHG emissions, and TN, TP, and COD run-off due to the overuse of chemical fertilizers and pesticides and improper handling of livestock manure. Feeding and animal health practices are also a major source of GHG emissions and resource use inefficiency. Given the increasing use of mechanized crop planting and harvesting techniques, as well as value added processing, energy consumption is becoming critical to resource use efficiency, as does the water used for irrigation and processing as well as waste water treatment. Waste water from livestock farms and slaughterhouses leads to agricultural pollution if not treated properly. Distribution and logistics service providers contribute to the solid waste and energy efficiency management.

24. **Green agriculture standards.** Currently, there is no science-based consensus on green standards and technologies to guide green agriculture investments in China. The current system of agricultural standards is composed of eight themes: (a) basic agricultural standards, (b) seed and seedling standards, (c) product quality standards, (d) method standards, (e) environmental protection standards, (f) health standards, (g) agricultural engineering and engineering component standards, and (h) management standards. There are no specific green standards although some of the current agriculture standards are related to green agriculture. As such, interpretation on green standards in China is largely related to agriproduct quality, nutrition, and food safety (that is, green and organic food labeling).

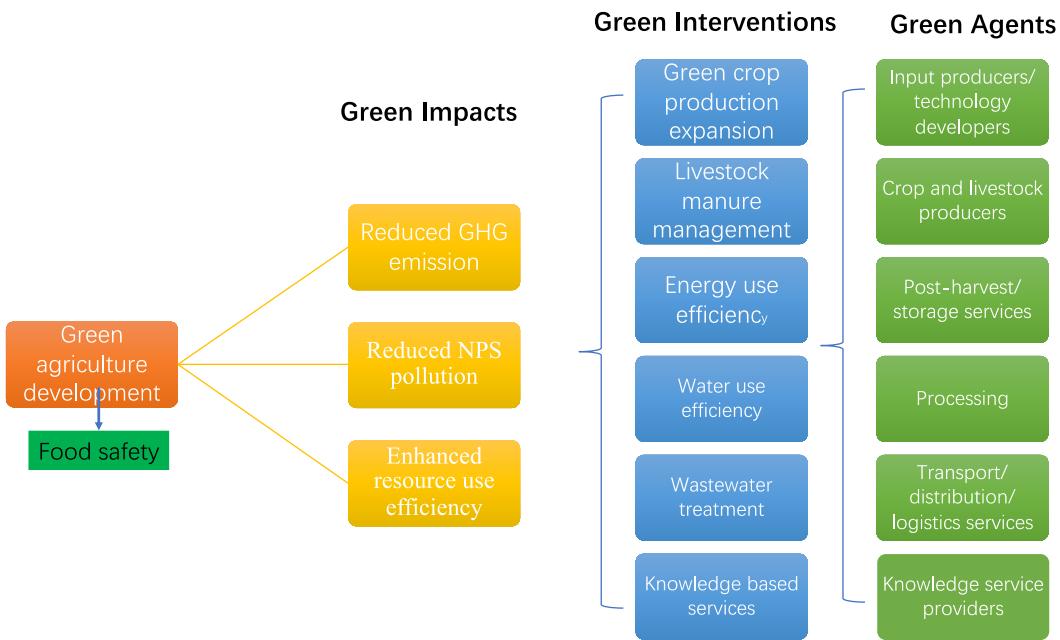
25. The proposed project will develop green standards, which follow international protocols, as it relates to the development of circular and low-carbon agriculture, efficient use of natural resources and production of nutritious, high-quality, and safe agricultural products with reduced impact on the environment. The challenge fund established by the project will solicit proposals for the development of agricultural green standards related to inputs quality, green production technologies/solution, evaluation methodology for agro-products food safety, and agriculture resource use efficiency. Selection criteria and processes will be developed as part of the challenge fund operational manual, and a technical advisory group will be formed to help the HADFC to screen the proposals while it is supposed to do the compliance review and due diligence review to assure the qualifications of the participating research institutes and the quality of proposals.

26. The proposed project is expected to have three key impact areas: (a) reducing GHG emissions, (b) mitigating agricultural nonpoint sources of pollution (TN, TP, and COD), and (c) enhancing resource use efficiency (that is, water and energy). The green agriculture development will not only have an impact on the three abovementioned environmental impact areas, but also on the safety of agricultural products. To realize these impacts, six types of green interventions are determined, including but not limited to green crop production expansion, livestock manure management, energy use efficiency, water use efficiency, wastewater treatment, and knowledge-based services. Each intervention is expected to have specific green technology solutions, which must be effectively applied by subprojects in a commercially



viable manner by various actors in the value chains, such as input producers, technology developers, crop and livestock producers, postharvest and storage service providers, processors, transport/distribution/logistic service providers, and knowledge service providers (Figure 2.4).

**Figure 2.4. Logical Framework of Green Agriculture Investments**



27. **Indicator system for M&E of green impacts.** The proposed project has prepared an indicator system to monitor and evaluate green and sustainable development impacts which are related to the previously discussed impact areas. The focus of the indicator system is to monitor the progress toward achievement of low-carbon and green development in the crop and livestock industries, based on the principles of source reduction, process control, and end-resource utilization. The indicators will be monitored throughout the targeted value chains including agricultural input provision, crop and livestock production, natural resources use efficiency, waste utilization, agriproduct processing, trading, and so on. The set of indicators developed for the project are grouped along the following categories: resource use efficiency and agricultural inputs safety; manure utilization and pollution reduction from livestock sector; pollution reduction from the crop sector; renewable energy production and utilization in the crop sector; GHG mitigation in the crop and livestock sectors, and establishment of the MRV system. It is expected that the HADFIC will use these indicators to screen, monitor, and evaluate the green impacts of the GAF investments.

28. **Green agriculture technologies.** The project has identified GTI, which would guide the HADFIC in the identification and screening of the subproject investments under the GAF. Green agriculture technologies are defined under the project as emerging technologies that increase the utilization efficiency of natural resources, reduce pollution (TN, TP, and COD) and GHG emissions, and improve the health of the ecological environment while ensuring the production of high-quality, nutritious, and safe food products. Tables 2.1 to 2.4 provide the list of feasible green technologies for crop and livestock subprojects from the GTI, and their protocols. The GTI currently includes 77 green technologies (35 livestock and 42 crop), 27 indicators (15 livestock and 12 crop), and 25 environmental mitigation



coefficients currently applied in livestock and crop value chains in China (Table 2.3 and Table 2.4). About two-thirds of the technologies in the inventory are used at the production stages, which would facilitate adaptation to the climate change, such as improved irrigation water efficiency and soil moisture retention approaches and the use of multi-resistant variety seeds to address risks related to increased variability of rainfall and increasing temperatures during growing season. Green technologies applied to processing and distribution segments of the value chain are mainly associated with resource utilization efficiency (that is, water and energy) and waste treatment (that is, wastewater).

29. The HADFIC is expected to use the GTI as a guideline to screen its clients/subprojects for green investments. Most technical solutions are related to the use of agricultural inputs and livestock manure management, where environmental and food safety risks are the highest. The green solutions for postharvest activities are primarily related to crop residue handling (that is, straw). The processing and distribution activities are mainly related to green solutions that improve resource use efficiency (that is, energy and water). Given the increasing labor and energy costs in China, it is expected that many technical solutions at the processing level are related to automation which results in increased energy efficiency. During the project implementation, the HADFIC would continue to update the GTI with emerging new green technologies, their technology-specific impact coefficients, and the related indicators, using expertise recruited under the TA component during the project implementation.

30. In addition to the GTI, the GAF investments will be subject to the following indicative criteria to better balance the investment portfolio mix and enhance its overall environmental impact:

- (a) Green investments should prioritize the highest environmental risk areas. It is suggested that about 60 percent of the total GAF investments be allocated to the enterprises involved in high-risk value chain segments (that is, production, postharvest processing of crops or feeding, manure handling, and slaughtering of livestock);
- (b) Green investment should have a direct impact on the reduction of GHG emission and agricultural pollution (TN, TP, and COD), as well as improved resource use efficiency in Henan Province. It is suggested that about 80 percent of the GAF investments are directed to the procurement of green solutions, which refers to equipment, facilities, software, and so on required to apply the green technologies listed in the GTI. The balance of 20 percent of the investments refers to the equipment, machines, and facilities supporting the application of green technologies, such as land and construction of facilities;
- (c) Enterprises should be willing to record any environmental/natural resources use baselines and track green impacts before and after the GAF investments according to the protocols and coefficients developed under the GTI.



Table 2.1. Technical Inventory of Green Technologies for Crop the Sector

Index	Indicators	Inputs	Productive Process Management	Waste Disposal	Processing and Storage of Agricultural Products	Distribution
1. Resource Saving and Input Safety	1.1 Effective Utilization Coefficient of Irrigation Water in Farmland	<ul style="list-style-type: none"><li>Stress-resistant varieties</li></ul>	<ul style="list-style-type: none"><li>Water-saving irrigation</li></ul>	—	—	—
	1.2 Fertilizer use per unit area of cultivated land	<ul style="list-style-type: none"><li>Application of slow/controlled-release fertilizers</li><li>Fertilizer synergists (by adding nitrification inhibitors, urine enzyme inhibitors)</li><li>Organic fertilizer instead of chemical fertilizer (eg. orchards, vegetable fields)</li></ul>	<ul style="list-style-type: none"><li>Soil testing and formula fertilization</li><li>Deep application of fertilizers by mechanics</li><li>Facility vegetable plots/orchards drip irrigation and fertilization</li></ul>	—	—	—
	1.3 Pesticide use per unit area of cultivated land	<ul style="list-style-type: none"><li>Biopesticides</li><li>High-efficiency, low-toxicity and low-risk chemical pesticides</li><li>Stress-resistant varieties</li><li>Seed coating</li></ul>	<ul style="list-style-type: none"><li>Physical and chemical inducement</li><li>Precision medication equipment</li><li>Unified control</li></ul>	—	—	—
	1.4 Comprehensive Utilization Rate of Crop Straw	—	—	<ul style="list-style-type: none"><li>Fertilization of straw</li><li>Straw feeding</li><li>Energy-saving of straw</li><li>Straw Materialization</li></ul>	—	—



Index	Indicators	Inputs	Productive Process Management	Waste Disposal	Processing and Storage of Agricultural Products	Distribution
	1.5 Energy consumption	<ul style="list-style-type: none"><li>Renewable energy use</li></ul>	<ul style="list-style-type: none"><li>Reduction of tillage and no tillage</li></ul>	<ul style="list-style-type: none"><li>Straw Materialization</li></ul>	<ul style="list-style-type: none"><li>Energy-saving agricultural machinery</li><li>Energy-saving drying technology for agricultural products</li><li>Energy saving in green storage buildings</li></ul>	<ul style="list-style-type: none"><li>Renewable energy</li></ul>
2. Production and Utilization of Renewable Energy	2.1 Renewable Energy Installation Capacity	—	<ul style="list-style-type: none"><li>Solar Irrigation</li></ul>	<ul style="list-style-type: none"><li>Centralized gas supply by straw pyrolysis and gasification</li><li>Concentrated gas supply from straw biogas</li><li>Straw solidified briquette fuel</li><li>Carbonization of straw</li><li>Straw power generation</li><li>Biodiesel</li></ul>	<ul style="list-style-type: none"><li>Solar energy/energy-saving grain dryer</li></ul>	—
3. Emission Reduction of Greenhouse Gases and	3.1 Greenhouse gas emission reduction and carbon sequestration	<ul style="list-style-type: none"><li>Application of slow/controlled-release fertilizers</li></ul>	<ul style="list-style-type: none"><li>Precise fertilization</li><li>Water-saving irrigation</li></ul>	—	—	—



Index	Indicators	Inputs	Productive Process Management	Waste Disposal	Processing and Storage of Agricultural Products	Distribution
Pollutants		<ul style="list-style-type: none"><li>Fertilizer synergists (adding nitrification inhibitors, urine enzyme inhibitors)</li></ul>	<ul style="list-style-type: none"><li>Returning straw to field</li></ul>			
	3.2 Ammonia emission	<ul style="list-style-type: none"><li>Addition of urine enzyme inhibitors to fertilizers</li></ul>	<ul style="list-style-type: none"><li>Fertilizer deep application</li></ul>	—	—	—
	3.3 Agricultural film recovery rate	<ul style="list-style-type: none"><li>Reduction of plastic film use</li></ul>	<ul style="list-style-type: none"><li>Use of degradable agricultural films</li><li>Use of Thickened Agricultural Film</li></ul>	<ul style="list-style-type: none"><li>Agricultural films picking machinery</li><li>Recycling of waste agricultural film</li></ul>	<ul style="list-style-type: none"><li>Light packaging</li></ul>	
4. Monitoring Management System	4.1 Good Practice Guidelines for Green Technology on multi-resistant varieties	<ul style="list-style-type: none"><li>Technical regulations for the implementation of green technology</li><li>Guidelines for monitoring, data quality control and quality assurance of green technology implementation</li><li>Guidelines for evaluation methods of green development of planting</li><li>Guidelines for reporting progress in green development of planting industry</li><li>Guidelines for Certification of Green Development in Planting</li></ul>	—	—	—	
	4.2 Certification of Green and Organic Agricultural Products	<ul style="list-style-type: none"><li>Green Agricultural Product Certification</li><li>Certification of Organic Agricultural Products</li></ul>	—	—	—	



Index	Indicators	Inputs	Productive Process Management	Waste Disposal	Processing and Storage of Agricultural Products	Distribution
	4.3 Risk Management	<ul style="list-style-type: none"><li>• Environmental protection labels</li><li>• Banning the use of high-risk pesticides</li><li>• Prohibition of straw burning in the field</li></ul>	—	—	—	



Table 2.2. Technical Inventory of Green Technologies for the Livestock Sector

Index	No	Feed inputs	Production process management	Waste treatment and utilization	Slaughter cleaning	Distribution sales
1. Resource conservation and input safety	1.1	Low protein diet	Intelligent farming and environmental control	—	Energy-saving slaughtering and processing	Control overpackaging
	1.2	—	Water-saving facility	—	Energy-saving storage	Green food
	1.3	—	LED lighting	—	—	—
	1.4	—	Energy-saving livestock house	—	—	—
	1.5	—	Land/farm matching	—	—	—
2. Waste utilization and pollution reduction	2.1	—	—	Covered storage	By-product utilization	—
	2.2	—	Blisters, no flushing	Biogas treatment and energy utilization	Waste water treatment	—
	2.3	—	Rainwater and sewage separation	Composting and fertilizer utilization	—	—
	2.4	—	—	Breeding and planting combine and local use	—	—
	—	—	—	Fermentation bed treatment	—	—
	2.5	—	—	Biogas slurry membrane concentration and utilization	—	—
3. GHGs et. al	3.1	—	—	Dead animal treatment	—	—
	3.2	Nutrient balance	Precision feeding	Biogas power generation, gas recycling	Energy conservation and mitigation	Low-carbon certified products
	3.3	Silage corn	Energy-saving ventilation	Bio filter	—	—
4. Monitoring &management system	—	—	Air discharge purification	Fertilizer deep and surface application technical and equipment	—	—
	4.1	No illegal addition of lean meat powder	Good guidelines or procedures	No pollution incident	Green organic food certification	Environmental-friendly tag food
	4.2	Traceability system /MRV, including guidelines on the evaluation methodology, technology application reporting, and certification for green development of livestock				



Table 2.3. Mitigation Coefficients of Green Technologies in the Cropping Systems

Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
1. Resource saving and input safety	1.1 Effective utilization coefficient of irrigation water	Increase WUE <ul style="list-style-type: none"> <li>• Canal seepage prevention</li> <li>• Low-pressure tube irrigation</li> <li>• Sprinkler irrigation</li> <li>• Micro-irrigation</li> </ul>	0.27 <sup>[1]</sup> 0.49 <sup>[1]</sup> 0.50 <sup>[1]</sup> 0.61 <sup>[1]</sup>	t CO <sub>2</sub> /ha	Water-saving Increase productivity	<p>[1] Zou XX (2012). How water-saving irrigation contributes to climate change resilience—a case study of practices in China. <i>Mitigation and Adaptation Strategies Global Change</i> (2012) 17:111–132. DOI 10.1007/s11027-011-9316-8</p> <p>Compared with traditional irrigation;            Using LCA approach;            Carbon footprint of traditional irrigation is 1.25 t CO<sub>2e</sub>/ha</p>
	1.2 Fertilizer use per unit of cultivated land	Reduced fertilizer application rate <ul style="list-style-type: none"> <li>• Controlled released fertilizer/inhibitors</li> <li>• Organic fertilizer instead of chemical fertilizer</li> <li>• Deep application of fertilizer by machinery</li> <li>• Fertigation in vegetable fields/orchards</li> </ul>	0.36 <sup>[2]</sup> 0.36 <sup>[3]</sup> 1.5 <sup>[4]</sup> 40 <sup>[5-6]</sup>	kg N <sub>2</sub> O/ha t C/ha/yr kg N <sub>2</sub> O/has %	Saving fertilizer Reducing CO <sub>2</sub> emissions from production of fertilizer Increase SOC Higher CO <sub>2</sub> emission from deep application (-) Higher cost for the special fertilizers (-)	<p>[2] calculated based on the database provided by Qian Yue in the article of Deriving emission factors and estimating direct nitrous oxide emissions for crop cultivation in China.</p> <p>[3] Yu'e LI Long-term (<math>\geq 20</math> years) application of fertilizers and straw return enhances soil carbon storage: a meta-analysis</p> <p>[4] Meta-analysis (unpublished)</p> <p>[5] Wang Y L, Li H, Sun Y, Wang L G. N<sub>2</sub>O emissions from a vegetable field with fertigation management and under greenhouse conditions. <i>Acta Ecologica Sinica</i>, 2016, 36( 7) : 2005-2014</p>



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
						[6] Chen Jing. 2015. Water-nitrogen dynamics and N <sub>2</sub> O emissions from wheat-maize rotation fields under drip fertigation in North China Plain. CAAS
	1.3 Pesticide use per unit of cultivated land	<ul style="list-style-type: none"> <li>• Biopesticides</li> <li>• High-efficiency, low-toxicity and low-risk chemical pesticides</li> <li>• Stress-resistant varieties</li> <li>• Seed coating</li> <li>• Physical and chemical inducement</li> <li>• Unified control</li> </ul>	- - 12.44 <sup>[7]</sup> 12.44 <sup>[7]</sup> -	- kg CO <sub>2</sub> e/kg pesticide kg CO <sub>2</sub> e/kg pesticide -	Higher food safety Higher food safety Higher productivity and less pesticide Higher productivity and less pesticide Food safety and less cost and pesticide Higher productivity and less pesticide	[7] Ecoinvent v2.2, Swiss Centre for Life Cycle Inventories, Switzerland
	1.4 Utilization rate of crop stalk	<ul style="list-style-type: none"> <li>• Straw amendment</li> <li>• Straw used for feed</li> <li>• Straw used for energy*</li> <li>• Straw as raw material</li> <li>• Straw as material for producing mushroom</li> </ul>	0.30 <sup>[3]</sup> - Coefficient provided in 2.1 1.1-1.2 <sup>[8]</sup> -	t C/ha/yr - t CO <sub>2</sub> /t straw t CO <sub>2</sub> /t straw -	Improvement of water maintenance Avoid water and fertilizer consumption for producing feed Avoid air pollution due to biomass burning; Saving fossil fuel Avoid wood consumption and deforestation Avoid air pollution due to biomass burning	[8] Straw to replace wood, calculated based on the straw carbon content and dry material content.
	1.5 Energy consumption	<ul style="list-style-type: none"> <li>• Reduction of tillage and no tillage</li> <li>• Energy-saving</li> </ul>	72.27 <sup>[10]</sup> 72.27 <sup>[10]</sup>	kg CO <sub>2</sub> /GJ(diesel) kg CO <sub>2</sub> /GJ(diesel)	Improvement of water maintenance	[9] unpublished report from Jiaqi Zhang [10] Data analysis from PDD of



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
		<ul style="list-style-type: none"> <li>• agricultural machine</li> <li>• Energy-saving/solar energy to process agricultural products</li> <li>• Renewable energy use</li> <li>• Energy saving in green storage buildings</li> </ul>	0.64 <sup>[11]</sup> 55.3 <sup>[10]</sup> 0.64 <sup>[11]</sup>  0.64 <sup>[11]</sup>	tCO <sub>2</sub> /MWh kg CO <sub>2</sub> /GJ(biogas) tCO <sub>2</sub> /MWh  tCO <sub>2</sub> /MWh	Reduced energy consumption Improvement of energy security  Reduced energy consumption and reduced cost	CCER projects (unpublished) [11] Greenhouse gas accounting and report requirement. Part I, Power Generation Enterprise
2. Production and utilization of renewable energy	2.1 Production and utilization of renewable energy	<ul style="list-style-type: none"> <li>• Solar Irrigation</li> <li>• Centralized gas supply through straw pyrolysis and gasification</li> <li>• Concentrated gas supply from straw biogas</li> <li>• Straw solidified briquette fuel</li> <li>• Straw power generation</li> <li>• Biodiesel</li> <li>• Solar energy to process agricultural products</li> </ul>	1.25 <sup>[1]</sup> 55.3 <sup>[10]</sup>  55.3 <sup>[10]</sup>  2.49 <sup>[10]</sup>  0.64 <sup>[11]</sup> 72.27 <sup>[10]</sup> 0.64 <sup>[11]</sup>	t CO <sub>2</sub> /ha kg CO <sub>2</sub> /GJ  kg CO <sub>2</sub> /GJ  kg CO <sub>2</sub> /kg standard coal tCO <sub>2</sub> /MWh kg CO <sub>2</sub> /GJ tCO <sub>2</sub> /MWh	Improvement of air quality Avoid biomass burning on site Improvement of energy security	
3. Air and soil pollution control	3.1 Ammonia emissions	<ul style="list-style-type: none"> <li>• Addition of urine enzyme inhibitors to fertilizers</li> <li>• Deep application of fertilizer</li> </ul>	53% <sup>[12]</sup>  48% <sup>[12]</sup>		Improve productivity Improve air quality	[12] ChaopuTi. 2018. Potential for mitigating global agricultural ammonia emission: A meta-analysis
	3.2 Mulching film recovery rate	<ul style="list-style-type: none"> <li>• Reduction of plastic film use</li> </ul>	22.72 <sup>[7]</sup>	kg CO <sub>2</sub> /kg film	Reduced soil and food pollution Avoid negative impacts of film	[13] Current situation and perspective of biodegradable



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
		<ul style="list-style-type: none"><li>• Use of degradable plastic films</li><li>• Recycling of used plastic film</li></ul>	20-40 <sup>[13]</sup> Increase CO <sub>2</sub> emissions from recycling	% CO <sub>2</sub> emission reduction	residue on crop yield (1) Avoid negative impacts of film residue on soil, food quality and crop yield	film development in China. <a href="http://www.sohu.com/a/24057014_100129163">http://www.sohu.com/a/24057014_100129163</a>



Table 2.4. Mitigation Coefficients of Green Technologies in the Livestock Sector

Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
1. Resource conservation and input safety	1.1 Water consumption reduction	• Water-saving drinker	2.26[16]	kg/herd/d (pig)	Reduce waste water	[16] Wang YF, Wei B, Chen H. Study on water-saving effect of new pig drinking water fountain in scale pig farm. Yunnan Journal of Animal Science and Veterinary Medicine, 2019(2):15-16 (In Chinese)
		• The water-saving manure cleaning system	1.3-1.7[17] 0.3-0.5[17] 3-10[17]	m <sup>3</sup> /100 herds/ d (pig) m <sup>3</sup> /1000 herds/ d (poultry) m <sup>3</sup> /100 herds/d (cattle)	Improve air quality Increase the nutrient value of manure Reduce the pollutant concentration in the slurry, make the slurry water treatment being easier	[17] Pollutant emission standards for livestock and poultry breeding (GB18596-2001)
		• Deep-pit, No flush	0.13-0.16[18]	m <sup>3</sup> /d/herd (sow)	No energy cost	[18] Wu ZH, Wang XM. Construction and environmental control of female piggery. Swine Industry Science, 2010 (3): 48-50. (In Chinese)
	1.2 Matching arable land	• Matching arable land	0.0123-0.166[19] 0.082-1.107[19] 0.042~0.554[19] 0. 49~6.64[19] 0.049-0.664[19]	ha/herd/year (pig) ha/herd/year (dairy cow) ha/herd/year (beef cattle) ha/100 herd/year (goat) ha/100 herd/year (poultry)		[19] Technical Guidelines for the Calculation of the Bearing Capacity of Livestock and Poultry Dirt Land



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
	1.3 Power saved	<ul style="list-style-type: none"><li>• LED lighting</li><li>• Energy-saving livestock house</li><li>• Intelligent animal raising and internal environmental control</li><li>• Energy-saving labeled storage</li><li>• Energy-saving labeled slaughter and processing</li></ul>	0.64[11]	tCO <sub>2</sub> /MWh		[11] Greenhouse gas accounting and report requirement. Part I, Power Generation Enterprise [14] Greenhouse gas accounting and report requirement. Cropping Enterprise
	1.4 Environmentally friendly feed	<ul style="list-style-type: none"><li>• Low protein diet</li></ul>	2-11[20,21] 63-332[20] 142[21]	% CO <sub>2</sub> eq emission reduction kg CO <sub>2</sub> eq /AU/year (swine)  kg CO <sub>2</sub> eq /AU/year (beef feedlot)	Reduce feed cost	[20] Wang Y, Dong HM, Zhu ZP, et al. Mitigating greenhouse gas and ammonia emissions from swine manure management: A system analysis. Environmental science & technology, 2017, 51(8): 4503-4511. [21] Wang Y, Li XR, Yang JF, et al. Mitigating greenhouse gas and ammonia emissions from beef cattle feedlot production - A system meta-analysis. Environmental Science & Technology. 2018, 52: 11232-11242.
	1.5 Safe veterinary drug	<ul style="list-style-type: none"><li>• Biosecurity measures</li></ul>	1 Kitasamycin Premix[22] 2 Bacitracin	1 For 1000 kg compound feed, pig 5~50 g; chicken 5~10 g		[22] MOA, on the release of the "drug feed additives category and use of the specifications notice" <a href="http://www.feedtrade.com.cn/">http://www.feedtrade.com.cn/</a>



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
			2 Methylleue Disalicylate Premix[22] 3 Nosiheptide Premix[22] 4 Bacitracin Zine Premix [22] 5 Chlortetracycline Premix[22] 6 Bambermycin Premix[22]	For 1000 kg compound feed, pig 10~30 g; Broiler 5~40 g; meat duck 5~50 g, continuously use not more than 42 days. 3 For 1000 kg compound feed, pig 2.5~20 g; chicken 2.5 g 4 For 1000 kg compound feed, calf < 3 months, 10~100 g, 3~6 month 4~40 g; pig < 6 months, 4~40 g; Poultry<16 weeks, 4~40 g. 5 For 1000 kg compound feed, piglet 25~75 g; broiler 20~50 g 6 For 1000 kg compound feed, fattening pig 5.0 g; piglet 20.0~25.0 g; broiler 5.0 g. beef cattle 30~50		news/review/2019-07-11/2032993.html



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
			7 Virginiamycin Premix[22]  8 Quinocetone Premix[22]	mg/herd/d.  7 For 1000 kg compound feed, pig 10~25 g; chicken 5 ~20 g  8 For 1000 kg compound feed, pig 50 g.		
2. Waste utilization and pollution reduction	2.1 Ammonia volatilization mitigation	• Closed storage	80[23]	% NH <sub>3</sub> emission reduction	Reduce odor emission, Preserve more N in manure	[23] Bittman S, Dedina M, Howard C M, et al. Options for ammonia mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen[M]. NERC/Centre for Ecology & Hydrology, 2014.
	2.2 Utilization	• Biogas production and energy utilization	0.64[11]	tCO <sub>2</sub> /MWh		[11] Greenhouse gas accounting and report requirement. Part I, Power Generation Enterprise
	2.3 Utilization	• Composting and utilized as fertilizer	0.36[3]	tC/ha/yr		[3] Yu'e Li Long-term ( $\geq 20$ years) application of fertilizers and straw return enhances soil carbon storage: a meta-analysis
	2.4 Utilization and reduce the application rate of nitrogen and phosphorus fertilizers	• Combination of planting and animal raising, local use of animal manure	170[24] 35[25]	kg N/hm <sup>2</sup> kg P/hm <sup>2</sup>	Increase soil fertility	[24] European Nitrate Directive 91/676/EEC [25] Jia Wei, Zhu Zhiping, Chen Yongxing, Dong Hongmin, et al. Manure nutrient management mode in typical mixed crop-dairy farm. Transactions of the CSAE, 2017, 33(12):209—217.



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
						(in Chinese with English abstract)
	2.5 Utilization	<ul style="list-style-type: none"><li>• Manure fermentation bed</li></ul>	80.2[26][20] 32.8[27]	kg N/AU/year kg P/AU/year	Reduce odor emission, Reduce deep-litter cost	[26] Calculated based on the N excreta amount per year for one pig minus the N loss in bedding house through gas emission; N excreta amount sources from ASAE; 146. ASAE Standards D384.1: Manure Production and Characteristics. American Society of Agricultural Engineers, St. Joseph, USA, 2004  [27]The excreted P was totally absorbed by bedding material; P excreta amount sources from ASAE; 146. ASAE Standards D384.1: Manure Production and Characteristics. American Society of Agricultural Engineers, St. Joseph, USA, 2004
	2.6 Biogas slurry utilization and adjusting nitrogen and phosphorus content in biogas slurry	<ul style="list-style-type: none"><li>• Biogas slurry membrane concentration and utilization</li></ul>	8.0[15]	kg CO <sub>2</sub> /kg N in Biogas slurry	Produce fertilizer, Reduce slurry amount	[15]WF Zhang, 2013
	2.7 Utilization	<ul style="list-style-type: none"><li>• Processing by-product</li></ul>				
	2.8 Nitrogen and	<ul style="list-style-type: none"><li>• Wastewater</li></ul>	70.1[28]	%, N reduction	Reduce fecal coliform	[28]Yao Huijiao, Dong



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
	phosphorus discharge reduction	treatment	68.3[28]	%, P reduction	reduction	Hongmin, Tao Xiuping, et al. Operation parameter optimization of wastewater from swine farms using submerged membrane bioreactor. Transactions of the CSAE, 2015, 31(15): 223—230. (in Chinese with English abstract)
	2.9 Biological pollution	<ul style="list-style-type: none"><li>• Animal carcass treatment</li></ul>	100[29]	% fecal coliform reduction	Produce organic fertilizer	[29]Guo DP. Research on Key Parameters of Dead Pig Composting[D]. CAAS, 2013.
3. GHG etc.	3.1 CH <sub>4</sub> emission mitigation	<ul style="list-style-type: none"><li>• Nutrient Use balance (MUB)</li></ul>	14.3-64.3[30]	g CH <sub>4</sub> /d/herd		[30]Na RH, Dong HM. Effects of dietary type on energy metabolism of dairy cows. China's Feed, 2011(18):24-27.
	3.2 CH <sub>4</sub> emission mitigation	<ul style="list-style-type: none"><li>• Silage corn</li></ul>	19.6[31]	g CH <sub>4</sub> /d/herd		[31]You YB. Studies on Methane Emission Measurement and Predicting Model of Beef Cattle[D]. CAAS, 2008.
	3.3 N <sub>2</sub> O emission mitigation	<ul style="list-style-type: none"><li>• Precise feeding</li></ul>	12%[32]	% N excreta reduction, no direct measurement of N <sub>2</sub> O reduction	Reduce feed cost	[32]Clemens J, Ahlgrimm H J. Greenhouse gases from animal husbandry: mitigation options[J]. Nutrient Cycling in Agroecosystems, 2001, 60(1-3): 287-300.
	3.4 Energy saving and CO <sub>2</sub> emission mitigation	<ul style="list-style-type: none"><li>• Energy-saving ventilation and cooling</li></ul>	0.64[11]	tCO <sub>2</sub> /MWh		[11]Greenhouse gas accounting and report requirement. Part I, Power Generation Enterprise
	3.5 Biogas production, CH <sub>4</sub> and	<ul style="list-style-type: none"><li>• Bioelectricity</li></ul>	0.64[11]	tCO <sub>2</sub> /MWh		[11]Greenhouse gas accounting and report requirement. Part



Index	Indicators	Green technology	Mitigation coefficient	Unit	Other co-benefit	Reference and note
	N <sub>2</sub> O emission mitigation					I, Power Generation Enterprise
	3.6 Exhaust gas purification, CH <sub>4</sub> , N <sub>2</sub> O, and NH <sub>3</sub> emission mitigation	<ul style="list-style-type: none"><li>• Biofilter</li></ul>	24[19] -12[19] 72-95[20,33]	% CH <sub>4</sub> mitigation reduction % N <sub>2</sub> O mitigation reduction % NH <sub>3</sub> mitigation reduction	Reduce odor emission	[33]Wang Y, Xue WT, Zhu ZP, (2019). Mitigating ammonia emissions from typical broiler and layer manure management—A system analysis. Waste Management, 93, 23-33.
	3.7 Precise slurry application, CH <sub>4</sub> , N <sub>2</sub> O, and NH <sub>3</sub> emission mitigation	<ul style="list-style-type: none"><li>• Fertilizing equipment for broadcasting and injection</li></ul>	7-11.3 [34] 0.7-1[35]	kg NH <sub>3</sub> -N/ha kg N <sub>2</sub> O-N/ha	Reduce odor emission	[34]McGinn, S. M.; Sommer, S. G. Ammonia emissions from land-applied beef cattle manure. Can. J. Soil Sci. 2007, 87(3): 345-352. [35]Webb, J.; Chadwick, D.; Ellis, S. Emissions of ammonia and nitrous oxide following incorporation into the soil of farmyard manures stored at different densities. Nutr. Cycl. Agroecosys. 2004, 70(1):67-76.



## ANNEX 3: ECONOMIC AND FINANCIAL ANALYSIS

COUNTRY: China  
Henan Green Agriculture Fund

### 1. Expected Benefits

1. The project is expected to produce two types of benefits: (a) increased production of safe agricultural produce and (b) environmental benefits from applying green technologies.

2. **Increased agricultural produce.** The project lends funds to the HADFIC that in turn invests in equity or loans to individual agribusiness enterprises. The pipeline of specific enterprise subprojects is not yet identified. Their investment proposals will be subjected to a detailed due diligence review by the HADFIC during the project implementation against agreed financial viability, technical (that is, green agriculture technologies), and E&S safeguards criteria. As such, it is not possible to anticipate which companies will be eventually financed. However, the HADFIC has already identified about 200 enterprises based on their expected financial viability from which it is expected to identify potential subprojects for green investments. Three types of enterprises were selected for the financial and economic analysis as representative of a good proportion of businesses likely to be financed by the GAF. The rationale for their selection is the following:

- **High-value annual crop.** It is assumed that the project-supported enterprises would not invest in large open field crops (such as cereals) but in high-value crop production (vegetables, microgreens, and hydroponic crops) that apply green technologies (organic production, IPM, less-polluting techniques, water-saving irrigation systems, and so on). Organic bean sprout production was chosen as an example of a popular hydroponic enterprise that is expected to increase in fast-growing urban agriculture business in coming years in response to changing consumer preferences.
- **High-value perennial crop.** Organic fruit production (apples, peach, and so on) under drip irrigation appears to be a growing business to respond to the sustained consumption of fruits and the rapidly increasing demand for organic products.
- **Livestock enterprise.** Meat consumption is still increasing in China as a result of the increasing purchasing power of urban-based consumers, and the domestic supply cannot meet the demand, leading to increasing imports, especially for pork meat, which is an important staple in Chinese diets. An integrated pig-raising enterprise was chosen as a representative business model. It is composed of three elements that all apply green technologies: (a) the use of improved feed (lower protein formulation and fermented feed that lead to higher nutrient efficiency and lower GHG emissions), (b) pig-raising with water- and electricity-saving techniques, and (c) use of manure to produce biogas and organic compost instead of disposal of fresh manure in the surroundings that produce GHG emission and soil pollution.

3. Financial models were prepared based on the assessment of actual enterprises that could be considered for financing under the project. Increased agricultural produce were quantified and valued at market prices before being converted into economic values for the economic analysis of the project.



4. **Environmental benefits.** The selected enterprise models would apply green technologies compared to the existing ones. The financial and economic returns do not include environmental externalities that are part only of the overall economic analysis. Table 3.1 describes environmental benefits that are more complex to capture, quantify, and value than agricultural benefits. While some of them were quantified and valued in the economic analysis, others were not. As such, the results of the economic analysis are conservative as it undervalues the project benefits.

**Table 3.1. Environmental Benefits and Their Quantification**

Green Investments	Expected Environmental Benefits Compared with Existing (without Project) Techniques	Quantification
Organic and resource-efficient crop production (bean sprout, other vegetables, and fruit trees)	Organic techniques, IPM, and no use of chemical inputs (fertilizers, disease, and pest control): - Impact of chemical inputs on GHG emissions - Lower air and soil pollution - Food safety and health benefits (lower absorption of chemicals)	Yes No No
	Resource-efficient production systems: Water savings from recycling in hydroponic system (microgreens) and more efficient irrigation techniques (drip irrigation) for vegetables and fruits Energy savings from more efficient technologies (both open field and hydroponic) and from reduced use of electricity for irrigation (pumping from underground water)	Yes, economic value of water Yes, economic cost of energy + its GHG equivalent
Pig production (integrated business of feed, piglets, and use of manure for biogas and organic compost)	Lower protein feed formula in the production of animal feed, leading to: Lower use of nitrogen component in the feed by animals, with GHG impact Reduced soil pollution from nitrogen residues in animal manure Higher efficiency of feed conversion into meat with lower animal mortality Water and electricity savings from more efficient technology in pig fattening units Use of animal manure to produce biogas and organic compost: Biogas production substituting use of electricity in the farm Avoidance of GHG from excessive disposal of manure in fields Reduced soil pollution from excessive disposal of manure in fields	Partly, for GHG No GHG of avoided losses GHG from electricity saving Yes, GHG of saved electricity Yes, GHG avoided No

## 2. Financial Analysis

5. The financial analysis aims to assess the financial viability of potential green agriculture enterprise subprojects from the investors' viewpoint. Simplified enterprise models were prepared in local currency (Chinese renminbi) applying market prices. Annual cost and benefits streams were calculated over a 20-



year period, which is the expected life of most of the assets of the investments, while replacement of some equipment has also been counted for, as well as maintenance expenditure accounting for 5 percent per year for infrastructure (for example, buildings) and 10 percent per year for equipment. The enterprises are assumed to self-finance half of the investment cost and borrow the remaining half at an 8.25 percent interest rate corresponding to the lower end of the current market rates for long-term loans. Repayments would start at the end of the second year and will be in five instalments. Interests paid during the repayment period were added to annual expenditures to calculate financial performance parameters that include the FIRR and the financial net present value (FNPV). An eight percent discount rate and exchange rate of US\$1 = CNY 6.88 were applied in the analysis.

6. **Bean sprout model.** Consumption of bean sprout and other microgreens is very popular in China as a source of vegetable proteins. Soya and green bean seeds are germinated and watered under temperature-controlled conditions with an average conversion rate of 8 kg of sprout produced per 1 kg of soya/green beans. The production of bean sprout is common, but the proposed model is in hydroponic conditions as an example of green technology, which would bring the following benefits compared to traditional technologies: (a) year-round production, (b) substantial savings of water (estimated at 60 percent) due to reuse of water and of electricity (30 percent) as a result of more efficient temperature control system, and (c) production of organic bean sprouts due to the controlled environment that does not require chemical treatment. The proposed investment cost is CNY 20.1 million (US\$2.9 million). Annual sales at full development would reach 100 tons per day, corresponding to 36,000 tons per year. Annual net income would then reach CNY 6.5 million (US\$0.9 million). The FIRR of this enterprise model is estimated at 25.0 percent, confirming its financial viability. The FNPV is estimated at CNY 33.0 million (US\$4.7 million).

7. **Fruit trees model.** The enterprise model consists of a 9,500 mu orchard (633 ha) planted with apple, peach, and apricot. Plantation would be phased over a three-year investment period; fruits would start producing in Year 4, and the orchard would reach full production in Year 8 with yields of 2–3 tons per mu (30–45 tons per ha). The green benefits would consist of (a) non use of pesticides (replaced by IPM techniques) and reduction by half of the use of chemical fertilizers; and (b) water- and electricity-saving production techniques, mostly drip irrigation. The proposed investment cost is CNY 29.4 million (US\$4.2 million). Annual net income would reach CNY 18.8 million (US\$2.7 million) at full development. The FIRR is estimated at 17.2 percent, and the FNPV is estimated at CNY 54.4 million (US\$7.9 million).

8. **Pig production.** The enterprise model consists of the following three elements: (a) the production of feed with customized formulas for various animals, (b) raising sows for the production of piglets, and (c) the utilization of manure for the production of biogas and organic manure. The main revenue source is the sale of piglets (and a proportion of unproductive sows every year). The enterprise would also sell organic manure annually that can be sold at CNY 900 per ton. Biogas would not be sold but used by the enterprise to heat the animal premises, thereby saving electricity expenditures. The green benefits arise from the three steps of the production cycle: (a) the production and use of low-crude protein animal feed, leading to better feed efficiency and reduced release of GHG-emitting N elements during the animal production cycle, (b) electricity and water savings throughout the entire cycle of production, and (c) the manure treatment in anaerobic conditions to produce biogas and organic manure instead of a combination of short pit storage and uncovered anaerobic lagoon that would cause high GHG emissions. The financial results have been calculated for each of these three elements separately. The production of piglets is the most profitable with an FIRR of 23.5 percent. The production of feed has an FIRR of 8.3



percent, which would cover the investment and recurrent costs with relatively modest profits. As expected, the manure treatment has a negative FIRR (-13.4 percent), which indicates that the investment is not profitable on its own on financial terms. At full development, the sale of manure can just cover annual expenses but not repay the investment cost, which is why conventional businesses are reluctant to invest in such facilities. The integrated business model shows good financial results, with an FIRR estimated at 18.7 percent and the NPV at CNY 170.0 million (US\$24.7 million).

### 3. Economic Analysis

9. The economic analysis was undertaken to assess economic viability of the entire project. The following assumptions were used:

- (a) Converting financial/market prices into economic values, either by using shadow prices when price distortions can be evidenced or by calculating parity prices for tradable goods. It was assumed that most financial prices reflect the actual value of investment and goods given the limited distortions in the current Chinese economy.
- (b) Overall investment equivalent to US\$285 million (Component 1) to be used to finance the loan/equity part of the investments;
- (c) Phasing of subproject investments is 10 percent in Year 1, 20 percent in Year 2, 30 percent in Year 3, and 40 percent in Year 4.
- (d) Investments would be equally shared between the three types of enterprise models.
- (e) Economic costs and benefits are aggregated from the enterprise models and TA costs 9US\$ 15 million) are added.

10. As a first step, the economic results were calculated without counting for GHG emissions. Without GHG benefits, the economic rate of return (ERR) of the project was estimated at 18.8 percent and the NPV at CNY 4,457 million, equivalent to US\$637 million.

### 4. GHG Emission Reduction

11. The ex-ante quantification of GHG emission reductions is an important step in managing and ultimately reducing GHG emissions. This is particularly important for the Henan Green Agriculture Fund project since it aims to demonstrate the viability of green technologies.

12. **Methodology.** To estimate the impact of agricultural investment on GHG emissions and carbon sequestration, the World Bank has adopted EX-ACT, developed by the FAO since 2010. EX-ACT allows the assessment of the project's net carbon balance, defined as the net balance of CO<sub>2</sub> equivalent GHG emitted or sequestered as a result of project implementation compared to a without-project scenario, assumed to be the adoption of conventional technologies. EX-ACT estimates the carbon stock changes (emissions or sinks), expressed in equivalent tons of CO<sub>2</sub> per hectare and year.

13. Specific (Tier 2) emission factors and emission reduction potential for livestock were derived from calculations based on GLEAM developed at the FAO. GLEAM is a biophysical model of livestock supply chains that calculates animal herd dynamics, feed rations, production, and GHG emissions with Tier 2 methodology (IPCC 2006), with a life cycle approach. Three gases are considered in the calculations:



carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ), and nitrous oxide ( $\text{N}_2\text{O}$ ). The latest available global warming potential from the Intergovernmental Panel on Climate Change (2014) are used to convert all emissions into  $\text{CO}_2$  equivalent (298 for  $\text{N}_2\text{O}$  and 34 for  $\text{CH}_4$ ). Warm temperate moist climate and soils with low activity clay were assumed to be representative of Henan Province. The reference value of 0.839 ton  $\text{CO}_2\text{eq}$  per MWh of electricity (Tier 1 in China) has been applied to estimate the impact of electricity consumption on GHG emissions.

14. **Bean sprout model.** The GHG reductions in the bean sprouts model are largely a result of electricity savings. The more efficient technologies for this kind of production system result in a 30 percent savings in electricity consumption. This would result in a reduction of 104 tons of  $\text{CO}_2\text{eq}$  per year, corresponding to 2,009 tons over the 20-year project life.

15. **Fruit trees.** The GHG emissions reductions from the apple model are a result of both the lower use of inputs as well as the possible land use change. EX-ACT was used to make projections. The conversion of 9,500 mu (633 ha) from annual crops to fruit trees would result in a total of 28,547 ton  $\text{CO}_2\text{eq}$  as a result of the land use change taking place at Year 1 and subsequently 82,268 ton  $\text{CO}_2\text{eq}$  progressively captured during the remaining 19 years as a result of tree growth. In addition, assuming that pesticides are substituted by biological control or IPM techniques, and that nitrogen-phosphorus-potassium fertilizer is reduced by half, further 5,601 tons  $\text{CO}_2\text{eq}$  is estimated from avoided GHG emissions. On an annual basis, the orchard would lead to a reduction of an estimated 9.2 tons per ha per year (0.61 ton per mu per year). This would correspond to a reduction of 5,827 tons of  $\text{CO}_2\text{eq}$  per year, corresponding to 139,300 tons over the 20-year project life per unit business.

16. **Pig raising.** GHG reduction would originate from three sources. First, anaerobic digesters are one of the most promising practices for mitigating  $\text{CH}_4$  emissions from manure. When correctly operated, anaerobic digesters are also a source of renewable energy in the form of biogas, which is 60–80 percent  $\text{CH}_4$ . Secondly, higher quality and digestibility of feed results in reduced manure emissions and better animal growth performance. Decreasing the proportion of direct proteins and increasing the share of higher quality ingredients (e.g. grains, oilseed cakes, minerals, additives (especially lysine and methionine) in the feed basket improves digestibility and animal growth performance, and reduces manure emissions, because less N and organic matter are found in faeces per unit of meat produced. It also reduces emissions to produce feed, because of the use of lower proportion of soybeans, which are usually highly correlated with deforestation GHG emissions. Finally, further reductions in emissions result from: (a) moving from using coal for heating to using the biogas; (b) improved electricity efficiency.

17. Improvement of manure management and improved feeding were modelled with GLEAM-i. A baseline scenario on herd dynamics for pigs in the Henan region was compared with the proposed green enterprise under the project. The amount of manure treated in anaerobic digestion was increased to 100 percent. Biogas produced by anaerobic digestion of manure was estimated and the equivalent  $\text{CO}_2$  emissions saved from fossil fuel substitution calculated. This compares with the baseline where 40 percent short pit storage and 60 percent uncovered anaerobic lagoon take place. Improved feeding consists of switching from 13 percent by-products from soy, 6 percent vegetable oil, 61 percent corn grains and 20 percent synthetic components to improved feed composed of: 10 percent by-products from soy, 6 percent vegetable oil, 64 percent corn grains and 20 percent synthetic components. GLEAM-i estimates that these changes would result in a reduction of 27,000 tons of  $\text{CO}_2\text{eq}$  per year, i.e. a 21.3 percent decrease compared to the baseline scenario.



18. Furthermore, savings from using biogas for heating would reduce an estimated 100 tons of coal per year. Assuming an average value of 2.86 ton CO<sub>2</sub>eq, this investment would generate an additional 286 ton CO<sub>2</sub>eq emissions reduction per year. Finally, as a result of the use of energy efficient technologies, it is estimated that pig enterprises can reach 10 percent of electricity savings per year. Assuming a value of 0.839 ton CO<sub>2</sub>eq per MWh/year, a total of 17,207 tons of CO<sub>2</sub>eq per year would be saved. In conclusion, the three sources of reduced emissions of the proposed livestock enterprise model would contribute to mitigating 283,810 tons of CO<sub>2</sub>eq per year at full development, or a total of over 4.9 million tons over the 20 year-life of the project.

19. **Total GHG benefits.** If the equivalent of US\$285 million is equally invested in the three enterprise models following the assumed investment phasing patterns, the total GHG benefits would reach an estimated 684,000 tons CO<sub>2</sub>eq per year at full development, corresponding to a total of about 12.1 million ton CO<sub>2</sub>eq over the project life. Using the economic value of CNY 206 per ton CO<sub>2</sub>eq (US\$30 per ton) would generate benefits of CNY 141.2 million (US\$20.2 million) per year and CNY 2,488 million (US\$355 million) during the project life.

## 5. Sensitivity Analysis and Conclusions

20. The sensitivity analysis was undertaken to (a) test the robustness of the project by assessing the impact of typical investment risks, such as the increase in investment cost by 20 percent or the decrease in annual net revenues by 20 percent, and (b) assess the impact of adding the GHG benefits in the economic analysis. The recommended value of US\$30 per ton of CO<sub>2</sub>eq was used as well as a higher figure of US\$100 per ton of CO<sub>2</sub>eq corresponding to a figure recommended by some scientific sources to account for the actual environmental damage of releasing 1 ton of CO<sub>2</sub>. The results are shown in Table 3.2:

**Table 3.2. Sensitivity Analysis**

Scenario	ERR (%)	NPV (8% Discount Rate) in CNY, millions	NPV (8% Discount Rate) in US\$, millions
Base case scenario	18.8	4,457	637
Investment costs increased by 20%	16.3	3,513	502
Annual benefits decreased by 20%	15.8	2,931	419
GHG benefits valued at US\$30 per ton CO <sub>2</sub> eq	21.1	5,445	778
GHG Benefits valued at US\$100 per ton CO <sub>2</sub> eq	26.7	7,752	1,107

21. The sensitivity analysis estimates appear robust. The inclusion of GHG benefits would increase the ERR from 18.8 percent to 21.1 percent and increase the NPV by 23 percent to CNY 5,445 (US\$778 million) when 1 ton of CO<sub>2</sub>eq is valued at US\$30. The impact of GHG benefits would be more dramatic if 1 ton of CO<sub>2</sub>eq is valued at US\$100. The ERR would reach 26.7 percent and the NPV would reach CNY 7,752 million (US\$1,107 million), that is, an increase by 75 percent compared to the base case scenario.

22. The effect of environmental benefits on the ERR and NPV is conservative as these environmental benefits go far beyond simply the GHG emissions used in these calculations. The proposed green technologies also carry important reductions in nitrogen pollution, nonpoint source pollution, improvements in aquifer and stream water quality, and health improvements, which have not been valued in economic terms.



## ANNEX 4: DUE DILIGENCE REVIEW

COUNTRY: China  
Henan Green Agriculture Fund

1. **Due diligence approach and efforts.** The Bank team conducted due diligence with a focus on the HADFIC, through interviews with: (a) the HADFIC management and technical staff; (b) the third-parties including Zero2IPO (a leading market consulting service provider in China's investment fund industry); (c) various Henan government agencies; and (d) selected HADFIC investee companies. The Bank has acquired and reviewed a diverse set of internal HADFIC documents and data, which provide evidence to its due diligence analysis.
2. **Overview of the HADFIC.** The HADFIC is the subsidiary of the Henan Agriculture Investment Group Co. Ltd (HAIGC) -- a wholly state-owned agricultural investment company of Henan Province. The HADFIC acts as both the representing entity of fiscal funding as an investor (typically GP) and the fund manager: if there is adequate interest from external fund managers (e.g. for funds with better commercial prospects), HADFIC typically acts as the GP only and hires external fund managers. For funds with a strong policy mandate that may not attract enough external interest as fund managers, HADFIC typically acts as the fund manager. HADFIC's investment objective is to balance the support for government policy objectives with acceptable rates of return. Currently HADFIC has 21 funds, 18 of which were funded by fiscal sources and 3 were funded by HADFIC's internal funding.
3. **Regulatory/supervision/reporting framework.** The HADFIC is under regulatory oversight and supervision of the following agencies: (a) as a fund manager registered at the Asset Management Association of China (AMAC), it is regulated and supervised by the AMAC and needs to follow its regulations and guidance, report regularly to the AMAC and undergo its random checks; (b) as a wholly-owned subsidiary of the HAIGC that is funded by the HDF, the HADFIC is supervised by its auditing unit; (c) as a state-owned-enterprise, the HADFIC follows SOE supervision and management requirements by the Department of Audit and Department of Discipline Inspection.
4. **Performance review.** The HDF oversees the operations of the HADFIC and reviews its performance annually (as part of the annual public agency/staff performance evaluation process) considering: (a) its performance in achieving its strategic objectives through its investments; (b) the quality of the HADFIC's corporate governance; and (c) its ranking in the industry based on the ratings from independent third party rating agencies (see next paragraph). Of the 18 funds managed by the HADFIC, 15 funds were rated as "Excellent" and 3 funds were rated as "Good" by the HDF. In addition, public companies, such as the HADFIC, may be awarded "bonus points" in their performance evaluation for attracting social capital and/or for introducing innovative approaches as documented in the media news or by qualified entities.



5. **Rankings and awards.** The HADFIC is ranked consistently under the top 30 public asset management companies among some 2,000 public asset management companies in China. Such rankings are done by third party ratings agencies, such as Zero2IPO based on objective and quantifiable criteria, such as assets under management, internal rates of return (IRR) on investments, annual total revenues, number of companies invested, successful exits, etc. The HADFIC was ranked as one of the “top 10 government guidance private equity funds” and one of the “top 20 limited partners of the private equity investment area” by CVINFO. In addition, HADFIC figures among the 20 asset management firms, both private and public, that manage agricultural funds (out of a total of 4,000 such companies).

6. **The HADFIC’s financial highlights.** HADFIC provided auditors’ reports for the years 2016 to 2018. The data provided by the HADFIC shows that its net profits increased from CNY 10 million in 2015 to about CNY 33 million in 2018.

7. **Funds managed and set up by the HADFIC and their investment performance.** According to the HADFIC, 17 of 18 funds that use fiscal resources record profit in their books, while one fund reports one percent loss. Two funds are reported to have some risky sub-projects (i.e. projects that may suffer an investment loss). The HADFIC’s reported IRRs on its existing funds have a wide variation, but for the two agriculture funds it was around 6 percent which is below the private fund equity returns. The HADFIC can at times reward social capital that contributes to its sub-funds a higher rate, thus capping its own returns to incentivize social capital partners to invest in its funds, on a case by case basis. Longer term pricing in HADFIC debt funds is also around 6-7 percent (PBOC 5-year benchmark rate is 4.9 percent) which is on the lower end of the interest rate spectrum of long-term debt for medium sized companies in China, but still within the market interest rate range. The portfolios of the funds HADFIC manages or invests in include both equity and debt investments. For the two agriculture funds, the investments so far have been mostly equity. All shares are remunerated pari-passu. However, HADFIC is willing to provide return enhancement for social capital, if risks are shared pari-passu. In the case of equity investments, HADFIC may take a board seat in the invested enterprise, but it usually takes a passive role, generally not interfering in the company’s day to day operations.

8. **Track records based on two existing agriculture funds.** The HADFIC manages two existing agriculture funds: Henan Agriculture Development Fund and Henan Agriculture Modernization Fund. The two funds were both rated as “Excellent” by the HFD despite of the lower financial returns. Leverage (multiplier of social capital) for Development Fund is 1:1, and for Modern Fund is 1:2. In addition to these two agriculture focused funds, there are also other funds that have agriculture or rural development elements. The specific features of these two funds include:

- **Agriculture Development Fund.** This fund managed by the HADFIC has been under contractual arrangements since April 1, 2015. Its size is CNY 300 million with a term of seven years. Fiscal capital from the HFD is CNY 135 million, with the remaining coming from social capital sources. The HADFIC has invested its committed capital fully and there



are no exists as of 2019. The fund carries out equity investments with up to 20 percent participation in the shares of the investee companies.

- **Agriculture Modernization Fund.** This fund was set up as LP on December 12, 2015 and it is managed by external fund managers. Its size is CNY 430 million with a term of seven years. Fiscal capital from PFB amounts to CNY 140 million, with the remaining being social capital. The fund manager charges 2 percent of total fund size as management fee. It has invested CNY 330 million and has reported no exit yet as of 2019. The fund carries out equity investments with up to 20 percent participation in the shares of the investee companies.

9. **Portfolio valuation.** The HADFIC fund structures, asset management and governance structure are dictated by regulations under the Securities Investment Fund Law and investment protection guidelines for state funds. State funds are required to preserve their capital, which means that managers of such funds cannot have losses, although the regulations about “state capital preservation” provide some flexibility and degree of risk tolerance, especially in the case of events beyond the control of investment firms. It provides that investments need to be marked-to-market at least annually. The HADFIC currently takes a rather conservative investment and valuation approach. It typically uses book value (cost) of investments unless there are major events suggesting a loss potential, in which case adjustments will be made, or when profit is realized. Given that enterprises in the HADFIC funds are not listed, mark-to-market is done using various valuation methods such as price-to-earnings multiples on earnings/profits ratios. Most valuations rely on a combination of revenues and net profits as key variables.

10. **Risk management.** The HADFIC have satisfactory internal mechanisms to manage risks. It relies on investment protection agreements with investee companies to compensate for significant shortfalls in their valuation either by asking them to surrender more shares, put some money into their account, or defer the assessed amount for the time of the exit, etc. The implementation of such agreements varies and there is no systematic way to assess their impact. Furthermore, the HADFIC relies on a process from identification of investments, to due diligence, internal approvals, negotiations, and exits that appears to be quite rigorous. Most of social capital invested in the two existing agriculture funds are in support of the specific public policy objectives. According to the HADFIC, it has also been able to mobilize commercial capital (i.e. social capital from commercial enterprises seeking to establish their presence in agriculture to diversify their portfolios) at sub-fund level of in other funds it has invested in or manages on behalf of investors.

11. **Investment cycle.** The HADFIC follows “13-step practice” in its investment cycle that includes all steps from the scoping of potential investments to exits from such investments. The investment appraisal focuses on legal and financial issues, and on the enterprise business plan assessment. The HADFIC verifies enterprise compliance to relevant laws and regulations, including E&S regulations. In the investment process, the HADFIC uses a risk control committee



that is independent from their IDC. A representative from the risk control committee sits in the IDC and opines when it comes to making investment decisions. Each fund has its own IDC and this usually consists of 5 members. In the case of funds that operate sub-funds, the sub-fund investment committee includes in most cases one officer appointed by the social capital partner. Before investments are presented to the IDC they pass through a quality control process (GPIDC) that recommends the investment to the IDC. The IDC and GPIDC can employ experts as needed.

12. **Mobilization of social capital.** In terms of additionality, private sector fund managers seek profits, while public sector fund managers such as HADFIC blend policy objectives with profits. A key objective of the HADFIC is to mobilize private capital and seek cooperation with private sector. Private capital can enter either through direct investments in the HADFIC sub-funds and through parallel investments in subprojects.

13. **Investment decision making.** The investment performance of the HADFIC is assessed by three indicators: (a) policy indicators, such as support for government policy objectives; (b) economic indicators, such as returns and profits; and (c) compliance indicators, meaning the extent to which investments meet standards and are compliant with relevant laws and regulations. The HADFIC monitors its investments on monthly basis and gets monthly progress reports from enterprises. In addition, the HADFIC receives from enterprises quarterly financial statements and annual audited financial statements. It provides to the GAF its monthly circular reports for each fund and shares its quarterly and annual audited reports. The HADFIC reports that a “typical” period from the beginning of due diligence to signing the agreement takes 2-3 months. However, delays may happen in disbursements for investments. Based on the review of its two agriculture funds, it took HADFIC about 30 months to draw down the financial resources it had raised for these funds. The HADFIC has in general good processes of managing and monitoring their investment due diligence. It takes usually a conservative investment approach in evaluating issues of compliance in their investee firms. It has strong incentives to assess and monitor its investments carefully as it is accountable for losses, is subject to close oversight and independent third-party rating.

14. **Why HADFIC?** Why chose HADFIC a state fund asset management company?

- **There is limited interest of private sector funds in agriculture:** Only 20 out of 4,000 active fund management firms in China which manage agriculture related funds, and most of these firms are state owned. The HADFIC is the only major agriculture investment company in Henan Province. While private fund management firms are not interested in investing in agriculture, the HADFIC has shown that it can blend policy objectives with reasonable profitability which makes it a suitable partner to manage the GAF.
- **Green agricultural financing is a marginal line of green finance:** out of CNY 8 trillion in green finance in China, only CNY 60 million are placed in green agriculture.
- **While adhering to market principles, the HADFIC needs to generate positive returns**



**and attract other sources of funding.** To do this the HADFIC has been able to accept lower returns thus providing incentives to other investors (including private investors) to engage in activities that per se may not appear attractive from a commercial vantage point.

- **Private fund asset managers focus mainly on high returns and consider agriculture too difficult and risky to achieve expected returns.** Lack of interest in agriculture and primary focus on profits makes private fund management firms not suitable for managing funds, such as the GAF, which are new and relatively untested.
- **Agriculture is inherently risky and green agriculture investments are new, with uncertain returns which makes it challenging for private fund asset managers.**

15. **Areas for improvement.** While the overall impressions of the HADFIC as a fund manager with dual policy and rate of return objectives is positive, it could benefit from further institutional capacity building. Areas where the HADFIC could improve include: (a) improving its debt product offerings to include products that would facilitate green agricultural investments (e.g. revolving lines of credit, supply chain finance, vendor finance, factoring, etc.); (b) strengthening the technical due diligence of green investments through training or recruiting personal with green agricultural technology competency, identification of green agriculture project pipeline, risk management of green agricultural projects, and structuring their financing transactions; (c) improving and making more flexible the valuation methods by considering a longer-term (vs. one year) perspective of its investments and considering alternative valuations methods as green investments may need more patience to generate expected financial returns; and (d) institutional enhancements which would lead toward preparations of entry into green bond markets through maintaining top asset class quality based on the professional due diligence and investment monitoring (VC approach), and having its investments green impacts certified through third-party monitoring, verification and reporting. The project will address these areas through suitable TA/institutional capacity building activities.

16. **SWOT Analysis of the HADFIC.** Building on the above, the text below summarizes the strengths, weaknesses, opportunities and threats for the GAF by the HADFIC.

#### ***Strengths of the HADFIC***

- Alignment of investment objectives
  - Investments balance public policy objectives with acceptable returns.
- Risk management
  - Satisfactory risk management focusing on preserving state capital;
  - Acceptable processes and procedures for investment cycle;
  - Independent (to investment committee) quality mechanism and risk controls during the investment process;
  - Focus on compliance issues (including E&S compliance of investments). However,



the focus is more on compliance rather than E&S risk management of investments.

- Supervision and reporting
  - Supervised by the HDF and AMAC;
  - Frequent internal (at least monthly) and external (quarterly, annually) reporting;
  - HDF uses a rating system for performance management based on: (a) meeting strategic objectives of the fund; (b) governance; and (c) rating among its peers done by a third-party private firm (e.g. Zero2IPO);
  - Positive image with the regulators.
- Performance
  - Consistently rated among the top 30 out of 2,000 state guided asset management firms as well as under the top 10 government guidance private equity funds by third-party rating firms (Zero2IPO and CVINFO);
  - Profitable and acceptable IRRs of its funds, keeping in mind the balancing of policy targets and acceptable returns in its investments;
  - HADFIC can allow, if needed, higher returns to social capital investors.
- Additionality
  - Investing in challenging sectors such as agriculture;
  - Key objective to mobilize social (including private) capital;
  - Leverages private sector either through investments into its funds or sub-funds but also in parallel investments (to the same project or company), plays the role of catalyst.

### ***Weaknesses of the HADFIC***

- Governance
  - Limited participation of external/private sector representatives in decision making bodies such as the IDCs or Risk Committees.
- Risk management
  - Conservative approach and limited risk taking due to “capital preservation” principle. “Capital preservation” should have some flexibility and not be applied strictly;
  - Reliance on “investment protection agreements” and “formulaic” mark-to-market calculations. Needs to strengthen its DD process;
  - Focus on assessing compliance rather than E&S risk management procedures for assessing investments.
- Green agricultural finance institutional capacity



- Expertise in “traditional” agriculture investments but needs additional expertise for green agricultural finance investments. Needs to develop skills: (a) to identify green agricultural pipeline; (b) assess green investments; (c) develop new products for green agriculture investments;
- Need to diversify its offering of lending products adapted to green agriculture investments.

***Opportunities for the HADFIC***

- Provide a significant contribution to the “greening” of agriculture in Henan;
- Enter into new markets and new clients;
- Ability to cross-sell additional investments to existing clients;
- Establish a leadership position in green agriculture in China;
- Generate positive branding image;
- Improve image towards HDF, Provincial and National governments and supervisors;
- Improve company ratings;
- Move up the path to prepare for Green Bond issuance.

***Threats to the HADFIC***

- Insufficient demand or insufficient capacity to identify adequate volumes of green agricultural investments in a timely manner;
- Inability to attract enough social capital, particularly from commercial sector;
- Inability to achieve acceptable returns from green agricultural investments.



### ANNEX 5: MAP

