



# **Options for Increased Private Sector Participation in Resilience Investment**

**Focus on Agriculture**

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# Abbreviations and Acronyms

2PL	Second party logistics
3PL	Third party logistics
4PL	Fourth party logistics
A/C	Air conditioning
AC	Advisory committee
ADB	Asian Development Bank
ADM	Archer Daniel Midlands Co.
AfDB	African Development Bank
Agri	Agriculture (abbreviation)
AgTech	Agriculture technology
AIFMD	Alternative Investment Funds Directive (of the European Union)
AIIB	Asian Infrastructure Investment Bank
AMC	Asset Management Company (IFC)
ARP	Agriculture Restructuring Plan (of Vietnam)
ASAP	Adaptation for Smallholder Agriculture Programme
ASEAN	Association of Southeast Asian Nations
ASRIF-Asia	Agriculture Sector Resilience Investment Fund (ASRIF)-Asia
AuM	Assets under management
BD & TA	Business development and technical assistance
BEE	Mexican-American agriculture venture development firm
Bn	Billion
C	Celsius
CAD	Canadian dollar
CAGR	Compound annual growth rate
CalPERS	California Public Employees Retirement System
CAPEX	Capital expenditure
CCCPC	Central Committee of the Communist Party of China
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDM	Clean Development Mechanism
CIF	Climate Investment Funds
CITIC	CITIC Group Corporation Ltd. (formerly China Int'l Trust Investment Corp.)
CO <sub>2</sub>	Carbon dioxide
COFCO	China Oil and Foodstuffs Corporation
CORS	Continuous Operational Reference System
CREWS	Climate Risk and Early Warning System
CSA	Climate-Smart Agriculture
CSO	Central Statistics Organization (Myanmar)
CSR	Corporate social responsibility

DFI	Development finance institution
DFS	Digital financial services
DJI	Da-Jiang Innovations
DPV	Distributed solar photovoltaic
DR	Demand response
DRR	Disaster reduction and recovery
EBRD	European Bank for Reconstruction and Development
EFO	Externally funded output
EIB	European Investment Bank
EIU	Economist Intelligence Unit
EMDE	Emerging and developing economy
EPM	Ecological pest management
ERR	Economic rate of return
ESG	Environment, social, and governance
ESMA	European Securities and Markets Authority
EU	European Union
EV	Electric vehicle
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistics (database)
FDI	Foreign direct investment
FIP	Forestry Investment Program
FMCG	Fast-moving consumer goods
FoF	Fund of funds
FRC	Finance Risk Committee
FSC	Forest Stewardship Council
FTTH	Fiber to the home
GAFFSP	Global Agriculture and Food Security Program
GARF	Global Adaptation and Resilience Fund
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
Gemloc	Global emerging markets local currency bond fund
GFDRR	Global Facility for Disaster Reduction and Recovery
GHI	Global Hunger Index
GHG	Greenhouse gas
GIF	Global Infrastructure Facility
GMO	Genetically-modified organism
GNSS	Global navigation satellite system
GP	General partner
GW	Gigawatt
Ha	Hectare
HFA	Hyogo Framework for Action
HVAC	Heating, ventilation, and air conditioning

I-D ETF	Issuer-Driven Exchange-Traded Fund
IADB	Inter-American Development Bank
IBM	International Business Machines Corporation
IBRD	International Bank for Reconstruction and Development
ICT	Information and communications technology
IDA	International Development Association
IDA18 PSW	International Development Association Private Sector Window in IDA18
IE	Irrigation efficiency
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFC PSW	International Finance Corporation Private Sector Window
IFI	International finance institution
IMF	International Monetary Fund
INDC	Intended nationally determined contribution
IPCC	Intergovernmental Panel on Climate Change
IPFP	Irrigation PPP Facilitation Program
IPO	Initial public offering
IRR	Internal rate of return
IRRI	International Rice Research Institute
ITFC	Integrated Tamale Fruit Company
JICA	Japan International Cooperation Agency
JV	Joint venture
KKR	Kohlberg Kravis and Roberts (KKR & Co. L.P.)
KPCB	Kleiner Perkins Caufield Byers [-backed Farmers Business Network]
Kg	Kilogram
Km	Kilometer
KPI	Key performance indicator
KW	Kilowatt
LAC	Latin America and the Caribbean
Lao PDR	Lao People's Democratic Republic
LCDF	Least Developed Countries Fund
LED	Light-emitting diode
LP	Limited partner
LPA	Limited partner agreement
LPI	Logistics Performance Index
MADB	Myanmar Agricultural Development Bank
MAIS	Módulo Agroclimático Inteligente e Sustentável
MAPCO	Myanmar Agribusiness Public Corporation
MCPP	Managed Co-Lending Portfolio Programme
MDB	Multilateral development bank
MDF	Medium-density fibreboard
MIF	Multilateral Investment Fund

MIGA	Multilateral Investment Guarantee Agency
mm	Millimeter
MM	Myanmar
MoF	Ministry of Finance
MSME	Micro, small, and medium enterprises
MW	Megawatt
N.A.	Not applicable
NAPA	National Adaptation Programmes of Action
NAV	Net asset value
NBC	New Business Committee
NBSC	National Bureau of Statistics of China
NCCD	National Centre for Cold-chain Development
NCREIF	National Council of Real Estate Investment Fiduciaries (Farmland Index)
NDF	Nordic Development Fund
ND-GAIN	University of Notre Dame Global Adaptation Initiative
NGO	Non-government organization
NIE	National implementing entity
NSADP	National Sustainable Agricultural Development Plan
O&M	Operations and maintenance
OCN	Oriental Cable Network Co. (China)
ODI	Overseas direct investment
OECD	Organization for Economic Cooperation and Development
ONA	Omnium Nord-Africain (succeeded by SNI: Société Nationale d'Investissement)
ORMVAs	Regional Agricultural Development Office (Morocco)
p.a.	Per annum
PCC	Permanent capital corporation
PCV	Permanent capital vehicle
PE	Private equity
PE pipe	Polyethylene pipe
PE/VC	Private equity/venture capital
percentPSE	Percentage producer support estimate
POS	Point of sale
PPCR	Pilot Program for Climate Resilience
PPF	Project preparation facility
PPIAF	Public Private Infrastructure Advisory Facility
PPP	Public-private partnership
PSW	Pension/Sovereign Wealth (investors)
PV	Solar photovoltaic
PVC pipe	Polyvinyl chloride pipe
PWC	PricewaterhouseCoopers
R&D	Research and development
RDB	Regional development bank
REC	Regional economic community

RIS	Resilience Investment Standards
RMB	Chinese renminbi
ROI	Return on investment
RWE	RWE AG (German electric utility company)
S&P 500	Standard & Poor's 500 Index
SABESP	Companhia de Saneamento Básico do Estado de São Paulo S.A.
SAP	Smallholder Agriculture Program
SAPA	Sustainable and Affordable Poultry for All
SAR	Special Administrative Region
SCF	Strategic Climate Fund
SCCF	Special Climate Change Fund
SCIC	State Capital Investment Corporation (of Vietnam)
SDG	Sustainable Development Goal (United Nations)
SIF	Strategic investment fund
SME	Small and medium enterprise
SOE	State-owned enterprise
SPCR	Strategic Program for Climate Resilience
SPV	Special purpose vehicle
SREP	Scaling-Up Renewable Energy Program
SRP	Sustainable Rice Platform
SSA	Sub-Saharan Africa
TEU	Twenty-foot equivalent unit
TFP	Total factor productivity
THAC	Truong Hai Auto Corporation
TIAA-CREF	Teachers Insurance and Annuity Association-College Retirement Equities Fund
TPG	TPG Capital (private equity group)
TSE	Total support estimate
TWh	Terawatt hour
UAV	Unmanned aerial vehicle
UHT	Ultra-high temperature (processing/pasteurization)
UK	United Kingdom
UK CDC	United Kingdom Commonwealth Development Corporation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Convention on Climate Change
UNGA	United Nations General Assembly
UNISDR	United Nations Office for Disaster Risk Reduction
USAID	United States Agency for International Development
USD	United States dollar
U.S.	United States
U.S. CIA	United States Central Intelligence Agency
U.S. EPA	United States Environmental Protection Agency
U.S. ITA	United States International Trade Administration

V1G	Charging of electric vehicles
V2G	Delivering energy or services from electric vehicles to the power grid
VC	Venture capital
VND	Vietnamese dong (currency)
WB	World Bank
WBG	World Bank Group
WCP2	Water Conservation Project II
WEF	World Economic Forum
WFP	World Food Programme
WHO	World Health Organization
WTO	World Trade Organization
WTP	Willingness to pay

# Report context

## What does this report aim to do?

This report highlights the principal challenges of attracting private capital to the financing of climate and natural hazards adaptation projects, and identifies concrete options to address these challenges through blended finance solutions with a focus on the agriculture sector. It is, necessarily, a high-level review of adaptation needs and related financing mechanisms, and it is not a guide on how to secure finance for adaptation projects or an investment prospectus for potential investors and fund managers.

## Who is this report aimed at?

This report addresses those in the public sector seeking to secure finance for adaptation projects or processes with focus on the agriculture sector, *to help them anticipate and respond to the challenges of financing adaptation*, and at policy makers and international finance institutions (IFIs) *to help them identify what can be done to make climate resilience more transparent for and attractive to the private sector*. It may also be useful for institutional investors, private foundations, and fund managers as potential adaptation project funders to help them understand how finance mechanisms may be tailored to be more relevant to adaptation projects. This report focuses on the financing of irrigation infrastructure and resilient agriculture value chains in South Asia, but most of the insights and findings are relevant outside that context.

## What do we mean by resilience investment?

In this report *resilience* is defined as the ability of a system, community, or society exposed to climate and natural hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. Adaptation and resilience are two sides of the same coin. While the term adaptation refers to the adjustment in natural or human systems in response to actual or expected climate and natural hazards or their effects, the term resilience refers to the ability of such natural and human systems to adapt. Therefore adaptation investments are those which alter planned or existing infrastructure or processes across an industry value chain to protect their security and performance from the consequences climate and natural hazards; in other words, to make them more resilient.

## How is this report structured?

This report is organized in six chapters as follows:

*Chapter 1. Climate and Natural Hazards Resilience.* This chapter contains a brief overview of climate and natural hazards disasters and risk, as well as a definition of adaptation and resilience. After reviewing existing literature on funding needs and funding gaps, this chapter briefly discusses the most notable global trend in private sector adaptation finance.

*Chapter 2. Resilience Market Segmentation.* This chapter contains a high-level analysis of the resilience impact and potential for commercial investment in four economic sectors – water, agriculture, transport, and energy, covering both infrastructure and value chains.

*Chapter 3. Agriculture Resilience In-Depth Analysis.* This chapter discusses the resilience relevance of the agriculture sector, and further analyses potential and investment barriers associated with resilience investment in agricultural infrastructure, and along the main link of the agriculture value chain.

*Chapter 4 – Resilience investors landscape and investment tools.* This chapter provides an overview of agri-resilience investors, focusing on private sector finance. It also contains an analysis of financing tools that are usually associated with climate finance, and adaptation finance.

*Chapter 5. Resilient agricultural infrastructure: the irrigation PPP facilitation program.* After reviewing the rationale for investing in irrigation infrastructure, this chapter analyzes the current investors' landscape, identifies issues that affect private sector participation, and proposes an integrate lifecycle financing approach.

*Chapter 6 – Resilient value chains: early stage and PE/VC in agri-resilience.* This chapter focuses on agriculture resilience in Asia, through the review of market structure, institutional environment, climate impact, and investors' landscape, and potential investment themes in three pilot countries – China, Myanmar, and Vietnam. A hybrid capital fund is suggested as efficient and scalable way to attract private sector funding to agri-resilience.

# Executive Summary

## Why are resilience projects hard to finance for the private sector?

The presence of a revenue stream and a commercial return are an absolute prerequisite for investment for the private sector. However, often adaptation benefits or the value added (resilience) of adaptation investment are difficult to quantify in financial terms. There is no accepted methodology to price the adaptation feature of an investment, that is to quantify when an investment has *successfully* adapted to climate change. While the risks from extreme weather and climate change are clearly recognizable, and many investors see these risks in the present or near term, uncertainty about the precise nature, timing and severity of climate impacts makes the return on investment of adaptation projects difficult to measure.

In many cases adaptation is embedded into project design and engineering. The fact that the adaptation component is often not able to be separated, or treated as an add-on feature, has consequences for fund raising and project financing. Particularly for infrastructure projects, the difficulty in ring-fencing adaptation components, and the uncertainty around the time and magnitude of climate impacts, make it difficult to charge separate/properly priced tariffs. These difficulties are compounded in emerging and developing economies (EMDEs), where users' ability to pay is limited.

Blended finance solutions are used to make projects bankable by closing viability gaps. Blended finance consists in the complementary use of concessional (grants or low interest instruments) and non-concessional financing from public and private sources to make projects financially viable and/or financially sustainable. Applying this approach to climate finance allows leveraging of limited public funding, enhances the overall effectiveness of aid, and potentially triggers an increase in private investment once the long-term viability of a market is demonstrated.

This report analyzes the potential and need for blended finance solutions in four economic sectors - water, agriculture, transport, and energy. For each economic sector, two broad classes of investment – infrastructure and value chains – are discussed. Investing in infrastructure or in value chains (that is, the range of goods and services that link the producer to the customers or end-consumer) requires different competencies, investment processes, project selection criteria, and attracts different classes of investors. Each investment theme is assessed for its resilience relevance and potential for commercial returns. An in-depth analysis of financing needs and potential blended finance solutions for resilience investment in the agriculture sector is presented, because of the economic relevance of agriculture in EMDEs, and its exposure to climate and natural hazards.

## Why blended finance could increase private sector funding to adaptation in the agriculture sector?

Many adaptation projects in the agriculture sector have some form of viability gaps. Many agriculture resilience projects that could be commercial end up not being financed for a variety of reasons, including: i) the true value of an adaptation investment is often not captured by financial markets, particularly when part of the benefit of the investment accrue to interest groups beyond the investor (positive externalities or investment co-benefits). For example, investing in precision agriculture generates co-benefits like food security, rural development, and climate mitigation but agricultural producers and their financiers are not rewarded for this service; ii) shareholders and financial markets often value short term gains, which means that there is a shortage of financing for investments that are required to cope with long-term or distant climate impacts. iii) the financial returns resulting from an agriculture adaptation project are inherently difficult to quantify because the effects of climate change are unpredictable. For example, a farmer in an area prone to droughts may not be able to determine the return on investment of an irrigation project because so much depends on actual weather and the future price of agricultural products; iv) the prevalence of SMEs in EMDE's agriculture value chains results in market fragmentation, which in turn increases the due diligence and monitoring costs for investors; v) it is hard to charge user tariff today for an investment which benefits may only materialize in the future; and vi) climate resilient infrastructure investments are also difficult to finance because of farmers' limited ability to pay.

## What agri-resilience investment themes are analyzed in this report?

Two investment themes are discussed in this report:

### *1. Promoting infrastructure investment for drought-resilient agriculture:*

**About 84 percent of the damage and losses caused by droughts is to the agriculture sector.** Virtually every continent is affected by increasing drought risk. However, 90 percent of production losses in sub-Saharan Africa were linked to droughts between 2003 and 2013. Since the sector in sub-Saharan Africa on average contributes to a quarter of GDP (rising to a half when agribusiness is included), droughts have a clear knock on effect on the economy. Other regions affected by drought are Latin America (30 percent), the Far East (50 percent) and Asia (10 percent). Droughts directly affect agriculture through decreased yields and production, and have indirect socio-economic impacts such as unemployment, food scarcity or increased costs, lower tax revenues and increased loan foreclosures.

**Irrigated agriculture represents 20 percent of the total cultivated land, but contributes 40 percent of the total food produced worldwide.** Over 324 million hectares are equipped for irrigation worldwide, but only 85 percent of such land is currently irrigated. About 42

percent of the irrigated land in the world is in only two countries: China and India - both affected by poor water use efficiency (FAO, 2014)). Without the high productivity permitted by irrigation, at least an additional 500 million ha would be needed to reach the current agricultural production.

**The global investment requirement in irrigation through 2050 is estimated to be US\$960 billion.** Over the past 60 years, most irrigation projects were led and financed by governments. The rate of public irrigation investment has slowed due to high and increasing construction costs, fiscal constraints limiting both capital expenditure and operation and maintenance, limited cost recovery through tariffs, and poor management and supervision due to lack of technical expertise and changing political agendas. Budget constraints and poor public management track record, however, call for new financing tools and greater private sector involvement.

## *2. Promoting climate and natural hazards adaptation investment in agriculture value chains*

**The agriculture sector in EMDEs is fragmented and there is a large presence of SMEs.** SMEs are particularly vulnerable to climate and natural hazards. They often have limited access to coping strategies, are often non-compliant with industry norms and regulations, which can lead to a lowered capacity to adopt risk management tools and expand customer and supply base. Access to timely, affordable, and appropriate type of finance; access to knowledge and technology, and consistent access to stable and high-value markets are the most daunting challenges faced by SMEs in agriculture sector in EMDEs. Investing in SMEs resilience often goes beyond the scope of a typical profit-driven private equity/venture capital investor. From an investor's standpoint, the costs associated with information screening, pipeline identification, and monitoring of investment performance are comparably higher for investing in SMEs as opposed to large agriculture companies. Moreover, fragmented markets are typically coupled with underdeveloped and unclear regulatory systems, with potential implications on investment and business risk.

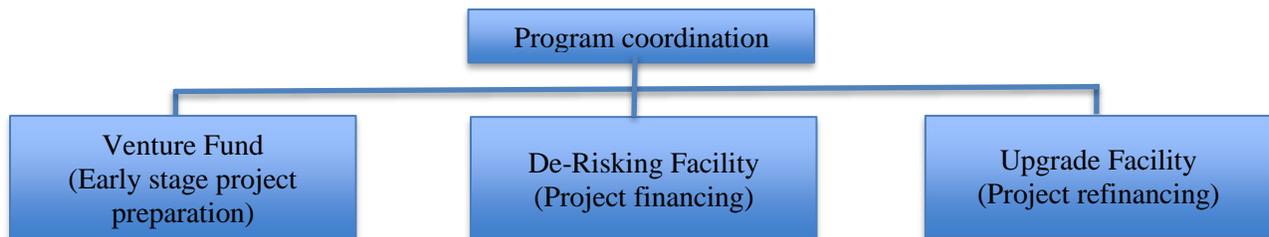
**Public capital has traditionally played a major role in agriculture value chains resilience in EMDEs, typically through the provision of subsidies.** However, agri-resilience value chains are complex and cut across a wide range of sectors and subsectors, with different market drivers, and different and constantly evolving technologies. Unlike large infrastructure projects for which governments could gather resources in a relatively efficient way, value chain financing needs are scattered from sector to sector, and usually involve SMEs, making public finance less effective and efficient.

**The agriculture sector and its resilience to climate and natural hazards are context specific.** The agriculture sector is greatly affected by the policy environment, natural

endowments (such as arable land, water resources, soil fertility), climate and natural hazards (such as the type of climate, the frequency and type of natural disasters), local traditions and practice (such as social awareness, technologies and local practice), institutional framework (such as the depth of local financial markets, land titles, and regulation), and so on. Any meaningful effort to identify ways to attract private capital to agri-resilience must content with this fact. This report contains an in-depth analysis of investment opportunities for resilient agriculture value chains in three Asian economies – China, Myanmar, and Vietnam – given the region’s exposure to a wide array of natural and climate hazards, and the considerable economic importance of the sector for local economies and export.

### What are possible blended finance solutions for irrigation infrastructure investment?

**The Irrigation PPP Facilitation Program (IPFP) is a life-cycle approach to infrastructure financing.** The IPFP would be managed by a program coordinator whose task is to raise awareness of the program, and help potential clients to identify the best service or package of services tailored to each client’s individual needs. The program would have three components designed to address specific project life-cycle challenges: i) the Venture Fund provides capital and expertise at the very early stages of project preparation, particularly in countries lacking an established PPP regulatory environment; ii) the De-risking Facility intervenes in the subsequent phase of project financing and aims to bridge the tariff gap that is the major stumbling block to private capital involvement in new irrigation PPPs; and iii) the Upgrade Facility aims to facilitate additional investments in existing irrigation PPPs to make them more climate-resilient or simply to enable their financial sustainability. The graph below summarizes the features of the IPEP.



**The Venture Fund would provide capital and expertise at the earliest stages of PPP project preparation, while alleviating some of the shortcomings of traditional project preparation facilities (PPFs).** By investing in early-stage irrigation PPP project preparation, in exchange for a minority equity stake – the fund will align its incentives to those of the lead project developer. To incentivize involvement in higher-risk projects both commercial and concessional investors will commit capital to the fund – concessional capital will be used to subsidize part of the preparation work. The Venture Fund will be

structured as a closed-end fund or a permanent capital corporation – investors or shareholders, respectively, will commit capital upfront, insulating the fund from any budget uncertainty that affects traditional PPFs. The fund will be run by an independent, professional team with private sector expertise in infrastructure PPP development, and attractive compensation and incentives.

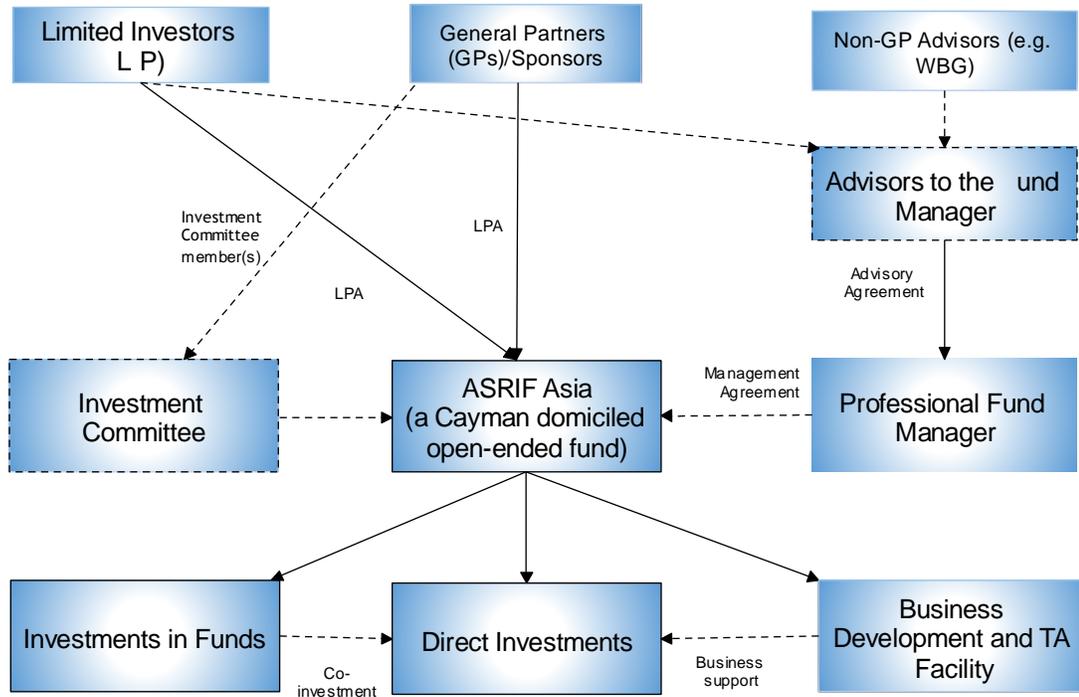
**The De-risking Facility is a versatile tool available at the project financing stage to facilitate the structuring and financial close of new irrigation PPPs via grants, concessional loans or guarantees.** Private developers participate as equity investors in a PPP project if the internal rate of return achievable throughout the project life, under realistic assumptions, reaches commercial levels, typically in the 15-20 percent range. This target may be hard to achieve if, for instance, the project involves a very large upfront investment for infrastructure and/or low water tariffs. The Facility, funded upfront by donors and managed independently of any political influence, will provide concessional capital to the government institution that signs the PPP contract with the private developer. This capital may take different forms (loans, grants, guarantees) depending on the project's economics as well as fiscal situation of the recipient government. The government will deploy the capital as grants for infrastructure building, viability gap payments or any other tool that best suits the specific PPP structure.

**The Upgrade Facility applies to existing irrigation PPP projects that need additional capital to make their infrastructure and operations more efficient/climate resilient.** For instance, an irrigation PPP may suffer from outdated, underinvested infrastructure and equipment (e.g. metering); without additional capex, it is likely that service quality deteriorates, reducing the willingness of farmers to pay tariffs for water use. Another scenario may involve a tariff structure that was set at unrealistically high levels, resulting in underuse of the irrigation scheme or poor tariff collection. If the capacity for private investment (equity or loans) is already maxed out due to risk/return considerations, an injection of concessional capital may be critical to the upgrade and, possibly, survival of the PPP. The Upgrade Facility will target these situations, through the same structure, decision-making process and instruments used by the De-risking Facility.

## **What are possible blended finance solutions for resilient value chains in Asia?**

**The Agriculture Sector Resilience Investment Fund (ASRIF)-Asia would be a regional fund specialized in leveraging patient, non-profit driven public capital to attract private capital.** ASRIF-Asia would invest in businesses that operate in the agri-resilience value chain. Examples of potential investments include: water saving irrigation, precision agriculture, crop management, soil management, livestock adaptation, agroforestry, crop insurance, urban agriculture, market access and transportation, food processing, food engineering, sustainable protein, agricultural waste use, and bioenergy. ASRIF-Asia's objectives would be three-fold: i) to crowd in private capital to agriculture resilience

investment across the sector’s value chain; ii) to set up clear standards and criteria to track and measure the value and impact of resilience, thus contributing to establish an asset class or investment category; and iii) to develop innovative financing tools to support growing investment needs. The structure of the fund is graphically represented below.



**ASRIF-Asia is designed as a hybrid fund with both public and private funding at fund level.** Given the pervasive presence of the public sector in the region’s agriculture sector, the public capital plays the role of anchor investment and risk mitigation towards changes in government policy. Public capital has a long-term commitment, and a revenue enhancing function (including capped return, first loss guarantees, and delayed draw-downs for commercial investors). This allows the ASRIF-Asia to crowd in private capital that would not have otherwise invested in agriculture resilience. The fund would be structured as Permanent Capital Corporation (PCC) or a limited partnership fund with a long funding term to: 1) attract and retain patient capital and match the life cycle of its investee projects; 2) offer fundraising flexibility suitable to an innovative investment facility with a staggered approach and limited track record; and 3) generate cost efficiency.

**ASRIF-Asia would be a Fund of Funds (FoF) and a direct-investment fund.** Given the prevalence of SMEs in the agriculture sector in Asia, the proposed fund would need to cover a broad range of investible assets and use a variety of investment strategies to ensure its financial sustainability. To this end, ASRIF is designed to invest in the entire sector’s value chain, both directly and through investment in other funds that invest in agriculture resilience. This would allow ASRIF to specialize in certain segments of the value chain

(knowledge advantage and cost efficiency), at the same time acting as catalyst of investment across the entire value chain.

**To support innovative technologies for agri-resilience ASRIF-Asia includes a Business Development and Technical Assistance Facility (BD & TA Facility).** The Facility is designed to support: i) the development and uptake of innovation in value chain processes and management; and ii) capacity building and technical assistance to SMEs through concessional financing and credit support. The Facility aims to improve knowledge and connectivity among private sector actors, and to contribute to the generation of investable projects for the investment arm of the ASRIF.

**Risks associated with ASRIF-Asia include fund risks, system and regulatory risks, and business and project risks.** A capable fund manager is the most effective risk mitigation strategy. However, a clearly specified investment strategy and sound governance arrangements are necessary to avert the risk of deviation from the investment mandate by fund manager. System and business risk are mitigated through the proposed BD and TA Facility, which will also promote policy dialogue thus mitigating regulatory risk. ASRIF-Asia will use de-risking instruments such as partial credit and/or partial risk guarantees to mitigate business and project risk. Revenue enhancement tools will also address business and project risks.

**ASRIF-Asia could be the first step of the global resilience investment initiative that will gradually expand to other regions.** Resilience investments are context specific, particularly when it comes to investing in value chains, and thus require deep local knowledge and extensive local connections. The preliminary analysis of pilot countries' investment opportunities suggest that it will be possible to create and maintain a balanced portfolio comprising both basic and more advanced agri-resilience investment projects. The implementation of the pilot region is expected to provide lessons for designing other regional funds, or to scale-up the regional fund into a global fund.

## What further work is needed?

The establishment of the financing structures recommended in this report requires a more detailed definition of their mandate, governance structure and processes, fund and program size, investment and exit strategy, project selection criteria, risk management, and disclosure and reporting arrangements. A detailed pipeline analysis, investors' landscape and appetite analysis, and fund design analysis will also be necessary to prove the viability of the suggested funding structures, as well as a preliminary market sounding with potential investors.

To facilitate the dissemination and appropriation of this report by each of its target audiences, focused briefing notes could be developed. For example, a series of briefs could be developed for donors involved in the financing of agri-resilience, focusing on three

themes: (i) available sources of climate-resilient finance; (ii) potential solutions for crowding in private finance leveraging existing donors-financed; and (iii) guidance on building an integrated financial structure for agri-resilience projects

# 1. Climate and Natural Disasters Resilience

*Around the world, the economic impact of natural and climate related disasters has been steadily growing over the past thirty years. Emerging and developing economies are more vulnerable since their limited of capacity and means compound the effects of physical exposure. Increasing the resilience of communities and businesses is critical to better prepare for and recover from natural and climate risks. This chapter contains a brief review of natural and climate disasters statistics, and a discussion of current and projected funding sources and financing gaps. The terms “resilience” and “adaptation” as used in this report are defined in section 1.2*

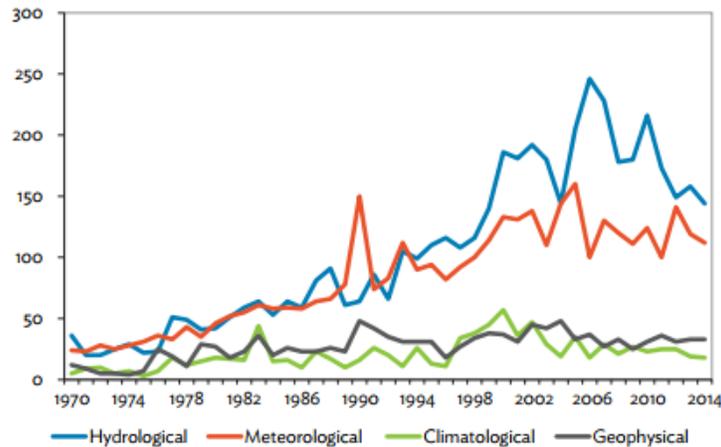
## 1.1 Overview of climate and natural hazard disasters and risks

**1.1.1 Natural and climate related disasters have been on the rise over the last three decades.** The Special Report on Extreme Events and Disasters by the Intergovernmental Panel on Climate Change (IPCC, 2012) predicted increases in the frequency, and to some extent in the intensity, of climate-related natural hazards, including heat waves, wind speed of tropical cyclones, droughts, and water levels in coastal areas.<sup>1</sup> Heavy precipitation events are also on the rise, potentially impacting the frequency of floods and almost certainly affecting landslides (Banholtzer et al., 2014). Figure 1.1 shows the trend in the occurrence of natural disasters over the past four decades.

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<sup>1</sup> A natural hazard is a naturally occurring event that might have a negative effect on people or the environment. Examples of natural hazards include geological and meteorological phenomena such as earthquakes, coastal erosion, volcanic eruption, cyclonic storms, and drought, as well as biological hazards that can refer to a diverse array of disease and infestation. Other natural hazards such as floods and wildfires can result from a combination of geological, hydrological, and climatic factors.

**Figure 1.1– Global Frequency of Natural Disasters by Type (1970-2014)**

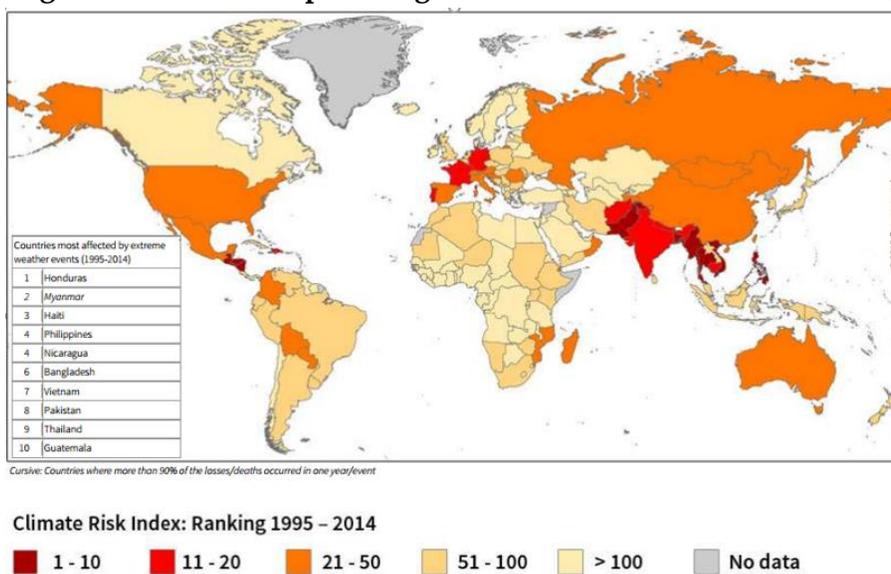


Source: Vinod T. and R. Lopez, 2015.

- 1.1.2 **Over the past 30 years, natural disasters accounted for close to US\$4 trillion in economic losses.** During this period, such losses have increased threefold—from US\$50 billion a year in the 1980s to just under US\$180 billion a year in the last decade. Almost 75 percent of the losses are attributable to extreme weather events (GFDRR, 2013). Although these figures may in part reflect improvements in reporting systems, increased insurance capacity, growing population, and similar factors, they remain lower bound estimates. This is because reported disaster losses usually reflect monetized direct damages to assets. However, impacts on the informal or undocumented economy as well as indirect economic effects can be very important in some areas and sectors (IPCC, 2012).
- 1.1.3 **Increasing exposure of people and economic assets has been the major cause of long-term increase in economic losses from natural and climate related disasters.** Vulnerability and exposure to natural hazards are the result of a variety of social, economic, institutional, and geographic factors. Indeed, economic activity and societies continue to develop in many of the world’s most vulnerable locations, often in floodplains or in areas that experience extreme weather or geophysical risks (USAID, 1990; PWC, 2013).<sup>2</sup> For example, rapid urbanization and the growth of megacities – especially where informal settlements and inadequate land management are a factor – have led to the emergence of highly vulnerable urban and business communities. Countries vary in their vulnerability to multiple climate hazards, and have varying capabilities to prepare for such problems. Rankings such as the one shown in Figure 1.2 provides an indication of relative country risk.

<sup>2</sup> The Global Risk Data Platform is an example of multi-agency effort to provide information on countries’ risk and exposure to natural hazards (<http://preview.grid.unep.ch/index.php?preview=home&lang=eng>).

**Figure 1.2 – World map of the global climate risk index (1995-2014)**

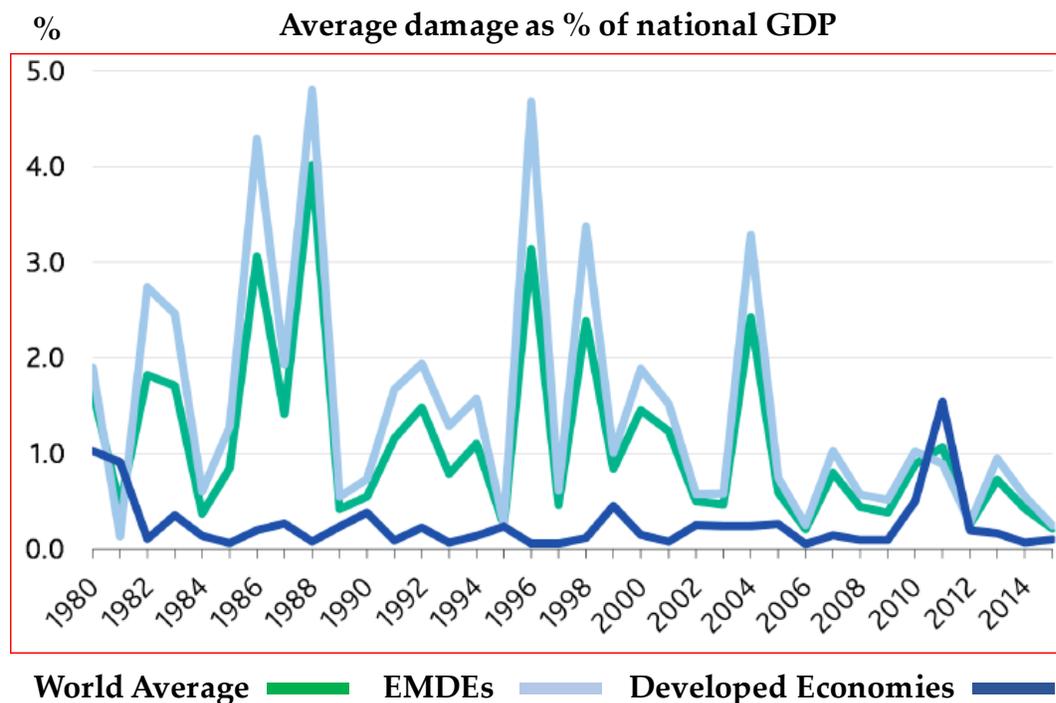


Source: Germanwatch and Munich Re, 2015.

1.1.4 **Developing countries often exhibit higher vulnerability to disaster risk and lower capacity to manage them.** Disasters can place an enormous pressure on public finance, resulting in loss of revenue and higher expenditure needs.<sup>3</sup> The capacity of a government to deal with these pressures depends on various factors, including its overall fiscal position, its level of access to international assistance and external capital markets, and its use of ex-ante or ex-post risk transfer and risk financing instruments (ADB, 2013). Since 1980, low income countries have accounted for only 9 percent of disaster events but 48 percent of the fatalities. Disasters’ impact on GDP is 20 times higher in developing countries than in industrialized nations (GDFRR, 2013). Loss of lives, diminished productivity and asset destruction lead to weaken livelihoods and poverty. In some countries, climate related risks could cost up to 19 percent of GDP per year by 2030, setting back years of economic growth (Frankhauser and Schmidt-Traub, 2010). Challenges are often compounded at the sub-national level, and economic globalization transmits climate and disaster related impacts beyond a country’s or region’s borders. Figure 1.3 provides an overview of the relative vulnerability to climate and natural disasters of EMDEs and developed economies.

<sup>3</sup> Revenue can decline as economic activity drops for affected communities and industries. Expenditure can rise as the result of repairs and reconstruction of public infrastructure and assets, as well as the fulfilment of public guarantees (for example in the form of financial backing to the banking sector that may struggle to recover after a disaster), and other emergency and post emergency social expenditure. For example, the lack of a functioning transport infrastructure can hinder reconstruction, and delay recovery.

**Figure 1.3 – EMDEs’ and Developed Economies relative vulnerability to climate and natural disasters**



Source: Moody’s Investors Service (MIS), EM-DAT, 2015  
[https://www.eenews.net/assets/2016/11/30/document\\_cw\\_01.pdf](https://www.eenews.net/assets/2016/11/30/document_cw_01.pdf)

## 1.2 Adaptation and resilience

1.2.1 **Adaptation and resilience are two sides of the same coin.** While the term *adaptation* refers to the adjustment in natural or human systems in response to actual or expected climate and natural hazards or their effects, the term *resilience* refers to the ability of such natural and human systems to adapt.<sup>4</sup> In this report resilience is defined as the ability of a system, community, or society exposed to climate and natural hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. This report also excludes urban sprawls resilience not linked to climate and natural hazards management, and resilience to conflicts. Resilience focuses on reinforcing against the impacts of natural and climate hazards, rather than trying to prevent them from occurring, which is commonly referred to as mitigation. Adaptation and mitigation are complementary to each other. For example, if mitigation measures are undertaken effectively, the impact to which natural and human systems need to adapt will be lower.

<sup>4</sup> The term “resilience” originates from the Latin verb “resilire” – to bounce back, to rebound. In the 1800s resilience also meant elasticity. The term is used in many disciplines, from economics, to engineering, psychology, and physics.

Similarly, if adaptation measures (or the degree of preparedness) are strong, the need for mitigating natural and climate events might be reduced.

**1.2.2 The risk that climate and natural hazards pose to society is a function of exposure and vulnerability.** Countries with similar exposure to climate and natural hazards exhibit different vulnerability. This is because countries have different level of preparedness. The ND-GAIN index scores the vulnerability of countries to climate and natural hazards, as well as their readiness.<sup>5</sup> Readiness measures a country's ability to leverage investments and convert them to adaptation actions. ND-GAIN measures overall readiness by considering three components – economic readiness, governance readiness and social readiness.

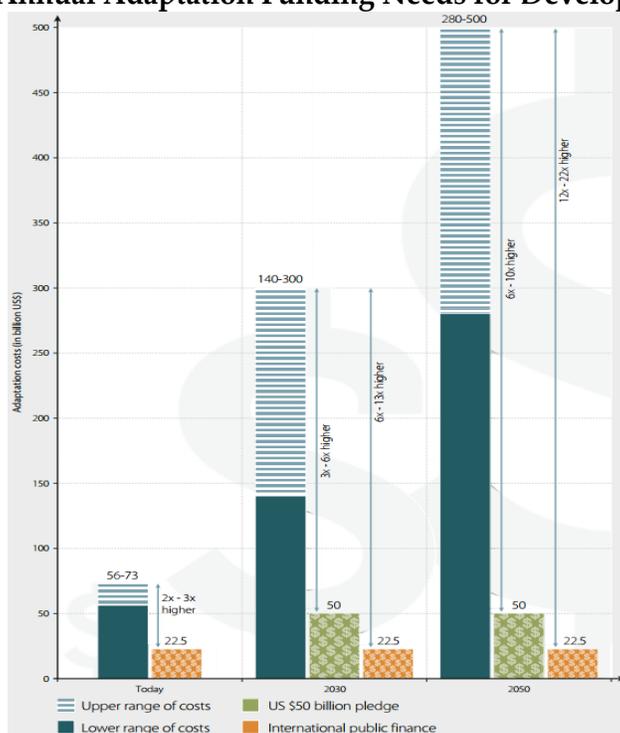
### **1.3 Adaptation funding and financing gap**

**1.3.1 Adaptation costs in EMDEs are estimated to be in the range of US\$280 to US\$500 billion per year by 2050.** If this estimate reveals accurate the current US\$22.5 billion of current international public finance for adaptation to EMDEs will need to increase exponentially. (UNEP, 2016). Adaptation funding gaps are difficult to estimate for a variety of reasons, including: (i) activities that improve climate resilience are often integrated in mainstream development interventions (CPI, 2014); (ii) scientific research on climate change impacts is constantly evolving, which influences adaptation finance needs; and (iii) many countries are increasing their own spending on adaptation, but these figures are not always publicly available (Dougherty-Choux, 2015). This results in a wide and growing range of estimates for adapting to climate change in developing countries, starting from US\$140 - US\$300 billion per year in 2030, up to US\$280 - US\$500 billion per year in 2050 (Figure 1.4). Developed and developing countries are responding to threats by committing increasing amounts of public finance to adapt to climate change, including from national, multilateral and bilateral sources.

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<sup>5</sup> The ND-GAIN index summarizes a country's vulnerability to climate change and other global challenges. It uses six measures describing exposure, sensitivity and capacity in each of six major sectors; food, water, health, ecosystems, human habitat and infrastructure. These 36 measures are combined to give a vulnerability score for each country. The ND-GAIN index also includes an estimate of a country's readiness to absorb and apply resources to actions to adapt to reduce its vulnerability. Readiness is based on 9 measures that indicate its economic, governance and social capacities. Countries' scores can be found at <http://index.gain.org/ranking>.

**Figure 1.4 – Estimated Annual Adaptation Funding Needs for Developing Countries**

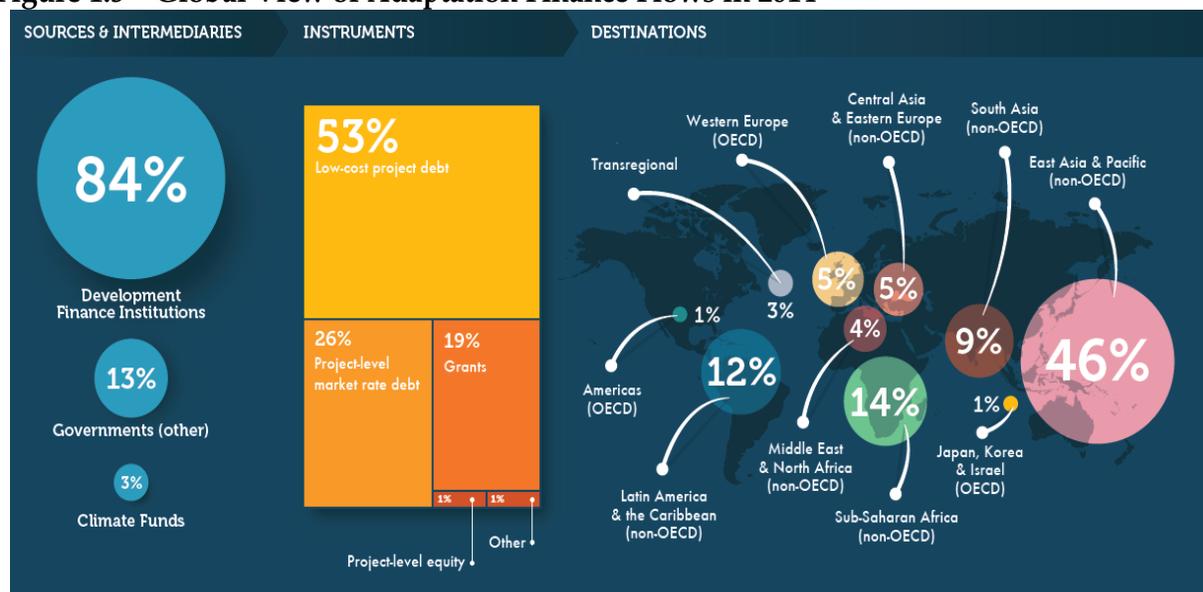


Source: UNEP, 2016.

**1.3.2 Funding from public international finance has so far provided the lion’s share of adaptation investment, particularly in term of concessional loans** A 2016 mapping of financial flows in developing countries shows that adaptation funding was about 10.9 percent of the total climate funding going to developing countries (UNEP, 2016). The vast majority of funding for climate change goes to *mitigation*, i.e. to support measures aimed at reducing or controlling greenhouse gas emissions. In 2011 almost all adaptation funding – 71 percent concessional loans and 27 percent grants – came from the public sector and donors (UNEP, 2011).<sup>6</sup> Financing tools have not changed substantially: 53 percent of MDB’s funding for adaptation in 2014 was in the form of low cost project debt, while only 26 percent was market rate project debt (Figure 1.5). Furthermore, funding tends to be somewhat linked to disaster recovery more than prevention.

<sup>6</sup> An earlier study of adaptation financing carried out by the Stockholm Environment Institute found that private finance to the developing world was concentrated in a small number of countries. In 2004, roughly 90 percent of private investment flows into Asia went to China (67 percent), India (14 percent) and Malaysia (9 percent) (Persson et al., 2009).

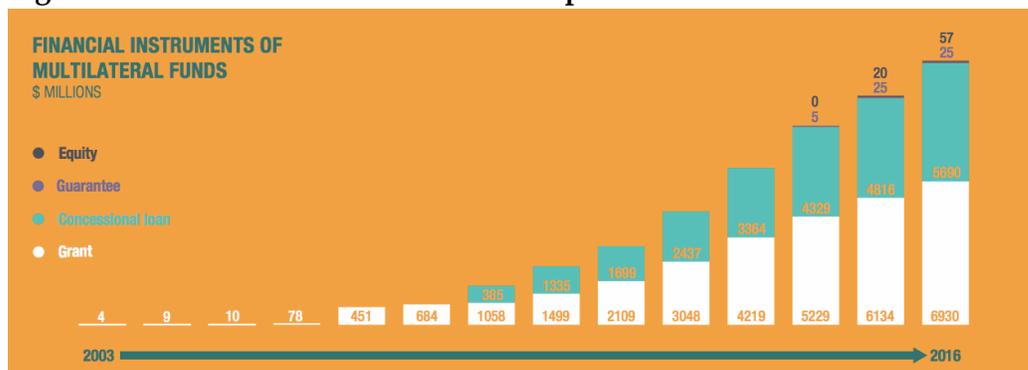
**Figure 1.5 – Global View of Adaptation Finance Flows in 2014**



Source: UNEP, 2016

**1.3.3 Adaptation funding is fragmented at national levels, and only a handful of global funds exists.** There is a growing number of climate funds, including the Adaptation Fund, the Least Developed Countries Fund, the Special Climate Change Fund, the Global Facility for Disaster Reduction and Recovery, the IFAD Adaptation for Smallholder Agriculture Programme (ASAP), the Green Environment Facility, the Green Climate Fund, the Pilot Program for Climate Resilience (under the Climate Investment Fund), each mobilizing concessional funding from government donors (Annex 1.A). Many of these funds support governments in developing countries to develop policy and regulatory frameworks for climate and natural hazards resilience, although few of them focus exclusively on this theme. These funds often lack private sector engagement to ensure that these reforms create an enabling environment for business investment and growth, although some funds have started to open private sector windows. Multilateral climate finance funds are often governed by bureaucratic structures that are not well suited to attract private sector investment. Financing tools are also evolving. From 2003-2008, multilateral climate funds utilized grant financing exclusively. Since that time, concessional loans have come to represent nearly 50 percent of total funding, and in the last four years, equity and guarantee instruments have begun to be used in small but growing numbers (Figure 1.6).

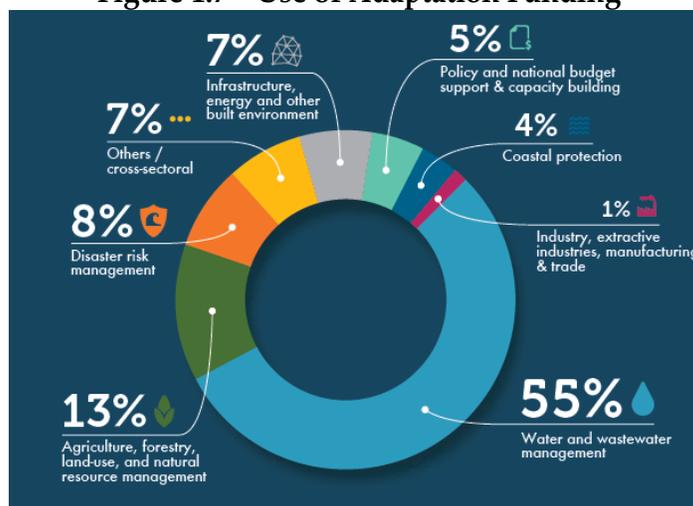
**Figure 1.6 - Financial Instruments for Adaptation**



Source: ODI, 2016 10 Things

**1.3.4 Adaption finance is distributed across an array of economic sectors.** The agriculture sector has received an estimated 13 percent of adaptation funding to date, and 126 countries of the 134 countries that include adaptation in their INDCs identify agriculture among their adaptation priorities.<sup>7</sup> Water and water management is the most popular theme (data likely include water for agricultural use), while other sectors such as ICT, financial services and the manufacturing sectors have received relatively small portions of adaptation funding (see Figure 1.7)

**Figure 1.7 – Use of Adaptation Funding**



Source: CPI, 2015.

**1.3.5 In 2013–14, MDB investment in the private sector for adaptation equaled US\$270 million.** When leveraged, this finance made US\$1.4 billion of MDB investment more climate-resilient, accounting for about 4 percent of total reported international public

<sup>7</sup> Specific data can be found at Agriculture Prominence in INDCs: Data and Maps: <https://ccafs.cgiar.org/agricultures-prominence-indcs-data-and-maps#.WYx2N-jyuUk> (link updated in September 2017).

adaptation finance (Vivid Economics, 2015; CIF, 2016). EBRD and EIB are generally the lead MDBs in terms of private sector adaptation finance. According to Vivid Economics, in 2015 the EBRD provided US\$162 million of private sector adaptation finance for 18 projects followed by EIB (US\$84 million, four projects), IDB (US\$14 million, three projects) and IFC (US\$9 million one project).<sup>8</sup>

### **1.3.6 Some MDBs are piloting private equity/venture capital funds investing in adaptation.**

For instance, EIB has invested in the Althelia Climate Fund, which targets ecosystem conservation and sustainable agroforestry primarily in EMDEs. Returns are generated through the production and sale of real assets in the form of sustainable agriculture and soft commodities (like certified cocoa and coffee), and undervalued environmental assets including payment for ecosystem services (like biodiversity and water) to several complementary high growth markets.<sup>9</sup> The Fund implements innovative financial approaches, including performance-based payments and advance market commitments (427 Investor Survey, 2016). Although most climate funds operate exclusively through public entities like MDBs, some climate funds like the Green Climate Fund (GCF) the Climate Investment Fund under its Pilot Program for Climate Resilience (PPCR), and the IFC's Global Agriculture and Food Security Program (GAFSP) have private sector windows (Table 1.1).

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<sup>8</sup> The numbers in this paragraph include investments in middle income countries, where up to 80 percent of private sector A&R finance takes place. In developing countries, significant donor co-financing in the form of concessional loan and CAPEX grants are married with these private investments (Vivid Economics, 2015).

<sup>9</sup> Soft commodities are those that are grown, rather than mined. Examples fall under agriculture, such as rice, wheat, and coffee, and they depend on the weather and on the harvesting cycle. In contrast, hard commodities are non-renewable products in the energy or mining sectors, and depend on the ability of producers to mine them.

**Table 1.1 – Main climate funds: scope, size, and type of financing**

Name	Private Sector Window	Geography	Sector	Fund Size (MUSD)	Committed Capital	Projects	Equity	Loan	Grant	Guarantee	Technical Assistance
Green Climate Fund	Yes	Focus on LDCs, SIDS, Africa	Multiple	10,300	2,200	43	Yes	Yes	Yes	Yes	No
Adaptation Fund	no	Multiple	Multiple	436	436	66	No	No	Yes	No	Yes
Pilot Programme for Climate Resilience	No	Shortlist of 20 eligible countries	Multiple	1,200	939	58	No	No	Yes	No	Yes
PPCR Competitive Private Sector Set-Aside	Yes	Shortlist of 20 eligible countries	Multiple	170	40	10	No	No	Yes	No	Yes
Global Facility for Disaster Reduction and Recovery (GFDRR)	no	Global	Multiple Themes	renewable donor commitments	240	300	No	No	Yes	No	Yes
Climate and Development Knowledge Network (CDKN)	no	Latin America and the Caribbean, Africa, Asia	Multiple Themes	renewable donor commitments	140	1,040	No	No	Yes	No	Yes
Caribbean Catastrophe Risk Insurance Facility (CCRIF)	no	Caribbean	Public sector	n/a	68	n/a	No	No	No	No	Yes
Adaptation for Smallholder Agriculture Program (SAP)	no	Multiple	Agriculture	314	314	41	No	No	Yes	No	Yes
Least Developed Countries Fund	no	LDCs	water; agriculture and food security; health; disaster risk management and prevention; infrastructure	1,219	1,009	242	No	No	Yes	No	Yes
Special Climate Change Fund	no	Primarily Non-Annex I (UNFCCC)	water resources management, land management, agriculture, health, infrastructure development	350	333	74	No	No	Yes	No	Yes
Inter-American Development Bank's (IADB) PROADAPT Facility	no	LAC	agriculture and fisheries, housing and the built environment, water and sanitation, transportation	n/a	12	8	No	Yes	Yes	No	Yes
Global Agriculture and Food Security Program (GAFSP)	yes	IDA-only	agriculture	1,577	1,279	74	Yes	Yes	Yes	Yes	Yes

Source: Authors.

## 1.4 Private sector in adaptation finance

**1.4.1 Opportunities to scale up public-private collaboration on building resilience are largely untapped.** Adapting to climate and natural hazards is often viewed as the responsibility of the public sector. This perception is reinforced by a tendency to link funding to disaster recovery. Furthermore, adaptation programs often focus on themes (such as water management, coastal resilience, etc.) rather than sectors to which business can relate. This might explain why the adaptation finance market is dominated by public entities.<sup>10</sup> However, the private sector can play multiple roles in building resilience to climate and natural hazards. It can participate as investors, providing debt and equity to support adaptation projects. The private sector can also be an agent for adaptation by providing products and services that help increase other parties' resilience. This may include engineering and consulting firms, climate data services, and a broad range of technology companies. The private sector could also be a subject of adaptation by taking measures to build resilience as part of their regular risk management and sustainability efforts. **Most companies' strategies are not designed to weather future physical impacts of climate change.** Most private investment is undertaken by firms as part of their capital investment programs and risk management strategies. The amount of investment and their returns are difficult to measure since most firms do not track these investments as such. While the clear majority of companies recognizes risks from extreme weather and climate change, and many see these risks in the present or near term, uncertainty about the precise nature, timing and severity of climate impacts often inhibits investment in resilience beyond "business as usual." Nonetheless, there is a growing interest in investing to protect supply chains, developing climate-friendly technologies, and opening access to innovations, products, and services that are vital to resilience. A few leading companies like American Water, Bayer, The Hartford Group, National Grid, Rio Tinto, Coca Cola, and Weyerhaeuser are taking steps to address climate risks where they see significant opportunities to become more efficient, reduce costs, or provide greater value to customers—in other words, where there is a clear business case to do so.<sup>11</sup> Existing literature suggests that, by and large the business response thus far is a continuation of existing practices based on a historical picture of past risks, and often fails to adequately consider changing climate and natural hazards conditions (Crawford and Seidel,

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<sup>10</sup> The Climate Policy Initiative (CPI) produces a comprehensive inventory of climate investment funding at global, national, and local levels. CPI was able to map \$27 billion in public finance to adaptation in 2016. This figure, roughly the same as last year, represents a partial and uncertain estimate as it is affected by the different accounting approaches used for tracking finance, and tracking gaps for domestic budgets and private investment. Details can be found at <http://www.climatefinancelandscape.org/>

<sup>11</sup> A private enterprise would typically choose to invest in adapting measures to maintain or increase value (e.g. revenue, credit, reputation), to reduce costs (e.g. loss and damage, business interruption, capital and operating expenditure), to transfer the risk through insurance, to follow regulation, or to capitalize on a new business opportunity that has arisen because of climate and natural hazards (FS-UNEP, 2016). For example, the Coca-Cola Company, with bottling plants in South and Southeast Asia, has invested in projects to guard against drought in Thailand and Vietnam, budgeting \$500,000 yearly for watershed conservation in those countries (<http://news.mb.com.ph/2017/04/10/usaid-forum-showcases-coca-cola-water-programs-in-asean/>).

2013). **Small- and medium- scale enterprises (SMEs) are particularly vulnerable to climate and natural hazards.** Often SMEs have limited access to coping strategies, are often non-compliant with industry norms and regulations, which can lead to a lowered capacity to adopt risk management tools and expand customer and supply base, which can lead to cessation of business operations (Ballesteros and Domingo, 2015). Yet SMEs are vital contributors to the national economies of disaster-prone regions across the world.<sup>12</sup> For example, the proportion of SMEs amongst all enterprises can be as high as 90 percent in countries like Japan and Thailand (UN World Conference on Disaster Risk Conference, 2015). The development of innovative business practices and business models that help to address climate and natural hazards is essential to building resilience. Notable examples include innovative and technology practices within the ICT sector, such as the emergence of social media involvement with disaster relief, environmental hazard planning through mobile communication networks, and carbon-light business practices, through digital e-commerce platforms or shared economy businesses. Yet only a handful of private and public funds target innovative solutions for business resilience. **Resilient infrastructure plays a crucial role for the business community.** Critical infrastructure is highly vulnerable to, and a major casualty of, natural disasters. Resilient infrastructure helps business and communities to withstand, respond to, and recover from the potentially impact of climate and natural disasters. Repairing or replacing infrastructure after a natural disaster is often costly and difficult, and can worsen the suffering of affected businesses and communities. Despite the significant investment that is often associated with building, maintaining, and repairing infrastructure, empirical evidence suggests that governments and business do not consistently consider the resilience of infrastructure when making investment decisions nor are there requirements to do so. For example, flooding of a state highway bridge in regional New South Wales (Australia) has caused six major traffic disruptions since its construction in 1987. The cost of future events is estimated at US\$75 million, totaling about US\$92 million (in present value terms) over the projected life of the asset. This compares to an estimated replacement cost of US\$7.4 million (Deloitte, 2016). The example highlights that addressing resilience up-front is often the most cost efficient solution for governments and the business community alike. However, the decision to build (or retrofit) infrastructure to resilience standards faces several hurdles, including capacity at state and subnational level, competing requirements, budgetary constraints, and lack of incentives for both the public and the private sector. **A small group of impact institutional investors actively invests in adaptation and resilience.** This group includes Root Capital, Affirmative Investment Management, Meridiam, Generation Investment Management, NatureVest, Althelia

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<sup>12</sup> Globally, young SMEs are the primary source of job creation. A recent OECD study across 18 countries over the 2001-2011 period shows that young SMEs (less than 5 years), although representing on average 17 percent of employment, contribute 42 percent of total job creation and only 22 percent of all job destruction, making them net job creators. By contrast, older SMEs are generally net job destroyers. The disproportionate contribution of young firms to employment creation holds across all economies, sectors and years considered (Criscuolo et al., 2014).

Climate Fund, the Global Adaptation and Resilience Fund (GARF), ResponsAbility, and others. These funds seek to achieve specific social/environmental impact objectives while also achieving a rate of return based on a market benchmark. With the exception of GARF, which markets itself as the first private fund to focus on climate adaptation, few of the funds in this category focus exclusively on adaptation. Those that do often do so as part of a broader mandate to invest in climate change or sustainability themes. **Large asset managers are increasingly incorporating ESG risk considerations into their portfolio management strategy.** These institutional investors are working to codify and measure the impact of ESG risk management on performance, and are increasingly activist in requiring portfolio companies to respond to these risks. As a recent example, Black Rock, Vanguard Group, and State Street Global Advisors all voted to require ExxonMobil to report to shareholders on climate change.<sup>13</sup> This investor group is concerned primarily with publicly traded companies, is not focused on EMDEs, and does not act specifically to bring about adaptive behavior. **Insurance initiatives have recently proliferated to address climate and natural hazards induced loss and damage.** The insurance sector is most frequently engaged by targeted initiatives including pilot projects for micro-insurance, index-insurance schemes, regional or country-based public-private catastrophe risk pools (e.g. Caribbean Catastrophe Risk Insurance Facility, Turkey Catastrophe Insurance Pool), and alternative risk transfer products (e.g. IFC-Swiss Re Global Index Insurance Facility; GFDRR Malawi weather derivatives, Mexico Catastrophe Bond). The agricultural sector receives the highest level of support compared with other economic sectors, such as the built environment and the manufacturing sector. For example, the Sompo Japan Nipponkoa Group has developed a weather index insurance for rice farmers in Thailand that covered 4,300 rice farmers in 2014. The percentage of losses in developing countries that are covered by insurance has increased to more than 10 percent.

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<sup>13</sup> S. Mufson, 2017, "Financial firms lead shareholder rebellion against ExxonMobil climate change policies, Washington Post ([https://www.washingtonpost.com/news/energy-environment/wp/2017/05/31/exxonmobil-is-trying-to-fend-off-a-shareholder-rebellion-over-climate-change/?utm\\_term=.353c09d13633](https://www.washingtonpost.com/news/energy-environment/wp/2017/05/31/exxonmobil-is-trying-to-fend-off-a-shareholder-rebellion-over-climate-change/?utm_term=.353c09d13633))

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## 2. Resilience Market Segmentation

*The presence of a revenue stream and a commercial return are an absolute prerequisite for private sector investment. Resilience is not an exception. This chapter reviews the potential for private sector investment in resilience in four economic sectors - water, agriculture, transport, and energy – selected through an investors' survey. Because investing in infrastructure or in business requires different competencies, investment processes, project selection criteria, and attracts different classes of investors, two broad classes of investment have been identified: infrastructure and value chains. Each investment theme is assessed for its resilience relevance and potential for commercial returns.*

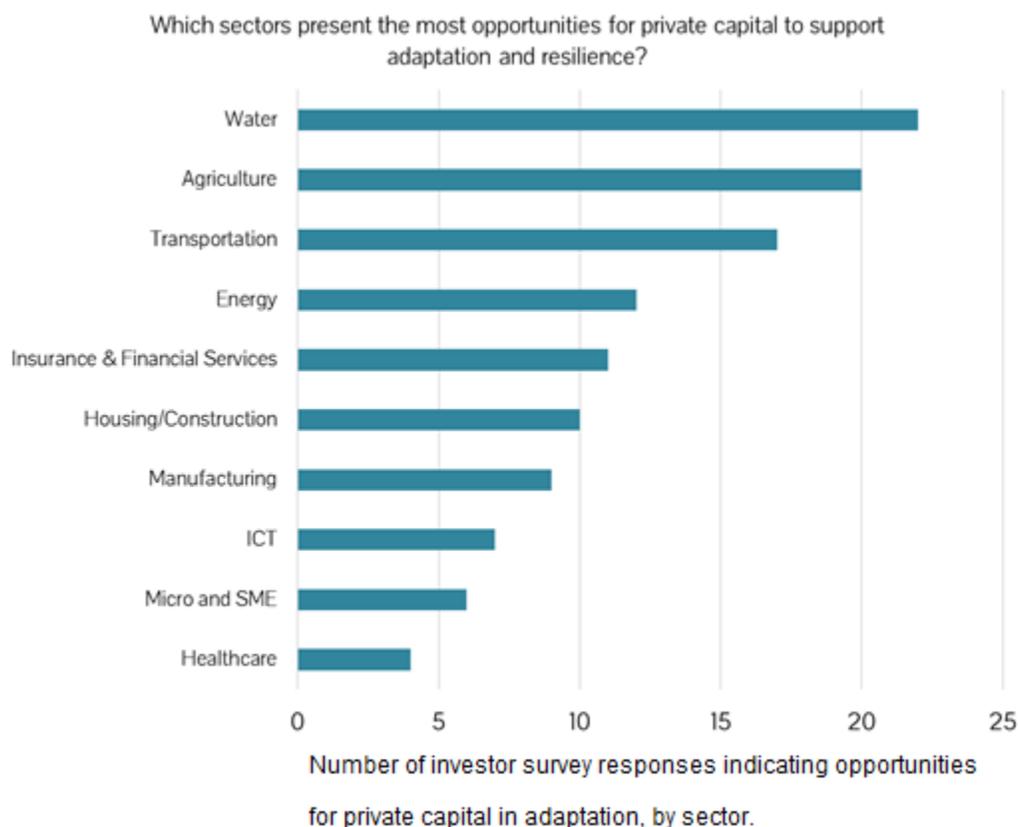
### 2.1 Economic sectors and resilience

2.1.1 **Resilience to climate and natural hazards is a relevant consideration for all economic sectors.** Many key economic sectors are affected by long-term changes in temperature, changes in the intensity and patten of precipitation, sea level rise, and extreme events. For example, energy is used to keep buildings warm in winter and cool in summer. Therefore, changes in temperature affect energy demand. Energy supply is also affected by temperature through the cooling of thermal plants, through wind, solar, and water resources for power, and through transport and transmission infrastructure. Water demand increases with temperature but falls with rising carbon dioxide (CO<sub>2</sub>) concentrations. Rising levels of CO<sub>2</sub> in the atmosphere can increase the yields of some crops by up to 20 percent; at the same time, however, the nutritional value of such produce may be lower. The impacts from higher CO<sub>2</sub> are highly dependent upon crop type and management type but it is estimated that yields will fall overall with temperature increases of more than 3°C (WEF, 2014). Water supply depends on precipitation patterns and temperature, and water infrastructure is vulnerable to extreme weather, while transport infrastructure is designed to withstand a range of weather conditions, and climate and natural hazards expose this infrastructure to stressors outside historical design criteria.

2.1.2 **Water, agriculture, transport, and energy present the most opportunities for private sector investment in resilience.** These sectors are at the basis of our society, and are tightly interlinked. For example, droughts can affect food prices, as well as energy from

hydro. Water production, distribution, and treatment are energy intensive processes, and can be affected by the availability and price of energy. Energy prices affect transport, with reverberations on food prices. Water levels also affect transport, and so on. A survey carried out by the climate change consultant FourTwentySeven on behalf of the World Bank found that institutional and corporate investors consider these sectors important for resilience and adaptation and potentially attractive for private capital (Figure 2.1). Several investors noted the opportunity for water as an enabler to be incorporated into a broad range of projects such as buildings, irrigation, water supply, hydropower, transportation (roads and ports), thermal power (water cooling in water scarce areas), agribusiness, manufacturing, especially for agriculture and mining where water use is intense.

**Figure 2.1 – Priority sectors for adaptation investment.**



Source: FourTwentySeven. *Report on Market Opportunities in Adaptation*, 2016. (unpublished).

2.1.3 **Both infrastructure and value chains associated with the water, agriculture, transportation and energy sectors are an adaptation priority.** Infrastructure accounts for the largest share of estimated adaptation cost. Resilient business relies on the availability of resilient infrastructure, and resilient infrastructure needs a sufficiently large user base to make commercial sense. In both cases, investments made today determine tomorrow’s vulnerability profiles. However, infrastructure and the business

community exhibit different type and level of exposure and vulnerability to climate and natural hazards. From an investor's perspective, these two sub-sectors are separate asset classes, requiring different management competences, investment processes, project selection criteria, and classes of investors, and are analyzed separately in the following sections and chapters.

## 2.2 The top four economic sectors' market segmentation

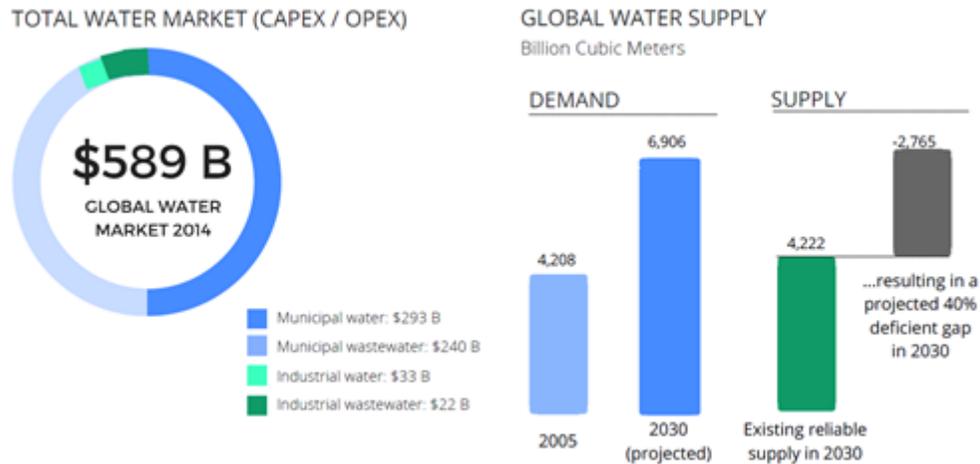
### The water sector

2.2.1 **About 80 percent of the world's population already faces serious threats to its water security, due to availability, demand and pollution.** In 2010, 36 percent of the global population, 39 percent of the world's grain production, and 22 percent of global GDP were at risk due to water stress. Under business-as-usual, 52 percent of the global population, 49 percent of the global grain production, and 45 percent of total GDP will be at risk due to water stress by 2050 unless measures are taken to address these issues.<sup>14</sup> Climate change is putting additional stress on water security, and reliable sources of water are expected to decrease. For each degree Celsius of global mean temperature rise, it is expected that an additional 4 percent of the world's surface will suffer a decrease in groundwater resources of more than 30 percent, and an additional 1 percent to suffer a decrease of more than 70 percent (Arent et al., 2014, Cisneros et al., 2014). Besides the climate stressors, human-related activities and trends also have significant impact on water, including: growing population and demand for water, energy and food, changes in lifestyle, and poor land use planning and resource extraction (Elliot et al, 2011). Figure 2.2 provides an overview of the global water market in 2014.

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<sup>14</sup> International Food Policy Research Institute (IFPRI), "Water Futures Project" (<http://www.ifpri.org/project/water-futures>)

**Figure 2.2 – Overview of the water sector**



Source: Climate Ventures 2.0.

2.2.2 **Water is a key resource, not only for human consumption, but also for many industries and economic activities.** Therefore, changes in availability of water will have economy-wide effects on agriculture, energy, municipal use, ecosystems, transportation, manufacturing, and others (Cisneros et al., 2014). Water availability is considered at risk from climate change, because of variable rainfall levels (*too little water* puts populations at risk, and aquifers are not keeping pace with levels of use; *too much water* can contaminate clean-water systems with dirty floodwater), and with rising sea levels (including saltwater intrusion into drinking areas and low-lying coastal agricultural land).<sup>15</sup> Climate change will intensify the water cycle, altering water availability, timing, quality, and demand. Indeed, freshwater systems are among the most vulnerable sectors of society to climate changes.<sup>16</sup>

2.2.3 **Water provision is contributing to greenhouse gas emissions because increasingly energy-intensive options are required to deliver scarce clean water to needy populations.** As traditional water sources become less predictable, expensive and energy-intensive (often fossil-fuel-powered) desalination plans are needed to convert seawater to water suitable for drinking or agriculture, and transporting water to populations whose sources have become untenable, is similarly energy-intensive and vulnerable to extreme weather.<sup>17</sup> Re-using used wastewater or “graywater” makes

<sup>15</sup> U.S. Environmental Protection Agency (EPA), “Climate Impacts on Water Resources”

([https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-water-resources\\_.html](https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-water-resources_.html))

<sup>16</sup> Pacific Institute, “Climate Change and Water” (<http://pacinst.org/issues/climate-change-vulnerability-and-resilience/climate-change-and-water/>)

<sup>17</sup> U.S. Environmental Protection Agency (EPA), “Climate Impacts on Energy” ([https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy\\_.html](https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy_.html))

populations more resilient to reduced rainfall, while ensuring that those treatment solutions are energy-efficient can minimize the climate impact of water provision.

2.2.4 **Seventy percent of water extracted from the world’s rivers, lakes and aquifers is used for agriculture. By 2050 the percentage will rise to 89 percent.** In developing countries irrigation already uses 85 percent of extracted water. Agricultural water use is under growing pressure as i) demand for water increases; ii) competition among cities, farmers, and the environment grows; and iii) large-scale overdraft of groundwater and water contamination from runoff continue unabated. The global population is expected to increase to over 10 billion by 2050, people will need food and fiber for basic needs. Furthermore, the increased consumption of calories and more complex foods (which accompanies income growth in much of the developing world) will result in a need for agricultural production to expand by 70 percent by 2050.<sup>18</sup> If this expansion is not to come at the expense of massive land conversions and the consequent impact on carbon emissions, agriculture must intensify. Irrigated agriculture is, on average, at least twice as productive per unit of land. It also provides an important buffer against increasing climate variability, and allows for more secure crop diversification. For these reasons, irrigation will continue to play a key role in ensuring global food and nutrition security.<sup>19</sup>

2.2.5 **The commercial viability of water adapting measures is challenging in many countries.** Often a combination of adaptation options, rather than a single approach, will bring about more positive outcomes. For example, interventions that consist of physical modifications of infrastructure often require robust information and decision tools, as well as policies to accompany the interventions to ensure their sustainability in the long term. Water policy frameworks that establish water markets or pricing schemes can foster climate change adaptation, but are currently weak in most countries. These frameworks often involve the setting of water pricing schemes in the domestic and agricultural sectors. However, prices are generally unevenly applied, collection rates are low, metering is rarely implemented, and pricing is often based on annual rather than usage-based fees. Barriers to water markets and pricing are omnipresent, including a lack of property rights, limits to transferability, legal and physical infrastructure, institutional shortcomings, and poor policy design (Vivid Economics, 2015) Table 2.1 provides a breakdown of the investments themes in water resilience, except for water infrastructure for agricultural use that is discussed in section 2.3.

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<sup>18</sup> World Bank, 2017, “Water in Agriculture” (<http://www.worldbank.org/en/topic/water/brief/water-in-agriculture>)

<sup>19</sup> Ibid.

**Table 2.1 - Resilience investment themes in the water sector**

Investment need	Resilience implications	Market size and geographies	Potential for commercial returns
<b>Infrastructure</b>			
Transport	<u>Services that deliver water to distressed</u> communities and/or remote areas that face variable weather patterns. Pipelines, trucks, and ships could work in this space.	In India, the government subsidized solar irrigation pumps – with 20,000 in service today. This could be replicated in other hard-to-reach areas. <sup>20</sup>	Not now: due to the weight of water, transportation of water is energy intensive and thus costly. There is some scope for pipelines with water pumps powered by solar energy, however.
Sewerage/sanitation system	<u>Management of communities' water supplies</u> during dry times and/or storage of excess water are important themes in building resilience.	Manila Water in the Philippines, Conhydra in Colombia, and SABESP in Brazil – the latter is recognized as one of the most financially solid operators in the LAC region.	PWC reports that delegation of public water and sanitation services to the private sector is the prevalent form of private sector participation in water management. As such, there is potential for commercial opportunities, although governments tend to focus on services.
Biosolids (sludge) management	The by-product of water treatment and reuse is sludge, a toxic substance that creates economic and environmental problems. New ways to <u>exploit sludge</u> will reduce its impact and could yield potential commercial opportunities.	Market size is currently small with only a few cases. Israeli company Applied CleanTech's Sewage Recycling System sterilizes biosolids and transforms them into products that can be used in the paper, plastic, and energy industries. The removal of biosolids reduces wastewater treatment plant costs and reduces sludge formation. <sup>21</sup>	Yes, captured methane gas formed during sludge decomposition can be used as a source of renewable energy to lower the energy costs of water treatment. Other costs can be trimmed (by up to 30 percent) through sludge reduction measures. Besides the cost efficiencies that come from exploiting sludge, the biosolids can yield valuable minerals and metals from the wastewater. Sludge produced yearly by a million people can contain as much as US\$13 million worth of metals. Other by-products from sludge can be sold as fertilizer or used in the paper industry.

<sup>20</sup> R. Colback, 2015, "The case for solar water pumps," World Bank (<http://blogs.worldbank.org/water/case-solar-water-pumps>)

<sup>21</sup> S. Udasin, 2013, "Israeli Company Mines Sewage Into Gold" Jerusalem Post (<http://www.jpost.com/Enviro-Tech/Israeli-company-mines-sewage-into-gold-330801>)

Value chain			
Increase and diversification of water supply	Technologies that produce freshwater by <u>removing contaminants</u> from seawater, brackish water, and/or contaminated water. Desalination can lead to diversification of water supply and resilience to water quality degradation when current water supply is inadequate.	Israel, Gulf states, Australia, Algeria, Spain, and China. <sup>22</sup> Recent technological change, if expanded, could lower the cost of desalination and make it more accessible. <sup>23</sup>	Commercial returns only currently viable in areas with high water cost driven by scarcity, and access to energy. Some lower cost opportunities in areas with brackish groundwater. Opportunity to pair with low-carbon and/or low-cost energy sources.
	<u>Rainwater harvesting</u> , for example the collection of rainwater from rooftop catchments. The diversification of household water supply would increase resilience to water quality degradation.	The increased proportion of hard (e.g. metal or tile) roofs and the availability of metal and plastic for conveyance have decreased the cost of implementation.	Not now, but there could be potential opportunities in roofing materials and storage vessels in the future.
Water Quality	Household drinking <u>water treatment</u> and storage, including treatment technologies to improve quality of water. Specifically, treatment technologies (chemicals, filters, ultraviolet, etc.) to improve microbiological and chemical quality of drinking water.	Global, but relevant case study in Haiti (Lantagne, et al., 2011).	Yes, there are opportunities for small-scale alternatives where municipal water systems are unavailable or unreliable. There is some scaling opportunity for improved, low-cost technologies, but many competing devices already exist.
Water storage	<u>Reservoirs</u> : surface water storage including dams and ponds. This contributes to resilience by boosting capacity to respond to diminished natural storage in snow and ice due to rising temperatures and changing precipitation patterns.	Global, with specific gaps recognized in Latin America. <sup>24</sup> High cost. Evaporative losses. May impact local food sources for downstream communities.	Yes, opportunities exist in some locations for infrastructure investment in reservoirs, particularly when paired with hydroelectric generation and flood control.

<sup>22</sup> WaterWorld, 2013, "Global Desalination Capacity Growing Substantially, Finds Study" (<http://www.waterworld.com/articles/2013/10/global-desalination-capacity-tops-80-million-cubic-meters-per-day.html>)

<sup>23</sup> T. Sumner, 2016, "New desalination tech could help quench global thirst," ScienceNews (<https://www.sciencenews.org/article/new-desalination-tech-could-help-quench-global-thirst>)

<sup>24</sup> World Bank, 2013, "World Water Day: Latin America leads in water management but inequalities in access remain" (<http://www.worldbank.org/en/news/feature/2013/03/22/world-water-day-latin-america-achievements-challenges>)

	<u>Groundwater recharge:</u> technologies for storing groundwater which includes injection wells, canals, and ditches. Like reservoirs, groundwater recharge contributes to resilience by boosting capacity to respond to diminished natural storage.	Global, but recognized and analyzed by OAS for use in helping to meet growing water demand in Latin America. <sup>25</sup> Must have appropriate geological and hydrological conditions and access to water supply for recharge.	Yes, especially since groundwater can be the lowest cost option for adding water storage in some locations. There are also opportunities in engineering and materials.
Improving resilience of water infrastructure	<u>Flood protection for wells:</u> Protection of wells to infiltration of contaminated water, collapse of unlined hand dug wells, and lack of well head access due to flood. This contributes to resilience by protecting water sources from contamination.	Global, but case studies in India reveal considerations on contributions to resilience, costs, and feasibility. <sup>26</sup>	Yes, there are opportunities, especially in the provision of in engineering and materials.
Water efficiency	<u>Leakage management, detection, and repair in piped systems.</u> This contributes to resilience by reducing pressure on existing water sources. <u>Increasing the use of water fixtures and appliances</u> contributes to resilience by reducing pressure on existing water sources. Techniques include the use of devices that supply less water while yielding comparable performance or that use alternative sources of water.	Global, although inappropriate water pricing removes incentives to conserve.	Yes, there are opportunities, especially in the provision of engineering materials.

## The agriculture sector

**2.2.6 The impact of climate change on crop production and biodiversity is expected to be negative, although variable across regions.** While rising temperatures could positively affect agriculture production and yields in certain high-latitude regions, at the global

<sup>25</sup> UNEP, 1997, "Artificial recharge of aquifers," in Sourcebook of Alternative Technologies for Freshwater Augmentation in Latin America and the Caribbean (<https://www.oas.org/dsd/publications/unit/oea59e/ch18.htm>)

<sup>26</sup> A. Armstrong et al., "Flood resilience for protected wells," ClimateTechWiki (<http://www.climatetechwiki.org/content/flood-resilience-protected-wells>)

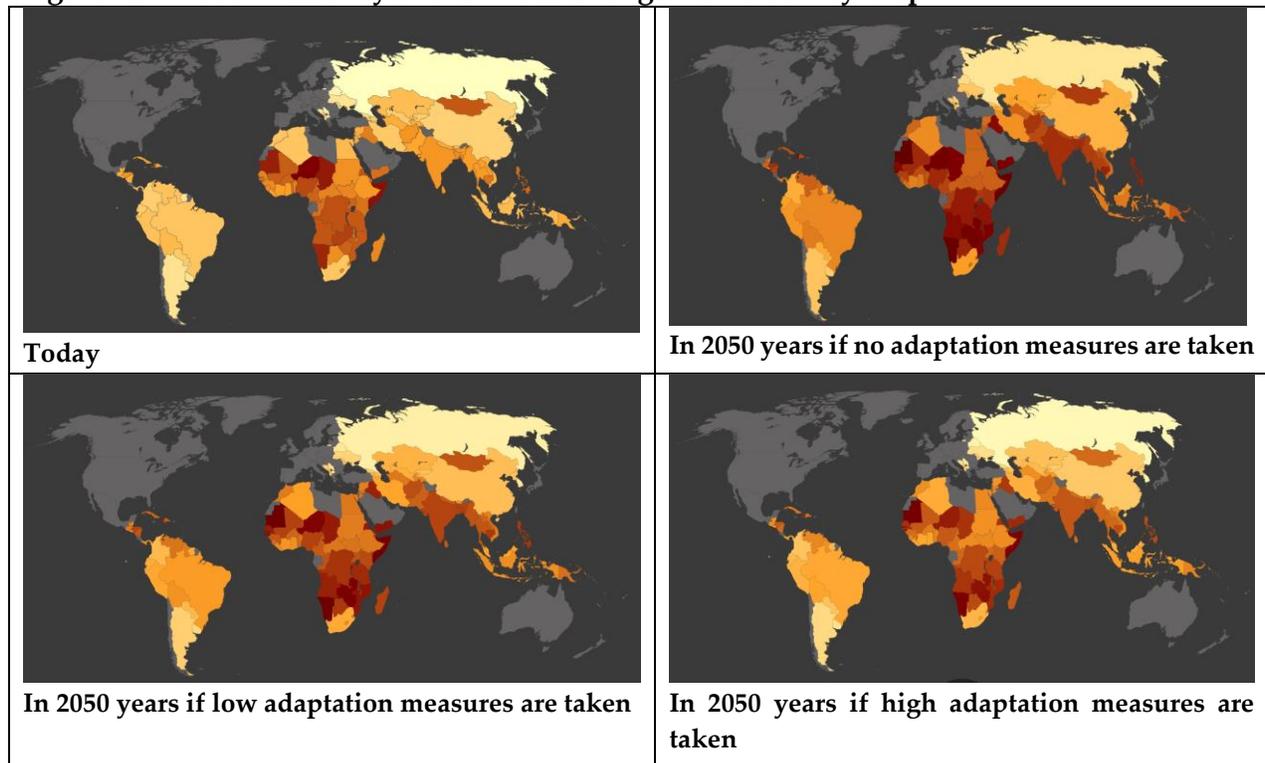
level the negative impacts will largely outweigh them. Wheat and maize yields have already shown a decline, which will continue to occur if no adaptation measures are taken. Extreme weather events in key exporting regions has resulted in price surges. With temperatures forecasted to increase by 1-3°C by 2050 and precipitation extremes to intensify, challenges are expected to increase: yields of major crops are expected to decline, heat-stressed livestock will grow more slowly and will be more likely to die before their scheduled slaughter, and herbicides will become less effective requiring higher applications.<sup>27</sup> Furthermore, extreme precipitation can erode soil, and extreme heat can lead to significant topsoil loss. These put financial pressures on farmers, and may put them at risk of financial destitution.

2.2.7 **Increasing food insecurity and malnutrition are among the most significant impacts of climate change on agriculture.** Beyond climate constraints, demand for crops is increasing rapidly (Arent et al., 2014). During the last two decades, 200 million have been lifted out of hunger and the prevalence of chronic malnutrition in children has decreased from 40 to 26 percent. In spite of this progress, 702 million people still live in extreme poverty, and 793 million people are undernourished (FAO, 2015). Climate change exacerbates the risks of hunger and undernutrition through: i) the increased frequency and intensity of extreme events such as droughts, floods, and storms that destroy crops, and infrastructure; ii) the long term rise in temperature that causes the melting of glaciers, affecting water supply, and the rise in sea levels, affecting the livelihood of coastal societies and low level lands. The Food Insecurity and Climate Change Vulnerability map (Figure 2.3), produced by the UN World Food Programme (WFP) and the Met Office Hadley Centre, illustrates how strong adaptation and mitigation efforts will prevent the worst impacts of climate change on hunger globally and help make people less vulnerable to food insecurity.

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<sup>27</sup> National Climate Assessment, "Agriculture" (<http://nca2014.globalchange.gov/report/sectors/agriculture>)

**Figure 2.3 – Food Insecurity and Climate Change Vulnerability Map**



Source: World Food Programme (WFP) and UK Met Office, interactive map (<http://www.metoffice.gov.uk/food-insecurity-index/>).

**2.2.8 Agriculture, forestry, and other land use are also a major contributor to climate change, representing over 20 percent of global emissions.** Livestock is the major factor, contributing to global GHG emissions to the tune of 14.5 percent, followed by manure left on pastures, the application of synthetic fertilizers, and biologic fermentation in rice paddies.<sup>28</sup> FAO estimates 44 percent of agricultural emissions in 2011 were produced in Asia, followed by the Americas (26 percent), Africa (15 percent), and Europe (12 percent) (FAO, 2011). Mitigation measures are required to reduce the need for adaptation.

**2.2.9 Possible adaptation measures in the livestock sector involve production and management system modifications and changes in breeding strategies.** Diversification of livestock can increase drought and heat wave tolerance, and may increase livestock production in animals exposed to temperature and precipitation stresses (Gerber et al., 2013). Improving feeding practices, such as modification of diets, changing feeding time and/or frequency, can reduce the impact of climate change by

<sup>28</sup> Livestock can influence climate through changes in land use, feed production, animal production, manure, and processing and transport. Among the emission contributors, enteric fermentation is the largest, accounting for 39.1 percent of total percent emission, followed by manure management (25.9 percent), feed production (21.1 percent), land use change (9.2 percent), post-farmgate (2.9 percent), and direct and indirect energy (1.8 percent) (Gerber et al., 2013). In addition, livestock production is limited by a variety of climate impacts, including impact on land and water, feed quantity and quality, livestock diseases, heat stresses and biodiversity loss. Measures that can maintain a balance between productivity, demand for livestock products and eco-environment preservation are important for increasing the resilience of the agriculture sector.

promoting higher intake or compensating for low feed consumption, reducing animal malnutrition and mortality. Likewise, improved biotech technologies in animal vaccines and feed enzyme additives can also improve animal nutrition and resistance to disease. Changes in breeding strategies can help animals increase their tolerance to heat stress and diseases and improve their reproduction and growth development (Henry et al., 2012).

2.2.10 **Intensified irrigation can increase agricultural yields. But it must be considered in context of overall water resources management and water security.** Sustainable management of water in agriculture is necessary to increase agricultural production while ensuring that water can be shared with other users to maintain the environmental and social benefits of water systems. This will involve adequately investing in the maintenance of irrigation and drainage systems and matching off-farm improvements with incentives and technology transfer for on-farm investments in improved soil and water management and improved seeds.<sup>29</sup>

2.2.11 **A review of the main agri-resilience investment themes suggests a potential for more private sector investment, particularly in emerging economies.** Table 2.2 provides a market segmentation of agri-resilience investments with commercial potential. Water infrastructure for agricultural use could be an interesting and expanding sector for combined private and public sector investment. However, these transactions are rather complex and require adequate institutional frameworks, making them less likely to succeed in developing economies. Overall agri-resilience value chain appears to be dominated by small and fragmented sub-sectors. Many of these sub-sectors require farmer training and technical assistance, suggesting the important role that impact funds and investors that specialize in farmer training and technical assistance play in ensuring access to finance and knowhow, as well as sustainability of agri-resilience investment for SMEs in less developed economies.

**Table 2.2 - Resilience investment themes in the agriculture sector**

Investment need	Resilience implications	Market size and geographies	Potential for commercial returns
<b>Infrastructure</b>			
Irrigation PPPs	Reduces water losses	Investment required for adaptation: US\$75-100bn p.a Notable geographies: Peru, Mexico, Brazil, and Argentina	Yes: but concessionality likely needed

<sup>29</sup> CGIAR, "Land and Water Solutions for Sustainable Agriculture" (<https://wle.cgiar.org/research/themes/sustainably-increasing-land-and-water-productivity>)

Wastewater treatment (for irrigation PPPs)	Conservation of freshwater sources	Some US\$2bn invested, with scope for more Notable geographies: Chile, Mexico, and Israel	Yes: but complex given low acceptance of using wastewater in agriculture
Wastewater treatment (and reuse)	<u>Water treatment and reuse</u> can treat effluent to a level of purification that enables reuse in agriculture This is particularly important for countries that face droughts or generally suffer from chronically-inadequate water supplies.	Israel, Gulf States, Australia, Brazil “...the industrial water treatment and recycling market is set to grow by over 50 percent over the next five years, from around US\$7 billion in 2015 to almost US\$11 billion in 2020” (Deloitte, 2016).	There is potential for commercial returns, especially in arid/drought-prone geographies. Israel, for example, reuses 70 percent of its water. The government of Western Australia committed to achieving 30 percent wastewater recycling in key cities by 2030 and 60 percent by 2060. More opportunities exist where off-takers are willing to pay market prices for water. Some innovation potential in monetizing co-benefits, such as electricity generation from waste products.
<b>Value chain</b>			
Rainwater collection	The <u>storage and use of rainfall</u> , diverted from runoff can provide convenient and reliable water supply during seasonal dry periods and droughts.	Kenya, Ethiopia, Mexico, Tanzania, Israel, and India. Can reportedly also improve stability of crop yields and raise agricultural productivity. <sup>30</sup>	Not now, although there could be some opportunities in roofing materials and storage vessels in the future
Boreholes and tubewells	Use of <u>narrow, screened tube or casing</u> driven into a water-bearing zone of the subsurface.	Increases access to groundwater during drought and could also serve as pre-drought mitigation. In many regions, groundwater is the only perennial source of water supply.	Yes, although engineering and materials are required, and costs vary depending on the location.
Precision agriculture and monitoring	Improves ability to plan/monitor cropping to <u>optimize yields and resource efficiency</u> . High precision data drives decisions for the farm	Total market size was US\$2 billion in 2013, and is expected to rise to US\$4.5 billion by 2020. Notable geographies: AgFunder’s BEE platform in Mexico; Chinese market.	Yes, this is an attractive and growing area with an opportunity to leverage mobile phone penetration to deliver relevant, localized information
Crop Management	<u>Crop diversification and new varieties</u> : introduction	US\$16bn in 2016	Yes, although concessionality likely

<sup>30</sup> J. Rockström and M. Falkenmark, 2015, “Agriculture: Increase water harvesting in Africa,” Nature (<http://www.nature.com/news/agriculture-increase-water-harvesting-in-africa-1.17116>)

	<p>of improved species in response to environmental and market stresses.</p> <p>Enhances resistance to stresses resulting from climate change or disasters, thereby improving soil health and crop yield.</p> <p>Diversification provides resilience to weather or pest losses</p>	<p>Notable geographies: MAIS pilots in Brail</p>	<p>needed, although the market for new seed varieties is growing</p> <p>Crop management also requires enhanced services, technology transfer, and capacity building</p>
	<p><u>Biotechnology</u>: provide the ability to detect and transfer genes of interest from organisms into the crop of interest, to boost resistance to environmental stresses.</p> <p>Promotes drought tolerance, salinity tolerance, and increased yields</p>	<p>In 2003, seven million farmers in 18 countries – more than 85 percent of them resource-scarce farmers in developing countries – were planting biotech crops. Almost one third of the total global biotech crop area was grown in developing countries.<sup>31</sup></p>	<p>Yes, there is a potentially large market for successfully developed seed varieties.</p> <p>Constraints: High development costs and significant regulatory hurdles for efficacy .</p> <p>Intellectual property rights provide limited protections to justify up-front expenditures</p>
	<p><u>Ecological pest management</u>: controlling pests by promoting natural enemies of pests, either directly or through crop selection or management.</p> <p>Promotes a healthier ecosystem that decreases crop vulnerability to pests.</p>	<p>In West Africa, the introduction of the wasp was a successful control of the slug of cassava, saving more of the staple food crop for consumption (Clements et al., 2011).</p>	<p>Not now, but could lower production costs through decreased pesticide use</p> <p>Lack of studies, cosmetic damage, lack of policy, lack of understanding of benefits, and vested interests from pesticide industry act as constraints</p>
	<p><u>Grain storage</u>: reduce food loss by controlling storage conditions: temperature, moisture, light, pests, and hygiene.</p> <p>Promotes preparation for poor harvest in the event of drought or weather-induced crop loss.</p>	<p>In the northern region of Afghanistan, farmers stored crops in plastic and fiber bags, which offered limited protection and contributed to post-harvest losses. After switching to metallic silos, storage loss was reduced from 10-20 percent to 1-2 percent (Clements et al., 2011).</p>	<p>Yes, there is an opportunity to optimize value chains by improving storage and transportation from grower to markets.</p> <p>However, depending on the market, commodities are sometimes sold immediately to pay expenses – especially for poorer farmers. This could be a constraint.</p>
Soil management	<p><u>Slow-forming terraces</u>: a levelled surface constructed from infiltration ditches, hedgerows, and earth or stone walls.</p>	<p>Research conducted in Peru found slow-forming terraces had improved productivity of peas, maize, fava beans, and potatoes. In this case, the slow-forming terraces enhanced water retention,</p>	<p>Yes, return on investment is possible through increased production, but longer term (10 years)</p>

<sup>31</sup> USAID et al., 2004, “What is Agricultural Biotechnology?”  
[http://absp2.cornell.edu/resources/briefs/documents/warp\\_briefs\\_eng\\_scr.pdf](http://absp2.cornell.edu/resources/briefs/documents/warp_briefs_eng_scr.pdf)

	Promotes water retention in soil, prevents soil erosion, and maintains soil fertility – can boost crop productivity	which benefitted the crops (Clements et al., 2011).	Also Constrained by a lack of access to credit and short planning horizons.
	<p><u>Conservation tillage:</u> Techniques to prepare the soil by mechanical, animal, or human-powered agitation – both small and large scale.</p> <p>Reduces the risk from droughts and floods (enhances moisture retention), and reduces soil erosion</p>	Conservation tillage was successful in Brazil and Argentina, both of which had 45-60 percent of all agricultural land under the practice (as of 2005). <sup>32</sup>	Yes, this can enhance production margins by reducing labor inputs by about 50 percent. However, a lack of capacity and local equipment act as constraints
	<p><u>Integrated nutrient management:</u> integrate natural and man-made soil nutrients to increase crop productivity and preserve soil productivity, focusing on a cropping system.</p> <p>Can reduce susceptibility to pests, better access to deep water. Reduces drought risk and increases tolerance to salinity and cold conditions</p>		Yes, there are opportunities in the market for fertilizers, although insufficient credit and infrastructure are constraints
Livestock adaptation	<p><u>Production adjustments:</u> changes in livestock practices that promote resilience to climate extremes. Practices include: diversification of livestock; altering operation timing; modifying stock distances; and introduce mixed livestock farming systems (such as stall-fed systems and pasture grazing</p>	<p>Pastoralists in the Sahel region of Africa used emergency fodder during droughts, used a multi-species composition of herds, and culled weak livestock for food during periods of drought.</p> <p>Changing from cattle to sheep and goat, husbandry, for example, was beneficial during droughts since the latter had lower feed requirements.</p>	Yes, services that provide support and/or technical assistance to those who manage livestock might be a viable route towards commercially-viable activity that contributes to resilience.
	<p><u>Breeding strategies:</u> adaptation strategies to address the tolerance of livestock to heat, and their ability to survive, grow, and</p>	In the Sahel region of Africa, pastoralists cross-breed livestock to improve local genetics with heat and disease-tolerant breeds.	Not now: many local breeds are already adapted to harsh living conditions, but developing countries lack livestock breeding

<sup>32</sup> A. Garg et al., “Conservation tillage,” ClimateTechWiki (<http://www.climatechwiki.org/technology/conservation-tillage>)

	reproduce in adverse conditions.		technology and programs that help adaptation.
	<u>Livestock management systems</u> : efficient and affordable adaptation practices will be necessary for livestock adaptation. Practices include: provision of shade and water; changes in herd composition; localized irrigation for drinking water; and infrastructure to harvest rainwater	Global	Yes, services that provide support and/or technical assistance to those who manage livestock might be a viable route towards commercially-viable activity that contributes to resilience.
Agroforestry	Reduce deforestation; protect yields from adverse weather	Nascent, but with large potential in forested regions Notable geographies: Brazil and Colombia	Yes, with an emphasis on increasing crop yields and wood sales
Crop Insurance	Provides income during bad weather	Nascent market Notable geographies: Blue Marble Consortium in SSA	Unlikely in the short term, absent concessionality
Agricultural loans focused on resilience	Long-term loans for CAPEX; short-term loans for seeds	US\$450bn Agri-finance market has scope for resilience focus Notable geographies: Accion PE fund in LAC	Yes, although it is difficult to separate the resilience component from normal agriculture investment
Urban Agriculture	Reduced reliance on good weather and land for food production	800m urban people produce 15-20 percent of world's food. Notable geographies: Sky Greens in Singapore	Yes, with opportunities in early stage ventures (seeds to series A)
Market Access and Transportation	Increases sales and decreases search/transaction costs	Online grocery sales approximately US\$48bn worldwide. Notable geographies: China (Future of Grocery Report, Nielsen)	Yes, there is strong and growing interest among commercial investors
Food Processing	Increased food safety; reduce environmental impact of agriculture	Of US\$4.6bn invested in 2015; 6.8 percent invested here (US\$312m). Notable geographies: East Bali Cashews (special packages)	Not now, in the short-term, there appear to be few opportunities, except in middle-income countries for shelf life.
Food Engineering and Sustainable Protein	Improvement in quality and density of nutrients in food	Of US\$4.6bn invested in 2015; 5.9 percent invested here (US\$270m) Notable geographies: Plumpy'Nut life-saving paste in Africa and India	Yes, there are opportunities for investment, especially in the SME space

Agricultural Waste Use	Self-made fertilizer can offer new revenue streams, and/or can lower costs	Fertilizer market is US\$185 billion. Notable geographies: Brazil and India	Yes, subject to commodity prices
Bioenergy 1: Biofuels	Limited impact on resilience: can only be considered when not impacting the value chain/competing for inputs	US\$98bn in 2013, growing to US\$178bn (2022). Notable geographies: limited, except cases in Brazil	Yes, although it will depend on the market for inputs
Bioenergy 2: Biomass Power	Reduces power needs for farmers while saving costs and insulating the chain	370 TWh in 2012; estimated growth to 600 TWh by 2020. Notable geographies: Brazil Bagasse	Yes, although it requires secure, long-term, low-cost fuel supply to ensure a return

## The transport sector

2.2.12 **The transport sector is a vital component of a well-functioning economy.** Transport is a crucial driver of economic and social development, bringing opportunities for the poor and enabling economies to be more competitive. Transport infrastructure connects people to jobs, education, and health services; it enables the supply of goods and services around the world; and allows people to interact and generate the knowledge and solutions that foster long-term growth. Rural roads, for example, can help prevent maternal deaths through timely access to childbirth-related care, boost girls' enrolment in school, and increase and diversify farmers' income by connecting them to markets. At the same time, transport accounts for about 64 percent of global oil consumption and 27 percent of energy consumption, and is responsible for around one-quarter of total GHG emissions.<sup>33</sup>

2.2.13 **Transportation networks are vulnerable to many stressors.** Examples of extreme weather damaging transport infrastructure include: i) heat waves can make roads and rail unstable or crack/buckle, ii) in heavy rainfall, floods and landslides (often caused by stronger-than-historical hurricanes) can flood or wash away roads and rail connections; iii) storm surges may damage ports, and silting can block water channels, preventing port access for extended periods of time.<sup>34</sup> Severe disruptions to transportation can isolate communities for long periods, restrict access to key markets and economic hubs, and lead to economic losses. Most transport systems are designed based on historical local conditions that no longer reliably predict future risk of delays, disruptions, damage, and failure (Ebinger & Vandycke, 2015).

<sup>33</sup> UNECE, "Climate Change and Sustainable Transport" (<http://www.unece.org/?id=9890>)

<sup>34</sup> Deccan Chronicle, 2016, "6 washed away as flash floods hit Guntur, railway stations submerged"

(<http://www.deccanchronicle.com/nation/current-affairs/220916/ap-6-washed-away-as-flash-floods-hit-guntur-railway-stations-submerged.html>); and J. Swearingen, 2016, "Watch This Suspension Bridge Get Washed Away in Heavy Flooding" Popular

Mechanics (<http://www.popularmechanics.com/technology/infrastructure/a22085/watch-this-suspension-bridge-get-washed-away-in-heavy-flooding/>)

2.2.14 **Costs increase significantly for retrofitting existing facilities, compared to integrating resilience in new build.** Well-conceived transport infrastructure can be resilient to climate and natural hazards (e.g. raising roads and train tracks, ensuring stronger foundations, including storm barriers for ports). Because these investments are long-lived, well-conceived investments can ensure lower future (and total) costs (Fankhauser et al., 1999). The scale of investment required is large: an estimated one billion people in low-income countries still lack access to an all-weather road. In many cities, time lost to congestion erodes prosperity. High mobility costs cut the disposable income of the poor who often lack reliable and affordable public transportation. In Asia alone, before 2030, US\$40 trillion will be required for infrastructure (which includes many other sectors aside from transport – AIIB).<sup>35</sup> Furthermore, opportunities for building climate resilience are greatest when integrated into the initial design and construction of new infrastructure rather than during retrofit.<sup>36</sup> But building resilient infrastructure adds costs. This must take uncertainty into account, and adopt appropriate strategies in response: “(i) no-regret” strategies that yield benefits even in absence of climate change; (ii) favoring reversible and flexible options; (iii) buying “safety margins” in new investments; (iv) promoting soft adaptation strategies, including long-term prospective; and (v) reducing decision time horizons” (Hallegate, 2009). Table 2.3 provides an overview of resilience investment opportunities in the transport sector.

2.2.15 **Resilient transport infrastructure tends to be heavily reliant on government policies.** Table 2.3 provides a market segmentation of investments in transport sector resilience. The sector provides market opportunities for investing in resilience, although there are constraints. First, there is still more work to do to position transport as a core part of the adaptation agenda. As of 2015, 100 countries submitted Intended Nationally Determined Contributions (INDCs) to the UN Convention on Climate Change (UNFCCC) that focused on climate change mitigation and adaptation in the period to 2030 – but only 16 of those countries highlighted transport among their priorities for adaptation, and fewer included transport-specific adaptation measures (Ebinger and Vandycke, 2015). Another problem corresponds to the lack of a transport resilience agenda: multilateral development banks (MDBs) pledged to increase their financing for sustainable transport to US\$175 billion by 2022.<sup>37</sup> However, only about 30 percent of adaptation finance mobilized by MDBs went to energy, transport, and other built environment and infrastructure. Third, much of the investment opportunity in transport resilience is in the realm of infrastructure, which tends to be heavily reliant upon

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<sup>35</sup> <http://www.scmp.com/week-asia/business/article/2020095/asias-infrastructure-problem-not-what-you-think>

<sup>36</sup> IFC, Pilot Climate Change Adaptation Market Study: Turkey, ([http://www.ifc.org/wps/wcm/connect/topics\\_ext\\_content/external\\_corporate\\_site/cb\\_home/publications/publication\\_adaptation\\_marketstudy\\_turkey](http://www.ifc.org/wps/wcm/connect/topics_ext_content/external_corporate_site/cb_home/publications/publication_adaptation_marketstudy_turkey)) (accessed Feb 21, 2017).

<sup>37</sup> Asian Development Bank (ADB), 2017, “Progress Report (2015-2016) of the MDB Working Group on Sustainable Transport” (<https://www.adb.org/documents/progress-report-2015-2016-mdb-wg-sustainable-transport>)

government policy and thus requires soft measures (such as capacity building and frameworks for PPP projects) in addition to physical upgrades.

**Table 2.3 - Resilience investment themes in the transport sector**

Investment need	Resilience implications	Market size and geographies	Potential for commercial returns
<b>Infrastructure</b>			
Roads	The most common and flexible route for inputs and outputs. Poor quality roads are likely to strand inputs and outputs from their destinations due to extreme weather events. Resilience investment include heat resistant paving materials, flexible pavement, reflective surfaces, permeable pavement (that allows movement of water through surface), and water drainage systems.	Road freight produces 6 percent of worldwide GHGs. <sup>38</sup> Cumulative road investment is forecast to be about US\$7 trillion in the period 2015-2025 (PWC, 2015). Most of that investment will be in developing countries. <sup>39</sup>  In LAC, road transport is expected to grow at 11 percent 2014-2025 (PWC, 2015).	Yes, although projects are often late and over budget, and are historically owned and operated by governments. <sup>40</sup> User fees may improve odds of returns. Higher cost can be partially offset by reduction in insurance premiums if insurers' adaptation standards are met. Furthermore, there is an opportunity for design and construction providers.
Rail	Rail can carry large quantities of products (including grain and livestock) between major areas. Limited flexibility, but resilient. Resilient rails require similar measures as in roads: heat resistant railroad track materials and elevated surfaces to avoid flooding.	Cumulative rail investment is forecast to be about US\$3.5 trillion from 2015 to 2025, with over US\$2 trillion expected to be invested in Asia alone (PWC, 2015). <sup>41</sup>  Vietnam has 25 road and 10 rail projects planned (Jones Lang LaSalle, 2013).	Yes, although largely driven by government priorities, as transport infrastructure is viewed as a public good. <sup>42</sup> There are opportunities for companies to develop and commercialize new or not-widely-used materials.
Ports	Shipping by water is the cheapest form of transport, and the one with the most flexibility in terms of destinations (sellers can change markets more	Cumulative port investment is forecast to be about US\$750 billion from 2015 to 2025, with most of those	Yes, with particular opportunities in Brazil and China (Garcia-Escribano et al., 2015). <sup>45</sup>

<sup>38</sup> Rocky Mountain Institute, "Trucking Efficiency" (<http://www.rmi.org/trucking>)

<sup>39</sup> PWC, 2015, "Assessing the global infrastructure market: Outlook to 2025" (<https://www.pwc.com/gx/en/transportation-logistics/pdf/assessing-global-transport-infrastructure-market.pdf>)

<sup>40</sup> T. Holland, 2016, "Asia's Infrastructure Problem is Not What You Think," South China Morning Post (<http://www.scmp.com/week-asia/business/article/2020095/asias-infrastructure-problem-not-what-you-think>)

<sup>41</sup> PWC, 2015, "Assessing the global infrastructure market: Outlook to 2025" (<https://www.pwc.com/gx/en/transportation-logistics/pdf/assessing-global-transport-infrastructure-market.pdf>)

<sup>42</sup> PWC, 2014, "Delivering Rail Projects in Asia" (<https://www.pwc.com/sg/en/capital-projects-infrastructure/assets/cpi-deliver-rail-projects-in-asia-201408.pdf>)

<sup>45</sup> A. Marjamaa, 2015, "The Infrastructure Gap in South America," Wallenius Wilhelmsen Logistics (<http://www.2wglobal.com/news-and-insights/articles/features/the-infrastructure-gap-in-south-america/>)

	flexibly as long as they can find an offtaker at a port). Particularly important for areas with poor infrastructure (especially at land borders).  Opportunities: upgrade flood defenses, update height restrictions, upgrade berths, foundations, drainage (including one-way valves).	funds expected to be invested in Asia alone. <sup>43</sup> Like roads, 11 percent growth expected in Vietnam in the next decade. <sup>44</sup> Vietnam has 7 port projects planned, which are important to raise the standards of its ports (Jones Lang LaSalle, 2013).	In China, the 2014 Fujian Fishing Ports Project (WBG) aims to upgrade ports to provide shelter from storms, improvement of port early warning systems, and capacity building (Ebinger and Vandycke, 2015).
Logistics centers	Improves smooth functioning of goods flows, including agriculture inputs and outputs. Examples of resilience investment include flood defenses, drainage systems, natural ventilation, shading and cooling (including heat sinks), refrigeration system upgrades.	Huge needs in Latin America, to improve currently-low capacity and meet expectations of future growth. <sup>46</sup>	Yes, but heavily dependent on government support. <sup>47</sup> Large opportunities seen in Vietnam (Jones Lang LaSalle, 2013) and Myanmar. <sup>48</sup>
<b>Value chain</b>			
Services – cold chain	Over 30 percent of all produced human food is wasted or lost (1.3 billion Metric tons), worth US\$1 trillion (of which US\$310 billion is in developing countries). <sup>49</sup> Additionally, cold chains provide opportunities for developing country small-and-medium sized farmers/businesses to enter	Considerable new construction in emerging markets accounts for most of the increase in refrigerated warehousing space: total capacity reached 600 cubic meters in 2016, an increase of 8.6% since 2014 (at 4.2% annualized growth rate). <sup>50</sup>  Asia is highlighted as a major area for cold chain	Yes, although navigating several challenges will be necessary. The biggest barriers to cold chain growth are policy barriers (in distribution services industries) and the logistical difficulties and delays of clearing customs or transporting products across borders (US ITA, 2016).

<sup>43</sup> PWC, 2015, “Assessing the global infrastructure market: Outlook to 2025” (<https://www.pwc.com/gx/en/transportation-logistics/pdf/assessing-global-transport-infrastructure-market.pdf>)

<sup>44</sup> PWC, 2015, “Assessing the global infrastructure market: Outlook to 2025” (<https://www.pwc.com/gx/en/transportation-logistics/pdf/assessing-global-transport-infrastructure-market.pdf>)

<sup>46</sup> L. Harrington, 2012, “Beating the Odds in Latin America,” Inbound Logistics (<http://www.inboundlogistics.com/cms/article/ beating-the-odds-in-latin-america/>)

<sup>47</sup> Indonesia Investments, 2016, “Jokowi Opens Bonded Logistics Centers to Improve Indonesia’s Competitiveness” (<http://www.indonesia-investments.com/news/todays-headlines/jokowi-opens-bonded-logistics-centers-to-improve-indonesia-s-competitiveness/item6589?>)

<sup>48</sup> I. Steger, 2014, “Companies Push into Myanmar Agriculture, Logistics,” Wall Street Journal (<https://www.wsj.com/articles/SB10001424052702303795904579432403417845492>)

<sup>49</sup> Food and Agriculture Organization (FAO), “SAVE FOOD: Global Initiative on Food Loss and Waste Reduction” (<http://www.fao.org/save-food/resources/keyfindings/en/>)

<sup>50</sup> Global Cold Chain Alliance, 2016, “Global Cold Chain Capacity” (<http://www.gcca.org/resources/publications/white-papers-reports/global-cold-storage-capacity/>)

	the supply chains of international markets, exporting temperature-sensitive products to retailers around the world.	investment, particularly China, India, and Vietnam. In India, the cold-chain infrastructure gap is estimated to be 3.28 million tons, in a market of 31.82 million tons of total cold chain storage in India (NCCD, 2015).	
Products - Efficient Trucking Fleets	Fuel-efficient fleets could travel further between refueling stops, require less maintenance in areas with limited parts. Networked “smart fleets” could reduce the absolute number and distance of trips required, although this is a challenge as many trucking fleets are SMEs. <sup>51</sup>	Huge market. Theoretically, any goods transported by truck could be transported in 1) more efficient trucks, 2) taking advantage of logistics improvements and 3) automation.	Not for now – despite the possibility of developing countries’ “leapfrogging” approaches, it will take time for smart trucking fleets to become more efficient in developed markets. <sup>52</sup>

## The energy sector

2.2.16 **Energy systems are major emitters, and they are also highly vulnerable to climate change and other stressors.** Energy production is a major *contributor* to climate change, producing 25 percent of global greenhouse gas (GHG) emissions, particularly from fossil thermal energy (coal, oil, gas) which has often been the primary production source for developing countries.<sup>53</sup> However, energy systems are also *vulnerable* to the effects of climate change: thermal power plants (coal, oil, and gas) need cooling water, which is less effective when it is too hot. Hotter-than-normal water intakes at power plants are not cool enough to be effective, and cooling water temperatures rates are too hot to put back into natural systems.<sup>54</sup> Beyond the power plant gate, extreme weather can disrupt both fossil-fuel inputs (by preventing coal and petroleum supply delivery) and electricity output (by damaging transmission systems as power lines are downed in extreme weather, or overwhelmed by high temperatures).<sup>55</sup>

2.2.17 **Changes in demographics, consumers’ behavior, regulations and technological innovations will largely impact the energy demand landscape.** Temperature increases will reduce the demand for heating but increase the demand for cooling, and the

<sup>51</sup> E. Jaffe, 2015, “How the Trucking Industry Could Be Vastly More Efficient,” Citylab (<http://www.citylab.com/tech/2015/01/the-trucking-of-tomorrow-is-here-and-its-a-huge-win-for-city-traffic/384672/>)

<sup>52</sup> North American Council for Freight Efficiency (NACFE), (<http://nacfe.org/>)

<sup>53</sup> J. DeCicco, “Transportation Energy and Climate Analysis,” University of Michigan Energy Institute (<http://energy.umich.edu/research/projects/transportation-energy-and-climate-analysis>)

<sup>54</sup> G. Franco et al., 2014, “Energy Supply and Use,” Global Change (<http://nca2014.globalchange.gov/report/sectors/energy>)

<sup>55</sup> <https://downloads.globalchange.gov/sap/sap4-5/sap4-5-final-all.pdf>

resulting balance will be highly dependent on the local context (Arent et al, 2014). Technological advances in distributed power generation, smart grids, energy efficient buildings, and alternative energy for transport are expected to improve efficiency and availability, but may result in increased demand. Currently, 1.1 billion people do not have access to a reliable source of power (UNGA, 2016). A growing population require more energy to thrive even if individual products become more energy efficient. Daytime cooling and heating needs are often highest at the same time as industrial demand is highest – and these times of peak demand produce stress on energy grids which increase the risk of system failure.<sup>56</sup>

2.2.18 **Renewable energies are vulnerable to extreme weather events.** Hydropower plants depend on regular rainfall, variability in levels of rainfall reduces their ability to generate power – they can need to be shut down from lack of water, or be overwhelmed by high rains.<sup>57</sup> Wind turbines can be damaged by high wind shear (which happens more with more intense storms); solar photovoltaic (PV) systems can be damaged by high levels of rain or hail – and often depend on the use of scarce water to clean solar panels. Although energy-production technologies are designed to deal with weather patterns which vary within the range of historical norms, extreme weather events are projected to become more common as a result of climate change – often beyond design limits.<sup>58</sup>

2.2.19 **Extreme weather events, can damage or destroy power lines or electricity cables testing the resilience of transmission and distribution system.** Extreme weather can shut down the grid, making business owners and others reliant on diesel generators, which are expensive and inefficient (Enriken and Lordan, 2012). Even without catastrophe, when air temperatures are higher electricity production, transmission and distribution systems become less efficient.<sup>59</sup> Advances in the efficiency of smaller power-production systems where power is produced close to where it is consumed (like solar PV mini-grids or rooftop solar PV), could improve the resilience of transmission and distribution systems. Many towns and villages are installing distributed power generation systems, such as distributed solar photovoltaic (DPV) systems either as a backup to conventional power systems, or as a primary source of power. Combined with battery systems, these are often sufficient to meet basic power needs (e.g. lights and refrigeration), and are an order of magnitude cheaper than connecting remote

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<sup>56</sup> U.S. Environmental Protection Agency (EPA), “Climate Impacts on Energy (Obama Administration Archive)” ([https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy\\_.html](https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy_.html))

<sup>57</sup> B. Plumer, 2013, “How climate change makes it harder to keep the lights on,” Washington Post ([https://www.washingtonpost.com/news/wonk/wp/2013/07/11/heres-how-climate-change-will-make-it-harder-to-keep-the-lights-on/?utm\\_term=.ffc24e5fe8b0](https://www.washingtonpost.com/news/wonk/wp/2013/07/11/heres-how-climate-change-will-make-it-harder-to-keep-the-lights-on/?utm_term=.ffc24e5fe8b0))

<sup>58</sup> U.S. Environmental Protection Agency (EPA), “Understanding the Link Between Climate Change and Extreme Weather (Obama Administration Archive)” ([https://19january2017snapshot.epa.gov/climate-change-science/understanding-link-between-climate-change-and-extreme-weather\\_.html](https://19january2017snapshot.epa.gov/climate-change-science/understanding-link-between-climate-change-and-extreme-weather_.html))

<sup>59</sup> U.S. Environmental Protection Agency (EPA), “Climate Impacts on Energy (Obama Administration Archive)” ([https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy\\_.html](https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy_.html))

villages to central power systems (as the cost of power cables in rural areas is often US\$50,000/km).

2.2.20 **Attractive commercial opportunities for climate resilience investment in the energy sector are on the rise.** Technological innovation, continuing reductions in the price of clean technologies, and increasingly robust policy frameworks as exemplified in the Paris Agreement, continue to open sizeable new potential markets for resilience investments in energy. Renewable energy power plants are expected to account for 72 percent of the US\$10.2 trillion spent on new power generation worldwide through 2040.<sup>60</sup> Solar is already cheaper than coal in the U.S., Germany, and several other countries, and will be so in China, India, Mexico, the U.K., and Brazil by 2021.<sup>61</sup> A recent IFC report suggests that enabling greater private sector investment in climate adaptation and resilience is becoming a priority for governments and business around the world (IFC, 2017). But scale and sustainability has so far proven a major constraint for private sector investment in resilient energy solutions in EMDEs. Table 2.4 provides a market segmentation of investments in energy sector resilience.

**Table 2.4 - Resilience investment themes in the energy sector**

Investment Need	Resilience Implications	Market size and geographies	Potential for commercial returns
<b>Infrastructure</b>			
Centralized and grid-level energy management	<u>Smart grid technologies</u> , including software and hardware, e.g. sensors Improved grid reliability and efficiency.	As of 2013, about US\$15 billion was being invested into the industry per year, with expert forecasting a growth to US\$400 billion by 2020. Brazil, India, and China have been prominent cases. <sup>62</sup>	Yes. Comparable to infrastructure investment where up-front capital investment can result in cost savings and improved customer experience.
	<u>Grid-level storage</u> : Batteries and other storage technologies on the utility side of the meter, usually 100kW - 10MW in size. Improved grid reliability through better integration of intermittent generation and resilience to outages.	Over the next decade, energy storage capacity in developing countries is expected to rise from two gigawatts (GW) today to more than 80 GW. Case studies in Chile and Indonesia (Eller and Gauntlett, 2017). Investment in emerging market energy	Yes. Ratio of cost to storage capacity is has been rapidly falling since 2010. As more renewable energy is deployed, along with the need to keep the lights on for urbanizing/growing populations, market opportunities could emerge.

<sup>60</sup> Bloomberg New Energy Outlook, 2017

<sup>61</sup> Bloomberg New Energy Outlook, 2017

<sup>62</sup> The Atlantic, 2014, "How Smart Grids Could Transform the Developing World" (<http://www.theatlantic.com/sponsored/siemens-2014/how-smart-grids-could-transform-the-developing-world/171/>)

		storage will grow from \$2.5 billion in 2016 to \$23 billion in 2025.	
	<u>Vehicle to grid</u> : to control timing of the charging of electric vehicles (V1G) or to deliver energy or services from EV batteries to the grid (V2G). Improved grid reliability and efficiency.	Global implications as electric vehicles (EVs) anywhere could participate: EV owners could profit from their batteries by utilizing vehicle to grid technology. <sup>63</sup>	Not at present, but potentially. V2G faces significant technological barriers, although Nissan has recently launched a pilot program.
	<u>Watershed management for hydropower</u> : Forest thinning and clearing to improve stream flow and run off for downstream hydropower resources.	Global, but with cases in Lao PDR (Phouangparisak et al., 2005) and Costa Rica (FAO, 2006). This segment will be driven by at least 56 EMDEs' targeting of hydropower, including Sub-Saharan Africa's potential to tap into 350 GW of hydropower capacity in the future (IFC, 2017).	Yes: there is an opportunity to monetize through social impact bonds or similar structure that allows for repayment from hydroelectric utilities. Only applicable to watersheds upstream of hydroelectric resources.
	<u>Energy efficient buildings and innovative building design</u> , e.g. passive cooling, green roofs, etc. Higher temperatures result in increased energy demand, stressing grid reliability and causing brownouts. Reduction in peak energy demand improves grid reliability and reduces energy costs.	Global. Experts expect most opportunities to arise in developed economies. However, EMDEs such as China, Indonesia, Mali, Morocco, and Uruguay hold sizeable potential (UNEP, 2016). There is \$3.4 trillion in green buildings investment opportunities in key emerging markets through 2025 (IFC, 2017)	Yes: There are opportunities for innovative applications of low-cost building materials, innovative lighting and heating. Energy efficiency gains are difficult to monetize without centralized utilities and effective regulatory institutions.
<b>Value Chain</b>			
Decentralized energy services, including higher	<u>Distributed residential generation and storage</u> : These systems are less vulnerable to	The market is estimated at US\$150 billion in 2016-2023. These are	Yes: The market potential is growing as costs of renewables have been

<sup>63</sup> K. Kilday, 2016, "Niche for Electric Vehicles in Developing Countries," Stanford Energy Journal (<https://sej.stanford.edu/niche-electric-vehicles-developing-countries>)

levels of energy access and resilience to outages caused by extreme weather events	catastrophic events than centralized systems. Distributed storage allows for continued energy services when the centralized grid is down.	being deployed as “leapfrog” technologies, allowing countries to install distributed photovoltaic without ever relying on a centralized grid.	falling rapidly. <sup>64</sup> But fossil fuel subsidies for heating and lighting reduce economic competitiveness of renewable home systems. Lack of capital / financing.
	<u>Micro-grids, mini-grids, village grids, and mini-utilities:</u> In addition to the broader contribution of energy access towards economic development, well-designed systems can have better reliability performance than the often unstable national grids in non-OECD countries.	The potential for investment in microgrids is large. Investment in micro- and mini-grids has accelerated, with the global market expected to reach \$200 billion (IFC, 2017). In India alone 240 million people lack access to electricity (IEA, 2015). Other notable markets are Bangladesh, East Africa, Ghana, and Nigeria (IFC, 2017).	Yes: The market potential is growing, but there is a lack of capital / financing. Technical issues and maintenance costs of operating systems. Social issues with community allocation of electricity produced.
Manage increased energy demand resulting from higher temperatures	<u>Demand response</u> , i.e. the ability to turn off or turn down electric loads, whether residential (central AC, water heaters, pool pumps) or commercial (HVAC, industrial equipment). Reduction in peak demand through load shifting.	According to Navigant Research, global DR spending is expected to grow from US\$183.8 million in 2015 to more than US\$1.3 billion in 2024. Opportunities are likely tied in with other energy initiatives, such as smart grid and microgrids.	Potentially in the future. Penetration of enabling technology, such as smart meters and smart appliances, is low but growing.

<sup>64</sup> See Bloomberg New Energy Finance or IEA: <https://www.bloomberg.com/news/articles/2017-09-19/tipping-point-seen-for-clean-energy-as-monster-turbines-arrive>.

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# 3. Agriculture Resilience: In-Depth Analysis

*Among all the economic sectors analyzed in chapter 2, the agriculture sector is the most severely impacted by climate and natural hazards. In EMDEs agriculture accounts for a third of GDP on average, and employs anywhere between 50-90 percent of the population. Smallholder farmers make up about 70-90 percent of the market. Farmers face a variety of difficulties that either keep them in poverty or make it hard to develop, including unproductive soil, plant diseases, drought, floods, pests, lack of access to water, seeds, or fertilizers, and others. By helping to alleviate these issues through acquisition of or innovation in water management, improved seeds, and access to market information, farmers' standard of living can improve, and a significant barrier to sustainable development could be removed. This chapter takes an in-depth look at opportunities for private sector investment in agri-resilience through a refined market segmentation that serves as the basis for the pilot studies presented in later chapters.*

## 3.1 Why focus on agriculture resilience?

3.1.1 **The agriculture sector is greatly exposed to climate change and natural hazards, in many cases increasing stress on already vulnerable and poor agricultural systems.** Crop yield, biodiversity, soil quality, and water use are directly linked to changes in climate. But climate also influences how much land people choose to farm, and the number of crops they plant each growing season.<sup>65</sup> Disasters do not affect all people and sectors in the same way, or to the same extent. A recent study shows that the agriculture sector accounted for 14 percent of the recorded damage and losses associated with 78 disaster events that occurred between 2003 and 2013 in developing countries in Africa, Asia and the Pacific, and Latin America and the Caribbean. The crop and livestock

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<sup>65</sup> A study on Mato Grosso in Brazil, an emerging global breadbasket that supplied 13.6 percent of the world's soybeans in 2016, shows that 1 percent increase in temperature will lead to 9 to 13 percent reduction in soy and corn production. Researchers looked not only at crop yield, but also at year-to-year variation in crop area and double cropping. Temperature in the study area is expected to increase by 2 degrees by midcentury under the range of plausible greenhouse gas emissions scenarios. The study shows that cropping frequency and area can exceed yield response, suggesting that current estimates of future agriculture production response to climate change may be optimistic. <http://www.nature.com/nclimate/journal/v6/n6/full/nclimate2934.html>

subsector accounted for almost three-quarters of these damages and losses. This is particularly striking given the relatively low monetary value of agricultural assets when compared with infrastructure such as housing or roads. If indirect damage and losses are included, the share of the agriculture sector raises to 25 percent. Production losses can reduce agriculture value added or sector growth, with severe consequences for food security and nutrition and for national GDP in countries where the sector is a key driver of economic growth.<sup>66</sup>

3.1.2 **Agricultural production must also meet the need of a growing population and an expanding middle class.** By 2050, the world’s population is projected to increase from 7.3 billion in 2015 to 9.7 billion. Furthermore, 2.5 billion more people are expected to move to urban areas, making metropolitan zones account for two-thirds of the world’s inhabitants – up from half of the population today, which in turn will affect the size of the rural population, reducing labor available in rural areas for growing food and driving the need for investments in increased productivity and resilience. The growing middle class segment of the world’s population (projected to grow to 70 percent by 2050) means that more consumers with greater financial means will drive food, feed, fiber, and fuel demand (GHI, 2015). To face this increase in demand agricultural output must nearly double by 2050.

3.1.3 **Without adaptation measures, agricultural deepening could increase pressure on natural resources and threaten global capacity to produce.** Resilience in agriculture is critical for all stakeholders, farmers, processors, retailers, governments, and consumers even minor changes in growing conditions can have far reaching impacts on agriculture yields. Examples of this fragility include the crop crisis in 2012, and the loss of coffee trees in of Central America in 2013. In this delicate equilibrium, increased stress on water, soil, and forests could accumulate in an unsustainable manner, which could decrease output potential and increase exposure to disaster risks such as extreme temperature and floods. In the context of growing population, a higher-impact and less-resilient agricultural sector would be detrimental for vulnerable communities - especially in EMDEs - that have low capacity and low investment in agricultural resilience (Grebmer et al., 2015). Taking crops as example, Table 3.1 provides an overview of climate-related stressors and their impact.

**Table 3.1 – Effects of climate change: the example of crops**

Stressor	Response
Drought	Drought is expected to limit the productivity of more than half of the earth’s arable land in the next 50 years. Competition for water between urban and agricultural areas will compound the problem.

<sup>66</sup> For example, agriculture value-added growth in Zimbabwe declined by an average of about 18 percent in 2007 and 2008 following a drought. A significant drop in sector growth was also observed after the 2012 drought in Paraguay, with agriculture value-added growth declining by an average of 16 percent in 2012 and 2013 compared with projected growth. On average global sectoral growth was eroded 2.6 percent after each disaster. <http://www.fao.org/3/a-i5128e.pdf>

	There is an urgent need for crop varieties and cropping systems that conserve water and retain yield during periods of water scarcity. To enable the use of brackish or saline water, there is a need to develop salt-tolerant crops or management practices that alleviate salt stress.
Temperature	Temperature and temperature variations influence the growth and development of all crops, shaping potential yield throughout the growing season. Elevated temperature reduces the grain-filling period, shorten the viability of pollen, the weight of grain. Warmer winters mean that pests can survive and affect the next season's yields. Regions specific techniques are necessary to adapt crop and crop systems to the new seasonal variations.
CO <sub>2</sub>	Rising CO <sub>2</sub> levels will likely boost the overall productivity of many crops, although important tropical grasses like maize, sugarcane, and sorghum and some cellulosic biofuel crops don't respond as well to elevated CO <sub>2</sub> levels. Increases in productivity could be offset, though, by pressures such as insect and fungal pests, ozone, and more variable precipitation, although the degree to which this occurs will depend on the physiology and biochemistry of each crop.
Ozone	Crops take ozone into their leaves during photosynthesis, where the gas lowers photosynthetic rates and accelerates leaf death, affecting crop maturity and productivity. Present-day global yield losses due to ozone are estimated at approximately 10 percent for wheat and soybean and 3-5 percent for rice and maize.

Source: *Crops Adaptation to Climate Change*, CSA 2011.

- 3.1.4 **The positive development impact of promoting agricultural resilience is particularly relevant in EMDEs, where the sector accounts for a significant share of employment.** In EMDEs, agriculture employs anywhere between 50-90 percent of the population – and within that group, smallholder farmers make up about 70-90 percent. These farmers face a variety of difficulties that either keep them in poverty or make it hard to develop, including unproductive soil, plant diseases, drought, floods, pests, lack of access to water, seeds, or fertilizers, and others. By helping to alleviate these issues through acquisition of or innovation in water management, improved seeds, and access to market information, farmers' standard of living can improve, and a significant barrier to sustainable development could be removed.<sup>67</sup>

## 3.2 Investing in agri-resilience

- 3.2.1 **Adaptation to climate and natural hazards involves changes in agricultural management practices in response to changes in climate conditions.** The most common agricultural adaptation strategies include the use of drought resistant varieties of crops, crop diversification, changes in cropping pattern and calendar of planting, the conservation of soil moisture through appropriate tillage methods, improvement of irrigation efficiency, and afforestation and agro-forestry. Livestock adaptation strategies

<sup>67</sup> Gates Foundation, 2017, Agricultural development overview, (<https://www.gatesfoundation.org/What-We-Do/Global-Development/Agricultural-Development>)

include (i) diversifying, intensifying and/or integrating pasture management, livestock and crop production; (ii) altering the timing of operations; (iii) conserving nature and ecosystems; (iv) modifying stock routings and distances; (v) introducing mixed livestock farming systems, such as stall-fed systems and pasture grazing. Improving and strengthening human capital through education, outreach programs, extension services at all levels will improve capacity to adapt to climate change impact (McCarthy et al., 2011).

3.2.2 **While the annual financing for agriculture adaptation in EMDEs is estimated at US\$2.5-US\$2.6 billion a year between 2010 and 2050, the needs are estimated to hover around US\$7 billion a year.** This is within the broader US\$83 billion in investment needed per year in the agricultural sector. To build resilience and boost productive capacity, the agricultural sector will need to attract three times the capital it has been able to attract so far. A considerable part of such financing needs is expected to be for buildings, machinery, equipment, farm improvements, and rural infrastructure. Innovative public-private partnerships (PPPs) could play an important role in driving the uptake of upgrades and improvements in technology and infrastructure. Access to these advancements are especially important to improve farming and agribusiness in EMDEs, where agriculture accounts for a third of GDP on average (FAO, 2010).

3.2.3 **Commercially viable agri-resilience investments often require careful design and patient capital.** In a study of the UK's Commonwealth Development Corporation (CDC), only one-third of their agriculture portfolio generated financial returns above 12 percent. The study covered 50 years of agriculture investment by the CDC, mostly in Sub-Saharan Africa and Southeast Asia, many of which in startup ventures/businesses with no track record. Sixty percent of failures were due to a "bad concept" which should have been caught at concept stage. The CDC study revealed that 70 percent of investments in Asia eventually delivered "moderately successful" long-term economic and financial benefits to later investors (Tyler & Dixie, 2013). The size of investment also matters: the International Finance Corporation (IFC) published returns data on more than 300 exits from SME businesses (across all sectors), which indicated that investments above US\$2 million delivered good financial returns and an acceptable level of write-offs – while investments below US\$2 million were generally not profitable and write-offs reached 20 to 30 percent. Furthermore, the widespread perception of agriculture as being a sector that exhibits low profitability, low margins, high actual and perceived risks, and high transaction costs contributes to dampening private sector interest (Sadler et al., 2016). Table 3.2 provides an overview of investment potential and barriers for a variety of activities in the agriculture value chain that are generally considered to improve resilience.

**Table 3.2 – Agri-resilience: investment potential and barriers**

Investment need	Resilience aspect	Market size and location	Potential for commercial return	Notable examples	Barriers to investment
<b>Infrastructure</b>					
<i>Irrigation PPPs</i>	Reduces water losses.	Investment required for adaptation: US\$75-100bn p.a Notable geographies: Peru, Mexico, Brazil, and Argentina.	Yes: but concessionality likely needed.	The West Delta Project in Egypt (Baietti and Abdel-Dayem, 2008).	Irrigation PPPs struggle to deliver short-term, predictable returns. Infrastructure providers are exposed to market and commodity risks. There are also legal issues pertaining to land ownership and regulation on water extraction levels. <sup>68</sup>
<i>Wastewater treatment (for irrigation)</i>	Conservation of freshwater sources.	Some US\$2bn invested, with scope for more.	Yes. In two cases prepared by the Asian Development Bank (ADB), there was a financial internal rate of return of 5% (ADB, 2015).	Notable geographies: Chile, Mexico, and Israel.	Complex given low acceptance of using wastewater in agriculture.
<i>Wastewater treatment (and reuse)</i>	Can treat effluent to a level of purification that enables reuse in agriculture This is particularly important for countries that face droughts or generally suffer from chronically-inadequate water supplies.	Israel, Gulf States, Australia, Brazil “...the industrial water treatment and recycling market is set to grow by over 50% over the next five years, from around US\$7 billion in 2015 to almost US\$11 billion in 2020” (Deloitte, 2016).	Yes, especially in arid/drought-prone geographies. More opportunities exist where off-takers are willing to pay market prices for water. Some innovation potential in monetizing co-benefits, such as electricity generation from waste products.	Israel, for example, reuses 70% of its water. The government of Western Australia committed to achieving 30% wastewater recycling in key cities by 2030 and 60% by 2060.	Adoption of new water technology/innovation can be hampered by roadblocks that delay time to market and increase product development cost. These roadblocks include fragmentation of the water sector across geographies, jurisdictions, and technical standards. <sup>69</sup>

<sup>68</sup> Public-Private Partnership in Infrastructure Resource Center, World Bank Group (<https://ppp.worldbank.org/public-private-partnership/ppp-sector/water-sanitation/ppps-irrigation>)

<sup>69</sup> U.S. Environmental Protection Agency (EPA), 2016, “Clusters: Overcoming Barriers to Water Innovation in the US” ([https://www.epa.gov/sites/production/files/2016-03/documents/overcoming\\_barriers\\_to\\_water\\_innovation\\_in\\_the\\_united\\_states\\_of\\_america.pdf](https://www.epa.gov/sites/production/files/2016-03/documents/overcoming_barriers_to_water_innovation_in_the_united_states_of_america.pdf))

Value Chain					
<i>Rainwater collection</i>	<p>The storage and use of rainfall, diverted from runoff can provide convenient and reliable water supply during seasonal dry periods and droughts.</p> <p>Can reportedly also improve stability of crop yields and raise agricultural productivity (Rockström and Falkenmark, 2015).</p>	<p>Rainwater harvesting is practiced worldwide.</p> <p>In 2014, about 800 million people worldwide lacked access to water. The UN Environment Program said that over two billion people will face water stress issues by 2050.<sup>70</sup></p>	<p>Not now, but some opportunities in roofing materials and storage vessels could emerge in the future.</p>	<p>Notable geographies: Kenya, Ethiopia, Mexico, Tanzania, Israel, and India.</p>	<p>The increase in rainwater collection capacity must be paired with water management and usage instructions. Without adequate technical and advisory support, there is a risk of water contamination from pathogens and animal droppings.<sup>71</sup></p>
<i>Boreholes and tube wells</i>	<p>Use of narrow, screened tube or casing driven into a water-bearing zone of the subsurface.</p> <p>Increases access to groundwater during drought and could also serve as pre-drought mitigation. In many regions, groundwater is the only perennial source of water supply.</p>	<p>While West Africa has developed only 34% of its potential for irrigation, more than 95% of the developed area relies on unreliable surface water (due to the region's high evaporation rate). Therefore, supplementary irrigation may benefit from groundwater.<sup>72</sup></p>	<p>Yes: there are some opportunities when costs are low and engine-driven water pump technology is available.</p>	<p>The Fadama Project in Nigeria, which yielded 40% ERR on tube well investment.<sup>73</sup></p>	<p>Engineering and materials are required, but costs are highly variable depending on location.</p>

<sup>70</sup> Technavio, 2016, "Global Rainwater Harvesting Market 2016-2020" (<https://www.technavio.com/report/global-water-and-waste-management-rainwater-harvesting-market>)

<sup>71</sup> Baguma, D. et al., 2012, "Rainwater and Health in Developing Countries: A Case Study on Uganda," United Nations University (<https://unu.edu/publications/articles/rainwater-and-health-in-developing-countries-a-case-study-on-uganda.html>)

<sup>72</sup> Sonou, M., "Low-cost shallow tube well construction in West Africa," FAO (<http://www.fao.org/docrep/w7314e/w7314e0v.htm>)

<sup>73</sup> Jammeh, S., 2002, "Nigeria: the National Fadama Development Project," World Bank Group (<https://openknowledge.worldbank.org/bitstream/handle/10986/9745/multi0page.pdf?sequence=1&isAllowed=y>)

<p><i>Precision agriculture and monitoring</i></p>	<p>Improves ability to plan/monitor cropping to optimize yields and resource efficiency. High precision data drives decisions for the farm. Key technologies include: 1) automation and robotics; 2) imagery and sensors; and 3) big data and digitization.</p>	<p>Total market size was US\$2 billion in 2013, and is expected to rise to US\$4.5 billion by 2020.</p>	<p>Yes: an attractive and growing area. Opportunity to leverage mobile phone penetration to deliver relevant, localized information.</p>	<p>AgFunder’s BEE platform (Mexico), with US\$8 million invested and seeking US\$7 million for BEE AG TECH and an additional US\$10 million for BEE AG LAND.<sup>74</sup></p> <p>In China, the precision agriculture market mainly focuses on automation of machine control and guidance systems. In 2015, this market stood at US\$67 million. Leading players include UniStrong, Huace, and ComNav Technology and Hi-Target Surveying Instruments.</p>	<p>Precision agriculture is increasingly dependent on new technologies that make use of information technology. Technical assistance and training, plus access to long-term capital, will be important.</p>
<p><i>Crop diversification and new varieties</i>  <i>(under the Crop Management umbrella)</i></p>	<p>Introduction of improved species in response to environmental and market stresses. Enhances resistance to stresses resulting from climate change or disasters, thereby improving soil health and crop yield. Diversification</p>	<p>World seed markets are US\$45 billion. If a low estimate of 20% were at risk, then there could be a market of US\$9 billion for climate tolerant seeds (PWC, 2013).</p>	<p>Yes, but concessionality likely needed, although the market for new seed varieties is growing.</p>	<p>Adapta Sertao’s MAIS (Módulo Agroclimático Inteligente e Sustentável) program in Brazil.<sup>75</sup></p>	<p>Crop management requires enhanced services, technology transfer, and capacity building, which add to costs.</p>

<sup>74</sup> Burwood-Taylor, L., 2016, “BEE: Reimagining the Emerging Market Farm at Infrastructure Scale – exclusive,” Agfunder News (<https://agfundernews.com/bee-reimagining-emerging-market-farm-infrastructure-scale.html>)

<sup>75</sup> Adapta Sertao, MAIS program overview, (<http://www.adaptasertao.net/o-mais>)

	provides resilience to weather or pest losses.				
<i>Biotechnology</i> <i>(under the Crop Management umbrella)</i>	Provides the ability to detect and transfer genes of interest from organisms into the crop of interest, to boost resistance to environmental stresses. Promotes drought tolerance, salinity tolerance, and increased yields.	In 2003, seven million farmers in 18 countries – more than 85 percent of them resource-scarce farmers in developing countries – were planting biotech crops. Almost one third of the total global biotech crop area was grown in developing countries. <sup>76</sup>	Yes: there is a potentially large market for successfully developed seed varieties.  Monsanto’s WEMA project introduced DroughtTEGO hybrid seeds to Sub-Saharan Africa, allowing farmers to harvest 20 to 35 percent more grain under moderate drought conditions as compared to previously-used seeds. This positively impacted the lives of approximately 250,000 farming families. <sup>77</sup>	Herbicide-tolerant soybean was the dominant transgenic crop in 2003, grown commercially in seven countries including Argentina, Mexico, and South Africa. <sup>78</sup>	High development costs. Significant regulatory hurdles for efficacy, food safety. Intellectual property rights provide limited protections to justify up-front expenditures.
<i>Ecological Pest Management (EPM)</i> <i>(under Crop Management umbrella)</i>	Controlling pests by promoting natural enemies of pests, either directly or through crop selection or management. Promotes a healthier ecosystem that decreases crop vulnerability to pests.	The global market for pesticides is US\$45 billion. The overuse of pesticides is a problem that EPM tries to address (plus other resilience aspects). 10-20 million farmers have graduated from a program that promotes EPM, including Bangladesh, India, Vietnam, Indonesia,	Not now, but could lower production costs through decreased pesticide use in the future.	In West Africa, the introduction of the wasp was a successful control of the slug of cassava, saving more of the staple food crop for consumption (Clements et al., 2011).	Lack of studies, cosmetic damage, lack of policy, lack of understanding of benefits, and vested interests from pesticide industry act as constraints.

<sup>76</sup> US Agency for International Development (USAID), Agricultural Biotechnology Brief, ([http://absp2.cornell.edu/resources/briefs/documents/warp\\_briefs\\_eng\\_scr.pdf](http://absp2.cornell.edu/resources/briefs/documents/warp_briefs_eng_scr.pdf))

<sup>77</sup> Monsanto, “Water Efficient Maize for Africa (WEMA)” (<https://monsanto.com/company/outreach/water-efficient-maize-africa/>)

<sup>78</sup> US Agency for International Development (USAID), Agricultural Biotechnology Brief, ([http://absp2.cornell.edu/resources/briefs/documents/warp\\_briefs\\_eng\\_scr.pdf](http://absp2.cornell.edu/resources/briefs/documents/warp_briefs_eng_scr.pdf))

		and the Philippines (Pretty and Bharucha, 2015).			
<i>Grain Storage</i>  <i>(under Crop Management umbrella)</i>	Reduce food loss by controlling storage conditions: temperature, moisture, light, pests, and hygiene. Promotes preparation for poor harvest in the event of drought or weather-induced crop loss.	Practiced globally, but while storage is sophisticated in developed countries, smallholders in developing countries face trade-offs and thus have scope for deepening. <sup>79</sup>	Yes, there is an opportunity to optimize value chains by improving storage and transportation from grower to markets.	In the northern region of Afghanistan, farmers stored crops in plastic and fiber bags, which offered limited protection and contributed to post-harvest losses. After switching to metallic silos, storage loss was reduced from 10-20% to 1-2% (Clements et al., 2011).	Some commodities are typically sold immediately to pay expenses (depending on the market), so commercial prospects for grain storage will depend on the type of cultivar and local/regional market trends. <sup>80</sup>
<i>Slow-Forming Terraces</i>  <i>(under Soil Management umbrella)</i>	A levelled surface constructed from infiltration ditches, hedgerows, and earth or stone walls. Promotes water retention in soil, prevents soil erosion, and maintains soil fertility – can boost crop productivity.	Practiced globally, particularly in East and Southeast Asia, Oceania, parts of Africa, and in the Andes of South America (particularly Peru). <sup>81</sup>	Yes, but the return on investment through increased production is in the longer term (10 years).	Research conducted in Peru found slow-forming terraces had improved productivity of peas, maize, fava beans, and potatoes. In this case, the slow-forming terraces enhanced water retention, which benefitted the crops (Clements et al., 2011).	Constrained by a lack of access to credit and short planning horizons.
<i>Conservation Tillage</i>  <i>(under the Soil Management umbrella)</i>	Techniques to prepare the soil by mechanical, animal, or human-powered agitation – both small and large scale.	Conservation tillage was successful in Brazil and Argentina, both of which had 45-60% of all agricultural land under	Yes, and it enhances production margins by reducing labor inputs by about 50%.	Brazil and Argentina.	Constrained by a lack of capacity and local equipment.

<sup>79</sup> Food and Agriculture Organization (FAO), "Who stores and why?" ([http://www.fao.org/docrep/t1838e/T1838E04.HTM#Who stores and why](http://www.fao.org/docrep/t1838e/T1838E04.HTM#Who%20stores%20and%20why))

<sup>80</sup> Food and Agriculture Organization (FAO), "Who stores and why?" ([http://www.fao.org/docrep/t1838e/T1838E04.HTM#Who stores and why](http://www.fao.org/docrep/t1838e/T1838E04.HTM#Who%20stores%20and%20why))

<sup>81</sup> Encyclopedia Britannica, "Terrace Cultivation" (<https://www.britannica.com/topic/terrace-cultivation>)

	Reduces the risk from droughts and floods (enhances moisture retention), and reduces soil erosion.	the practice (as of 2005). <sup>82</sup>			
<i>Integrated Nutrient Management</i>  <i>(under the Soil Management umbrella)</i>	Integrate natural and man-made soil nutrients to increase crop productivity and preserve soil productivity, focusing on a cropping system. Can reduce susceptibility to pests, better access to deep water. Reduces drought risk and increases tolerance to salinity and cold conditions	Organic fertilizers in Mozambique, Malawi, and Ghana provided low-cost technology for improving soil fertility (as long as they were produced and used within a close distance). <sup>83</sup>	Yes, with opportunities in the market for fertilizers.	Myanma Awba, an IFC investee, sells organic and inorganic fertilizers, and provides services that advise on soil health management.	Insufficient credit and infrastructure are constraints.
<i>Livestock Production Adjustments</i>  <i>(under the Livestock Adaptation umbrella)</i>	Changes in livestock practices that promote resilience to climate extremes. Practices include: diversification of livestock; altering operation timing; modifying stock distances; and introduce mixed livestock farming systems (such as stall-fed systems and pasture grazing	Global	Yes, although concessionarity is likely needed: services that provide technical assistance to those who manage livestock could be a route to commercially-viable activity that contributes to resilience. There are some opportunities in supplying livestock farming system equipment.	Pastoralists in the Sahel region of Africa used emergency fodder during droughts, used a multi-species composition of herds, and culled weak livestock for food during periods of drought.  Changing from cattle to sheep and goat, husbandry, for example, was	Will require training on using new methods and systems, which increases costs.

<sup>82</sup> A. Garg et al., "Conservation Tillage," Climate Tech Wiki (<http://www.climatetechwiki.org/technology/conservation-tillage>)

<sup>83</sup> A. Quezada et al., "Integrated Nutrient Management," Climate Tech Wiki (<http://www.climatetechwiki.org/content/integrated-nutrient-management>)

				beneficial during droughts since the latter had lower feed requirements (427 Report, 2017). <sup>84</sup>	
<i>Breeding Strategy</i>  <i>(under the Livestock Adaptation umbrella)</i>	Adaptation strategies to address the tolerance of livestock to heat, and their ability to survive, grow, and reproduce in adverse conditions.	Global	Not now, and concessionality is reportedly necessary: many local breeds are already adapted to harsh living conditions, but some developing countries lack livestock breeding technology that help adaptation.	In the Sahel region of Africa, pastoralists cross-breed livestock to improve local genetics with heat and disease-tolerant breeds (427 Report, 2017). <sup>85</sup>	High costs and variable conception rates make continuous public sector support necessary, implying a poor private good (de Haan, 2001).
<i>Livestock Management Systems</i>  <i>(under the Livestock Adaptation umbrella)</i>	Efficient and affordable adaptation practices will be necessary for livestock adaptation.  Practices include: provision of shade and water; changes in herd composition; localized irrigation for drinking water; and infrastructure to harvest rainwater.	Global	Yes: services that provide support and/or technical assistance to those who manage livestock might be a viable route towards commercially-viable activity that contributes to resilience.	The WBG's Henan Ecological Livestock Project (China, 2010-2015) achieved its objective of improving environmental health management practices on targeted livestock enterprises in the project area, with the following efficacy rating: substantial. <sup>86</sup>	Capacity constraints in areas such as procurement management and technical advisory services could derail a livestock management project (see footnote for WBG Zambia initiative). This will require attention in any future case. <sup>87</sup>
<i>Agroforestry</i>	Reduce deforestation; protect yields from adverse weather.	Nascent, but with large potential in forested regions.	Yes, although nascent -- with the added benefit of increasing crop yields and wood sales.	The FAO field project in Vietnam: Market-Oriented Agro-Forestry to Reduce	Limited awareness of the advantages of agroforestry, delayed ROI (occurring only after a number of years), and lack of capital can inhibit

<sup>84</sup> 527 Report

<sup>85</sup> 527 Report

<sup>86</sup> World Bank, 2010, "Henan Ecological Livestock Project" (<http://projects.worldbank.org/P100455/henan-ecological-livestock-project?lang=en&tab=overview>)

<sup>87</sup> World Bank, 2012, "Zambia: Livestock Development and Animal Health Project" (<http://projects.worldbank.org/P122123/zambia-livestock-development-animal-health-project?lang=en&tab=overview>)

		Other notable geographies: Brazil and Colombia. <sup>88</sup>		Poverty in Quang Nam Province (FAO, 2011). The first phase of the project achieved higher incomes from the sale of agroforestry products.	agroforestry success and will require solutions beforehand. <sup>89</sup>
<i>Crop Insurance</i>	Provides income during bad weather.	According to a WBG report (2009), direct premiums written for this type of insurance rose from US\$8 billion in 2005 to about US\$18.5 billion in 2008. Although 62% of that was in the U.S. and Canada, there is scope for growth in developing countries (Iturrioz, 2009). As of 2010, agricultural crop insurance was available in over 100 countries (Mahul and Stutley, 2010).	Commercial returns are unlikely in the short term, absent concessionality.	Blue Marble Consortium is a for-profit enterprise that provides insurance protection to the underserved. <sup>90</sup>  Nine million farmers had weather index insurance in India in 2010-2011, with a total premium value of US\$258 million (PWC, 2013).	The market is nascent in developing countries – particularly in low-income frontier markets. Exceptions may exist, such as India and China where agricultural insurance penetration is high (promoted by government subsidies) and accounts for most of the US\$5 billion crop insurance premiums in developing countries.
<i>Agricultural loans focused on resilience</i>	Long-term loans for CAPEX; short-term loans for seeds.	Of the US\$391 billion in global climate finance (2014), just US\$6-US\$8 billion were invested in agriculture, and about US\$3 billion of that was directed to	Yes: the Agri-finance market has scope for a deeper resilience focus. <sup>91</sup>	The Agriculture Finance Support Facility (AgriFin) has a component for resilient agriculture. Accion’s investment in Apollo Agriculture aims to finance access	Difficult to separate the resilience component from normal agriculture investment.

<sup>88</sup> A. Wachira, 2016, “Restoration through agroforestry in Brazil” (<http://blog.worldagroforestry.org/index.php/2016/07/22/restoration-through-agroforestry-in-brazil/>)

<sup>89</sup> Food and Agriculture Organization (FAO), 2015, “Main challenges for agroforestry” (<http://www.fao.org/forestry/agroforestry/90001/en/>)

<sup>90</sup> Blue Marble Microinsurance, Home Page (<http://bluemarblemicro.com/>)

<sup>91</sup> World Bank, 2015, “Agriculture Finance (brief)” (<http://www.worldbank.org/en/topic/financialsector/brief/agriculture-finance>)

		adaptation (Sadler et al., 2016).		to fertilizer and seeds. <sup>92</sup>	
<i>Urban Agriculture</i>	Reduced reliance on good weather and scarce land for food production.	800m urban people produce 15-20% of world's food.  In four case studies analyzed by a WBG report, the diversification of food sources increased the stability of household food consumption against disturbances in food supply due to climate change and other factors (World Bank, 2013).	Yes: with opportunities in early stage ventures (from seed stage to series A).	Sky Greens in Singapore: a hydraulic-driven vertical farm. <sup>93</sup>	Lack of access to safe water for irrigation, capital/credit, and training constrain success in urban agriculture.
<i>Market Access and Transportation</i>	Increases sales and decreases search/transaction costs.	Online grocery sales approximately US\$48 billion worldwide.  Access to efficient transport logistics as part of modern supply chains has been found to increase farmer income by 10 to 100% (World Bank, 2017).	Yes, with strong and growing interest among commercial investors.	China: 46 percent of Chinese respondents say they use an online grocery service (Nielsen, 2015).	Will rely on access to reliable transport infrastructure and vehicles.
<i>Food Processing</i>	Increases food safety; reduces environmental impact of agriculture.	Of US\$4.6bn invested in 2015; 6.8 percent invested here (US\$312 million). <sup>94</sup>	Not now: in the short-term, there appear to be few opportunities, except	East Bali Cashews enables farmers to earn more from value-added products, which are then packaged and	Difficult to separate resilience aspect from marketing opportunities in low-carbon ventures.

<sup>92</sup> Accion, "Venture Lab Portfolio" (<https://www.accion.org/content/venture-lab-portfolio>)

<sup>93</sup> Skygreens, "About Sky Greens" (<https://www.skygreens.com/about-skygreens/>)

<sup>94</sup> AgFunder, 2016, "AgTech Investing Report: Year in Review 2015" (<https://research01.agfunder.com/2015/AgFunder-AgTech-Investing-Report-2015.pdf>)

			in middle-income countries for shelf life.	sold, rather than processed elsewhere. The company earned US\$1 million in revenues in 2014 and was backed by KKR. <sup>95</sup>	
<i>Food Engineering and Sustainable Protein</i>	Improvement in quality and density of nutrients in food.	Of US\$4.6bn invested in 2015; 5.9% invested here (US\$270m).	Yes: there are opportunities for investment, especially in the SME space.	Plumpy'Nut, a paste used to boost calorie consumption in at-risk parts of Africa and India. Earned US\$132 million in revenues in 2016 and has a franchise system with production centers in Africa and Asia. <sup>96</sup>	Different geographies will have different priorities (boosting calories vs. addressing deficits in certain vitamins or minerals). Furthermore, the food engineering field can be highly technical, although social responsibility is becoming a factor. <sup>97</sup>
<i>Agricultural Waste Use</i>	Self-made fertilizer can offer new revenue streams, and/or can lower costs.	Fertilizer market is US\$185 billion.	Yes, subject to commodity prices. There could be opportunities in technical support and equipment sales.	Brazil: produces large amounts of agricultural waste and residues, which could be transformed into other products (Forster-Carneiro et al., 2013).	Commercial success will depend on the ability to transport the product, and on commodity prices.
<i>Bioenergy 1: Biofuels</i>	Limited impact on resilience: can only be considered when not impacting the value chain/competing for inputs	US\$98 billion in 2013, growing to US\$178 billion (2022).	Yes: although it will depend on the market for inputs.	Limited cases that are applicable to resilience, except cases in Brazil.	Must take care to not negatively impact the agricultural value chain by taking away inputs for crop or livestock production.
<i>Bioenergy 2: Biomass Power</i>	Reduces power needs for farmers while saving	370 TWh in 2012; estimated growth to 600 TWh by 2020.	Yes: although successful investment will require secure, long-term, low-	Notable example is using bagasse from sugarcane to generate	Care must be taken that the inputs are waste from

<sup>95</sup> A. Budisatrijo, 2014, "Bali cashew factory changes villagers' fortunes," BBC (<http://www.bbc.com/news/business-29751792>)

<sup>96</sup> C. Purdy, 2017, "The story behind Plumpy'Nut, the "Nutella for the poor" used to fight famine and malnutrition," Quartz (<https://qz.com/945314/the-story-behind-plumpynut-the-nutella-for-the-poor-used-to-fight-famine-and-malnutrition/>)

<sup>97</sup> S. Saguy, 2016, "Challenges and opportunities in food engineering (Highlights)," ScienceDirect (<http://www.sciencedirect.com/science/article/pii/S0260877415003118>)

	costs and insulating the chain.		cost fuel supply to ensure a return.	power, which has provided benefits to investors (Dantas et al., 2013). <sup>98</sup>	agriculture, and not from cleared forests.
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Source: Authors.

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<sup>98</sup> Renewable Energy World, 2013, "Tapping Brazilian 'Bagasse' for Electricity Production" (<http://www.renewableenergyworld.com/articles/2013/07/tapping-brazilian-bagasse-for-electricity-production.html>)

### 3.3 Choice of pilot investment

To assess the potential for attracting private capital to agri-resilience, two investment themes have been selected for in-depth analysis:

**3.3.1 Promoting infrastructure investment for drought-resilient agriculture.** Water scarcity has a negative impact on agriculture, including drop in crop yields and production in areas relying on precipitations and rain fed irrigation.

- *The relationship between water scarcity and agriculture is particularly important, as 84 percent of the damage and losses caused by droughts is to the agriculture sector. (FAO, 2015). Although water scarcity is a global concern, about 90 percent of production losses in sub-Saharan Africa were linked to droughts between 2003 and 2013. Since the sector in sub-Saharan Africa on average contributes to a quarter of GDP (rising to a half when agribusiness is included), droughts have a clear knock on effect on the economy. FAO (2015) found that between 1991 and 2013 Sub-Saharan African countries lost an average of 3.5 percent of agriculture value-added growth after each drought – a figure that is likely to be more acute at the subnational level. Other regions affected by drought are Latin America (30 percent), the Far East (50 percent) and Asia (10 percent).*
- *Irrigated agriculture represents 20 percent of the total cultivated land, but contributes 40 percent of the total food produced worldwide. Over 324 million hectares have irrigation equipment worldwide, but only 85 percent of such land is irrigated. About 42 percent of the irrigated land in the world is in only two countries: China and India - both affected by poor water use efficiency (FAO, 2014)). Without the high productivity permitted by irrigation, at least an additional 500 million ha would be needed to reach the current agricultural production.*
- *Temperate or humid areas allowing rainfed production are often already densely populated or environmentally disturbed, therefore having no additional land for agriculture available anymore. Currently, countries reaching their limit of cultivated areas already buy or rent large areas in other less intensely developed countries, also known as land grabbing.*
- *The global investment requirement in irrigation through 2050 is estimated to be US\$960 billion. To date, the vast majority of irrigation projects have been financed by the public sector. Attracting institutional investors and the private sector to irrigation projects is therefore a resilience priority. Chapter 5 discusses a private-public approach to irrigation projects, and proposes a possible way forward.*

**3.3.2 Promoting climate resilience investment in agriculture value chains.** Agriculture value chain refers to the full range of goods and services that link the farmers and the

end customers or consumers (Table 3.2). Each link of the chain has specific resilience challenges.

3.3.3 **The agriculture sector and its resilience to climate and natural hazards are context specific.** The agriculture sector is greatly affected by the policy environment, natural endowments (such as arable land, water resources, soil fertility), climate and natural hazards (such as the type of climate, the frequency and type of natural disasters), local traditions and practice (such as social awareness, technologies and local practice), institutional framework (such as the depth of local financial markets, land titles, and regulation), and so on. Any meaningful effort to identify ways to attract private capital to agri-resilience must content with this fact.

3.3.4 **This report focuses on Asia as a pilot region to identify potential ways to promote private sector investment in agriculture value chain resilience.** This region was chosen for the following reasons, which are further discussed in Chapter 6:

- Asia faces a wide array of climate and natural hazards, including increasing temperature extremes, drought, and floods;
- The agriculture sector generates a large share of the global value added. In 2014 agriculture value added in Asia accounted for US\$1.3 trillion, nearly half of the global agricultural value added;
- The sector employs 600 million people, which corresponds to 30 percent of the entire workforce;
- The region is a crucial part of the global food chain. As of 2016, the region was responsible for 19 percent of global food and agriculture exports, and 31 percent of total food and agriculture imports;
- Regional demand for food and feed crop is expected to almost double over the next 50 years because rising population and average income, adding further stress to land and resource use;
- Economic growth and increasing demand for agriculture products has historically resulted in over-cultivation, over-grazing, and deforestation, leading to environmental degradation (like reduced fertility, fertilizers pollution, erosion);
- Lack of knowledge and awareness, low affordability of advanced practices and technologies, and poor enabling environment (like the pervasive presence of the government as investment actor, the widespread use of price control and subsidies, land tenure issues and land fragmentation, and shallow financial markets), act as barrier to private sector investment in agri-resilience; and
- The agriculture sector in Asia is less efficient compared to other regions. The clear majority of SMEs and state owned companies in Asia use traditional farming

methods, suggesting that the potential exists for fast tracking adaptation investments.

3.3.5 **Three pilot countries were selected for detailed analysis.** Pilot countries were selected to cover an array of economic contexts:

- **China** is a large emerging economy that may present opportunities for investment in climate-resilient technologies. The country is going through a demographic transformation: the increase in the middle to high income portion of the population is affecting consumption patterns in the agriculture sector, steadily moving away from basic consumption to specialty products and higher quality standards. Meeting this growing and more sophisticated demand for food poses special challenges, particularly given the fragmentation of agriculture production, land degradation due to over-cultivation, over-grazing and deforestation, and severe water stress. To address these challenges, three potential investment themes are discussed in this report: i) sustainable production of animal protein; ii) water-saving irrigation; and iii) precision agriculture.
- **Myanmar** is a fragile, limited capacity economy that only recently emerged from isolation. Myanmar agricultural production is characterized by a preponderance of smallholder farmers growing staple crops, low levels of mechanization and fertilizer usage, scarce infrastructure, and lack of access to capital. However, its proximity to the major emerging food markets of China and India gives the country a distinct competitive advantage for doing business. The challenge ahead is to leverage abundant natural resources and favorable geographic position with limited capital resources and scarce capacity. Two potential investment themes were investigated: i) quality of and access to resilient agriculture inputs and fertilizer; and ii) access to agriculture finance.
- **Vietnam** is a medium-sized country in the lower-middle income group. Vietnam's society is in transition, with a growing part of the population moving to the cities, the expansion of its middle class, the reduction in agricultural labor, and related socio-economic changes. Much of Vietnam's past agricultural growth is due to expanded or more intensive use of land and fertilizer. This has come at a cost to the environment, including land degradation and reduced competitiveness and efficiency. The challenge ahead is to produce more from less, that is the agriculture sector will need to create more economic value (farmer and consumer welfare) and use less natural, human, and other resources. In line with these challenges, three potential investment themes are explored: i) sustainable production with higher productivity (including crops and animal protein); ii) resilient forestry and agriculture inputs against floods and droughts; and iii) sustainable logistics and transport for agriculture.

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# 4 Agriculture Resilience Investors and Investment Tools

*The agriculture sector in EMDEs is typically dominated by SMEs. This fragmented structure presents a challenge for scaling up resilience investment. However, increasing concern over the effects of climate change are driving more and more investors and raising the aggregate amount of capital available for adaptation-focused investments. This chapter examines the universe of existing and potential private sector investors in agri-resilience, as well as the broader investment tools used in climate mitigation and adaptation finance that may be relevant to agri-resilience.*

## 4.1 Overview of investors' landscape

- 4.1.1 **Investments in resilience and adaptation in agriculture have traditionally been made by farm owner/operators as part of their risk management strategy.** Resilience investment in agriculture is as old as agriculture. Farmers make investments in capital goods, technologies, and new farming techniques to improve production efficiency in the face of scarce natural resources, and to reduce volatility associated with the unpredictable effects of weather and climate. Traditionally such resilience investments are made at the firm (corporate or SME) level.
- 4.1.2 **Particularly in EMDEs private sector investment in agriculture resilience is hindered by several factors.** Resilience investments in agriculture are a form of risk management. Private sector actors may not be aware of the nature or magnitude of the risks climate change poses to their business operations, nor of tools that may be available to mitigate those risks. Even if actors are aware of risks and opportunities, resilience activities often involve higher up-front capital expenditures, which are burdensome for SMEs. The benefits of resilience investments often accrue over a long time. High discount rates to future returns may discourage such investments in favor of a short-term investment mindset. Resilience investments are often cost-saving in nature. Behavioral research shows that private sector actors tend to prefer activities that generate revenue over those that reduce costs (Ward and Caldwell, 2016).
- 4.1.3 **Agriculture has recently been recognized by the broader institutional investor community as a discrete asset class. This has increased capital flows to the sector.** Agriculture assets began to gain in popularity among institutional investors following

the spike in commodity prices during the early 2000s, and again following the global financial crisis when the low interest rate environment caused investors to explore new asset classes in search of additional sources of return. Still, most institutional investors consider agriculture as a sub-category of existing asset classes, either real assets (37 percent of investors), natural resources (16 percent), or private equity (16 percent), while only 6 percent have a separate allocation to agriculture/farmland.<sup>99</sup>

**4.1.4 Institutional investors are increasingly adopting environmental, social, and governance (“ESG”) factors into their capital allocation decisions.** But the impact of ESGs on resilience investment in EMDE has yet to be seen. Corporate or SMEs operating in agriculture traditionally factor resilience considerations in their capital allocation decisions. As institutional investors enter the agriculture space, they introduce ESG factors into the funds and companies into which they invest. The Farmland Principles, a set of responsible investment principles developed by a group of European stakeholders, and signed by several large asset managers and asset allocators, are an example of this trend (Valoral Advisors, 2015).<sup>100</sup> On the policy side, the UN Global Compact food & agriculture business principles, launched in 2014, establish the attributes of well-functioning and sustainable global food & agriculture systems, and articulate a common understanding of the resources, ecosystem services and socio-economic impacts needed to build resilience into these systems and the markets that they serve. The six principles are designed to complement existing initiatives that advance sustainability in food & agriculture, and serve as an umbrella over voluntary standards and technical compliance platforms (Valoral Advisors, 2015).<sup>101</sup> However, not all institutional investors have agreed to incorporate ESG standards, the standards themselves are not consistent, and they do not necessarily lead to targeted resilience activities. Furthermore, the current signatories have relative few holdings in EMDEs (except for a few relatively well-developed markets in Latin America). For example, TIAA-CREF is a major farmland asset holder, but almost all its farm acreage is in Brazil, Australia, and the United States (TIAA-CREF, 2014; TIAA-CREF, 2016).

**4.1.5 Very few publicly funded resilience initiatives focus exclusively on agriculture.** Annex 1.A provides an overview of publicly financed initiatives and impact

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<sup>99</sup> Preqin Special Report: Agriculture, 2016 (<https://www.preqin.com/docs/reports/Preqin-Special-Report-Agriculture-September-2016.pdf>).

<sup>100</sup> The signatories to these principles include AAG Investment Management (Australia), ABP (Netherlands), Adveq Management (Switzerland), AP1 (Sweden), AP2 (Sweden), APG (Netherlands), Aquila Capital Green (Germany), Insight (UK), PFZW (Netherlands), PGGM (Netherlands), Rabo Farm (Netherlands), Southern Pastures Management (New Zealand), TIAA-CREF (US), Treetops Capital (US), UFF Asset Management (South Africa) and Valiance Advisors (UK).

<sup>101</sup> The six principles are a response to the outcome from the Rio+20 conference and are as follows: 1) Aim for Food Security, Health and Nutrition; 2) Be Environmentally Responsible; 3) Ensure Economic Viability and Share Value; 4) Respect Human Rights, Create Decent Work and Help Communities to Thrive; 5) Encourage Good Governance and Accountability; 6) Promote Access and Transfer of Knowledge, Skills and Technology.

investment funds. One of the most notable is the IFAD Adaptation for Smallholder Agriculture Programme (ASAP), the largest global financing source dedicated to supporting the adaptation of poor smallholder farms to climate change, with committed funding of US\$301.5 million.<sup>102</sup>

**4.1.6 Historically, these initiatives have not effectively “crowded-in” private sector investment in resilience.** These programs have made progress in helping governments to develop policy and regulatory frameworks for resilience, but (except for the insurance sector) have not been able to engage private sector capital in a meaningful and lasting way (PWC, 2013). A 2017 study of agricultural adaptation projects in Sub-Saharan Africa reviewed 39 projects in agriculture by five international climate funds and Rwanda’s Green Fund that sought to incorporate private actors. It found that only two funds had explicit strategies for working with private sector actors, and observed limited evidence of projects using public adaptation finance to leverage private investment in agriculture projects.<sup>103</sup> The Global Agriculture & Food Security Program (GAFSP) is actively promoting IFC’s newly announced Private Sector Window (PSW) to “crowd-in” private sector investment funding.<sup>104</sup> It is too soon to assess the impact of the PSW in this regard.

**4.1.7 Resilience – in agriculture or otherwise – is not considered an asset class.** This has significant implications both for mapping prior capital flows as well as for fundraising. Most agriculture investors do not conceive of resilience or adaptation as a coherent theme toward which capital can be deployed. Investors who hold real or corporate agricultural assets may encourage their portfolio companies to invest in resilience/adaptation as part of their strategy to enhance the value of these assets. However, such decisions are made at the portfolio or operating company level, not at the fund level. Operators do not typically measure or report the value generated by resilience investment, nor do investors. Furthermore, as resilience is not an asset class that is widely recognized by the investor community – and as data demonstrating the value proposition to resilience is not typically collected or measured – fund sponsors are reluctant to market funds that focus on resilience.

**4.1.8 Agriculture investors remain a large untapped source of potential capital for resilience over the near-to-medium term.** With increasing concern over the effects of climate change the number of investors and the aggregate amount of capital available for adaptation-focused investments is expected to increase. Still, this capital base is

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<sup>102</sup> IFAD, Adaptation for Smallholder Agriculture Programme (ASAP) overview (<https://www.ifad.org/topic/asap/overview>).

<sup>103</sup> N. Canales, 2017, “What roles could private actors play in agricultural adaptation in sub-Saharan Africa? Insights from publicly funded projects,” Stockholm Environment Institute (<https://www.sei-international.org/mediamanager/documents/Publications/SEI-2017-DB-adaptation-agriculture-private-sector.pdf>)

<sup>104</sup> Global Agriculture & Food Security Program (GAFSP), The Private Sector Window, (<http://www.gafspfund.org/content/private-sector-window>)

small in comparison to the amount of capital available for agriculture investments in general. In 2015, an estimated US\$1.5 billion in adaptation finance from public sources was directed to the entire private sector. Assuming that 13 percent of this total was directed toward agriculture, this would equate to US\$195 million. By comparison, an estimated US\$45 billion of investment capital was directed specifically at the agriculture sector (Ward and Caldwell, 2016; Valoral Advisors, 2015). If only a small portion of this private capital could be channeled toward adaptation activities, the amount mobilized is likely to be much greater than that of adaptation finance from public sources. This could achieve an impact far greater than that of the adaptation finance.

## 4.2 Agriculture Sector Investment Landscape: Participants and Performance

4.2.1 **A variety of private sector market participants are active in agriculture sector investment.** These participants differ in their investment style, time horizon, return expectations, and volatility tolerance. Figure 4.1 below describes various categories of market participants. It should be noted that these categories are broadly construed, and that variations will exist even within each category depending on the investor’s strategy, size, geography of focus, etc.

**Figure 4.1 – Private Sector Agriculture Investor Typology**

Agriculture Investor Type	Style	IRR Expectations	Time/Liquidity Horizon	Short-Term Volatility Tolerance	Investment Target			Potential Uses for Agri-resilience Financing
					Real Asset	Corporate Asset	Product Derivative	
<b>Pension/Sovereign Wealth</b>	Primarily indirect via funds, although increasingly in-house/direct	~7%	Long-term	Low	yes	yes	yes	Co-investment capital First-loss capital Guarantees Discounted debt
<b>Operators (Corporate/SME)</b>	Direct (M&A, Capex)	Variable	Variable	Medium	yes	yes	yes	Co-investment capital Guarantees Discounted debt
<b>Commercial Banks</b>	Direct	Variable	Variable	Low	yes	yes	yes	Guarantees First-loss Capital
<b>Private Equity</b>	<b>Infrastructure</b>	Direct	10-15 years	Medium	yes	no	no	Co-investment capital LP Subscription First-loss capital Guarantees Discounted debt
	<b>Real Estate</b>	Direct	7-10 years	Medium	yes	no	no	Co-investment capital LP Subscription First-loss capital

									Guarantees Discounted debt
<b>Growth</b>	Direct	20-30%	5-7 years	Medium	no	yes	no	Co-investment capital LP Subscription First-loss capital Guarantees Discounted debt	
<b>Venture Capital</b>	Direct	20-30%	8-10 years	High	no	yes	no	Co-investment capital LP Subscription First-loss capital Guarantees Discounted debt	
<b>Impact</b>	Direct and Indirect	Variable	Variable	High	yes	yes	no	Co-investment capital LP Subscription First-loss capital Guarantees Discounted debt	
<b>Hedge Fund</b>	Direct	n/a	Short	High	no	no	no	LP Subscription First-loss capital Guarantees Discounted debt	

Source: authors' research

4.2.2 **Hedge funds are the least relevant investor class for resilience in the EMDE agriculture sector.** Hedge funds typically focus on short- and medium-term trades in liquid securities (such as listed equities). Consequently, they are not well positioned to influence the implementation of adaptive techniques, capital goods, or technology in EMDEs.

4.2.3 **Pension/Sovereign Wealth (PSW) investors are active in the agriculture space. But their ability to support adaptation activities in EMDEs is primarily indirect.** PSW investors manage large pools of permanent capital. They seek to preserve adequate capital to meet the distribution needs of their beneficiaries (pension holders, governments, endowments, etc.) in perpetuity. To manage risk they seek broad diversification of their portfolios across different asset classes and investment strategies. These investors usually invest indirectly via financial intermediaries such as fund managers, although in recent years pension funds have begun to conduct more investment activities in-house. As such, PSW investors are not usually in a position to directly augment resilience investment. However, as the primary “buyers” of investment funds, they wield significant influence over which investment products the market of asset managers supplies. A notable example occurred in 2009, when a group of large capital allocators, including the influential California Public Employees Retirement System (CalPERS), publicly criticized the high fees charged by hedge

funds, resulting in a large number of funds reducing fees.<sup>105</sup> , PFZW, the second largest pension fund in the Netherlands have set targets for investments in sustainable solutions in the climate and food domains, both in developed and emerging markets.<sup>106</sup>

**4.2.4 While large operators may not be appropriate recipients for development finance, they can provide deal flow and strategic guidance due to their market presence and knowledge.** Large multinational companies operating in the agriculture space can be useful partners for agricultural resilience investments targeting EMDEs. These entities have extensive presence and operations in EMDEs and have a detailed understanding of the various opportunities and obstacles in the markets. These firms are concerned with the impact of climate change on their business operations, and their interests are aligned with investors seeking to address this space. For example, Mars Incorporated has an extensive research and development division that addresses topics of global relevance such as food security and climate change. The firm has partnered with IBM to found the Consortium for Sequencing the Food Supply Chain, as well as with the FAO to address food safety and quality in developing countries, including with respect to mycotoxin contamination.<sup>107</sup> Heineken partnered with the IFC in Rwanda to test low-cost irrigation systems, such as foot or solar pumps.<sup>108</sup> The company owns various breweries in Africa that depend on local farmers for input. Hence, investing in agri-resilience is part of Heineken business model.

**4.2.5 Private equity (PE) investors have significant potential to influence resilience in EMDE agriculture.** PE investors place capital in real and corporate assets and engage in various activities to increase the value of these assets over a multi-year time horizon. These investors are best placed to make meaningful and lasting impact on resilience in agriculture in EMDEs. Agriculture/farmland focused PE funds have raised approximately US\$26 billion since 2006. This figure represents total assets under management (AUM) of the 122 funds that have closed during this period (Figure 4.2 below).<sup>109</sup> Fundraising has been particularly strong recently: US\$20.3B of this amount has been raised by 88 funds since 2011. As of the beginning of 2016, approximately 35 percent of AUM was available as "dry powder" for investment.<sup>110</sup> Table 4.1 lists the 10 largest agriculture focused investment funds.

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<sup>105</sup> Z. Kouwe, 2009, "Hedge Funds Challenged Over Fees," New York Times (<http://www.nytimes.com/2009/09/17/business/17FEES.html?mcubz=0>)

<sup>106</sup> [https://www.pggm.nl/english/what-we-do/Documents/PGGM-Annual-Responsible-Investment-report\\_2016.pdf](https://www.pggm.nl/english/what-we-do/Documents/PGGM-Annual-Responsible-Investment-report_2016.pdf).

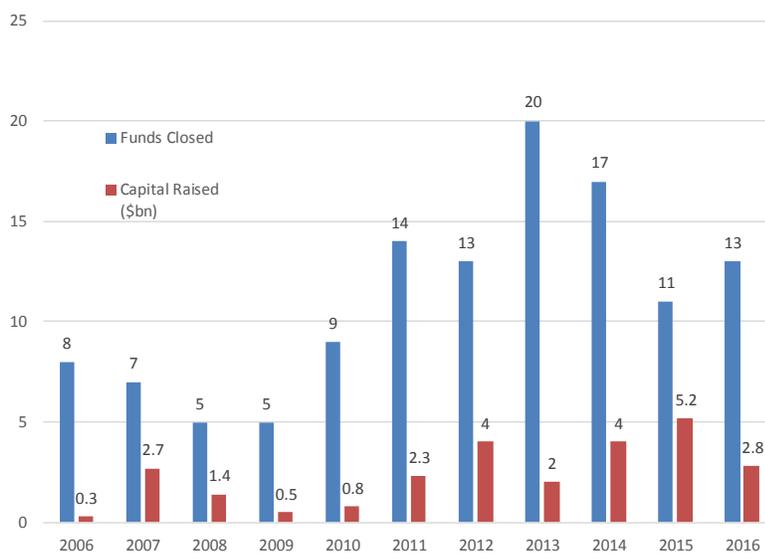
<sup>107</sup> Food and Agriculture Organization (FAO), 2015, "FAO and Mars join forces to strengthen food safety" (<http://www.fao.org/news/story/en/item/338562/icode/>)

<sup>108</sup> The first pilots will be installed in March 2017 ready for the start of the planting season (see <http://www.theheinekencompany.com/sustainability/case-studies/promoting-farming-best-practices-in-africa>).

<sup>109</sup> AUM include capital committed but not yet called up, or "dry powder", as well as unrealized portfolio value..

<sup>110</sup> Preqin Special Report: Agriculture, 2016 (<https://www.preqin.com/docs/reports/Preqin-Special-Report-Agriculture-September-2016.pdf>).

**Figure 4.2 – Unlisted Agriculture/Farmland Fundraising, 2006-2016**



Source: Preqin, 2017

**4.2.6 The agriculture sector in developed markets has provided relatively strong returns with low correlation to traditional assets.** A sample of agriculture funds that have reported performance indicate a weighted average of 12.20 percent net IRR (Table 4.2). Although a global farmland benchmark has not yet been developed, agricultural land, as measured by the U.S.-only NCREIF Farmland Index, has outperformed both domestic stocks and bonds on an annualized basis over the last 22 years, providing both consistent income and capital appreciation (Table 4.3). Data show that, since 1970, total returns from U.S. farmland have averaged 10.7 percent, providing further long-term support for the asset class.<sup>111</sup> When measured on a risk-return basis, farmland compares favorably to other asset classes, demonstrating strong returns per unit of risk.<sup>112</sup> Over time, agricultural investment performance has moved in very different cycles from traditional asset classes like stocks and bonds; as a result, adding farmland to an investor’s portfolio enhances diversification and can result in lower volatility. Over the past 40 years, agricultural land has demonstrated a low performance correlation to both stock and bond indices, meaning that land prices have generally risen as stocks have fallen and vice versa. However, agriculture is a relatively new asset class, there is limited institutional track record of realized gains with which to evaluate the performance of the sector.

<sup>111</sup> TIAA-CREF, 2013, “Investing in Agriculture” ([https://www.tiaa.org/public/pdf/C11718\\_Agriculture+Primer\\_Dec+2013.pdf](https://www.tiaa.org/public/pdf/C11718_Agriculture+Primer_Dec+2013.pdf)).

<sup>112</sup> TIAA-CREF, 2013, “Investing in Agriculture” ([https://www.tiaa.org/public/pdf/C11718\\_Agriculture+Primer\\_Dec+2013.pdf](https://www.tiaa.org/public/pdf/C11718_Agriculture+Primer_Dec+2013.pdf)).

**Table 4.1 – The Ten Largest Agriculture-Focused Funds (as of July 2016)**

Fund	Firm	HQ	Size (mm)	Final Close	Focus
TIAA-CREF Global Agriculture II	TIAA Asset Management	US	USD 3,000	Jul-15	Global
TIAA-CREF Global Agriculture	TIAA Asset Management	US	USD 2,000	May-12	Global
NCH Agribusiness Partners	NCH Capital	US	USD 1,205	Dec-07	Central & East Europe
Paine & Partners Capital Fund III	Paine & Partners	US	USD 1,204	Apr-07	Global
Altima One World Agriculture Development Fund	Altima Partners	UK	EUR 756	Nov-08	Global
Mahaseel Agricultural Investment Fund	Kenana Agriculture	Sudan	USD 1,000	Nov-12	MENA
Paine & Partners Capital Fund IV	Paine & Partners	US	USD 893	Dec-14	Global
Macquarie Pastoral Fund	Macquarie Infrastructure and Real Assets (MIRA)	UK	AUD 700	Apr-11	Australia
Black River Food Fund 2	Proterra Investment Partners	US	USD 700	Nov-14	Emerging Markets
AMERRA Agri Fund II	AMERRA	US	USD 535	Jan-13	North America, Latin America

Source: Prequin Natural Resources Online.

**Table 4.2 – Sample Agriculture/Farmland Fund Performance**

Fund	Firm	Vintage	Size	Geography	Net IRR (%)	Reported
Ag Real Value Fund	Teays River Investments	2010	USD 478	US	15.6	Dec-15
Bonnefield Canadian Farmland I	Bonnefield Financial	2010	CAD 31	Canada	14.5	Dec-14
Bonnefield Canadian Farmland II	Bonnefield Financial	2013	CAD 27	Canada	11.7	Dec-14
Black River Capital Partners Fund (Food)	Proterra Investment Partners	2011	USD 455	Emerging Markets	9.0	Dec-15
Avrio Ventures II	Acrio Ventures	2011	CAD 91	North America	9.0	Sep-15

Source: Prequin Natural Resources Online.

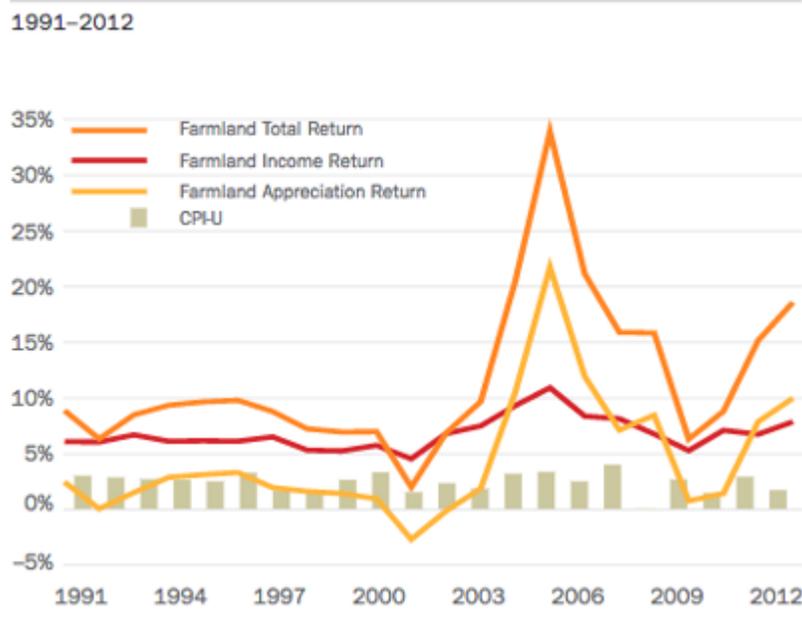
**Table 4.3 – US Farmland Asset Return Characteristics**

Asset/Index	Annual Average Return	Standard Deviation	Coefficient of Variation	U.S. Avg. (All) Correlation
	1970–2012			
U.S. Farmland	10.7%	6.5%	0.61	1.00
PPI	4.0%	4.9%	1.22	0.63
CPI	4.2%	2.9%	0.68	0.64
3M T-bill	5.3%	3.1%	0.59	0.23
S&P 500	6.3%	17.0%	2.68	-0.26
10-year Treasury	7.0%	2.7%	0.39	0.04
EAFE	6.5%	21.2%	3.26	0.00

Source: TIAA-CREF Center for Farmland Research, Standard & Poor's, Federal Reserve, MSCI, Commodity Research Bureau, Consumer Price Index.

4.2.7 **Returns on farmland investments have historically outpaced inflation.** Through a combination of current income from operations as well as land value appreciation, returns from farmland investments in developed markets have consistently and substantially exceeded the rate of inflation. Although a global benchmark for farmland has not yet been developed, the aforementioned NCREIF Farmland Index's Total Return has consistently provided returns more than double the inflation rate since 1991 (Figure 4.3).<sup>113</sup>

**Figure 4.3 – NCREIF Farmland Returns vs. Inflation**



Sources: NCREIF Farmland Index and Consumer Price Index- Urban.

Note: The Inception date of the NCREIF Farmland Index is 4Q 1990. The CPI-U produces monthly data on changes in the prices paid by urban consumers for a representative basket of goods and services since 1913. NCREIF Farmland Index returns are used for the time frame above to demonstrate income and capital appreciation components, which are not available from the TIAA-CREF Center for Farmland Research database.

4.2.8 **Overall PE return expectations in developed economies are on a downward trend.**

This may increase the willingness of PE firms to seek opportunities in EMDEs. Rolling ten-year returns of the US Private Equity Index peaked in 2013; for the period of 2006-2015, the Index returned 11.3 percent annually, approaching the long-term return from public markets.<sup>114</sup> Infrastructure funds targeted an average 10.6 percent IRR in 2016, down from 14 percent in 2004 (PWC, 2017). The majority of buyout funds raised between 1994-2007 outperformed the S&P 500 average, while 75 percent of funds raised

<sup>113</sup> TIAA-CREF, 2013, "Investing in Agriculture" ([https://www.tiaa.org/public/pdf/C11718\\_Agriculture+Primer\\_Dec+2013.pdf](https://www.tiaa.org/public/pdf/C11718_Agriculture+Primer_Dec+2013.pdf)).

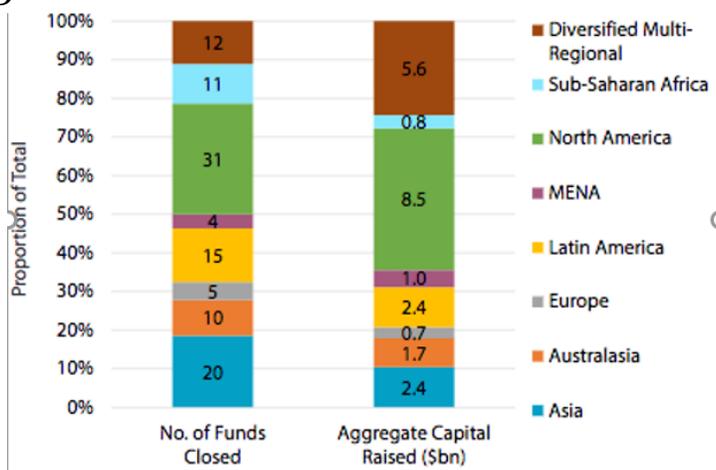
<sup>114</sup> N. Kaissar, 2016, "Private Equity's Diminishing Returns," Bloomberg (<https://www.bloomberg.com/gadfly/articles/2016-05-11/private-equity-has-diminishing-returns>)

between 2006-2016 underperformed.<sup>115</sup> One reason for this decline is increased competition for deals, as more fund managers enter the market. This increased competition may increase investors' appetite for higher-yielding opportunities in EMDEs.

### 4.3 Agriculture Sector Investment Landscape: Geography

4.3.1 **Land fertility, macroeconomic and regulatory attractiveness, and relative value affect the geographies in which agriculture investors invest.** Land fertility is paramount to all agricultural endeavors and therefore a prime determinant of investors' geographic preferences. Investors also seek a stable and favorable macroeconomic and regulatory environment, as well as ample market liquidity. For investors in farmland, strong property rights and rule of law are paramount, and crop exporters are sensitive to exchange rates and inflation. Investors in various parts of the value chain are also concerned with the strength of intellectual property rights, particularly those seeking opportunities in agricultural technology. Finally, investors will seek those geographies that have the potential to provide a superior rate of return. North America is the target destination for 26 percent of capital raised for unlisted agriculture/farmland funds. Anecdotally, investors confirm a general preference for investments in North America, Europe, and Australia over emerging and developing markets (Figure 4.4).

**Figure 4.4 – Unlisted Agriculture/Farmland Fundraising by Primary Geographic Focus, 2008-2017 YTD**



Source: Preqin Natural Resources Online

4.3.2 **Investors are increasingly open to agriculture opportunities in EMDEs.** In some cases, this is due to the improving investment climate, modernization of the

<sup>115</sup> A. Jacobius, 2017, "Waning returns have some doubting private equity's value," Pensions & Investments (<http://www.pionline.com/article/20170206/PRINT/302069982/waning-returns-have-some-doubting-private-equitys-value>)

agriculture sector, and growing familiarity and track record of global investors in specific emerging economies like Brazil or Argentina. It may also be attributed in part to the continuing low-interest rate environment, which has pushed institutional investors into higher risk environments in search of yield. Some agriculture investors may also pursue a globally diversified portfolio of agricultural investments in order to reduce risk by spreading exposure among a variety of crops, government structures, and climates. When there is drought in Russia, for instance, growing conditions in Australia may be very positive. By investing globally, the impact of unexpected events in any single portion of the portfolio can be reduced.<sup>116</sup> Notably, Chinese investors have pursued aggressive global diversification in the past decade, acquiring farm and agribusiness assets in the United States, Europe, Latin America, Africa, and Australia. (further discussed in Chapter 6).

4.3.3 **The fragmented structure of the agriculture sector in EMDEs presents a challenge for investment opportunity pipeline development.** The primary deterrent to investments in EMDE agriculture is the weaker macroeconomic and regulatory environment. Investors cited weaker property rights and regulatory regimes, and exposure to interest rate and inflation risks, as significant deterrents to seeking investments in EMDEs.<sup>117</sup> In addition, investors also point to the fragmented nature of EMDEs' agriculture sectors as an impediment to the deployment of capital. These markets are often characterized by a large volume of relatively capital-poor and fragmented smallholders selling to local distributors. As a result, it is difficult to deploy capital at scale. For investors whose activities seek to implement material changes in day-to-day farming practices, the level of fragmentation witnessed in EMDEs is a particular challenge. These investors report the lack of reliable "aggregating entities" that can effectively distribute capital, equipment, and expertise to small farmers in EMDEs as a significant impediment to their ability to deploy capital.

4.3.4 **Finding, overseeing, and executing investments in EMDEs can be a complex endeavor.** The majority of agriculture fund managers are based in the US and Europe (Figure 4.5 below). These investors anticipate significant additional time and capital costs to finding and executing investments in EMDEs, which would require a local office and staff. They also report difficulties in communicating with entrepreneur in less sophisticated environments, and suggested they would be more willing to consider investments in EMDEs if they were able to partner with an organization that

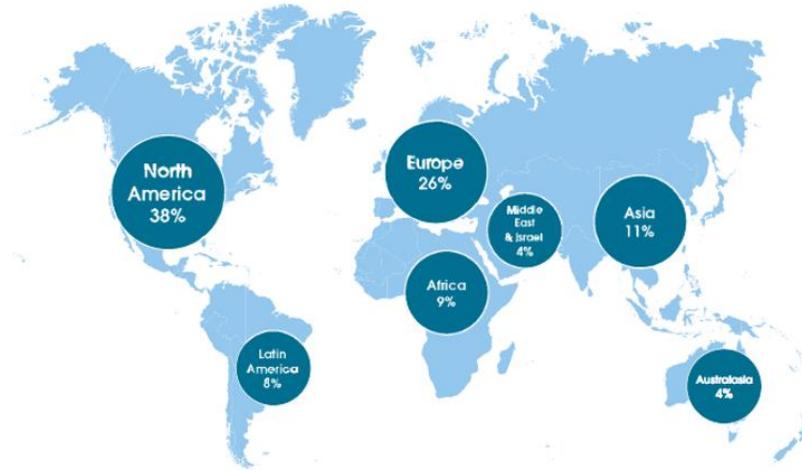
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<sup>116</sup> TIAA-CREF, 2013, "Investing in Agriculture" ([https://www.tiaa.org/public/pdf/C11718\\_Agriculture+Primer\\_Dec+2013.pdf](https://www.tiaa.org/public/pdf/C11718_Agriculture+Primer_Dec+2013.pdf))

<sup>117</sup> Authors' interviews with: Bill & Melinda Gates Foundation, Emergence Capital, Green Growth Fund, Impax Asset Management, Monsanto Ventures, Naturevest, Omidyar Network, Paine Schwartz Partners, Proterra Investment Partners, Syngenta

could provide “boots on the ground,” including transaction preparatory work to build a pipeline of potential investee companies.

**Figure 4.5 – Fund Managers by Location**

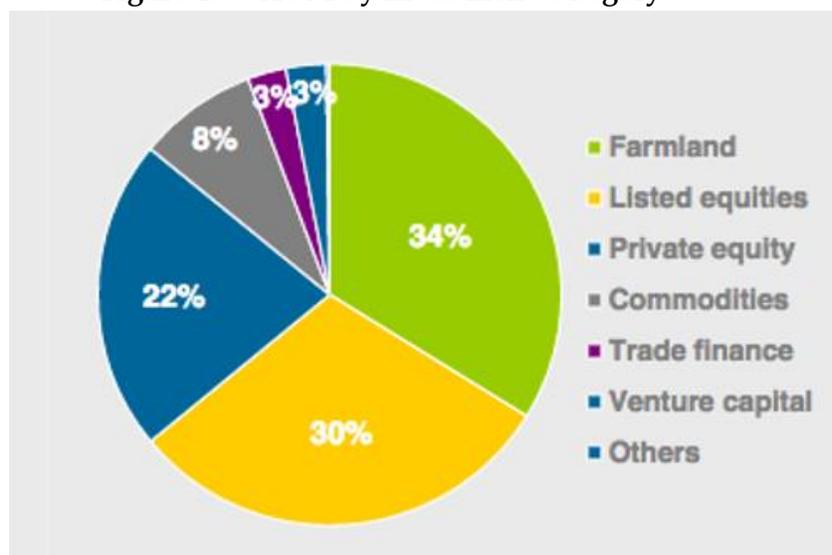


Source: Preqin Natural Resources Online

#### 4.4 Agriculture Sector Investment Landscape: Targets

4.4.1 Investors typically gain exposure to the agriculture sector via seven categories of investments: farmland (i.e. real estate), private equity, listed equities, venture capital, commodities, trade finance, and other (including water, or mixed investment strategies). By some estimates, the total AUM of funds focused on the food and agriculture sector is US\$45 billion worldwide (Valoral Advisors, 2015). Farmland focused funds represent the largest portion of AUM, at 34 percent (Figure 4.6).

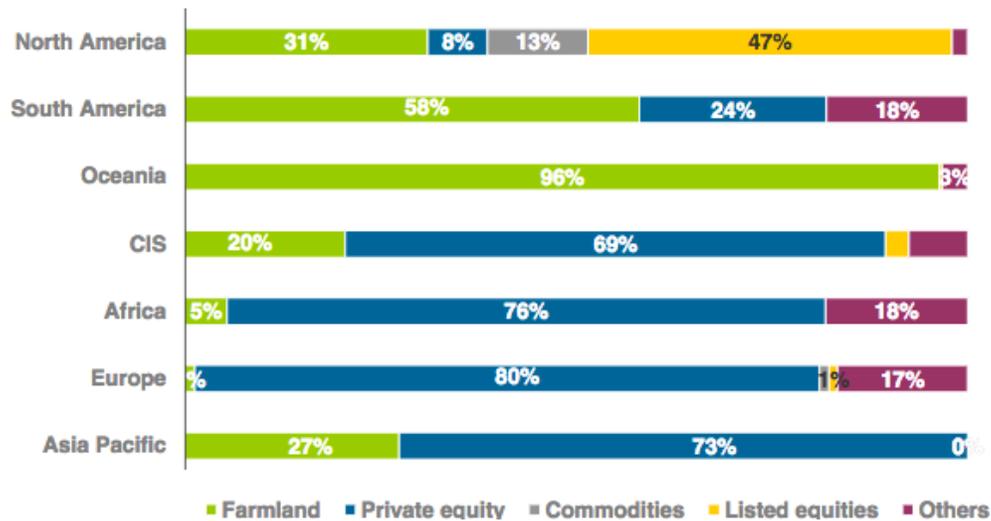
**Figure 4.6 – AUM by Investment Category**



Source: Valoral Advisors, 2015 Global Food & Agriculture Investment Outlook.

4.4.2 **Investors exhibit different preferences among these investment categories across different geographies.** Nearly all agriculture investments in listed equities are made in North America, where they are the largest single category of investment, owing to the better developed capital markets and listings available (Figure 4.7 below). Outside of North America private equity investments accounted for the largest share of capital allocations in every other region aside from South America and Oceania, where farmland investments were the dominant type.

**Figure 4.7 – Asset Allocation of Agriculture-focused Funds by Region**



Source: Valoral Advisors, 2015 Global Food & Agriculture Investment Outlook.

4.4.3 **The most relevant categories for resilience in agriculture are farmland, private equity, and venture capital.** Resilience activities will typically involve introducing a permanent change to farming techniques, land, or capital goods. Investments in listed equities present fewer opportunities to address resilience, except potentially through shareholder activism. Farmland investments involve a direct purchase or long-term lease of a land asset; these investments are closest to the land in the value chain, and thus present significant opportunities for investment in resilience. Farmland investors derive returns from both the appreciation of land values (including from capital improvements made), as well as from current income derived from farming activities. Typically, an investor will seek to enhance productivity either via aggregation of several smaller parcels in order to take advantage of economies of scale and supply chain efficiency, or via improved capital goods or farming techniques.

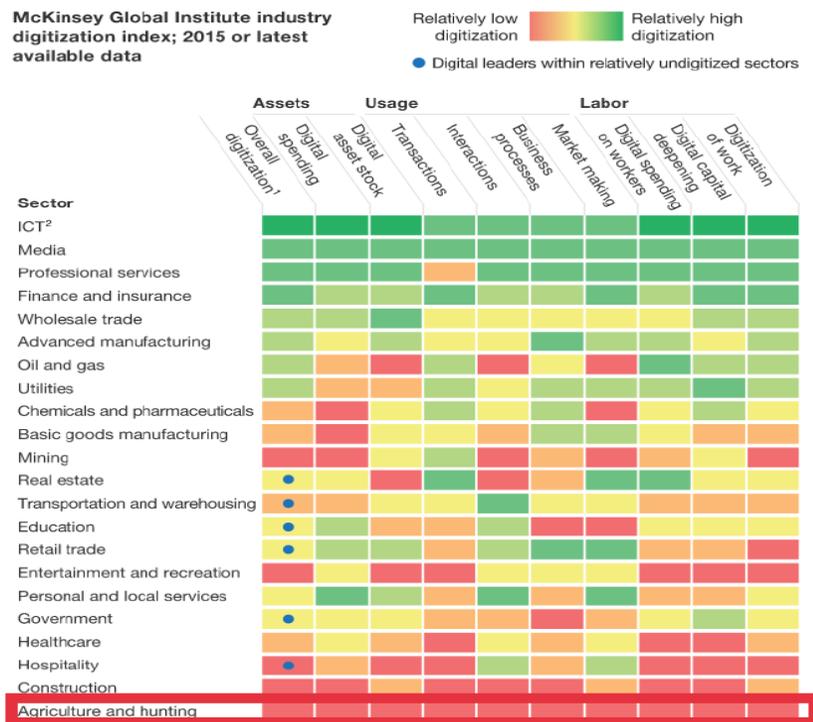
4.4.4 **Farms in developed markets are highly mechanized.** Investors in these markets increasingly seek tech-driven solutions to enhance productivity. Advanced farming

and irrigation equipment, soil science, and crop strains are widely available to farms in developed markets. Investors in these markets are increasingly turning to technology-driven solutions in order to drive productivity gains, as the agriculture sector is among the least digitized (Figure 4.8).

4.4.5 **By contrast, farmland investors in EMDEs typically allocate capital first toward improving farming techniques and levels of mechanization.** Farms in EMDEs exhibit low levels of mechanization, which limits the gains to be had from digitization. Farmland investors in these markets will typically focus on “quick wins,” for example by implementing nutrient management, no-till farming, and center pivot irrigation, and acquiring harvesting or processing equipment. These activities enhance risk management and productivity, thereby producing positive resilience outcomes.

4.4.6 **Investors point to these “quick wins” as good potential areas for resilience investment in EMDE agriculture, but warn of the necessity of locally-tailored solutions.** Activities that improve soil health and crop and nutrient management are expected to produce significant productivity gains. However, soil and growing conditions vary greatly from region to region, and some investors have observed advanced farming techniques prevalent in developed economies to fail in EMDEs after having been applied without careful regard for local soil conditions, precipitation, and other environmental characteristics.

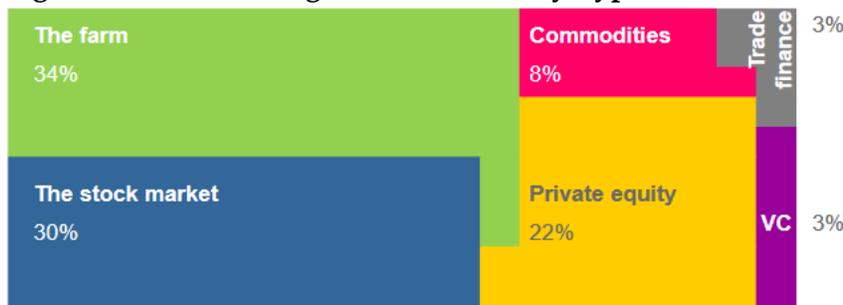
**Figure 4.8 – Digitization levels of various economic sectors**



Source: McKinsey Global Institute, 2016

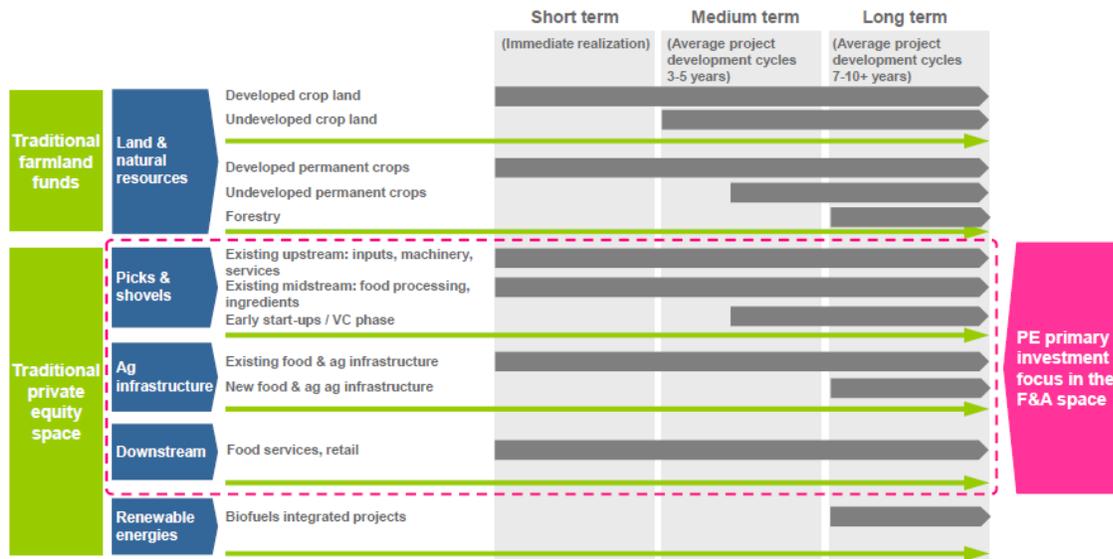
4.4.7 **Private Equity (PE) investments account for approximately 25 percent of the AUM of funds targeting the agriculture sector** (Figure 4.9). Private equity investments target later-stage businesses with proven business models requiring growth or expansion capital. PE investors invest across the value chain, but tend to focus on several distinct themes: inputs, equipment, and services; midstream and downstream processing; agricultural infrastructure; and renewable energies (Figure 4.10). PE investors are increasingly looking at AgTech opportunities as well, but this segment continues to be dominated by Venture Capital (VC) and corporate investors.

**Figure 4.9 – AUM of Agriculture Funds by Type**



Source: Valoral Advisors, 2015

**Figure 4.10 – PE Agriculture investment opportunity landscape**



Source: Valoral Advisors, Global Food and Agriculture Investment Outlook, 2015

4.4.8 **Opportunities for EMDE agriculture resilience investments exist throughout much of the traditional PE agriculture value chain.** Investments in opportunities close to the farm, such as inputs, equipment, and services, food and agriculture infrastructure, and biofuels, have high potential for enhancing resilience in EMDEs. Investments closer to the consumer, for example in retail or food services such as delivery, are less attractive from a resilience standpoint.

4.4.9 **Venture Capital (VC) is a small but growing segment of the investment landscape in terms of AUM with significant potential for resilience.** In recent years, investment in agriculture technology (or “AgTech”) business has increased dramatically. Box 4.1 proposes a segmentation of the AgTech market. Percentages associated with each category represent the number of deals in the category as percentage of total deals. By one estimate, over the period from 2014-2015 approximately US\$7 billion was raised for 830 individual AgTech companies from over 900 unique investor groups.<sup>118</sup> Figure 4.11 contains an analysis of 104 AgTech companies backed by venture capital firms, sorted into nine categories.

**Box 4.1 – AgTech Market Segmentation**

- **Farm Management Software (13 percent):** This includes software like that produced by Andreessen Horowitz-backed Granular that allows farmers to more efficiently manage their resources, crop production, farm animals, etc.
- **Precision Agriculture and Predictive Data Analytics (19 percent):** These startups include those that focus on using big data and predictive analytics to address farm-related issues and make better farm-related decisions in order to save energy, increase efficiency, optimize herbicide and pesticide application (such as Prospera, which uses machine vision and artificial intelligence), and manage risk, among other uses (e.g., automation and robotics; imagery and sensors; and bio-engineering).
- **Sensors (20 percent):** Startups in the sensor category include Arable, which offers smart sensors that collect data and help farmers monitor crop health, weather, and soil quality.
- **Animal Data (8 percent):** These companies provide software and hardware specifically aimed at better understanding livestock, from breeding patterns (Connecterra) to genomics (TL Biolabs).
- **Robotics and Drones (13 percent):** This category includes drone companies and related drone services that cater to agricultural needs (such as TerrAvion), as well as robots or intelligent farm machines that perform various farm functions more efficiently (such as Blue River Technology, backed by Monsanto Growth Ventures, Syngenta Ventures, and Khosla Ventures, among others).
- **Smart Irrigation (11 percent):** These startups, including Hortau, provide systems that help monitor and automate water usage for farms using various data exhausts.
- **Next Gen Farms 8 percent):** A growing category of companies that utilize technology to provide alternative farming methods to enable farming in locations and settings that cannot support traditional farming. Examples include AeroFarms for vertical farming and BrightFarms for new greenhouses.

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<sup>118</sup> Global AgInvesting, 2016, “Agriculture: A New Asset Class Presents Opportunities for Institutional Investors” [http://www.globalaginvesting.com/wp-content/uploads/2016/06/GAI\\_White-Paper\\_Institutional-Investment-in-Agriculture-1.pdf](http://www.globalaginvesting.com/wp-content/uploads/2016/06/GAI_White-Paper_Institutional-Investment-in-Agriculture-1.pdf)

- **Marketplaces (6 percent):** These startups offer marketplaces relevant to agriculture by connecting farmers directly to suppliers or consumers without any middlemen. While some are e-commerce platforms, others use tech to facilitate physical marketplaces (La Ruche Qui Dit Oui).
- **Plant Data/Analysis (3 percent):** These startups are getting more granular data about plant composition (microbial makeup, genetic expression, etc.) and/or analyzing that data to improve seed research & development and breeding (such as Benson Hill Biosystems).

Source: CB Insights, 2017<sup>119</sup>

Figure 4.11 – AgTech Ecosystem: 100+ Technology Companies Changing the Farm



Source: CB Insights, 2017

4.4.10 **Corporate entities are increasingly active participants in the burgeoning AgTech sector.** Corporates participated in 24 percent of all AgTech transactions in 2016, up from just 3 percent in 2013.<sup>120</sup> Some corporates have established standalone venture capital divisions, while others continue to invest from their balance sheet. BASF and Monsanto have been the most active, making 18 and 14 investments, respectively, from 2012-2016. ADM, Bayer, Cargill, Dow, Dupont, Land O’Lakes, and Syngenta are also active in venture investing. Corporates have also begun to partner with accelerators in order to get access to early-stage ventures as they develop. Bayer and Syngenta have partnered with the AgTech Accelerator; John Deere and Du Pont have

<sup>119</sup> CB Insights, 2017, “The Ag Tech Market Map: 100+ Startups Powering the Future of Farming and Agribusiness” (<https://www.cbinsights.com/research/agriculture-tech-market-map-company-list/>)

<sup>120</sup> Cultivating Ag Tech: 5 Trends Shaping the Future of Agriculture, CB Insights, 2017, <https://www.cbinsights.com/research/agtech-startup-investor-funding-trends/>

partners with Cultivation Corridor; Bayer and Du Pont have partnered with Radicle; Land O' Lakes has partnered with TechStars; and Monsanto has partnered with Fundo BR Startups.

4.4.11 **Silicon Valley firms are also active participants in AgTech startups.** Well-known venture capital firms also participate in the AgTech space (Figure 4.13). Corporate VC investors report that they will usually seek to partner with a traditional VC when pursuing AgTech investments.

**Figure 4.13 – Most Active AgTech Investors 2012-2016**

Investor	Rank	Companies
Y Combinator	1	TL Biolabs, PickTrace, Raptor Maps, Edyn, TerrAvion, Farmlogs
Monsanto Growth Ventures	2	AgSolver, HydroBio, Resson, VitalFields, Blue River Technology
Middleland Capital	2	Benson Hill Biosystems, Conservis, AAD, Mercaris, AeroFarms
Syngenta Ventures	4	Phytech, Agworld, S4, Blue River Technology
Khosla Ventures	4	Granular, Blue River Technology, Climate Corporation, Solum
Andreessen Horowitz	4	Granular, Solum, AgLocal, Farmlogs
Omnivore Venture Partners	7	Sellapps, Eruvaka Technologies, FrontalRain Technologies
Google Ventures	7	Farmers Business Network, Granular, Climate Corporation
Felicis Ventures	7	Grove Labs, Granular, Climate Corporation
Techstars	7	Platfarm, Freight Farms, Avemus

Source: CB Insights 2017

4.4.12 **Two trends observed in developed market AgTech VC investments – decentralization and the use of information technology - suggest that opportunities for impactful resilience investment are likely to open up in EMDEs.** Increasingly lower operating costs due to technology uptake are making smaller farms more economically feasible. This will allow food to be produced closer to consumers, and in a more distributed manner, reducing the severity of supply shocks and transportation costs. An example is Freight Farms, a subscription-based service which allows urban residents to tend their own hydroponic farms delivered in repurposed freight containers. Software tools are aggregating information from small- and mid-sized farmers while providing them with more effective farm management solutions. Better and aggregated data can allow farmers to negotiate for better prices and function more like farming cooperatives. An example is KPCB-backed Farmers Business Network, which aggregates agronomic intelligence and pricing data into a subscription service.

4.4.13 **AgTech VC firms in general are not exploring opportunities in EMDEs.** AgTech VC firms are overwhelmingly focused on developed markets (primarily US, Canada, Europe) for several reasons. The execution/market risk associated with early-stage investments is already high, investors are not willing to take political/macro-economic risk. Also, AgTech investments usually require strong intellectual property protections, large research and development budgets, and pools of skilled science and programming talent, all of which are comparatively rare in

EMDEs. Furthermore, higher-cost investment, such as in genetically modified crop strains, are difficult to make. EMDE operators cannot afford higher cost inputs as they are already not operating at economies of scale and have low access to capital. Moreover, corporate AgTech investors report that EMDE regulators are often reluctant to approve new science in the agriculture sector (for example, GMOs).

## 4.5 Investment Tools

This section provides an overview of green investment tools. A more in-depth analysis is provided in Annex 4.A.

### The Universe of Green Finance Instruments

4.5.1 **The objective of this section is to rationalize and segment the vast and expanding universe of DFI finance solutions applied to climate adaptation investments.** The analysis is based on extensive research, data gathering and conversations with WBG and outside experts in the field. The analysis is confined to tools used by DFIs for the purpose of mobilizing private capital towards green projects.

4.5.2 **Since climate adaptation is not yet identified as a standalone asset class (as is the case for renewable energy for instance), the green finance tools analyzed here apply to the broader spectrum of climate mitigation and adaptation.** The analysis identified eight types of green finance instruments, summarized in Figure 4.14. They range from direct DFI investments in green projects, to investments via funds and other ad hoc vehicles such as green banks, to risk mitigation and return enhancement solutions.

**Figure 4.14: Overview of Green Finance Instruments**

Tool	Description
<i>Green Banks</i>	Vehicles wholly-owned and funded by national or subnational governments to invest professionally in renewables and other green projects. Mostly funded through budget appropriations. They aim for commercial returns. None is an actual, regulated bank – some are ring-fenced as companies, others are pure ministerial units. Can invest in equity and/or debt. Sometimes provide guarantees.
<i>Investments in Private Equity Funds</i>	DFI investments in private equity funds run by professional managers. Funds usually have a geographic or sectorial focus. DFIs typically limit their investments to minority stakes (e.g. <20 percent for IFC). DFIs can seed new managers or back established ones. In general, DFIs expect full commercial returns, although in some instances private investors received preferential treatment.
<i>Investments in Private Equity Funds of Funds</i>	DFI investments in funds of funds ("FoFs") run by professional managers. FoFs in turn invest in private equity funds with a geographic or sectorial focus. DFIs usually limit their investments to minority stakes of FoF (e.g. <20 percent). DFIs can seed new managers or back established ones. In general, DFIs expect full commercial returns. Less common than straight private equity investments.

<i>Direct Investments</i>	DFI funds a company or project with a direct equity or debt injection. Investment in itself is on a commercial basis, but often other DFIs (or other divisions of same DFI) will offer return enhancement or risk mitigation solutions. Very established tool.
<i>Guarantees</i>	DFI offers private investors political risk insurance (against risk of expropriation, exchange controls, war, breach of contract), partial credit guarantees or partial risk guarantees. Usually in support of foreign (not domestic) investors. Guarantee can cover debt and/or equity. Guarantee can be priced on a commercial or concessional basis; in the latter case, it is usually backed by sovereign counter-guarantee. DFI disburses capital only if guarantee is called, but may set up reserves in advance.
<i>Green Bonds</i>	Securities issued by governments, DFIs and corporates, usually bearing the same credit risk as generic bonds of the issuer, but with a commitment to use proceeds to finance or re-finance green projects, assets or businesses.
<i>Blended Climate Finance</i>	DFI funds a portion of a project on a concessional basis, to enhance the risk/reward profile for private investors. Can take the form of soft loans (more flexible terms, e.g. pricing, tenor, currency, subordination), guarantees, equity, grants and other instruments. Often used as temporary subsidy for high-risk, early-stage projects, pre-commercial viability.
<i>Other Concessional Finance</i>	Traditional DFI tool. Brings capital to countries and projects unable to access private markets. Sometimes in the form of capital, sometimes guarantees. No/limited expectation of market returns. May ignite a virtuous circle of investment and growth, but may also cause market distortions.

## Additionality and Multiplier Considerations

- 4.5.3 **This section analyzes how the various green finance instruments achieve the private capital mobilization goal. The assessment is based on two criteria: additionality and capital multiplier.** The objective is not to rank or score instruments on a deterministic basis, but rather to gather insights applicable to the design of climate adaptation investments.
- 4.5.4 **Additionality provides an important perspective on the effectiveness of the various instruments.** If a project can take place without a public capital injection, the latter would be better directed elsewhere, regardless how high the project's multiplier is. This part of the analysis focuses, in qualitative terms, on the "real" value added of the instruments under consideration.
- 4.5.5 **The multiplier is a useful quantitative reference, but needs to be contextualized.** The development finance sector, in recent years, has placed great emphasis on measures of private capital mobilized, without reaching a consensus on methodology. In this section, one definition is applied consistently across the product universe. The numerical analysis is complemented with a qualitative discussion that aims to capture the different instruments' goals and features.

### *On Additionality*

- 4.5.6 **When looking at additionality, the relevant question to answer is: "would a project have taken place regardless of public intervention?"** The analysis in this study is

limited to the domain of projects that offer the potential for financial return – albeit not necessarily at full commercial levels. When projects do not have any commercial prospects, one could argue that public capital is by definition additional. Key findings are summarized in Figure 4.15.

- 4.5.7 Demonstration, standardization and aggregation are the most common sources of additionality for green finance instruments.** Demonstration refers to investments in unproven sectors or regions, presenting risks that commercial investors find hard to quantify. For instance, early investments in offshore wind farms by the UK Green Investment Bank and many frontier market investments fall in this category. The African Development Bank expressly mentions its goal to demystify the risk perception of Africa through its private equity investments. Early entrants usually lead the way in standardizing investment structures, documentation and procedures. Aggregation is relevant in markets where capital is allocated on a very fragmented basis – for instance the financing of residential solar panel installations.
- 4.5.8 Investments in funds (and funds of funds) provide extra additionality when they seed new managers.** Institutional investors (pensions funds, insurance companies, endowments) are reluctant to back fund managers without a proven track record, regardless how sensible their investment strategies may be. Some DFIs try to cover this gap – the African Development Bank, for instance, has a stated goal of developing the private equity industry in the continent. At the same time, they also back established managers or new vintages of existing funds, hoping for more predictable returns.
- 4.5.9 Guarantees offered by DFIs are a strong source of additionality.** Both MIGA, a commercial entity, and the IBRD guarantee unit, which operates on a concessional basis, are able to cover risks that private insurers are unwilling to take. For instance, they operate in frontier markets, or provide very long-dated coverage (15-20 years) for complex risks. They benefit from a strong underwriting track record and unique access, as World Bank Group entities, to local officials for transaction structuring and dispute resolution. In addition, Guarantees minimize crowding-out of the private sector by involving commercial co-insurers or re-insurers.
- 4.5.10 Additionality considerations vary for blended finance and other concessional tools.** Blended climate finance is a return enhancement solution, on a concessional basis, for projects that are far from commercially-viable, and as such may prove to be a significant source of concessionality. Proceeds from green bond issuance, while dedicated to green, are allocated based on eligibility criteria set by the issuer – IBRD green bonds, for instance, are subject to tight criteria on use of proceeds. Green bond proceeds are not always used for financially viable projects. In some instances, they were used to refinance existing projects (e.g. hydro power in Scandinavia), which

would have likely found other sources of funds in any case. Other concessional finance tools are generally aimed at non-commercial projects.

**Figure 4.15: Summary Sources of Additionality**

Instrument	Sources of Additionality
Green Banks	Demonstration, standardization, aggregation.
Investments in Private Equity Funds	Demonstration, standardization, aggregation, seeding of unproven managers.
Investments in Private Equity Funds of Funds	Same as above (but indirectly through investee funds).
Direct Investments	Demonstration, standardization, aggregation.
Guarantees	Coverage of high-risk, frontier markets, Complex policies (hard-to-assess risks, long tenures).
Green Bonds	Dedicated use of proceeds, with low credit risk of issuing DFI.
Blended Climate Finance	Enhancement of sub-market returns.
Other Concessional Finance	Limited if applied exclusively to non-commercial projects.

*On Multiplier*

- 4.5.11 **There is no generally accepted definition of multiplier, which makes comparisons across instruments difficult.** Some DFIs publish a ratio of private investments to public capital. Others include in the numerator capital provided by other public institutions. In some cases, the multiplier only captures a step in the process – for instance co-investments at fund level, but not at portfolio company level.
- 4.5.12 **Throughout this study the following definition is applied: multiplier = total investment volume / public capital invested.** Total investment volume refers to the total amount of capital (debt and equity) invested in projects or companies as a result of the initial public capital injection. If such injection is through a fund, which then invests in a portfolio of companies, total investment volume refers to the enterprise value of the entire portfolio.
- 4.5.13 **Project leverage (debt/equity ratio), size of the stake acquired by a DFI, and fund structure are key determinants.** Assume a project requires US\$300 millions of funding, of which US\$200 million in loans and US\$100 million in equity. A DFI contributes 20 percent of the equity through a direct investment, or US\$20 million. In this case, the multiplier is  $300 / 20 = 15x$ . Alternatively, assume that the same US\$20 million investment comes from a private equity fund, 50 percent of whose assets

come from a DFI. In this case, the DFI's effective capital injection is US\$10 million, resulting in a multiplier of 30x.

- 4.5.14 **A thorough assessment of the multiplier must take into account project and instrument-specific factors.** For instance, it may be difficult to argue that public funds representing a very small portion of a project's capital structure are the primary catalyst for private investment – the multiplier would be optically high, but not very meaningful. Some projects may not be suitable for private investment due to their financial profile, but may still be essential from a development perspective; in these cases, concessional finance is a more appropriate tool even if, by definition, it does not aim to crowd-in private capital. Risk mitigation tools such as guarantees can contribute to high multipliers, but do not play a proactive role in the pipeline origination phase – an essential first step in infrastructure investing.
- 4.5.15 **Figure 4.16 summarizes the key findings for the instruments in the universe analyzed.** The analysis is based on data disclosed by relevant institutions, if available; otherwise, a range was estimated based on reasonable assumptions. A detailed discussion follows.

**Figure 4.16: Summary Overview of Multiplier**

Instrument	Multiplier	Source	Comments
Green Banks	2.8-4.8x	Green banks' disclosure.	Mostly direct investments (no fund-level multiplier). Leverage is limited in greenfield projects. As a result, multiplier tends to be low.
Investments in Private Equity Funds	5-60x	Indicative range.	Very wide range, depending on: (i) percent of public capital invested in fund, (ii) portfolio companies' leverage, (iii) fund's percent stake in portfolio companies.
Investments in Private Equity Funds of Funds	10-120x	Indicative range.	Same as above, but further amplified by private capital mobilization at fund of fund level.
Direct Investments	2-15x	Indicative range.	Wide range, depending on: (i) project/company leverage, (ii) public investor's percentage stake in project/company.
Guarantees	46x	Estimate for MIGA, based on latest annual report.	High, as a result of: (i) limited capital required by guarantor, (ii) re-insurance allows greater gross exposure, (iii) guarantees typically partial, (iv) guarantees may cover only one instrument (e.g. debt but not equity).
Green Bonds	N.A.	N.A.	No specific information on use of green bond proceeds (determined by issuing sovereigns/DFIs/corporates).
Blended Climate Finance	N.A.	Very project- specific	Involves mostly projects at sub-commercial level.
Other Concessional Finance	1.3-1.7x	Estimate for Global Environment Facility and Climate Investment Funds	Low, as concessional finance mostly crowds in public rather than private investments.

Source: Authors

- 4.5.16 **Funds (and funds of funds) generate higher multipliers than direct investments, but the range is wide.** The crowding in of private investors at fund (or fund of fund) level amplifies the multiplier of the underlying projects. At the same time, project leverage and minority vs. control stake considerations result in a wide range of multipliers.
- 4.5.17 **Green banks operate mainly through direct investments and with lower leverage, achieving relative low multipliers.** Green banks prefer to fund green field renewable projects, or early-stage clean technology companies. Limited cash flow generation hinders the ability to lever up these investments significantly. The relatively unproven nature of these investments means that green banks often take large stakes, acting as demonstrators for future private investors.
- 4.5.18 **Guarantees can produce a powerful multiplier effect.** Notwithstanding their limited role in project origination, guarantees have limited public capital requirements upfront. Guarantors do not disburse funds until risks materialize and guarantees are called – they set aside capital reserves based on an actuarial assessment of these risks. In addition, through re-insurance they are able to take higher gross exposures. MIGA, for instance, has a gross exposure equivalent to 13x its equity capital. Finally, guarantees are usually partial; they make the risk/reward of an investment appealing enough to attract investors also for the uncovered portion.
- 4.5.19 **Unsurprisingly, concessional finance has the lowest multipliers.** Concessional finance facilitates projects that are not expected, from the outset, to generate market-level returns (but may still be very relevant from a development perspective). In most cases, DFI concessional finance crowds-in other public capital, from local or international sources.

### Snapshot on Infrastructure Projects: Investment Lifecycle Matrix

- 4.5.20 **This section addresses the role played by each instrument in all phases of a typical infrastructure investment, recognizing that infrastructure is a component of many climate adaptation projects.** Not all instruments are meant to play a comprehensive role – some are in fact very specialized (guarantees, for instance). The purpose of this analysis is to highlight strengths and complementarities, rather than product gaps.
- 4.5.21 **The analysis identified six phases in the infrastructure investment lifecycle.** They encompass the whole process, from fund raising to investment exit. Figure 4.17 provides an overview, as well as the criteria that make an instrument stand out in a specific phase.
- 4.5.22 **Instruments (or combinations of instruments) that address financial, operational and political risks are more likely to produce successful projects.** These three risk

factors surface in various phases of the investment cycle. Naturally, some events are just unpredictable. Barring this scenario, it is critical that all three areas are addressed both in planning and execution, and that the instrument mix is chosen accordingly.

**Figure 4.17: Phases of the Infrastructure Investment Lifecycle**

Investment Phase	Criteria for Instrument Evaluation
Fund raising	- Is instrument effective in raising permanent capital? - Conversely, does it rely on discretionary budget allocations?
Pipeline origination	- Does instrument proactively source and build pipeline? - Does it constructively involve relevant public authorities?
Transaction structuring and execution	- Is instrument proactive in deal structuring and execution? - Is financial viability considered upfront?
Risk mitigation / return enhancement	- Important feature for many infrastructure projects - Does instrument provide relevant solutions?
Ongoing project operations	- Does instrument contribute to operational viability? - Key in greenfield projects with a construction phase
Market exit	- Does instrument assume a full market exit (sale, IPO)?

Source: Authors.

4.5.23 **The matrix in Figure 4.18 summarizes the findings of the analysis, and is followed by a detailed discussion of the instruments' value added in each phase.** For simplicity, a check is used when an instrument does provide the service at a given phase, a cross when it does not, and an "S" if sometimes it does and sometimes it does not.

**Figure 4.18: Infrastructure Investment Lifecycle Matrix**

Instruments	Availability of Capital	Pipeline Origination	Transaction Structuring & Execution	Risk Mitigation	Ongoing Project Operations	Market Exit
Green Banks	S	✓	✓	S	S	✓
Investments in Private Equity Funds	✓	✓	✓	X	S	✓
Investments in Private Equity Funds of Funds	✓	X	X	X	X	X
Direct Investments	S	✓	✓	X	X	✓
Guarantees	S	X	S	✓	X	X
Green Bonds	✓	X	X	X	X	X
Blended Climate Finance	S	X	S	✓	X	X
Other Concessional Finance	S	S	S	S	X	X

Source: Authors.

Note: "S" indicates that an instrument sometimes provides the service, and sometimes does not.

## Phase 1: Availability of Capital

- 4.5.25 The focus of the analysis is on the stability of the sources of capital, rather than the magnitude.** The latter is affected by factors that do not necessarily pertain to the design of an instrument. From a stability standpoint, capital or capital commitments specifically dedicated to green infrastructure, contractually sanctioned, and long-term are preferable to those subject to the vagaries of national budgets and of the political cycle.
- 4.5.26 Private equity funds, funds of funds and green bonds score highly on this metric.** Fund structures and bonds offer certainty of proceeds to, respectively, fund managers and issuers – albeit with a finite tenure or maturity. In general, private equity funds and funds of funds are exclusively dedicated to commercial projects, whereas green bonds may or may not have a commercial focus. Green bonds are subject to voluntary criteria to ensure the allocation of proceeds to green uses. The WBG green bond certification process, for instance, is very strict in determining the use of proceeds. The Climate Bond Initiative is actively promoting an industry effort to standardize green bond definitions and certifications.
- 4.5.27 The other instruments rely on government/ donor budgets or other official sources for funding.** These are affected by the political cycle. DFIs rely at least in part on capital contributions and grants from governments, which are in turn affected by national budget decisions. Inside a DFI, different instruments compete for a finite pool of capital. Guarantees, while not requiring an upfront disbursement of funds, need to be backed by capital reserves of the DFI/guarantor and, as a result, are subject to the same issues as straight cash instruments; in particular, when guarantees are booked at face rather than actuarial value – as is the case for the IBRD – they compete for capital on a one-on-one basis with straight loans.
- 4.5.28 Green banks, despite their misleading definition, are government-controlled entities that rely almost exclusively on budget appropriations.** The only exception to the rule is, perhaps, the UK Green Investment Bank, which has raised private capital for a separate Offshore Wind Fund and is also contemplating an IPO to reduce its reliance on the UK Treasury.

## Phase 2: Pipeline Origination

- 4.5.29 All instruments with an explicit investment mandate play a proactive role in origination.** Green banks, funds and direct investments rank high. Their success hinges upon sourcing good projects, among other factors. Institutions with a granular presence on the ground, like the IFC, are able to screen a large number of projects, for both fund and direct investments.

- 4.5.30 **Funds of funds usually do not play a direct role in sourcing investable projects for their investee funds, although they have a strong indirect interest in the ultimate sourcing of good projects and deals.**
- 4.5.31 **Guarantees are passive in the origination phase, but synergistic with instruments that could feed deals.** MIGA, for instance, will commence its underwriting work only after receipt of a formal application by a lender or investor. Conversations with MIGA representatives indicated their strong desire to be presented with more deals, especially if compliance with the WBG ESG standards has already been confirmed by due diligence.
- 4.5.32 **Green bonds, blended climate finance and other concessional tools are generally passive on the origination front.** Some concessional finance tools offer project preparation facilities that can be helpful in the origination phase.
- 4.5.33 **Involving local policy-makers and regulators early in the process is an important aspect of deal sourcing.** The presence of sovereigns and DFIs in the investor base of a fund can be beneficial. The AfDB-seeded African Renewable Energy Fund has screened several projects referred by AfDB and other fund investors, although only one out of 10 investments currently in its portfolio is an AfDB originated project.

### Phase 3: Transaction Structuring and Execution

- 4.5.34 **Instruments with an explicit investment mandate are naturally focused on structuring and execution.** In the universe analyzed, these are the green banks, private equity funds, and direct investments. This is reflected in their management teams, which usually include finance and investment professionals. The UK Green Investment Bank, for instance, has former investment bankers, private equity investors and professionals from the renewables sector in its team.
- 4.5.35 **Fund of funds are not involved in structuring and execution at project level.** Their investee funds are primarily responsible for this, as part of their normal investment activities.
- 4.5.36 **Guarantors are sometimes involved early on in the process, if risk mitigation is key to a project's financial viability.** IBRD, for instance, works with host governments to assess project feasibility and design, including risk mitigation, from a relatively early stage. The issuance of guarantees is subject to deal closing.
- 4.5.37 **Green bonds and blended climate finance are passive when it comes to transaction structuring.** Recipient governments and institutions will be the primary project drivers.

- 4.5.38 **Other concessional finance tools do sometimes take a proactive role in structuring.** The Global Environment Facility, for instance, provides technical assistance to its private sector partners to prepare transactions, in addition to capital.

#### Phase 4: Risk Mitigation or Return Enhancement

- 4.5.39 **Guarantees are provided by several DFIs, typically through ad hoc units, with WBG entities in a clear leadership position.** Funds and direct investors are users – rather than providers – of guarantees. They find them particularly useful in high-risk frontier markets, where certain investments would otherwise be impossible.
- 4.5.40 **Blended climate finance is a form of return enhancement.** It uses concessional finance tranches to enhance returns for commercial investors in a project. It is meant to be temporary, targeting early-stage projects with limited evidence of financial viability.
- 4.5.41 **Green banks operate mostly as lenders and investors, but some offer guarantees and structured products.** GreenTech Malaysia, in particular, operates almost exclusively via guarantees and rebates on interest payments, attached to loans extended by Malaysian commercial and Islamic banks.
- 4.5.42 **Some concessional finance instruments operate occasionally through risk mitigation, rather than upfront capital.** Both the Climate Investment Funds and Global Environment Facility offer guarantees, structured products and other de-risking mechanisms to projects not yet commercially viable.

#### Phase 5: Ongoing Project Operations

- 4.5.43 **Infrastructure projects, especially green field ones, require heavy involvement in development, construction and ongoing management.** Most financial investors tend to delegate these aspects to project development teams, while providing board-level supervision. This appears to be mostly the case in the green finance universe analyzed.
- 4.5.44 **The only exceptions to this rule are some private equity funds, and possibly the UK Green Investment Bank.** Some renewable energy funds, such as the African Renewable Energy Fund, are hands-on project managers; they believe their competitive advantage is the detailed understanding of, and proactive involvement in, the technical, engineering and regulatory details of a project. The UK Green Investment Bank appears to be very proactive in the management of green field projects, in particular in the offshore wind sector.
- 4.5.45 **The other instruments in the universe analyzed are not typically involved in ongoing project operations.** Funds of funds are one step removed from the project portfolio. Direct investments by DFIs are usually minority stakes, not warranting full

operational involvement, which is the responsibility of the client. Guarantees, green bonds, blended climate finance and other concessional finance are pure financial tools.

#### Phase 6: Market Exit

- 4.5.46 **“Handing over” a project or company to the private market via sale or IPO, for instance, is the ultimate seal of financial viability.** Some instruments in the universe analyzed work expressly for that objective, while others are less relevant.
- 4.5.47 **Green banks, private equity funds and direct investments are all actively working for the ultimate market validation.** Their time horizons may change, depending on their strategy, sector of focus and investor base, but an exit is their clear goal.
- 4.5.48 **Funds of funds share the same interest in market exits at project portfolio level, but leave the exit decisions and execution to investee funds.**
- 4.5.49 **Green bonds, blended finance and other concessional tools do not usually play any role in exit decisions and implementation.** Blended finance does have the expressed goal to make investments financially viable for commercial co-investors, but does not drive the exit decisions.

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# 5 Resilient agricultural infrastructure: the irrigation PPP facilitation program

*The increasing frequency and intensity of droughts are prominent consequences of climate change. Droughts have a negative impact on agriculture, with a reduction in crop yields and production, and broad socio-economic side-effects. Building and/or upgrading irrigation infrastructure can address this problem. This chapter reviews the pitfalls of the traditional public finance model for irrigation, and proposes an Irrigation PPP Facilitation Program (IPFP) as a potential solution to maximize project success.*

## 5.1 The Underlying Climate Adaptation Problem

- 5.1.1 **The increasing frequency and intensity of droughts, often coupled with more unpredictable and intense periods of rainfall, are two of the most prominent consequences of climate change globally.** Virtually every continent is exposed, including not only developing but also advanced economies – Russia and the US, for instance, were hit by long and intense droughts in 2010-11, and Australia suffered from multi-year droughts between 2002 and 2010. According to the United Nations Framework Convention on Climate Change (UNFCCC, 2007), the developing countries most exposed to increasing drought risk are in Africa (increasing impact in areas already naturally prone to droughts, as well as emergence of drought risk in new areas), Asia (in particular during the summer months and El Niño events) and Latin America (in particular during El Niño events and in areas such as northeast Brazil).
- 5.1.2 **Droughts have a direct negative impact on agriculture, including drop in crop yields and production particularly in areas relying on rain-fed agriculture, and several indirect social and economic impacts.** Reduced soil moisture and evaporation can increase land degradation and desertification. Agricultural production is negatively affected by land losses, shorter growing seasons and

uncertainty as to what and when to plant. For instance, in Africa UNFCCC estimates that yields from rain-fed crops could be halved by 2020 in some countries, and net revenues from these crops could fall by 90 percent by 2100. FAO reported a 45 percent drop in wheat yields in Kenya during the 2011 drought. In Latin America, UNFCCC estimates that in some areas 50 percent of agricultural land could be exposed to desertification and salinization by the 2050s. Indirect impacts of the loss of agricultural production include reduced income for farmers and agribusinesses, increased food prices, increased unemployment, reduced tax revenues, increased loan foreclosures on agribusinesses, increased social insecurity and potentially crime and migration.

- 5.1.3 **Several adaptation measures can contribute to mitigating the impact of droughts on agriculture.** The fund structures proposed in this chapter focus on improving irrigation infrastructure through public-private partnerships (PPPs). Adaptation measures to deal with droughts in agriculture include the switch to drought-resistant seeds, the adoption of climate smart agronomic techniques, improved drought monitoring systems, more reliable information on the condition of food crops and the improvement or introduction of proper irrigation infrastructure, especially for small farmers. This chapter focuses on the latter intervention, identifying potential hybrid finance solutions to crowd in private capital to irrigation infrastructure projects.

## 5.2 Issues Affecting Public Irrigation Schemes

- 5.2.1 **The majority of irrigation projects have so far been funded by public finance.** Over the past 60 years, investment in irrigation schemes has occurred predominantly under the traditional model based on (i) public funding for capital investment, (ii) public management of the infrastructure and (iii) water supply to farmers at highly subsidized rates. Irrigation today provides water to one-fifth of the cultivated land globally, from which one-third of food crops are harvested. A significant portion of this investment has taken place in developing countries.
- 5.2.2 **A number of issues limit the ability of publicly funded irrigation projects to fulfill demand for significant future investments, driven by climate change among other factors.** High construction costs and fiscal constraints limit governments' ability to fund the initial capital investment for dams, reservoirs, canals and ancillary infrastructure and equipment. Similar considerations have limited available funding for operations and maintenance (O&M), which has resulted in poor service quality and water waste. Attempts to charge and collect fees to recover at least part of the construction and O&M costs have been generally unsuccessful – due to farm income and affordability issues and to the vicious circle linking poor service quality to users' unwillingness to pay. Lastly, poorly designed irrigation policies, inadequate

government oversight and limited technical expertise, coupled with changing political agendas, have contributed to the deterioration of existing infrastructure and services. Table 5.1 summarizes these pitfalls.

**Table 5.1 - Issues affecting public irrigation schemes**

Issues	Comments
Limited funding for capex	<ul style="list-style-type: none"> <li>• Rate of recent irrigation investment slowed by: (i) high and increasing construction costs of irrigation schemes, (ii) tight financial position of many development country governments, (iii) budget competition from other public finance projects with more immediate political return and (iv) environmental concerns for certain projects (e.g. involving dam construction, river diversion, ecosystem changes)</li> </ul>
Limited funding for O&M	<ul style="list-style-type: none"> <li>• The initial public investment in capex is often not followed through with ongoing investment in operation and maintenance of the scheme, due to budget and supervisory issues.</li> <li>• When pumping stations, canals, sluice gates and metering systems are not properly maintained, water is lost in the system and supply to farmers is unreliable.</li> <li>• The World Bank's Public-Private Infrastructure Advisory Facility estimates that only 25-30 percent of water diverted in large canal systems in developing countries reaches crops (Mandri-Perrot and Bisbey, 2016).</li> </ul>
Insufficient cost recovery from users	<ul style="list-style-type: none"> <li>• User willingness to pay for irrigation services is affected by: (i) evidence of higher production as a farm switches from rain-fed agriculture to irrigation, (ii) ability to realize such higher production through appropriate farming techniques, agricultural input and equipment, (iii) the ability to sell the farm's production (existence of a local market for the commodity, storage and transport infrastructure), (iv) the market price of the relevant agricultural commodities, (v) quality and reliability of irrigation services and (vi) social perception of water as a free, public good (Malik and Marwah, 2014).</li> <li>• A water user base skewed to large agribusiness rather than subsistence farmers allows for higher tariffs, as the former are fully equipped to take full commercial advantage of access to irrigation water.</li> <li>• For a combination of the above factors, irrigation user fees in emerging markets tend to be very low – often lower than the level required to recover O&amp;M, let alone capex.</li> <li>• Collection rates tend also to be low, due to poor supervision and enforcement in public irrigation schemes, especially when the user base is skewed towards subsistence farmers.</li> <li>• The issue concerns in particular subsistence farmers that do not gain an immediate commercial return from access to irrigation.</li> <li>• Inadequate user fees compound the maintenance and service quality issues resulting from lack of sufficient public funding.</li> </ul>
Inadequate policies and supervision	<ul style="list-style-type: none"> <li>• Government efforts tend to prioritize the building of physical infrastructure (dams, aqueducts, canals, etc.) over institutional and implementation arrangements (e.g. concerning water access and usage, maintenance and supervision).</li> <li>• Lack of technical expertise at government level can result in poor project design and service quality.</li> </ul>

	<ul style="list-style-type: none"> <li>• The operation, maintenance and supervision of an irrigation scheme is also affected by changing political agendas throughout its lifetime (usually [20-30] years).</li> </ul>
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Source: Authors

Section 5.4 describes how irrigation PPPs can address some of the issues encountered by public irrigation schemes, and highlights issues that remain unresolved under the orthodox PPP model. Section 5.5 proposes structures to deal with the open issues using concessional finance.

### 5.3 Irrigation PPPs Investors’ Landscape

#### Key Actors

- 5.3.1 **To keep pace with anticipated food demand, the global investment requirement in irrigation through 2050 is estimated to be US\$960 billion.** Growth of the demand for all crop and livestock products is projected to be lower than in the past (1.5 percent annually in the period 199/2001-2030 and 0.9 percent annually for 2030-2050, as compared to approximately 2.2 percent annually for the preceding four decades). This deceleration in growth is driven primarily by China, where caloric consumption per capita will grow by 11 percent over the next 30 years to approach that of developed countries. However, growth in demand will not slow in lesser developed countries, and food demands in sub-Saharan Africa alone will more than triple from 2000-2050 (Koohafkan et al., 2011). To meet anticipated global demand, the FAO predicts a total investment requirement over the 44-year period 2005/2007-2050 of US\$9.2 trillion, of which irrigation improvement and expansion comprises US\$960 billion (Koohafkan et al., 2011).
- 5.3.2 **MDBs have increased focus on water infrastructure financing in recent years.** The 2030 Water Resources Group, hosted at the IFC since 2012, is a public-private-civil society collaboration comprising multiple development banks, corporations, bilateral agencies, and NGOs. Following on the Managed Co-Lending Portfolio Programme (MCP) of 2013, which allocated US\$3 billion from the People's Bank of China to 70 deals over two years, the IFC is currently raising an MCP Infrastructure fund, seeking to raise US\$5 billion of private capital for investment in emerging market infrastructure loans.<sup>121</sup> Water will be a focus sector for the MCP.
- 5.3.3 **As investment funds increasingly adopt infrastructure as an asset class, more financial buyers have begun to examine opportunities in water infrastructure.** In 2014, Blackstone announced the launch of Global Water Development Partners, a water infrastructure fund, and peer firms KKR and Carlyle have made several water-

<sup>121</sup> J.T. Philip, 2017, "There is a lot of positive sentiment around India now, says IFC's Ralph Keitel," Livemint (<http://www.livemint.com/Industry/IVPC7XNCEqiPk2IjnpjPjN/There-is-a-lot-of-positive-sentiment-around-India-now-says.html>)

related transactions in recent years. Smaller, water-focused firms such as Water Asset Management and Impax Asset Management are also active in this sector, both in private and public equity investments.

- 5.3.4 **Little institutional money is going to infrastructure in emerging markets, including water infrastructure.** In the 18 months from the start of 2016 to the end of June, funds raised almost US\$53bn for North American infrastructure projects, while the comparable figure for all of Asia was only US\$9.2 billion.<sup>122</sup> Infrastructure investments are particularly susceptible to the challenges commonly found in emerging and developing markets - bureaucracy, corruption, financing costs, political risk - for two reasons. First, infrastructure investment are generally made with a long time horizon, which extends the duration of an investor's exposure to risk. Second, to date infrastructure investments are sought for their ability to deliver stable long-term cash flows. The real or perceived elevated level of volatility in EMDEs serves as a deterrent, and redirects investors to markets they perceive as more stable, even if it means sacrificing some return. It also renders investors more willing to invest in brownfield projects rather than greenfield projects which may carry some execution risk as well.<sup>123</sup>
- 5.3.5 **The private sector has yet to enter irrigation in large numbers.** Private sector actors - particularly engineering and construction firms - are increasingly becoming involved in municipality water infrastructure globally. In water infrastructure, private companies are often hired as service providers or technical operators, including in EMDEs. In some cases, these private actors have also invested in water infrastructure, not only in developed markets but also in EMDEs. For example, Suez, Veolia, and RWE are investors in approximately 10 percent of water PPPs in China.<sup>124</sup>
- 5.3.6 **Irrigation investments in EMDEs are particularly unattractive to private investors.** The irrigation sub-segment of the infrastructure investment landscape shows generally low levels of profitability, and is vulnerable to the dissatisfaction of consumers (Jensen, 2017). Also, the low ability or willingness to pay of smallholder farmers makes these projects even more complex. According to some investors the potential for popular opposition to such projects and any resultant negative reputational effects have served as a disincentive to investing in irrigation PPPs.<sup>125</sup>
- 5.3.7 **Fifteen irrigation PPP initiatives launched in EMDEs in recent years, primarily with local or regional private sector investors, show with mixed results.** Approximately half of these projects included MDB participation, primarily as

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<sup>122</sup> H. Sender, 2017, "It is odd that money is not flowing to EM infrastructure," Financial Times (<https://www.ft.com/content/e0f8d562-80c0-11e7-a4ce-15b2513cb3ff>)

<sup>123</sup> L. Teo, 2015, "India's Infrastructure Investments: Huge Opportunities but no Takers," CFA, (<https://blogs.cfainstitute.org/investor/2015/01/26/indias-infrastructure-investments-huge-opportunities-but-no-takers/>)

<sup>124</sup> World Bank, "Private Participation in Infrastructure Database," (<https://ppi.worldbank.org/data>)

<sup>125</sup> Authors' interviews

transaction advisers although the IBRD has also invested in four of these projects (Trier, 2014). Some notable examples include the Guerdane project in Morocco (consortium led by Moroccan conglomerate ONA), the Olmos project in Peru (led by Odebrecht Engineering and Construction), and the Majes-Siguas II irrigation project (led Angostura-Siguas, a consortium of Spain's Cobra Instalaciones and Peru's Cosapi construction company). While the Guerdane project has been viewed as successful, both Olmos and Majes-Siguas II faced significant opposition, at times violent, from end users who perceived the projects to threaten their livelihood for the benefit of large corporate interests.

## Challenges

- 5.3.8 **Irrigation PPPs typically achieve returns through long-term predictable cash flows.** This makes such projects difficult to fund on a commercial basis in EMDEs, which investors perceive to be more unstable. Irrigation projects usually envision an initial expenditure of capital which is recovered along with profits via long-term offtake agreements, either with a government or a collective comprising end users. In either case, the investor is subject to a risk of the offtaker's willingness to pay (WTP). In the case of a government offtaker, the WTP may be implied in the issuer or the sovereign credit rating. In the case of an end user collective the WTP may also be linked to the farmers' commercial success; hence investors are exposed indirectly to market and commodity risks. Financial commitments will only be forthcoming if private sector partners can have a degree of certainty that they will be able to recover their investments.<sup>126</sup>
- 5.3.9 **Analysis of PPP or concession models for irrigation suggests that they are more appropriate for new "greenfield" projects than for "brownfield" projects.** A study of a wide array of global PPP initiatives in irrigation suggests that attempts to introduce a PPP model into an existing irrigation scheme encountered significant resistance from a variety of stakeholders and incumbents, including farmers, staff of the current operator, and local political leaders (Trier, 2014).

## Opportunities

- 5.3.10 **With increasing land aggregation and participation of domestic corporates in EMDE agriculture ventures, irrigation schemes are becoming less risky.** The entry of larger, well-resourced corporates into the agriculture sector in EMDEs reduces some of the barriers to entry for potential water investors. These actors present water suppliers with a less fragmented, more creditworthy consumer base. Moreover, their

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<sup>126</sup> World Bank, "PPPs in Irrigation," in Public-Private Partnership in Infrastructure Resource Center (<https://ppp.worldbank.org/public-private-partnership/ppp-sector/water-sanitation/ppps-irrigation>)

ability to achieve economies of scale and to undertake capital investment in their land assets gives them more ability to pay water tariffs without recourse to unsustainable subsidies.

- 5.3.11 **Integrated micro-irrigation networks have shown promise.** The Ramthal Micro Irrigation project, slated for inauguration in September 2017, is expected to bring drip irrigation to over 70,000 acres of water-scarce land in the Bagalkot district of India's southwestern Karnataka state.<sup>127</sup> This project may serve as a bellwether for projects in areas with similar agricultural characteristics, particularly the preponderance of smallholders.
- 5.3.12 **MDBs can draw on their extensive experience in water management and EMDEs to mitigate risks for prospective water investors and help bridge the financing gap.** With extensive experience advising on water transactions, working with governments to optimize regulatory regimes, and with the benefit of an array of risk management instruments at their disposal, MDBs are well positioned to act as co-investors and draw outside capital into irrigation projects in EMDEs.
- 5.3.13 **Returns for infrastructure investment funds are decreasing as the number of participants in the sector increases.** This could increase the willingness of investors to seek out opportunities in new subsectors (i.e. water), or new geographies.

## 5.4 Irrigation PPPs as a Potential Solution

- 5.4.1 **Irrigation PPPs come in different flavors.** An irrigation PPP is a contractual arrangement between a government institution and a private sector firm giving the latter responsibility for the construction, maintenance and operation of infrastructure for water distribution to farmers, under specified performance parameters. During the contract period (usually 25-30 years) the private developer/operator charges usage fees to recover construction, O&M and financing costs and realize a return on invested capital. In the most "orthodox" version of a PPP, the private partner funds all capex and O&M costs through its own equity and commercial loans, and user fees are set at levels that allow full recovery of these costs plus a margin. In practice, the model can be adapted to different economic, financial and regulatory circumstances; for instance, public or concessional sources of funds can cover part of the initial capex, or allow for lower user fees via viability gap payments.
- 5.4.2 **The advantages of irrigation PPPs include the relief of government budget from construction and O&M costs, a clear contractual framework for maintenance and operations, and the professional expertise of the private developer/operator.** A properly managed and regulated PPP ensures the timely completion of the required

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<sup>127</sup> Daijiworld, 2017, "Bengaluru: CM to dedicate world's largest micro irrigation project next month", <http://www.daijiworld.com/news/newsDisplay.aspx?newsID=466991>

infrastructure investment, high service quality according to key performance indicators clearly set in the PPP contract, and stable and professional management during the contract period, insulated from the political cycle.

**5.4.3 Low user tariffs that do not allow for full capex and O&M cost recovery and the realization of a margin for the developer/operator are one of the main challenges for irrigation PPPs.** The reasons for this are largely exogenous and can be addressed via concessionality. As shown in Table 5.1, the willingness of farmers to pay for irrigation services depends on the potential for higher production and revenues. Commercial agribusinesses are most suited to capture this potential, having both the means to ramp up production (seeds, farming techniques) and access to market for the incremental crops. The same is not true for subsistence or smallholder farmers that may lack the capacity, financial means and value chain access to take advantage of increased production. The farmer mix (agribusiness vs. smallholders) is a given for any irrigation PPP. When smallholder farmers are the main water user group, concessionality must be considered to bridge the gap between affordable and full tariffs. The next section discusses a de-risking Facility aimed at addressing this issue. There is also an endogenous reason for low tariffs, namely poor service quality – farmers are unwilling to pay full price for untimely, unreliable water delivery. This issue, however, can be resolved through competitive selection of a qualified private sector developer/operator, definition of clear KPIs in the PPP contract and proper regulatory supervision.

**5.4.4 A PPP legal and regulatory framework and related supervisory bodies are necessary conditions for the establishment of an irrigation PPP.** This makes irrigation PPPs unsuitable for countries with underdeveloped or unclear legal regimes, unless a significant effort is made at the very early stages in the form of technical assistance to create the legal enabling environment. The next section discusses a PPP Venture Facility aimed at addressing this issue. Table 5.2 provides an overview of the advantages and issues associated with the establishment of irrigation PPPs.

**Table 5.2 - Advantages and issues of irrigation PPPs**

Issues of public irrigation schemes	PPP advantages	PPP issues
Limited funding for capex	<ul style="list-style-type: none"> <li>The private sector developer assumes all or at least part of the construction costs, reducing the impact on public budget.</li> <li>The developer has an incentive to execute the capex plan on time and on budget, since this is critical to its returns.</li> </ul>	<ul style="list-style-type: none"> <li>Full capex funding by the private sector developer may not be compatible with the realization of a commercial IRR on the project. This is especially true when water tariffs must be kept low. (See</li> </ul>

	<ul style="list-style-type: none"> <li>The PPP contract details the specs of the irrigation infrastructure built, to avoid opportunistic behavior by the developer.</li> </ul>	<p>discussion on cost recovery via tariffs below).</p> <ul style="list-style-type: none"> <li>Concessionality must therefore be explored to make irrigation PPPs feasible.</li> </ul>
Limited funding for O&M	<ul style="list-style-type: none"> <li>The developer/operator takes charge of O&amp;M costs, to be recovered via user tariffs.</li> <li>The developer/operator is chosen through a competitive process. Expertise and track record in running infrastructure concessions are key selection criteria.</li> <li>The PPP contract clearly details the O&amp;M obligations of the private developer/operator and sets key performance indicators (KPIs).</li> <li>Failure to meet KPIs can result in penalties or even loss of the concession, creating a strong incentive for the developer/operator to comply with contractual requirements.</li> </ul>	<ul style="list-style-type: none"> <li>O&amp;M is usually a smaller component of the overall project budget than capex. Nevertheless, in developing countries water tariffs are often so low as to allow only partial recovery of O&amp;M costs (see discussion on cost recovery via tariffs below).</li> </ul>
Insufficient cost recovery from users	<ul style="list-style-type: none"> <li>The private operator has a strong incentive to improve tariff <u>collection</u>, since this is key to IRR.</li> </ul>	<ul style="list-style-type: none"> <li>The private operator has little influence over tariff <u>levels</u>, which are driven mostly by the exogenous factors described in Table 5.1 and tend to be generally low in developing markets.</li> <li>As a result, the “orthodox” PPP model – based on full cost recovery plus margin via tariffs – is hard to apply in irrigation.</li> <li>Concessionality must therefore be explored to make irrigation PPPs feasible.</li> <li>In addition, in most developing countries the risk of a unilateral reduction in tariff by the government must be considered and potentially insured against.</li> </ul>
Inadequate policies and supervision	<ul style="list-style-type: none"> <li>The PPP specifies KPIs the private operator must achieve, at the risk of penalties or loss of the concession.</li> <li>As a prerequisite for any PPP, a PPP law/regulation and a regulator in charge of its application must be in place. The regulator will monitor compliance with KPIs and review the tariff formula at predetermined intervals.</li> </ul>	<ul style="list-style-type: none"> <li>Irrigation PPPs are not feasible unless solid PPP regulation is already in force, including the relevant supervisory bodies.</li> <li>Countries with a very poor legal and regulatory framework, or limited capacity to implement one, are therefore unlikely candidates for irrigation PPPs.</li> </ul>

## 5.5 Irrigation PPPs Facilitation Program

- 5.5.1 **The Irrigation PPP Facilitation Program (IPFP) is a financing scheme designed to support the adoption of climate and natural hazards resilience criteria in new and existing PPPs.** The IPFP aims at facilitating (i) the launch of new irrigation PPPs to deal with the increasing requirements of climate change and (ii) the upgrade of existing irrigation PPP infrastructure and services to increase their efficiency and effectiveness in dealing with climate change. IPFP has three components, summarized in Table 5.3 and discussed in detail afterwards: the Venture Fund and De-risking Facility, both aimed at new irrigation PPPs, and intervenes in two distinct phases of project launch (early-stage preparation and project financing); and the Upgrade Facility, aimed at refinancing or additional capital injection in existing irrigation PPPs.
- 5.5.2 **The Venture Fund provides capital and expertise at the very early stages of project preparation, particularly in countries lacking an established PPP regulatory environment.** These countries are often disregarded by pure private sector investors. Its hybrid structure, which combines commercial and concessional funds, not only enables such early-stage involvement but also resolves some of the inefficiencies associated with traditional project preparation facilities. In particular, the Venture Fund participates in project upside by receiving a stake in the equity, in exchange for its early-stage preparation work. Concessional capital subsidizes part of project preparation costs, limiting the downside should the project not come to financial close.
- 5.5.3 **The De-risking Facility intervenes in the subsequent phase of project financing and aims to bridge the tariff gap that is the major stumbling block to private capital involvement in irrigation PPPs.** As illustrated earlier, the difficulty in charging full tariffs is a major stumbling block to private capital involvement in irrigation PPPs. In addition, irrigation PPPs are very heterogeneous, their features depending on geography, hydrology, the composition of the user base (smallholder vs. large commercial farmers), the agricultural commodities involved and the existence of and connection to an established agricultural value chain. The De-risking Facility is a flexible source of concessional finance (grants or soft loans) for irrigation PPPs or the governments hosting them, aimed at bridging the tariff gap. The use of proceeds can take different forms depending on project features, including capex contributions or viability gap payments.
- 5.5.4 **The Upgrade Facility allows additional investments in existing irrigation PPPs making them climate resilient or simply enabling their sustainability.** As previously highlighted, poor operation and maintenance result in substandard service quality (water losses, untimely and unreliable water supply) that not only

reduces the climate adaptation effectiveness of the PPP but also triggers a vicious circle of poor service quality leading to unwillingness to pay for the service itself. Also existing PPPs may have been built in compliance with outdated standards or technologies, and may require retrofitting to become more climate resilient. Given the variety of circumstances that can lead to the loss of efficiency or outright failure of an irrigation PPP, the Upgrade Facility is flexible in terms of (i) financial instruments offered (grants, concessional loans and risk mitigation tools), (ii) destination of proceeds (the PPP concessionaire or the host government) and (iii) use of proceeds (refinancing of existing capital structure on cheaper terms, capex contributions and viability gap payments, among others).

**Table 5.3 Overview of the Irrigation PPP Facilitation Program (IPFP)**

Component	Target Projects	Project Phase	Structure
<b>Venture Fund</b>	New irrigation PPPs	Early-stage project preparation	Hybrid fund (combining commercial and concessional capital) that invests in early-stage PPP preparation, in exchange for an equity stake in the project.
<b>De-risking Facility</b>	New irrigation PPPs	Project financing	Concessional facility that provides grants or soft loans to new irrigation PPPs, as capex contributions or viability gap payments to offset low tariffs.
<b>Upgrade Facility</b>	Existing irrigation PPPs	Project refinancing	Concessional facility that provides grants or soft loans to existing irrigation PPPs, primarily as capex contributions for infrastructure and equipment upgrade.

### Venture Fund description

5.5.5 **The Venture Fund aims to provide capital and expertise at the earliest stages of PPP project preparation, while alleviating some of the shortcomings of traditional project preparation facilities (PPFs).** These shortcomings are summarized in Table 5.4. The Venture Fund takes a leading role in the following phases: (i) creation of the enabling environment (legislation and policy design, capacity building), (ii) project definition (desired outputs and priorities, pre-feasibility studies, action plans) and (iii) project feasibility studies (environmental, technical, social, economic and financial). To a lesser extent, the Venture Fund may contribute also to subsequent phases of project structuring (project finance, legal design, definition of private vs. public sector involvement), transaction process (bid management, contract drafting and negotiations) and project monitoring and evaluation.

**Table 5.4 - Shortcomings of traditional project preparation facilities**

Shortcoming	Description
Uncertainty of funding	Most PPFs rely on donor funding or public contributions (often one-off) and are therefore exposed to external budget constraints. Financing for project preparation is often mobilized <i>ad hoc</i> , without pre-agreed replenishment. In addition, the success of PPFs is often judged by the amount disbursed, rather than ultimate project success, distorting incentives when it comes to PPF replenishment.
Excessively broad mandate	PPFs with limited financial and human resources are often spread too thin – covering multiple sectors and geographies. This not only exacerbates the financial gap but also limits the ability of a team to develop deep sector focus and generate economies of scale (e.g. through the development of standardized, sector-specific documentation). The large number of small PPFs chasing a wide array of projects also results in problems of coordination and information sharing.
Unclear institutional arrangements	Most PPFs are hosted by the development banks that provide funding, and must conform with their operational procedures. Procurement policies, for instance for the hiring of external consultants, can be slow and cumbersome, limiting a PPF’s effectiveness.
Unsustainable business model	Most PPFs do not recover the preparation expenses incurred. This is understandable when projects fail to achieve financial close, but most PPFs are not designed to recover preparation costs even for successful projects – something that could be achieved charging the project developer or incoming concessionaire, ideally with a margin to offset the sunk costs incurred by the PPF for other failed projects. Coupled with volatile government and donor budgets, these dynamics results in a high risk of discontinuing PPF operations once funds are depleted, wasting the expertise accumulated by the PPF team.
Unclear strategy and lack of long term planning	PPFs often distribute funds without setting clear, long-term project goals. Once funds are disbursed, PPFs have little incentive and resources to remain engaged with the client – in an ideal scenario, they would provide ongoing advice, assist with project monitoring and help clients build internal capacity. PPFs also have limited incentives and expertise to engage with private sector partners, whose contribution could improve project design, financial structuring and likelihood of success.
Limited private sector expertise	PPF personnel often comes from a development or public policy background. A PPF’s ability to hire private sector professionals is hindered by its limited resources and by compensation policies that are unattractive vis-à-vis the private sector. As a result, PPFs may not adequately incorporate in their work the perspective of a potential investor or private sector developer, especially when it comes to the financial structure of a project.

Source: authors.

5.5.6 **The irrigation PPP Venture Fund aims to address some of these challenges through stable funding, a sustainable business model, specific sector focus and professional management.** More specifically, the features of the Venture Fund are:

- (i) **Institutional independence.** The Venture Fund will operate as an independent entity. It could be sponsored by the WBG or other DFIs and donors, but will hire its own team instead of drawing on sponsor resources, and will be a separate legal entity. The Venture Fund will have sole discretion in project

selection, although the sponsor could present projects to the fund. The sponsor could take a board seat for supervisory purposes, but would have no role in day-to-day management of the fund.

- (ii) Upfront capital commitment.** The Venture Fund will be structured as a closed-end fund or a permanent capital corporation. In both cases, investors or shareholders, respectively, will commit capital upfront – insulating the fund from any budget uncertainty that affects traditional PPFs. As the Fund’s pipeline becomes live, capital commitments will be drawn down to finance project preparation work.
- (iii) Exclusive sector focus on irrigation PPPs, globally.** The Venture Fund will only focus on irrigation infrastructure projects, and specifically on projects that present the potential for a public-private partnership – unlike other PPFs that do not make a distinction between public finance projects and those that could also attract private finance. The geographic scope will be global, reflecting the limited number of irrigation PPP investment opportunities at country or regional level, and the transferability of project preparation expertise between geographies.
- (iv) Sustainable business model through use of hybrid funds.** The Venture Fund will be hybrid, meaning that both commercial and concessional investors will commit capital to the fund. Commercial investors include pension funds, insurance companies and other institutional investors that customarily invest in private equity and infrastructure funds. Concessional investors can include DFIs, governments and other donors. The fund will invest in early-stage preparation work, for instance by hiring technical and legal consultants that are key in structuring PPP projects and advising governments on suitable regulatory reforms. The fund will be compensated by receiving a minority equity stake in the project, commensurate with the amount of resources committed in preparation work; the stake can be monetized at a later stage, via put option to the controlling shareholder, sale to another investor or IPO (assuming that the conditions exist for an exit in the stock market). The fund will also have the ability to top-up the stake it receives in-kind for its preparation work with additional cash injections in the project. The concessional pocket of the fund will subsidize part of the project preparation work by allocating a set amount per each project undertaken, in the form of grants or long-dated, low-interest loans. The concessional pocket will allow the fund management team to recoup part of the costs incurred in preparation, increasing the likelihood that the fund undertakes projects with a lower probability of success – i.e. projects that will not reach financial close and will therefore represent a sunk cost for the fund.

- (v) **Alignment of incentives with project developers and owners.** As part of its remuneration for project preparation work, the Venture Fund will receive an equity stake in projects that achieve financial close. This is a powerful incentive to select the best projects and bring them to successful closure. The size of this stake will depend on (i) whether the fund acts as main or co-developer, (ii) the extent of preparation work conducted by the fund (fund staff time, size of consulting team, time devoted to project) and (iii) whether the fund decides to top-up its equity investment with an injection of cash in the project. With these factors in mind, it is expected that the Venture Fund's typical stake in a project will be 20-40 percent. As shareholder, the Venture Fund will have board representation and veto rights to be negotiated as part of the shareholder agreement with the lead developer, and will provide ongoing advice.
- (vi) **Professional team with private sector expertise and incentives.** The Venture Fund will select its team independently of any institutional influence. It will be able to offer attractive, private-sector style compensation including performance bonus packages and equity participation at fund or project level. This will facilitate the hiring of experts from professional backgrounds such as project development, private equity or infrastructure investing.

### De-risking Facility description

5.5.7 **The De-risking Facility is a versatile tool available at the project financing stage, to facilitate the structuring and financial close of new irrigation PPPs via grants, concessional loans or guarantees.** Private developers participate as equity investors in a PPP project if the internal rate of return achievable throughout the project life, under realistic assumptions, reaches commercial levels, typically in the 15-20 percent range. The financial structure of an irrigation PPP involves the following elements: (i) an initial capex investment to set up the required infrastructure (e.g. dams and canals), funded through a mix of equity from the developer and other equity co-investors and commercial loans; (ii) ongoing annual operation and maintenance costs (personnel, depreciation) incurred throughout the concession life (25-30 years); (iii) ongoing financial costs incurred to service the debt assumed at the outset; and (iv) annual revenues generated by charging tariffs to water users (based on access to the scheme and/or volumes used), with tariff levels set at the beginning of the concession and revised periodically by an independent regulator according to predetermined criteria. The IRR on the project is negatively correlated to the first three variables and positively correlated to tariff levels and revenues. For instance, a project that requires a large capital investment but can only charge low tariffs – due to the specific circumstances of the agricultural area involved – may not offer a commercial IRR; in

this case, concessional finance may help bridge the gap, for instance by funding a portion of capex or by providing an annual top-up to tariff revenues.

5.5.8 **The De-risking Facility will be funded by donors, including development banks, international organizations, philanthropic institutions and corporates whose CSR efforts are focused on water preservation.** Alternatively, the Facility could also be set up as a dedicated window of an existing facility, such as the Global Infrastructure Facility (GIF) or the Pilot Program for Climate Resilience (PPCR). In either case, the Facility will exclusively focus on irrigation PPPs, i.e. infrastructure projects that envisage at least partial cost recovery through tariffs charged to the private sector. Public finance projects will be expressly ruled out from the scope of the Facility. The benefits of the De-risking Facility compared to other concessional tools routinely offered by DFIs are summarized in Table 5.5. The De-risking Facility will have the following features:

- (i) **The recipient of any disbursement from the Facility will always be the government institution that signs the PPP contract with the private developer/operator.** Given the heterogeneous nature of irrigation PPPs, the De-risking Facility will use a variety of financial instruments including grants, concessional loans and guarantees. The choice of instruments will be determined primarily by the project's economics (particularly project capex and realistic tariff levels). As a secondary parameter, the income level of the recipient country will be considered. Projects with a very high level of upfront capital investment, low tariffs, and located in low-income countries will be better candidates for grants. Projects with better economics and located in higher-income countries will be better candidates for concessional loans or guarantees.
- (ii) **The Facility will be administered by a Board including donor representatives and independent members from the financial, academic and climate community.** The Board will meet regularly (for instance every quarter) to review project applications and provide guidance to applicants. Full Board proceedings will be publicly available online. Applications to the Facility will be submitted by specially accredited entities, including regional and multilateral development banks, national development funds, and well-known non-profit organizations. Accredited entities will work in conjunction with the governments requesting assistance from the Facility, guiding them through the application process and advising on project structures that are compatible with the Facility's approval criteria.
- (iii) **The Board will review two types of applications: full funding proposals and earlier-stage concept notes.** Funding proposals will include a full feasibility study, detailed financial structure, model and assumptions, an environmental

report, a social safeguard report and letters of commitment from other providers of capital (e.g. developer and commercial banks). The approval of a funding proposal leads to the subsequent disbursement of grants or concessional loans, or extension of guarantees as the case may be. Concept notes can be submitted at an earlier stage for consultation purposes. They will include summary versions of the above documentation, with sufficient specificity to allow the Board to express a view on the suitability of the project for the Facility and provide recommendations prior to the submission of a full funding proposal.

- (iv) **The decisions of the Board, both concerning the size of the financing and the choice of instrument, will be based on a detailed investigation of project economics and the structure of the private financing package.** As previously highlighted, different variables affect the financial returns of an irrigation PPP. Concessionality can come at different stages – for instance at inception through capex contributions, or on an ongoing basis through viability gap payments. It is essential that the Board includes members with deep expertise in infrastructure finance and a background in commercial or investment banking, or infrastructure investing. Unlike other concessional facilities, it is envisaged that Board decisions may require a more iterative process and direct discussions with all project stakeholders, including private counterparties.

**Table 5.5 – Benefits of the De-risking Facility**

<b>Feature</b>	<b>Description</b>
<b>Exclusive focus on irrigation PPPs</b>	Whether set up as an independent entity or a window of an existing facility, the De-risking Facility will be exclusively devoted to projects that include private participation and the charging of user tariffs. Public finance projects will be excluded from the mandate.
<b>Expertise and hands-on involvement</b>	A Board with high degree of technical and financial expertise in PPPs, and hands-on involvement in project structuring.
<b>Flexibility</b>	Ability to tailor the concessional package to the specific needs of the project and structure of the private financing package.
<b>Independence</b>	Independent decision-making, detached from the agendas of any specific organization.
<b>Transparent decision making</b>	Full transparency of decision-making and Board proceedings.

### Upgrade Facility description

- 5.5.9 **The Upgrade Facility applies to existing irrigation PPP projects that need additional capital to make their infrastructure and operations more efficient/climate resilient.** For instance, an irrigation PPP may suffer from outdated, underinvested infrastructure and equipment (e.g. metering); without additional capex, it is likely the service quality deteriorates, reducing the willingness of farmers

to pay tariffs for water use. Another scenario may involve a tariff structure that was set at unrealistically high levels, resulting in underuse of the irrigation scheme or poor tariff collection due to delinquencies. In these situations, if the capacity for private investment (equity or loans) is already maxed out due to risk and return considerations, an injection of concessional capital may be critical to the upgrade and, possibly, survival of the PPP.

- 5.5.10 **The structure, decision-making and instruments used by the Upgrade Facility would be essentially the same at the De-risking Facility.** In fact, it would be conceivable, if not advisable, that the same Board administers both facilities, to take advantage of lessons learnt from both new and existing PPPs. It is crucial for the Board of the Upgrade Facility to be actively involved in project structuring, since off-the-shelf, standardized financial solutions are unlikely to apply in the realm of irrigation PPPs.

## 5.6 Irrigation PPPs Precedents and Potential Pipeline

**This section analyzes precedents and potential pipeline for irrigation PPPs in their most comprehensive contractual framework (concession scheme), rather than capital-light versions focused mainly on operation and maintenance.**

- 5.6.1 **IPFP is meant to facilitate irrigation concessions, alleviating the fiscal burden on the public sector.** In a concession scheme, the private developer/operator has the widest set of responsibilities, from initial construction and project financing to operation and maintenance (O&M) and tariff collection (from water users or the government). These concessions are usually awarded for long periods, typically 25-30 years, and involve a large upfront capital commitment from the private developer and commercial lenders for infrastructure build-up. There are more precedents of “light” PPPs, where the private developer is in charge of O&M and perhaps construction activities, but not financing. These PPPs are more akin to service agreements and involve limited private capital investment, leaving the burden of infrastructure financing to the public sector.
- 5.6.2 **Precedents of irrigation concessions are limited, and very diverse in terms of features and outcomes.** Table 5.6 shows nine precedents of irrigation concessions that underwent significant study and planning over the past 10-15 years. Of these, only four reached financial close – a testament to the complexity of this type of PPPs. Project features vary: project size is positively correlated to the size of the area irrigated, with capital costs ranging from a few million dollars to a few hundred million in the case of Olmos (Peru); projects target different mixes of commercial and smallholder farmers; the crops irrigated also vary widely, depending on the geographic location of the project.

**Table 5.6 Precedents of irrigation PPP concessions in developing countries**

Scheme	Country	Project Costs <sup>128</sup>	Area Irrigated	Water Users	Agricultural Off-take	Current Status
Guerdane (2004)	Morocco	US\$85m	10,000 ha	Mostly commercial farmers (600 out of 670)	Citrus	Implemented
Olmos (2010)	Peru	US\$527m	43,500 ha	Commercial and smallholder farmers	Sugarcane, cotton, pepper, vegetables, grapes and citrus	Implemented
Chiansi (2014)	Zambia	US\$25m +US\$6m working capital	2,500 ha	Commercial farmers and smallholders organized in cooperative	Commercial: wheat and soya, smallholder: maize	Implemented
ITFC (...)	Ghana	US\$4m +US\$33k O&M	202 ha	Smallholder farmers (1,300)	Mangoes	Implemented
Pontal (...)	Brazil	US\$120- US\$150m	8,000 ha	Commercial and smallholder farmers (latter representing at least 25 percent of area irrigated)	Sugarcane, citrus, banana, other fruits and vegetables	Planning
Accra Plains (...)	Ghana	US\$77m + US\$8m O&M	11,000	Commercial and smallholder farmers	Mainly rice, also banana	Planning
ORMVAs (...)	Morocco	N.A.	375,000	Commercial [and smallholder] farmers	Cereals, fodder, sugar beet and sugarcane, citrus, vegetables	Closed
Dina Farm (...)	Egypt	N.A.	4,400	Dina Farm	Wheat, clover, alfalfa, corn, banana, tomato, potato, other veg.	Closed
Toshka (...)	Egypt	N.A.	230,000	N.A.	Grapes, fruit trees, vegetables in greenhouses, trees	Closed

Source: Information derived from Mandri-Perrot and Bisbey, 2016.

**5.6.3 The significant involvement of concessional capital – provided predominantly by relevant government institutions – is a common feature among all precedents (implemented or planned).** Table 5.7 describes the financial and tariff structure of the nine precedents. What emerges clearly is a significant participation by the public partner in the financing of the initial infrastructure investment – representing in most cases more than 50 percent of it. Such participation occurred either via grants or concessional loans (long-dated loans at low interest rates and possibly subordinated

<sup>128</sup> Construction costs unless otherwise indicated.

in the capital structure). Other forms of concessional support included: partial credit guarantees on debt assumed by the PPP's special purpose vehicle; annual or one-off viability gap payments; free access to groundwater or surface water for subsequent distribution to farmers; and contributions to O&M costs. This variety of concessional mechanisms reflects different project features, the government's fiscal capacity, and the local regulatory environment.

5.6.4 **Tariff structures vary widely among different projects.** In most cases, farmers pay on a per usage basis – typically per cubic meter of water or per hectare irrigated. Olmos (Peru) includes a penalty for non-use of water, to avoid the scenario in which the new infrastructure goes unutilized. ITFC (Ghana) takes into account affordability issues affecting smallholder farmers by structuring service fees as payments in-kind – smallholders transfer their production to a large agribusiness until the cost of their participation in the irrigation scheme is fully recouped. In Guerdane (Morocco) farmers – mostly commercial – also contribute to 5 percent of the overall infrastructure investment.

5.6.5 **Guerdane in Morocco was the first irrigation PPP in the world and is generally considered the most successful example. With local adaptations, Guerdane could be a template for future projects.** The project addresses the depletion of groundwater sources for citrus farmers in a large area of southern Morocco, through a newly-built irrigation network connected to a distant dam complex. In July 2004, through a competitive tender, the Government awarded ONA, a Moroccan industrial conglomerate, a 30-year concession to build, co-finance, and operate the irrigation network. The main selection criterion was the lowest water tariff. ONA received exclusive rights to channel and distribute irrigation water within the perimeter, in exchange for assuming construction (time and cost) and tariff collection risk. Demand/payment risk was mitigated by conducting an initial subscription campaign whereby farmers paid a fee covering the average cost of on-farm connection; ONA's construction obligation only started when subscriptions were received for 80 percent of available water. Water shortage risk was allocated among ONA (with revenue losses from water shortage capped at 15 percent), farmers (with a tariff surcharge of up to 10 percent in case of drought) and the Government (with a financial compensation to ONA in case of very significant shortages). Construction costs were allocated between ONA (50 percent), the Government (45 percent) and farmers (5 percent, through the one-off connection fee). A public subsidy was designed to maintain water tariffs equivalent to pumping costs previously incurred by farmers; in reality ONA was able to charge even lower tariffs. Guerdane was a success in several respects: (i) by 2009, 100 percent connection rate was achieved, reducing the risk of depleting underground water resources; (ii) the transparent and competitive bid process resulted in lower-than-expected water tariffs; (iii) it was the first

irrigation PPP project in the world and a potential template for future projects; (iv) in addition to the climate adaptation benefits, the project improved the income and livelihood of over 1,900 farmers and 11,000 people in the local economy. While project structuring was key to the success of Guerdane, it is important to note that the PPP benefited from an established base of commercial farmers, who quickly saw the benefits and returns from a tariff-based irrigation scheme.

**Table 5.7 Irrigation PPP precedents – financing and tariff structure**

Scheme	Contract Type	Private Partner	Public Partners	Private Financing	Public/Donor Financing	User Tariffs
<b>Guerdane</b> (Morocco)	30-year concession	ONA (Moroccan industrial group)	Government of Morocco	50 percent of infrastructure cost	45 percent of infrastructure cost (50/50 grant and concessional loan)	5 percent of infrastructure cost funded through one-off per ha charge. Fixed annual fee per ha for use of water
<b>Olmos</b> (Peru)	23-year concession	Odebrecht (construction and infrastructure group)	Government of Peru, regional government	Most of infrastructure cost (through own capital + bonds issued on Lima exchange)	Part of infrastructure cost + partial credit guarantee on US\$50m worth of project bonds	Farmers acquire title to land and right to irrigation services. Water usage fee on a per cubic meter basis, with penalty if water supply not used
<b>Chiansi</b> (Zambia)	[...]-year concession	[...]	Ministry of Agriculture, [DFIs]	40 percent of infrastructure cost (16-18 percent target equity IRR)	60 percent of infrastructure cost (concessional long-term subordinated capital)	[...]
<b>ITFC</b> (Ghana)	15-year concession	ITFC (commercial agribusiness)	Government of Ghana, World Bank, Millennium Challenge	100 percent of infrastructure and O&M	[None]	Smallholder farmers receive no-interest loan to participate in scheme, repaid over-time by selling production to ITFC

<b>Pontal</b> (Brazil)	25-year concession	To be determined	Agency of Government of Brazil	Approx. 50 percent of infrastructure cost	Approx. 50 percent of infrastructure cost + annual capacity payment to private partner (per hectare irrigated)	Annual tariffs per m3 and per ha, subject to caps
<b>Accra Plains</b> (Ghana)	15 to 25-year concession	To be determined	Government of Ghana, World Bank	Part of infrastructure cost	Part of infrastructure cost through one-off viability gap funding	To be determined
<b>ORMVAs</b> (Morocco)	Concession	To be determined	Government of Morocco, public irrigation agencies	To be determined	To be determined	Tariff on a per m3 basis
<b>Dina Farm</b> (Egypt)	Concession	Dina Farm (large commercial farm)	Various government counterparts	100 percent of infrastructure cost	Free concession of groundwater and additional river water (if groundwater insufficient)	N.A.
<b>Toshka</b> (Egypt)	Concession	To be determined	Min. of Water and Irrigation	Some components of O&M	100 percent of infrastructure cost + some components of O&M	Water pumping and distribution fees per m3, with progressive scale

Source: Information derived from Mandri-Perrot and Bisbey, 2016.

**5.6.6 The irrigation PPP pipeline is limited, unlike other more established infrastructure PPP investments. IPFP could play an important role in the sourcing, structuring and executing projects that would otherwise remain a paper exercise.** Table 5.8 summarizes 5 projects in which the World Bank is involved in a technical assistance capacity. Of these, the Argentinean projects are currently in feasibility study phase.

**Table 5.8 Indicative pipeline of irrigation PPP concessions**

Scheme	Country	Project Costs <sup>129</sup>	Area Irrigated	Financial Structure	Tariff Structure	Current Status
<b>Negro Muerto</b>	<b>Argentina</b>	US\$138 m	58,509 ha	Private partner and public partner (Government, Province) jointly contribute equity capital to an SPV. Additional project finance by commercial banks. SPV in charge of capex and O&M.	Tariffs could include: connection charge, take or pay, consumption-based	WB producing feasibility study
<b>Mari Menuco</b>	<b>Argentina</b>	US\$75m	14,517 ha	As above	As above	WB producing feasibility study
<b>Meseta Intermedia</b>	<b>Argentina</b>	US\$212 m	35,000 ha	As above	As above	WB producing feasibility study
<b>N.A.</b>	<b>Malawi</b>	US\$200 m	N.A.	To be determined	To be determined	WB developing concept
<b>N.A.</b>	<b>Zambia</b>	N.A.	N.A.	Most capital investment from public partner. Private partner mainly responsible for O&M	N.A.	Tender for selection of private operator

Source: Information derived from Mandri-Perrot and Bisbey, 2016.

<sup>129</sup> Construction costs unless otherwise indicated.

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## 6 Resilient value chains: early stage and PE/VC in agri-resilience

*The agriculture sector is greatly affected by the policy environment, natural endowments (such as arable land, water resources, soil fertility), climate and natural hazards (such as the type of climate, the frequency and type of natural disasters), local traditions and practice (such as social awareness, technologies, and local practice), institutional framework (such as the depth of local financial markets, land titles, and regulation), and so on. Any meaningful effort to identify ways to attract private capital to agri-resilience must contend with this fact. This chapter focuses on agri-resilience opportunities in Asia, given the region's exposure to a wide array of natural and climate hazards, and the considerable economic importance of the sector for local economies and exports. The heterogeneity of the Asia region in terms of development status, climate vulnerability, geography, and economic preparedness prevents any "one-size-fits-all" method. Therefore, three pilot countries— China, Myanmar, and Vietnam – are analyzed in this chapter. An Agriculture Sector Resilience Investment Fund (ASRIF)-Asia is proposed to promote resilience across the agriculture value chain through early stage PE/VC investments.*

### 6.1 The Rationale for Investing in Value Chains in Asia

**6.1.1 There are common challenges for and key features of the agriculture sector in Asia that impact the space and hinder the pace of adaptation investment.** This chapter illustrates these challenges through the experience of three countries – China, Myanmar, and Vietnam – and proposes a possible solution aimed at facilitating private sector investment in resilient value chains.

- *Considerable water challenges and pollution of agricultural land.* Economic growth and increasing demand for agricultural products has historically resulted in over-cultivation, over-grazing and deforestation, leading to environmental degradation, including reduced fertility, erosion, acidity change, and damage from overuse of fertilizers. Lack of knowledge and awareness, low affordability of more advanced facilities and technologies, and poor supporting

environment (including price and subsidy policies), combined with the effects of climate change on water resources, are common features across developing Asia.

- *Pervasive presence of the government as investment actor.* Direct intervention of the government in the agriculture sector is still noticeable across the region, in some cases acting as barrier to private sector investment;
- *Shallow financial markets.* The depth of financial markets varies across the region, but access to finance for agriculture remains a common challenge across different market structures.
- *Land tenure issues and land fragmentation.* Small landholdings are typical in Asia, making it more difficult to adopt resilient agriculture techniques and technologies. Land consolidation has started in some countries (for example, China and Vietnam) and may create opportunities for economies of scale, although the trend is still in its infancy.
- *Low efficiency compared to developed countries.* At the macro level the Asian agriculture sector is less efficient than other regions. This, coupled with rising risks from climate change, increasing local demand, and changing demand patterns suggest that substantial potential exists for fast tracking adaptation investments in Asia.
- *The vast majority of SMEs use traditional farming methods.* Agriculture markets are generally fragmented and SMEs play a significant role across the region. Some regional leaders are starting to emerge in certain business segments and value chain links. But these remain exceptions.

## 6.2 China

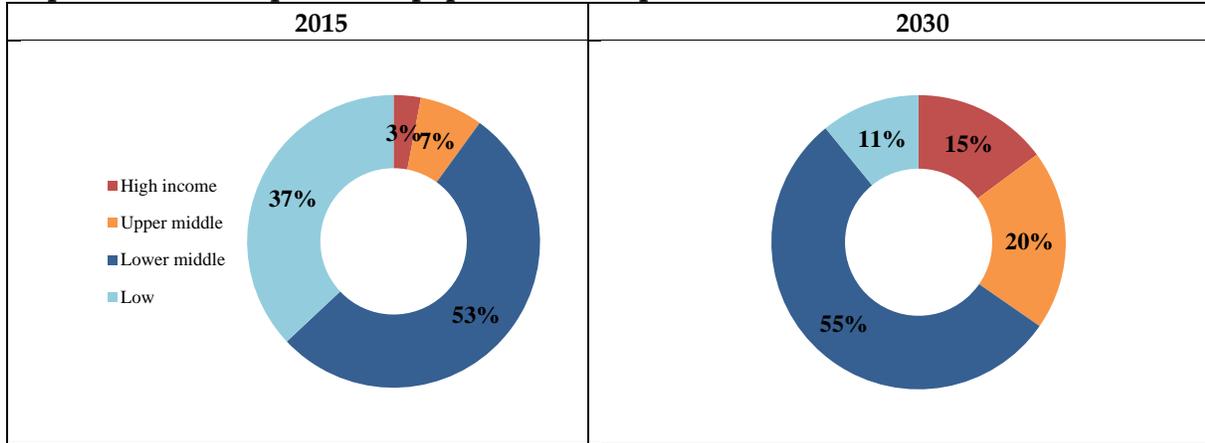
*The challenge ahead is to meet the increasing demand for consumption upgrading, with severe resource constraints*

### 6.2.1 Agriculture Market Analysis

- 6.2.1.1 **The emergence of a middle class has profound implications for food consumption in China.** Although the definition of middle-class in China is debatable, it is a fact that a growing number of people can afford a higher level of consumption. This trend is expected to continue as suggested by the estimated increase in the middle to high income portion of the population shown in Figure 6.1. After decades of catch-up growth in basic consumption, “Consumption Upgrading” – including agriculture products – is now the main theme of the consumer sector in China. “Consumption

Upgrading” refers to the switch to more expensive goods with perceived or real higher quality standards.

**Figure 6.1 - Estimates of future income distribution (measured by per capita annual disposable income, percent of population, 2015 prices)**



Source: EIU (Chart recreated from data from Economist Intelligence Unit via South China Morning Post report)<sup>130</sup>

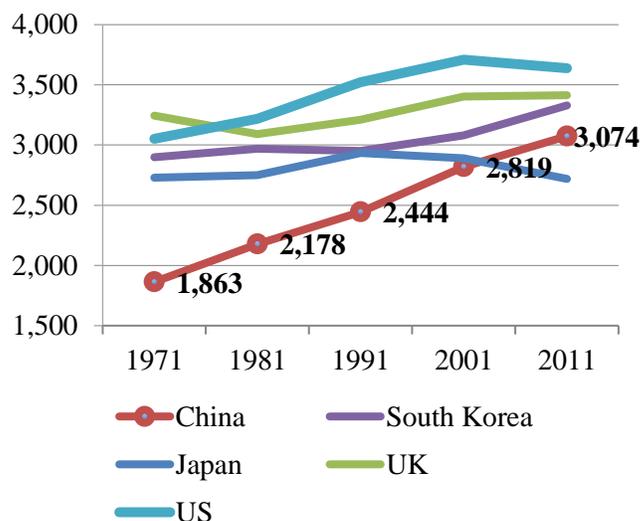
**6.2.1.2 The changing demand for food is leading to the transformation of China’s agriculture industry.** The transformation of the agriculture sector started four decades ago with the reform of the country’s system of production. Government policies successfully increased the production of staples like rice and wheat, and led to the rise of the middle class.<sup>131</sup> The profile of the demand for food in China has changed overtime: products like meat and milk are no longer luxuries (Figure 6.2). Increasingly Chinese consumers are seeking products that offer convenience, and packaged food sales are expected to reach a value of US\$350.5 billion by 2020.<sup>132</sup>

<sup>130</sup> M. Zuo, 2016, “China’s middle class to rise to more than third of population by 2030, research firm says,” South China Morning Post (<http://www.scmp.com/news/china/money-wealth/article/2042441/chinas-middle-class-rise-more-third-population-2030-research>)

<sup>131</sup> Bloomberg News, 2017, “Farming the World: China’s Epic Race to Avoid a Food Crisis” (<https://www.bloomberg.com/graphics/2017-feeding-china/>)

<sup>132</sup> Government of Canada, 2016, “Market Overview – China” (<http://www.agr.gc.ca/eng/industry-markets-and-trade/foreign-market-information-by-region/asia/market-intelligence/market-overview-china/?id=1473866800326>)

**Figure 6.2 - Per capita daily calorie consumption in kcal (1971-2011)**



Source: Authors' estimates based on PWC, "China's agricultural challenges, Roads to be travelled," 2015

**6.2.1.3 Meeting a growing and more sophisticated demand for food poses special challenges to an already stretched agricultural sector.** China has the world's largest agricultural sector, and it is the leading producer of rice, cotton, pork, tomatoes, fresh eggs, garlic, and watermelons. However, the country has only 10 percent of the world's agricultural land while it hosts almost 20 percent of the world's population. China only has about 0.2 acres of arable land per citizen. In comparison, it takes about one acre (half a hectare) to feed the average U.S. consumer.<sup>133</sup> About 86 percent of farms in China are small-sized: only 1.6 acres compared to the average 441-acre of US industrialized farm.<sup>134</sup>

**6.2.1.4 Water scarcity and water overexploitation have weakened the adaptive capacity of China's agriculture sector.** Agriculture remains the key user of water, accounting for 76 percent of total water consumption compared to the OECD average of 42 percent. According to the UNDP (2006), nationwide, per capita freshwater resources are 2,039 m<sup>3</sup>, which is only 35 percent of the world average. In the dry regions of the North and Northeast, freshwater resources are only 785 m<sup>3</sup> per person, about 200 m<sup>3</sup> less than the international threshold for "severe" water stress. In addition, overexploitation of water resources, including withdrawals from rivers and overdraft of ground water resources, has caused water tables to drop. Even in regions where annual precipitation is expected to increase, such as the North, Northeast, and

<sup>133</sup> Bloomberg News, 2017, "Farming the World: China's Epic Race to Avoid a Food Crisis" (<https://www.bloomberg.com/graphics/2017-feeding-china/>)

<sup>134</sup> CKGSB, 2017, "Down on the Farm: Agriculture in China Today" (<http://knowledge.ckgsb.edu.cn/2017/02/06/agriculture/china-agriculture-today/>)

Northwest, the water stress is unlikely to be alleviated, as absolute demand by industries, agriculture, and cities continues to rise (Sall, 2013).

**6.2.1.5 Limited and deteriorating land resources pose adaption challenges.** Massive agricultural land has been lost to the rapid industrialization and urbanization during the past decades (Shi et al., 2016).<sup>135</sup> Soil quality also took a toll. More than 40 percent of the arable land is suffering from degradation, including reduced fertility, erosion, acidity change, and damage from pollutants mostly due to over-cultivation, over-grazing, and deforestation.<sup>136</sup> The increasing desertification aggravates the land and water shortages. Pollution of arable land poses additional challenges. According to *The Investigation Report on the Situation of Soil Pollution in China* published by the Ministry of Environment Protection and the Ministry of Land Resources of China (2014), 19.4 percent of the country’s arable land is contaminated (Table 6.1). Soil contamination is more severe in southern China, and some of the more economically developed regions such as the Yangtse River Delta, the Pearl River Delta, and the Northeast Industrial Bases suffer from the most severe soil contamination in China.

**Table 6.1 - Land contamination (percentage of total land)**

Type	Contamination ratio	Minor*	Light*	Medium*	Severe*
Arable land	19.4	13.7	2.8	1.8	1.1
Forest land	10.0	5.9	1.6	1.2	1.3
Grass land	10.4	7.6	1.2	0.9	0.7
Unutilized land	11.4	8.4	1.1	0.9	1.0

Source: *The Investigation Report on the Situation of Soil Pollution in China* (2014) <http://www.zhb.gov.cn/gkml/hbb/qt/201404/W020140417558995804588.pdf>

Notes: \* Minor: pollutants tested are 1-2 times of the national standard; Light: 2~3 times; Medium: 3~5 times; Severe: >5 times

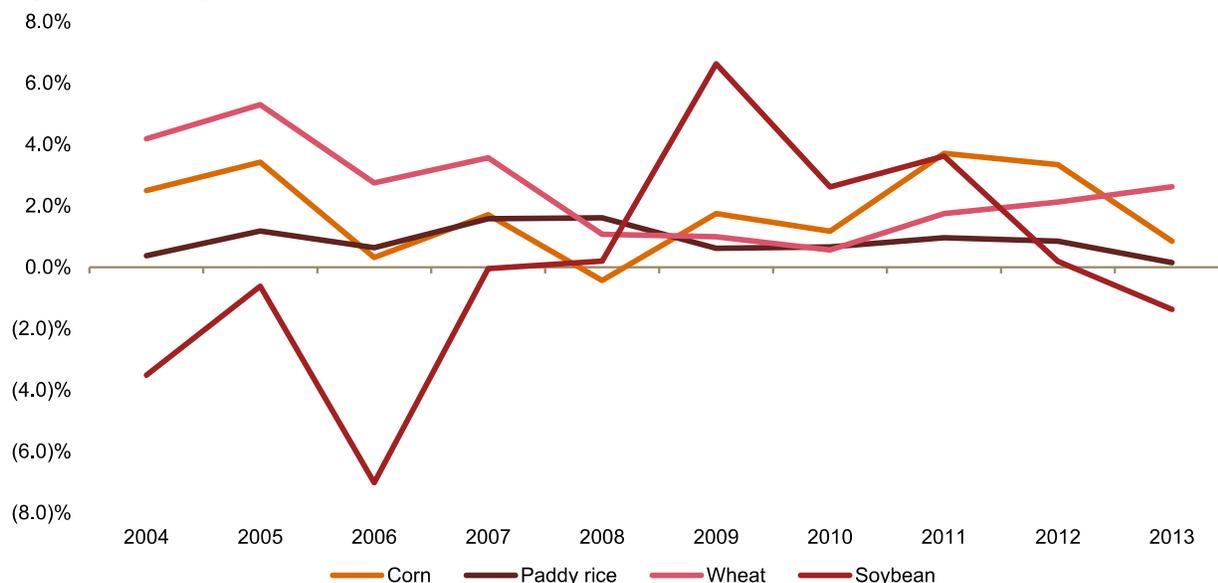
**6.2.1.6 Average agricultural yield continues to lag behind that of the United States and the European Union.** China’s agriculture sector experienced high growth since the 1980s. During 1985-2007, agricultural output grew an average 5.1 percent annually in real terms (Wang et al., 2013). However, total factor productivity (TFP) decreased from 5.1 percent between 1996 and 2000 to 3.7 percent per year in 2005-07 (Wang et al., 2013). As shown in Figure 6.3, yields of major commodities have stagnated or grown slowly in recent years (Bruinsma, 2003). In an effort to increase yields, famers have made intensive use of chemicals and fertilizers, with diminishing marginal

<sup>135</sup> Studies showed that China’ total urban area grew at an average annual rate of 13.36 percent from 2001 to 2013, and consumed 33,080 km<sup>2</sup> of agricultural land during this time (Shi et al. 2016).

<sup>136</sup> China Daily, 2014, “More than 40% of China’s arable land degraded: report” ([http://www.chinadaily.com.cn/china/2014-11/05/content\\_18871081.htm](http://www.chinadaily.com.cn/china/2014-11/05/content_18871081.htm))

impact on outputs and considerable agricultural pollution, including pollution of the water system, degrading soil fertility, and GHG emissions.<sup>137</sup>

**Figure 6.3 - Major Commodities Annual Yield Growth in China**



Source: PWC, 2015; USDA

Note: Yields are calculated on a 3-year moving average basis

**6.2.1.7 There is significant room for mechanization in Chinese agriculture.** Some 35 percent of China’s labor force is employed in the sector, compared to the 2 percent that is typical for capital-intensive, high-technology agricultural sectors in the OECD.<sup>138</sup> Automation and mechanization require a certain scale for efficiency.<sup>139</sup> However, in China the average farm size is 0.62 hectares.<sup>140</sup> By comparison, in the United States nearly all farms are larger than five hectares. Figure 6.4 provides a comparison of farm sizes in China and in other countries.

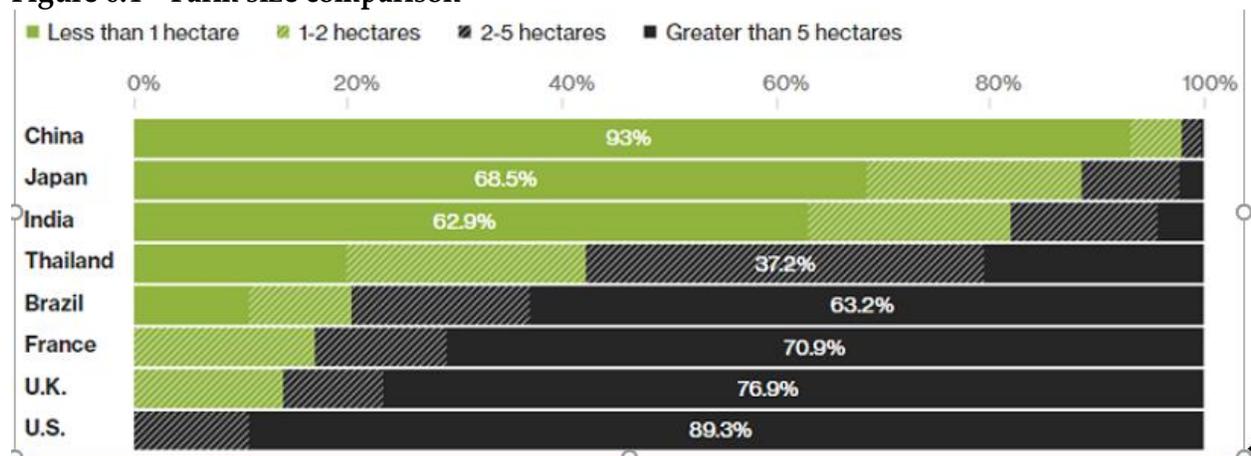
<sup>137</sup> China’s chemical fertilizer use has roughly doubled over the past two decades while pesticide use and mechanized inputs have increased even faster; China has slightly less agricultural land than the United States, but its chemical fertilizer use is now double that of the United States (Carter, 2011).

<sup>138</sup> U.S. International Trade Administration (ITA), 2015, “China” in 2015 ITA Agricultural Equipment Top Markets Report ([http://trade.gov/topmarkets/pdf/ag\\_equipment\\_china.pdf](http://trade.gov/topmarkets/pdf/ag_equipment_china.pdf))

<sup>139</sup> Bloomberg News, 2017, “Farming the World: China’s Epic Race to Avoid a Food Crisis” (<https://www.bloomberg.com/graphics/2017-feeding-china/>)

<sup>140</sup> Per capita arable land is 0.16 ha in 2012 according to NBSC, which gives per household land size of 0.62 ha under the assumption of 3.88 people per rural household. This is in contrast with the land size of farming households in Japan (1.4 ha), South Korea (1.2 ha), the US (195.2 ha) and major western European countries (ranging from 18 to 69 ha) (Huang et al., 2016).

**Figure 6.4 – Farm size comparison**



Source: Bloomberg, FAO

**6.2.1.8 The socioeconomic significance of the agriculture sector amplifies the risks posed by climate change, and increases the country’s vulnerability.** Despite China’s rapid industrialization during the past three decades and recent rise of the service industry, the agriculture sector remains essential to the country, especially in terms of economic growth, rural employment, and poverty reduction. According to the National Bureau of Statistics of China (NBSC), as of 2015, the agricultural sector employed more than 219 million people, and contributed about 8.9 percent to the country’s GDP. Rural households are significantly poorer and have less access to basic services, which increases their exposure to climate risks and makes it more difficult for them to cope with changing production and living conditions.<sup>141</sup>

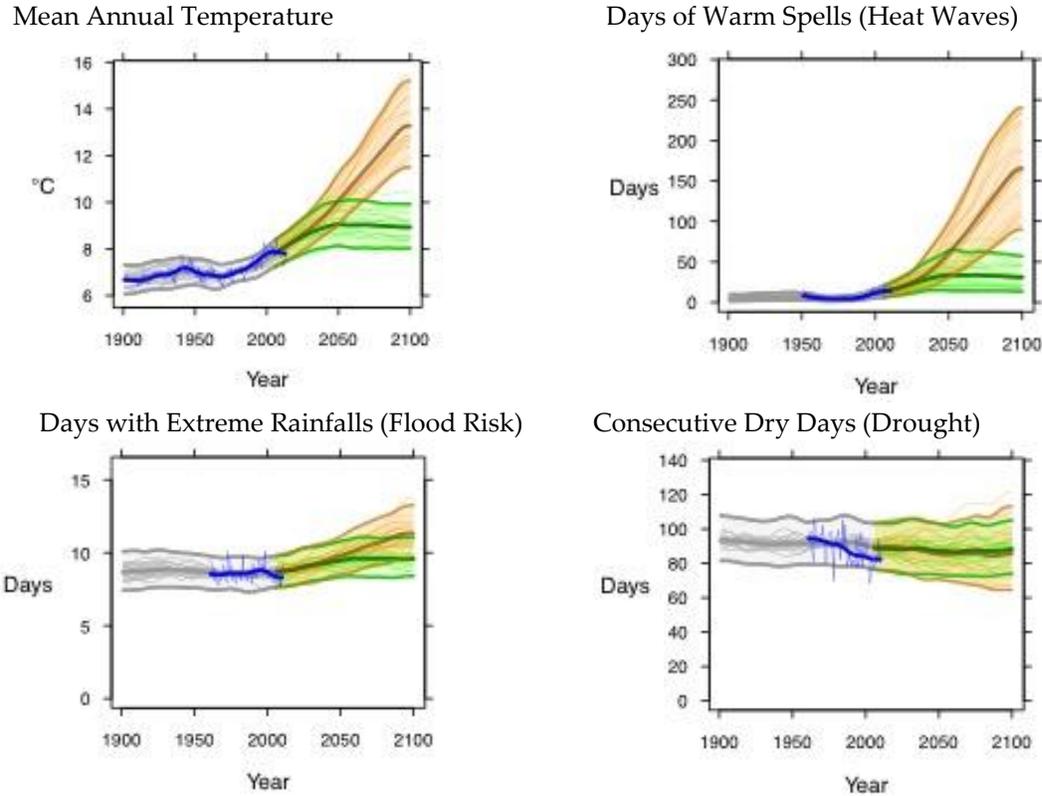
**6.2.1.9 Major climate and climate change hazards in China include flooding due to extreme storms, sea-level rise, storm surges, glacier and permafrost melt, droughts, and heat waves.** Research suggests that evaporation and drought will increase across the North, Northeast, and Northwest; flooding is expected to increase for the middle and lower reaches of the Yangtze and Pearl River basins.<sup>142</sup> A higher portion of rainfall is projected to come from shorter and intense storms in some regions. The melting of glaciers in the Southwest and Northwest parts of the country will affect river flows downstream, and heat waves are expected to become more common (ADB, 2015). In addition, the storm surges, tidal floods, and rising seas will threaten a large area of coastal lands (ADB, 2015). These primary hazards would lead to

<sup>141</sup> In 2015, per capita disposable income of urban households is RMB 31194.83, compared to the RMB 11421 of rural households (NBSC Data)

<sup>142</sup> The Yangtze region is home to more than 400 million people, or nearly one-third of China’s population. Some of China’s largest cities—Chengdu, Chongqing, Wuhan, Nanjing, and Shanghai—are all located in the plains that adjoin the banks of the Yangtze River and its tributaries in the basin. (<https://www.worldwildlife.org/places/yangtze>) The Pearl River Basin covers one-fifth of China’s area, contains one-third of its population. The Pan-Pearl River Delta comprises the provinces and administrative regions of Guangdong, Guangxi, Yunnan, Sichuan, Guizhou, Hunan, Jiangxi, Fujian, Hainan, Hong Kong and Macao. (<https://www.chinadialogue.net/article/show/single/en/3266-Fighting-pollution-on-the-Pearl-River->)

secondary impacts, which include subsidence, coastal land loss, forest and grassland fires, saltwater intrusion, desertification, land degradation, and landslides. Figure 6.5 provides an overview of estimated future climate hazards.

**Figure 6.5 – China Climate Hazard Projections**



Source: WHO, UNFCCC

Notes: The model projections above present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 (in orange) and a low emissions scenario (in green). The figures also show each model individually as well as the 90 percent model range (shaded) as a measure of uncertainty and, where available, the annual and smoothed observed record (in blue).

**6.2.1.10 China is severely affected by natural disasters and the risk is expected to rise.**

Between 2000 and 2014, weather related disasters caused more than US\$628.6 billion of damage in China, equal to 1-3 percent of the country’s GDP. China is one of the countries that suffer from frequent disasters because of the vast territory, variety of climatic zones, complex geographical environment, and fragile ecological conditions (Zhou et al., 2015).<sup>143</sup> Evidence suggests that climate change is altering the profile of hazards in China with visible effects (Seneviratne et al., 2012).<sup>144</sup> Increased precipitation has taken the form of short and intense storms. At the same time, despite the projected increase in overall rainfall, drought is expected to affect many

<sup>143</sup> Xinhua, 2010, “Weather Disasters Cause RMB 200-300 Billion in Economic Damages Each Year in China” ([http://news.xinhuanet.com/video/2010-03/30/content\\_13270583.htm](http://news.xinhuanet.com/video/2010-03/30/content_13270583.htm))

<sup>144</sup> B. Mehta, 2017, “In Lishui, China’s “home of longevity”: working towards resilience and adaptation to climate change” World Bank (<http://blogs.worldbank.org/eastasiapacific/chinas-home-of-longevity>)

regions (Zhai et al., 2005; Zhai et al., 2007). The average annual surface temperatures have increased by 1.38°C between 1951 and 2009. The change was more drastic in the North and Northeastern provinces. Regional variations in precipitation have become more pronounced and extreme climatic events are becoming more severe (Woetzel and Joerss, 2009).

**6.2.1.11 Although significant progress has been made on high-level adaptation policies, challenges remain in the implementation of the national adaptation plans.** China has made significant progress in the design and adoption of national adaptation policies.<sup>145</sup> The guiding policies and plans are comprehensive and region-specific, and identify rising levels of soil erosion, poor water management, technological bottlenecks, and the low public awareness of adaptation challenges. However, uncertainty remains on ways to translate policies into actions, particularly with regard to capital mobilization, and market mechanisms to be used to achieve adaptation targets.

**6.2.1.12 Reforms in land use rights have resulted in the consolidation of operators, laying the ground for the use of modern agriculture techniques that improve resilience.** Although the responsibilities of farming were devolved to individual households in the 1980s, farmers still do not own the land – the state owns it through local rural/village collectives. Arable land is legally owned by the village collective, which is contracted to households that receive 30-year rights to an average of 6-10 acres (2.4-4 hectares) of land.<sup>146</sup> Each of the pieces of land is then usually divided into separate plots and use rights are given to farmers. Since the launch of Household Responsibility System in late 1970s, the government has gradually loosened control over the transfer of agricultural land use right.<sup>147</sup> Recent reforms allow the transfer of land rights from title-holders to land users. The system is designed to foster the transfer of land use rights from small farmers to entrepreneurs to achieve scale for more efficient crop production via mechanization and new technology. The ratio of transferred farmland rose from 5 percent in 2005 to over 30 percent in 2013 (Figure 6.6). In 2016, the Chinese government issued a new set of guiding policies to further clarify the rural land rights, accelerate the rural land registration program, and improve rural land rights transfer markets (General Office, CCCPC, 2016). The renewed policy impetus is expected to lead to further land circulation and consolidation, which in turn will enable the use of modern agriculture techniques including those aiming to improve resilience.

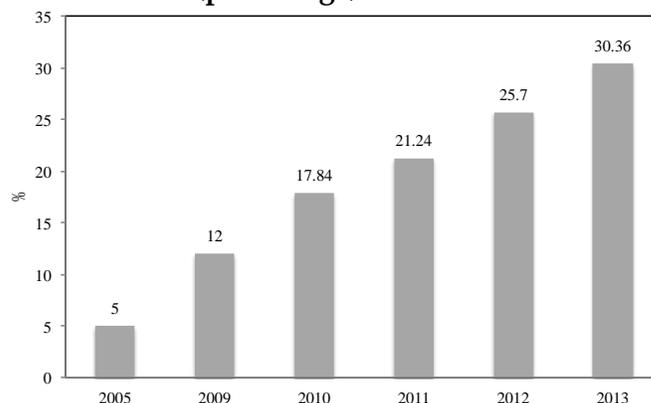
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<sup>145</sup> The National Climate Change Program was developed and implemented in 2007; three rounds of climate change national assessments have been conducted; China's Climate Change Adaptation Strategies before 2020 was also developed.

<sup>146</sup> L. Hornby, 2016, "China land: losing the plot," Financial Times (<https://www.ft.com/content/42eca2b6-3d4d-11e6-8716-a4a71e8140b0>)

<sup>147</sup> Farmland in China is collectively owned and farmers only have the right to contract and use the land.

**Figure 6.6 –Transferred Farmland (percentage)**



Source: Huang et al. (2017); China Agricultural Development Report; Ministry of Agriculture of China

**6.2.1.13 Demographic changes may accelerate land consolidation, leading to higher productivity and efficiency.** About 60 percent of China’s senior citizens live in rural areas, accounting for some 80 million elderly (age 60 or older). Chinese farmers typically work in the fields past 70 and many of these elderly farmers are facing a difficult situation: besides concerns about caring for the aging rural population, their children and grandchildren are less likely to return to take care of the farm.<sup>148</sup> Elderly farmers may see an opportunity to secure a more stable source of revenue through leasing their land to corporations. However, scaled-up agribusinesses will develop over time. This is because the long-term use of land plots is usually the only safety net that Chinese farming families have. For example, if workers face hardship and unemployment in cities, they can return home and provide a living for themselves from the land.<sup>149</sup> The government has been introducing regulation to incentivize private industry to enter the once off-limits agricultural sector by developing corporate farms.<sup>150</sup> Several models have emerged including the “Capitalist Entrepreneur Model” operated by companies owned by entrepreneurs, and the “Model Large-scale Farm” operated by companies funded by the government, SOEs, or other public capital.

**6.2.1.14 Despite some movement towards price liberalization, food security considerations underpin the extent and pace of price reforms.** The Total Support Estimate (TSE) was 2.4 percent of GDP in 2014-2016, about four times higher than the OECD average. However, the level of support to farmers has stabilized in recent years, with the

<sup>148</sup> World Bank, 2012, “New Bank Report Looks at China’s Rural Elderly” (<http://www.worldbank.org/en/news/press-release/2012/04/09/new-bank-report-looks-at-china-rural-elderly>); and D. Roberts, 2017, “China’s Rural Poor Bear the Brunt of the Nation’s Aging Crisis,” Bloomberg (<https://www.bloomberg.com/news/articles/2017-01-05/china-s-rural-poor-bear-the-brunt-of-the-nation-s-aging-crisis>)

<sup>149</sup> T. Nunlist, 2017, “Down on the Farm: Agriculture in China Today,” CKGSB (<http://knowledge.ckgsb.edu.cn/2017/02/06/agriculture/china-agriculture-today/>)

<sup>150</sup> U.S. International Trade Administration (ITA), 2015, “China” in 2015 ITA Agricultural Equipment Top Markets Report ([http://trade.gov/topmarkets/pdf/ag\\_equipment\\_china.pdf](http://trade.gov/topmarkets/pdf/ag_equipment_china.pdf))

percentage Producer Support Estimate (percentPSE) fluctuating between 14 and 16 percent in the period 2013-2016. This partly reflects policy reforms undertaken in China, such as: (i) stabilization or even lowering of minimum prices for rice and wheat; (ii) exclusion of some commodities from government purchases at intervention prices (cotton, soybeans, rapeseed, and maize); and (iii) partial replacement of market interventions by direct payments.<sup>151</sup>

**6.2.1.15 Analysis of structural factors further support the needs of increasing agriculture productivity, efficiency, and sustainability, and substantial amount of long-term capital would be required to fund such efforts.** (1) The increasing needs for food consumption and upgrading, the severe resources constraints including water shortage, low efficiency, and soil contamination, and the current land consolidation trend require improvement across the agriculture value chain. (2) Long-term capital is needed for agriculture (resilience) investments in China. Early cases indicate that companies getting into agriculture make substantial investments, but then get caught off guard by market volatility, especially under the less liberalized market condition. Furthermore, it takes months before crops are ready and new market entrants underestimate crop failure risks. Given these realities, it appears as though long-term, patient capital will be necessary to buttress any serious attempt at farming consolidation and modernization.<sup>152</sup>

## 6.2.2 Agriculture Resilience Investors' Universe

### Key Players

**6.2.2.1 State-owned institutions continue to play a dominant role in China's agricultural sector.** The state owns all agricultural land and regulates its use. Individual farmers with lease rights to farm small plots make up the majority of agricultural labor. Although private firms have been steadily entering the market since China's entry into the WTO, SOEs continue to play a major role in most market activities along the value chain. Recently, the Chinese government announced plans to invest US\$450 billion toward food security, domestic seed development, and other agriculture reforms, and the state-owned Agricultural Development Bank has already committed to lending a similar amount to agricultural enterprises (it is not clear if the amounts are separate).<sup>153</sup> In recent years, agriculture SOEs have begun to reorganize as part of the government's food security strategic shift away from self-

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<sup>151</sup> OECD, "Producer and Consumer Support Estimates database" (<http://www.oecd.org/tad/agricultural-policies/producerandconsumersupportestimatesdatabase.htm>)

<sup>152</sup> T. Nunlist, 2017, "Down on the Farm: Agriculture in China Today," CKGSB (<http://knowledge.ckgsb.edu.cn/2017/02/06/agriculture/china-agriculture-today/>)

<sup>153</sup> RT, 2016, "China to invest \$450 billion in agriculture" (<https://www.rt.com/business/359841-china-invest-billions-agriculture/>)

sufficiency. For example, the China Oil and Foodstuffs Corporation (COFCO), China's largest commodities trader and agribusiness conglomerate, has begun to introduce mixed ownership into its 18 subsidiaries and seek listing for some of its divisions.<sup>154</sup> COFCO's restructuring includes the formation of COFCO Capital, an acquisition platform that lists among its shareholders the state-owned Enterprise Structural Adjustment Fund, Beijing Capital Agribusiness Group, and the privately-owned Guandong Wen's Foodstuff Group (China's largest pig farmer).<sup>155</sup>

**6.2.2.2 Over the past decade, China's state institutions have dramatically increased external investments in agriculture to meet the country's food challenges.** SOEs and sovereign investors have sought overseas agriculture investments for decades, but the pace and scale has increased dramatically since the global food crisis of 2007-2008. This strategy has evolved to encompass every step along the agricultural value chain, from farmland to operators to processing to logistics to commodities trading (Gooch and Gale, 2015). Chinese firms have spent at least US\$52 billion on overseas agriculture-related endeavors since 2005.<sup>156</sup> This figure comprises investments in land or business – of which 70 percent in developed markets – and construction contracts, which have focused exclusively on frontier and emerging economies. For example, ChemChina is planning a US\$43 billion takeover of Swiss-based Syngenta, a leader in insecticides, herbicides, and seeds, which if completed would be China's largest-ever foreign acquisition, and five times larger than any other agriculture investment.<sup>157</sup> Analysts have suggested that this strategy is driven primarily by commercial evaluation and secondarily by food security concerns, although prominent acquisitions in this space have not always borne positive commercial results (Gooch and Gale, 2015). For example, only a few months after acquiring Dutch grain trader Nidera and merging it with recently acquired Noble Agri in an attempt to compete with the big four "ABCD" global grain traders, COFCO is reportedly seeking a sale of Nidera amid unexpected losses in its Latin America portfolio.<sup>158</sup>

**6.2.2.3 Global institutional and corporate investors have undertaken several high-profile agriculture transactions in China over the last decade.** The Goldman Sachs-led 2006 acquisition of Shineway, then China's largest top meat processor, blazed a trail as one of the first leveraged buyouts in China by a group of foreign investors. Just three years later, Goldman sold part of its holdings to a subsidiary of the state-owned

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<sup>154</sup> Reuters, 2017, "China's COFCO Capital draws new state, private shareholders" (<https://www.reuters.com/article/us-china-cofco-investment-idUSKCN1B20BS>)

<sup>155</sup> Ibid

<sup>156</sup> American Enterprise Institute (AEI), "China Global Investment Tracker" (<http://www.aei.org/china-global-investment-tracker/>)

<sup>157</sup> G. Colvin, 2017, "Inside China's \$43 billion Bid for Food Security," Fortune (<http://fortune.com/2017/04/21/chemchina-syngenta-acquisition-deal/>)

<sup>158</sup> K. Wu and J. Zhu, 2017, "COFCO considers sale of Nidera's Latam seeds business: sources," Reuters (<https://uk.reuters.com/article/us-china-cofco-m-a-idUKKCN1B31GV>)

China Investment Corporation, reportedly for five times its initial investment.<sup>159</sup> In 2010, a Blackstone-led group invested US\$600 million into a Chinese agricultural logistics park prior, and the Carlyle Group invested US\$175 million into a livestock and aqua feed producer. Cargile, ADM, and Bunge are also active in the Chinese market, and are thought to control a significant portion of China's soya processing capacity.<sup>160</sup>

**6.2.2.4 Well-resourced domestic private enterprises are buying into the long-term demand trend with investments at home and abroad – even those with no agriculture sector experience.** At the beginning of this decade, several large Chinese conglomerates began to explore possibilities in the domestic agriculture sector. In 2012, Legend Holdings, best known as the parent of major computer manufacturer Lenovo, established Joyvio Group as its exclusive investment platform for food and agribusiness holdings. The company's portfolio now comprises 11 companies in beverages, fruit, protein, and packaged food. Dalian Wanda Group, a property and entertainment conglomerate and consortium led by Tsing Capital invested US\$10 million into Shanghai's largest organic farm, Tony's Farm, in 2010. More traditional agriculture groups have also participated. The New Hope Group, China's largest privately owned agriculture firm, has undertaken an aggressive international expansion campaign since 1999 alongside its domestic investments. As of 2014 the group had 40 facilities in 16 countries, and has recently created a fund specifically targeting further investments in Australia.<sup>161</sup> It has also announced an investment of US\$1.35 billion in its domestic pig farming operations.

**6.2.2.5 Often these investments are structured as partnerships between private companies, local governments, and occasionally third party investors.** Multiple stakeholders are responding to the government's encouragement of private capital investments into agricultural endeavors. For example, in February 2016, New Hope Capital, the financial management arm of New Hope Group, launched a US\$460 million fund with investments from the Harvest Fund, the Zhejiang provincial government, and a co-investment pool from Hosen Capital. This year Hosen, which spun out of New Hope Capital, closed its third agribusiness fund, Hosen Investment Fund III, including a US\$30 million investment from the IFC.<sup>162</sup> Other groups like Black Soil, the agri-investment company founded by former Warburg Pincus Asia

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<sup>159</sup> G. Chen and M. Flaherty, 2009, "Goldman to sell stake in landmark China buyout deal" (<http://www.reuters.com/article/us-goldman-china-meat-idUSTRE5A311Q20091104>)

<sup>160</sup> F. Lawrence, 2011, "The global food crisis: ABCD of food – how the multinationals dominate trade," The Guardian (<https://www.theguardian.com/global-development/poverty-matters/2011/jun/02/abcd-food-giants-dominate-trade>)

<sup>161</sup> C. Aizhu, 2016, "China's New Hope accelerating fund raising for future acquisitions," Reuters (<http://www.reuters.com/article/us-china-parliament-new-hope-idUSKCN0W807G>); and Z. Gidwitz, 2015, "A New Hope for China's Agricultural Ambitions" (<https://www.linkedin.com/pulse/new-hope-chinas-agricultural-ambitions-zachary-gidwitz>)

<sup>162</sup> L. Kiernan, 2016, "Hosen Investment Fund III to see \$400M Close by Year End," Global AgInvesting (<http://www.globalaginvesting.com/hosen-investment-fund-iii-see-400m-close-year-end/>)

chairman Chang Sun, seek to take advantage of land law changes to aggregate small holdings into larger farms that can take advantage of economies of scale and additional mechanism.

**6.2.2.6 MDBs are promoting resilience in China’s agriculture sector, but with a focus on bilateral public sector aid, not private enterprises.** The World Bank has lent to various regional resilience initiatives, such as the US\$313 million multi-province Integrated Modern Agriculture Development Project and the Guangdong Agricultural Pollution Control Project. These initiatives have focused on pilot and demonstration programs for resilient farming techniques and technology. The Asia Development Bank has earmarked approximately US\$10 billion in 2016 in lending, grants, and technical assistance for agriculture and water projects in China, and committed US\$2 billion annually to food security including climate change threats.<sup>163</sup>

### Challenges

**6.2.2.7 China’s increasing consumption of higher-value agricultural products is the key driver of agricultural investments, but much of the investment activity around this theme is not taking place.** As noted above, some investment in downstream agribusiness has taken place in China on behalf of foreign and domestic investors. However, China does not have sufficient arable land to meet its anticipated food needs, and the Chinese government itself has actively encouraged investment in external agricultural assets as part of its food security strategy. Both foreign and domestic investors have sought to address this trend by investing in supplier markets to China that have a mature private agriculture sector, high quality growing conditions, good availability of quality inputs, and a stable, predictable regulatory regime featuring strong property rights.

**6.2.2.8 The value proposition of investing directly in agricultural land in China is weaker when investors are faced with a potentially long and costly rehabilitation of soil to realize returns.** Soil health and water quality are significant constraints for investors that are interested in improving domestic agricultural production. Decades of rapid industrialization with insufficient environmental protections and oversight have had a deleterious impact on China’s soil quality. As noted in paragraph 6.2.1.5, 19.4 percent of all farmland is considered contaminated by pollutants. Remediation efforts focused on urban centers have only pushed polluting activities into rural areas, including into agricultural lands, where they are less easily monitored. Some agricultural policies themselves have hurt the land. In pursuing staple crop self-sufficiency, the Chinese government has paid subsidized prices for these crops to

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<sup>163</sup> Asian Development Bank (ADB), 2014, “Investing in Food and Agriculture in Asia and the Pacific” (<https://www.adb.org/news/infographics/investing-food-and-agriculture-asia-and-pacific>)

farmers, who saturated their plots with fertilizers and pesticides to maximize their harvest. The World Bank estimates that China applies the most fertilizer of any major agricultural nation – 650kg per hectare of arable, compared to 163kg in India, 156 in the EU, 181kg for Brazil, 75kg in Canada, and 39kg in Argentina (PWC, 2015). As a result, soil quality has declined significantly.<sup>164</sup>

**6.2.2.9 The bulk of China’s agriculture sector remains fragmented, and while mechanization levels have improved, they are inconsistent across regions and are generally lower than those found in developed markets.** Farm consolidation has recently begun to take hold. Chinese entrepreneurs are developing a model whereby an acquirer consolidates agricultural land use rights from smallholders or village councils, makes capital investments in equipment and techniques, and commits to hiring the small farmers from whom it purchased the usufruct rights. This keeps farmers employed and connected to the land (thereby avoiding landless communities migrating to cities) and enhances economies of scale.<sup>165</sup> But this incipient model has encountered some difficulties in application, and there is far to go before Chinese farms achieve the level of consolidation and mechanization that would permit advanced technological investments.

**6.2.2.10 Genetically Modified (GM) crops are viewed by the local market with heavy skepticism. GM crop planting in China has declined significantly since the late 1990s.** Until 2001, it was the 4<sup>th</sup> largest GM grower in the world, but strong public opposition has caused the decline of GM crop production, and budgets for GM research have been slashed. The Chinese government has recently expressed its desire to reinvigorate domestic research and development into home-grown GM crops as part of a broader food security strategy.<sup>166</sup> Indeed, ChemChina’s bid for Syngenta is thought to be a step toward “normalizing” crop science in the eyes of the Chinese consumer, and select foreign GM crops may be imported. But the Chinese public distrusts the government and local agriculture sector, which hampers the possibilities of resilience investments in the sector as genetic modification is a major avenue by which crops are made more climate resilient.

**6.2.2.11 Land rehabilitation, land reform, and agricultural efficiency improvements are declared government priorities, but there is no concrete strategy to promote resilience investments.** As noted above, China’s declared strategy to encourage private investment in agriculture has spurred some early movers to increase investment in the sector. Still, it is unclear how or if the large sums announced for

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<sup>164</sup> Bloomberg News, 2017, “Farming the World: China’s Epic Race to Avoid a Food Crisis” (<https://www.bloomberg.com/graphics/2017-feeding-china/>)

<sup>165</sup> L. Hornby, 2016, “China land: losing the plot,” Financial Times (<https://www.ft.com/content/42eca2b6-3d4d-11e6-8716-a4a71e8140b0>)

<sup>166</sup> Xinhua, 2015, “China eyes GMO progress amid crop shrinkage, safety concerns,” ([http://news.xinhuanet.com/english/sci/2015-02/04/c\\_133970206.htm](http://news.xinhuanet.com/english/sci/2015-02/04/c_133970206.htm))

agriculture reforms will be spent. Many investors will likely wait to see how successful well-connected and well-resourced incumbents fare under these reforms before entering at scale, and they may prefer initially to partner with local investors when they do enter.

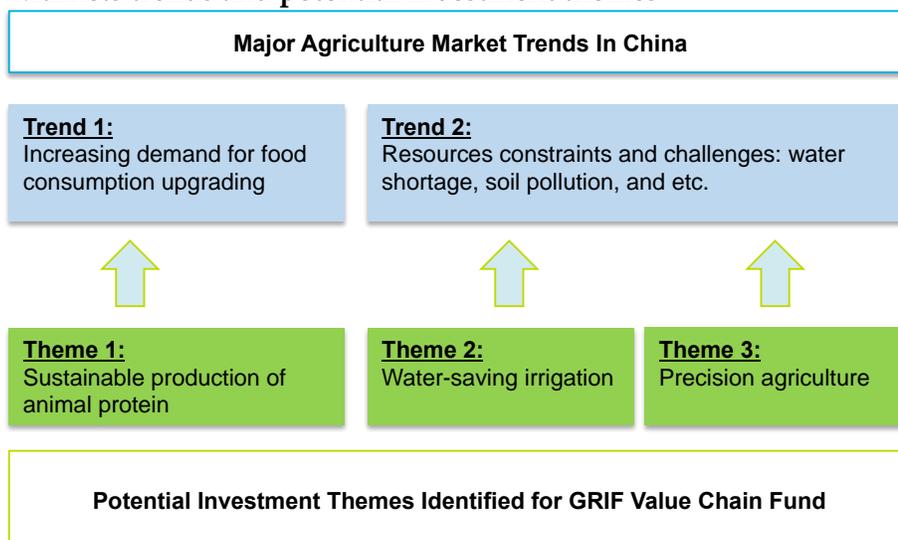
### Opportunities

- 6.2.2.12 “Quick wins” from mechanization and farm consolidation will be available for some time.** The recent changes to land exploitation models enshrined in the rural-land contract law of November 2016 opened the door to larger-scale corporate farming. Although the process of land aggregation may take time to accelerate, agricultural investment and resilience opportunities will increase in the medium term as farms in China consolidate and mechanize toward developed-country levels.
- 6.2.2.13 Soil health, water efficiency, and water quality present good potential opportunities for resilience investments.** China desperately needs to improve the productivity of its arable land, to reverse the degradation of its soil, and improve the quality and efficient use of water resources. As noted above, private sector investors have prioritized investments that are more immediately monetizable, including those in supplier markets to China. Businesses that address soil health and water efficiency or quality will be of commercial value to the increasing number of domestic firms seeking to aggregate farm holdings, as well as to the Chinese government as it seeks to manage its public resources and irrigation infrastructure.
- 6.2.2.14 Organic food brands are desirable among an increasingly affluent population.** Concomitantly with income growth, Chinese are increasingly quality conscious. Chinese agriculture investment in Australia alone tripled year-on-year in 2016 to US\$1.2 billion, driven in part by rising demand for premium quality food (KPMG, 2017). As noted above, private local investors have sought to create premium local brands that offer high-quality organic foods. Businesses that can provide technologies or practices that reinforce sustainability and sanitary food production for these local brands may have a significant opportunity for local market entry.

### **6.2.3 Agriculture Resilience Investment Themes: Examples**

- 6.2.3.1 Three investment themes have been identified: sustainable production of animal protein; water-saving irrigation systems, and precision agriculture.** Theme 1 addresses the needs of the emerging middle class to catch up with consumption patterns of developed economies. Theme 2 and 3 aim to address the water and land stresses, and other constraints facing agri-resilience in China (Figure 6.7). These investments themes are important to building resilience, and at the same time present interesting investment opportunities.

**Figure 6.7 - Markets trends and potential investment themes**



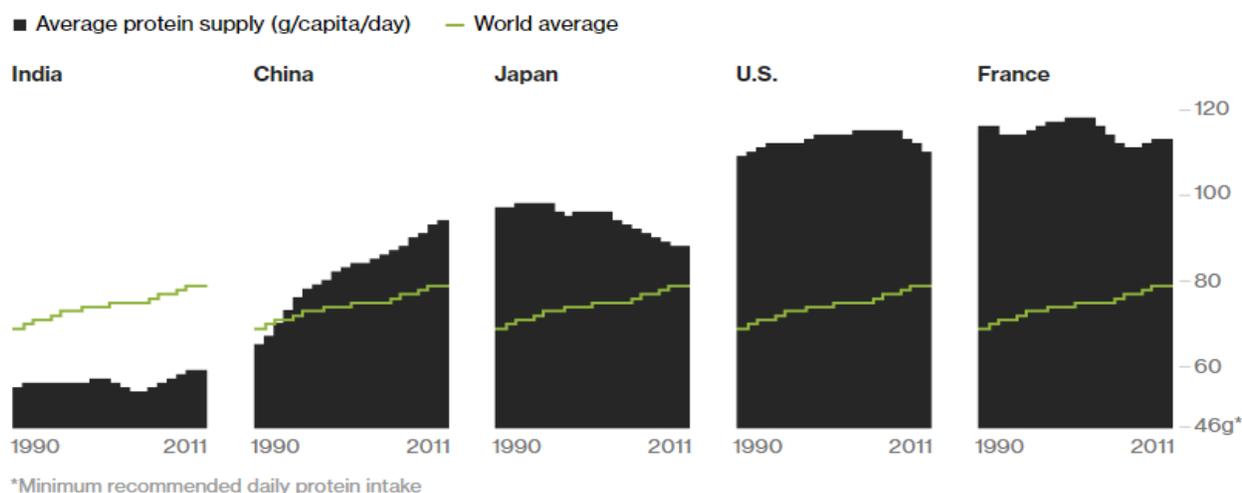
Source: the authors.

**Investment Theme 1: Sustainable Production of Animal Protein**

**6.2.3.2 Local demand for protein is quickly catching up with that of developed economies.**

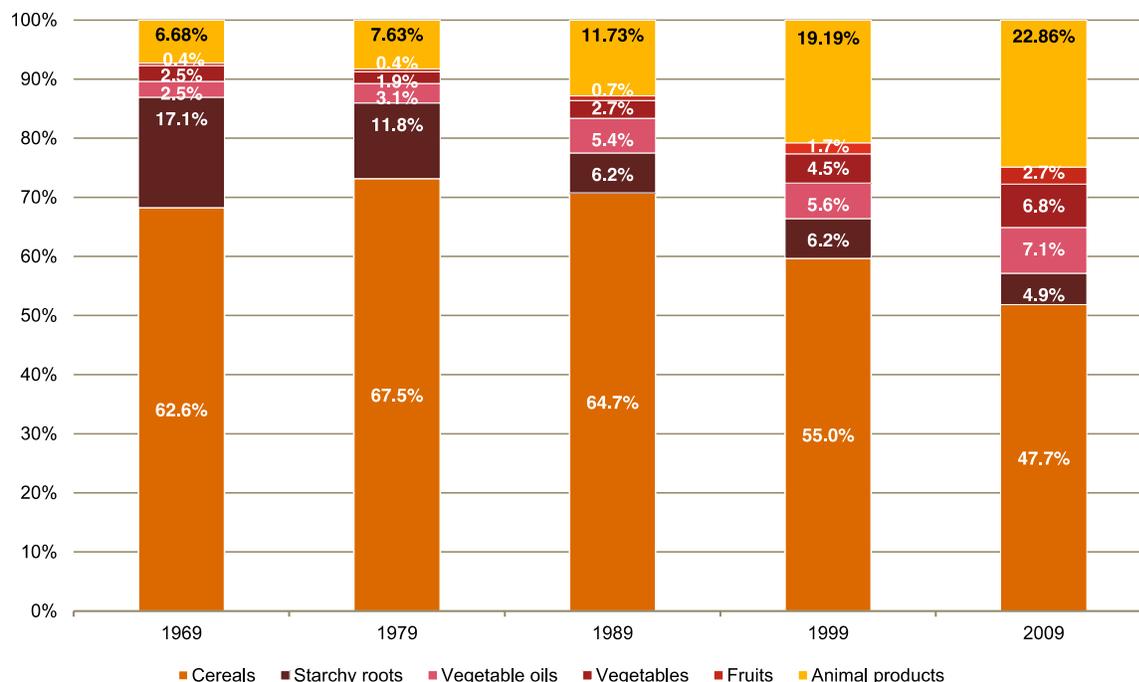
Figure 6.8 shows the rapid increase in protein consumption in China, compared with other countries. Figure 6.9 shows the change in calories consumption, indicating a robust contribution from animal products.

**Figure 6.8 - China's Increasing Protein Consumption**



Source: Bloomberg, FAO

**Figure 6.9 - China Calorie Consumption Distribution (1969-2009)**



Source: FAO, PWC 2015

**6.2.3.3 China's livestock sector faces big adaptation challenges.** China produces and consumes half of the world's pork, consumes nearly 20 percent of the world's poultry, 10 percent of the world's beef, and is the fourth largest milk producer (Allidina et al., 2011). The protein consumption is expected to grow 3-4 percent per year by 2020, mostly driven by the rising middle class.<sup>167</sup> Pork and poultry will continue to dominate the meat consumption in the near future, while consumption proportions of beef, mutton, fish and dairy products in total animal protein consumption are expected to increase (Yang, 2013). Livestock producers are already feeling the effects of constraints arising from limited natural resources, as shown by increasing imports of animal feed and meat and ODI in overseas animal protein suppliers.<sup>168</sup> China's current livestock production remains largely domestic, with the

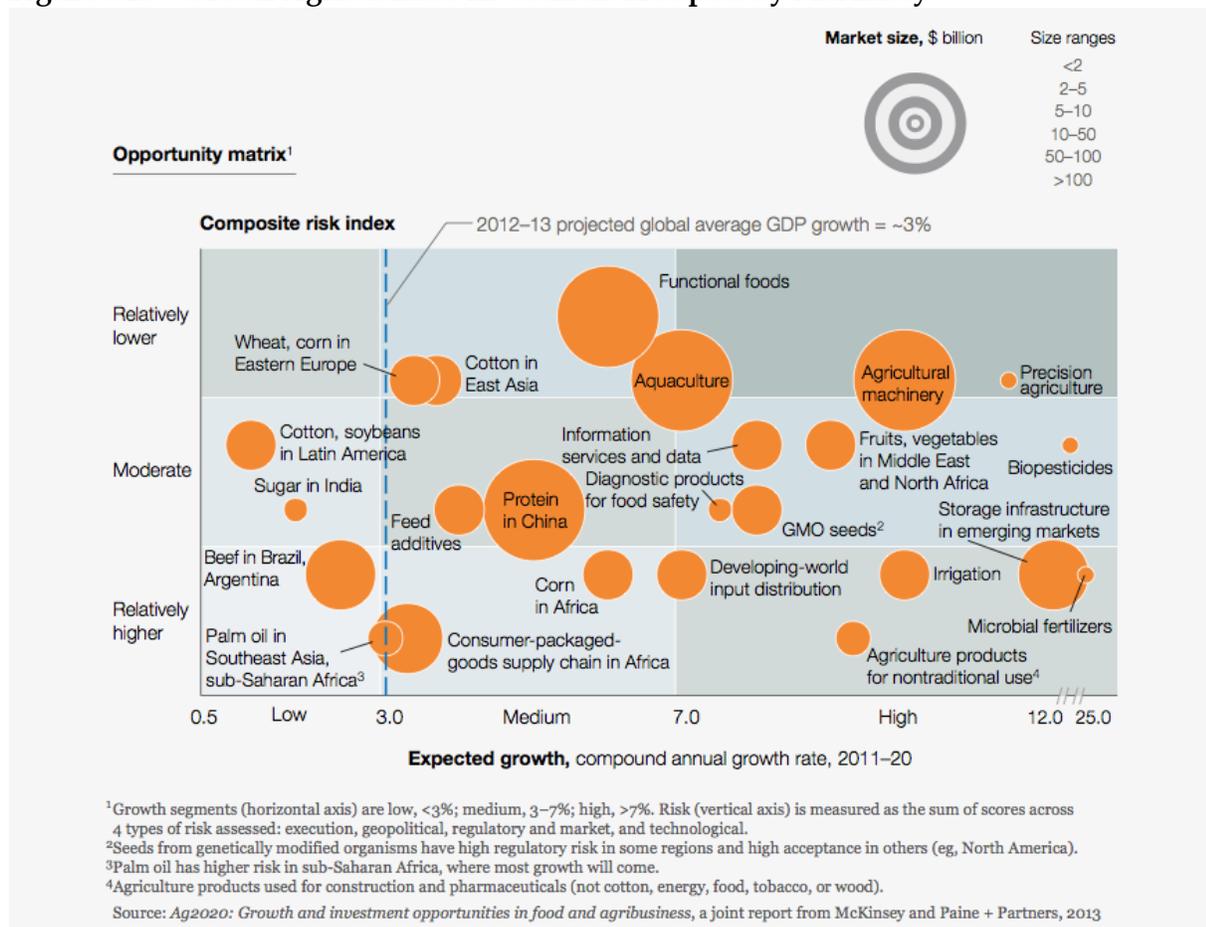
<sup>167</sup> L. Goedde et al., 2015, "Pursuing the global opportunity in food and agribusiness," McKinsey & Co. (<http://www.mckinsey.com/industries/chemicals/our-insights/pursuing-the-global-opportunity-in-food-and-agribusiness>)

<sup>168</sup> In addition to natural resources scarcity and depletion, in some cases it is also due to the implementation of *Regulation on the Prevention and Control of Pollution from Large-scale Breeding of Livestock and Poultry* (2013) by the State Council ([http://www.gov.cn/zwqk/2013-11/26/content\\_2534836.htm](http://www.gov.cn/zwqk/2013-11/26/content_2534836.htm)). It is the first environment-related regulation tackling pollution in agriculture at the national level. Among other requirements, the Regulation stipulates livestock and poultry farms are not allowed to operate in designated conservation and natural environment protection areas, which in effect can further shrink size of available land for animal husbandry. According to PWC (2015), China's corn imports have gone from being non-existent to about 3mnt and soybean imports have tripled to 74mnt in the past decade. Simultaneously, meat imports have grown five-fold to 1.5mnt. It is believed that this trend is likely to continue with both feed grains and meat imports growing. The purchase of the USA's largest pork producer Smithfield, by the Chinese company Shuanghui International, is a demonstration of how Chinese meat imports are likely to rise.

imported meat accounting for 5.3 percent in 2016, placing most of the adaptation burden on domestic companies.<sup>169</sup>

**6.2.3.4 China’s animal protein sector is expected to grow further and strategic investments can help industry shift into a more sustainable production mode.** China’s animal protein sector holds good investment opportunities among other agribusiness sectors (Figure 6.10). Pork (pig meat) and fish account for a substantial portion of China’s aggregate meat consumption. According to the OECD-FAO Agricultural Outlook (2013-2022) robust growth is expected for fish, poultry meat, as well as beef and mutton meat consumption. In addition to core production, the surge in demand would also drive the growth of supporting industries, such as feed, breeding, animal-health testing and vaccines.<sup>170</sup>

**Figure 6.10 – Global Agribusiness Investment Hotspots by McKinsey**



<sup>169</sup> National Bureau of Statistics of China data shows that the domestic meat production amounted to 8.54 mnt in 2016; China Customs data shows that China’s meat imports amounted to 0.45 mnt in 2016.

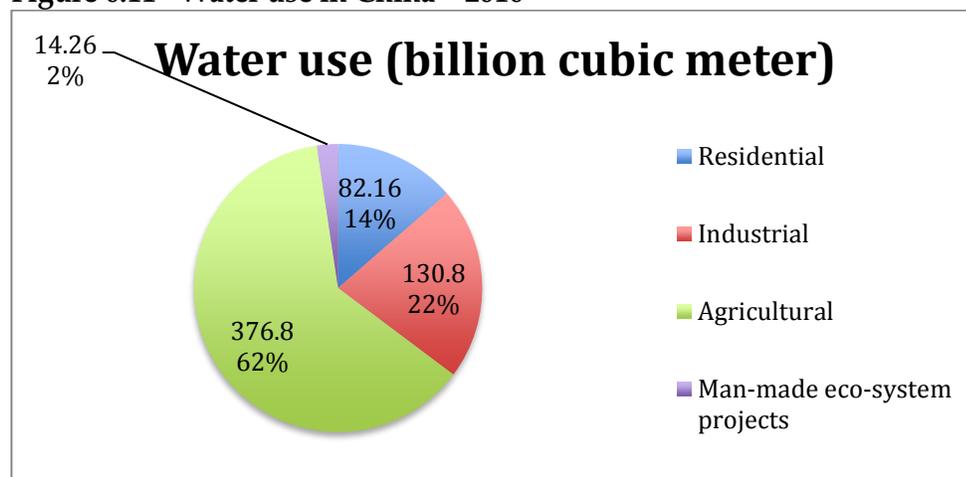
<sup>170</sup> L. Goedde et al., 2015, “Pursuing the global opportunity in food and agribusiness,” McKinsey & Co. (<http://www.mckinsey.com/industries/chemicals/our-insights/pursuing-the-global-opportunity-in-food-and-agribusiness>)

**6.2.3.5 Most livestock companies are SMEs with little access to finance to support resilience investment. Early stage investment in strategic subsectors would provide demonstration effect and attract further private capital in the future.** Preliminary research suggests that value chain integration, biotech and information technology advancement, agro-logistics and agricultural e-commerce offer investment opportunities for agri-resilience (Deloitte, 2014). Domestic PE/VC's interest in the animal husbandry sector is steadily growing, particularly in inbound and outbound *value chain integration* (Deloitte, 2014). International financial institutions (including IFC) are investing in the operation and business growth of Chinese agribusiness companies, through equity and/or debt financing. Examples include Muyuan Foods Co., Ltd whose business involves, pig feed processing, pig breeding, pig processing activities and pig husbandry, animal feed producer, and Shandong Hekangyuan Poultry Breeding Company, contributing to a more sustainable livestock sector in China. *Biotechnology* is also a nascent niche (see Annex 6.A, business case 1, Anyou Biotechnology Group). Attracting private capital to value chain integration and biotechnology would require early stage investment for demonstration effect.

### **Investment Theme 2: Water-Saving Irrigation**

**6.2.3.6 Water scarcity and water overexploitation in China call for investment in irrigation efficiency.** As discussed earlier in this section, low per capita freshwater resources, overexploitation, uneven distribution of water resources across regions, and natural disasters such as droughts, severely affect the agriculture sector in China. Irrigation accounted for about 62.4 percent of total water use in 2016 (Figure 6.11), compared to an average 40 percent in developed countries (Wu et al., 2006). Higher incidences of drought and rising temperatures are expected to increase water demand per unit of cropland area, and to reduce crop yields. Given China's water shortage, securing more water for irrigation will be challenging. Improving irrigation efficiency is therefore critical the critical adaptation measure

**Figure 6.11 - Water use in China – 2016**



Source: Ministry of Water Resources: China Water Resources Bulletin 2016

### 6.2.3.7 Water efficient irrigation practices are particularly critical for Northern China.

Northern China has 64 percent of China's total arable land, but only 22 percent of total water resources. For this reason, Northern China has always been the focus of China's irrigation water efficiency market.<sup>171</sup> The leading players in water-saving irrigation such as Xinjiang Tianye (Annex 6.A, Business case 2) and Dayu are both located in this region. The World Bank has worked with the Chinese government in

#### Box 6.1 - World Bank's Water Conservation Project II (WCP2) in Northern China

The Water Conservation Project II (WCP2) was a World Bank Group (WBG) project intended to improve agriculture water management in China's Ningxia Autonomous Region, Shanxi, and Hebei Provinces – all of which suffer from water scarcity that is exacerbated by climate change. The project area was located in the arid and semi-arid areas within the Hai and Huang (Yellow) River Basins. Most of the project area faces water shortage and overuse from increasing agricultural demand, which has led to the degradation of ecosystems. Climate change impact made the situation worse through precipitation uncertainty: higher evaporation and uneven spatial and temporal distribution of precipitation. The water shortage as of 2011 was about 30-40 km<sup>3</sup> per year, and is projected to increase to 56.5 km<sup>3</sup> unless effective measures are taken to improve water use efficiency and productivity.<sup>1</sup>

The WCP2 had the following components: (i) water works and water-saving facilities (US\$98.71 million); (ii) agricultural water-saving measures and support services (US\$25.31 million); (iii) management measures and institutional development (US\$6.44 million); and (iv) project management, implementation support (US\$7.88 million). The total project cost was US\$159.45 million, of which US\$80 million in IBRD loan, and the rest in counterpart funds from different levels of government: national, provincial, and county, as well as contributions from project beneficiary communities. The implementation period was from 2012 to 2017. The project was implemented under the guidance of China's Ministry of Water Resources at the national level. The project overall benefitted over 500,000 farmers in the 24 counties, meeting all eight Project Development Objective (PDO) indicators.

Source: World Bank project documents.

<sup>171</sup> The Qin Mountains-Huai River Line is often used as the geographical dividing line between northern and southern China.

promoting water conservation in three northern provinces Hebei, Shanxi, and Ningxia, by way of a US\$80 million loan in the US\$1.6 billion Water Conservation Project II from 2012 to 2017. The project aims to improving awareness of water conservation measures among farmers by incentivizing them to change their water-use habits and promoting the use of water-saving technologies (see Box 6.1).

**6.2.3.8 An overall low level of irrigation efficiency compounds the challenges associated with water shortage and rainfall uncertainty.**

Irrigation efficiency (IE) is the ratio of the amount of water consumed by the crop to the amount of water supplied through irrigation (surface, sprinkler or drip irrigation).<sup>172</sup> According to the China Water Resources Bulletin 2016, the average irrigation efficiency stands at 0.546, which is a considerable improvement over the past, although lagging behind the average level in developed economies (0.7-0.8). It is estimated that merely 48 percent of irrigated areas in China adopt water saving technologies. Despite the improvement of irrigation methods over the years, water waste during agricultural process is still very high and flood irrigation is still the predominant irrigation method (Zhu et al., 2013). High efficiency water-saving irrigations, including low-pressure pipe irrigation, sprinkler irrigation and micro-irrigation, account for only 23 percent of the total irrigated area (Minsheng Securities, 2016).

**6.2.3.9 The market for water-saving irrigation equipment and practices is expected to grow dramatically.**

The Climate Change Adaptation Strategies and National Sustainable Agricultural Development Plan (2015-2030) (NSADP) confirmed the important role of water-saving irrigations in addressing challenges posed by water scarcity and deterioration, climate change and grain security. Ambitious agriculture water-saving targets have been set by the government. According to NSADP, (i) China's irrigation efficiency is expected to reach 0.55 by 2020 and 0.6 by 2030; (ii) the share of irrigated area that adopts water-saving technologies is expected to reach 64 percent by 2020 and 75 percent by 2030, a steep improvement over the current 48 percent; and (iii) the irrigated area that applies high efficiency water-saving irrigation is expected to increase by 100 million mu (6.7 million ha) by 2020. Analysts estimate that these policy targets would translate into RMB hundreds of billions growth in the high efficiency water-saving irrigation market, benefiting integrated solution providers, such as Dayu Water Saving Group, Kingland Technology, as well as major irrigation tape and pipeline providers such as Tianye Water (Annex 6.A, Business Case 2).<sup>173</sup>

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<sup>172</sup> G. Erkun, 2016 ([http://www.gov.cn/zhengce/2016-06/03/content\\_5079394.htm](http://www.gov.cn/zhengce/2016-06/03/content_5079394.htm))

<sup>173</sup> According to Minsheng Securities (2016), government investment still plays a role in water conservancy and irrigation projects.

**6.2.3.10 The total market size of water-saving irrigation, including both equipment installment and maintenance, is expected to be about RMB 170 billion (USD 25.5 billion) during the 13th Five-Year-Plan period (2016-2020).** Irrigation efficiency was not an easy business in the past due to low water price and collection ratio, the lack of awareness among farmers, and the affordability of irrigation facilities and technologies (Box 6.2). But Government support and improved business models are opening new investment opportunities. Since 2016 water tariff reforms require localities to step up water-pricing related physical infrastructure and institutional framework, develop proper pricing mechanisms, and pilot targeted water rates. In June 2017 the National Development and Reform Commission devised detailed evaluation system to push forward agriculture-use water tariff reforms. Local governments will be evaluated on indicators such as installation of agriculture water meters, design and implementation of pricing mechanism, progress on water rights reform, tariff collection, irrigation coverage, application of water-saving irrigation systems. Localities are also exploring more targeted agriculture water subsidies.<sup>174</sup> PPP style financing for water-saving irrigation projects are actively explored in China. For instance, the local government of Shangyi County (Hebei Province) partners with social investors in financing irrigation system. Each party contributes half of the installation cost. Social investors are allowed to recoupe their investment through water tariff collection within a timeframe of 20 years. Irrigation companies such as Dayu Water-Saving Group have begun exploring applying information technology to irrigation monitoring and analysis. In addition, the consolidation of arable lands allows economies of scale, making water-saving irrigation more affordable. The emergence of regional leaders such as Xinjiang Tianye and Dayu Water-saving opens the door to value chain integration and business model improvement.

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<sup>174</sup> One approach is cost-based subsidization, wherein subsidies help cover the equipment installation and maintenance cost for cooperatives and irrigated area management entities. Another approach targets grain farmers and subsidizes using stepped tariffs. In addition, cash or in-kind or water rights concessions are used to encourage farmers and cooperatives to adopt water-saving irrigation systems.

### ***Box 6.2 - Irrigation efficiency: historical challenges***

Irrigation efficiency was not an easy business in the past due to low water price and collection ratio, the lack of awareness among farmers, and the affordability of irrigation facilities and technologies. Historical challenges include:

- *Low water price and fee collection ratio.* According to a survey in 2014 on 290 irrigation zones in China, the average agriculture water supply cost was RMB 0.096 per cubic meter, while the median water price was only RMB 0.056 per cubic meter, leaving the cost uncovered. A national study on average water price shows that the measured water price (price assumed to breakeven) was RMB 0.116 per cubic meter, but the average approved water price was only RMB 0.039 per cubic meter, and the average collection ratio of water tariff was 62 percent. This implies a recovery ratio of water costs as low as 21 percent of actual cost.
- *Lack of awareness of water conservation among farmers.* The low water price and lack of incentives for water saving has led to the lack of awareness of water saving technologies. The World Bank Water Conservation Project II contributed to address this issue.
- *Low affordability of irrigation facilities and technologies.* Although fiscal subsidies to farmers might cover some costs, adopting water-saving irrigation practice would still pose a heavy burden to farms and farmers. According to market estimates, the unit cost of water-saving irrigation system is around US\$4,500 per hectare. Given most of farmland is less than 1 hectare, one-time fixed investment of US\$4,500 (RMB 30,000) would be a sizable upfront cost for small farms.

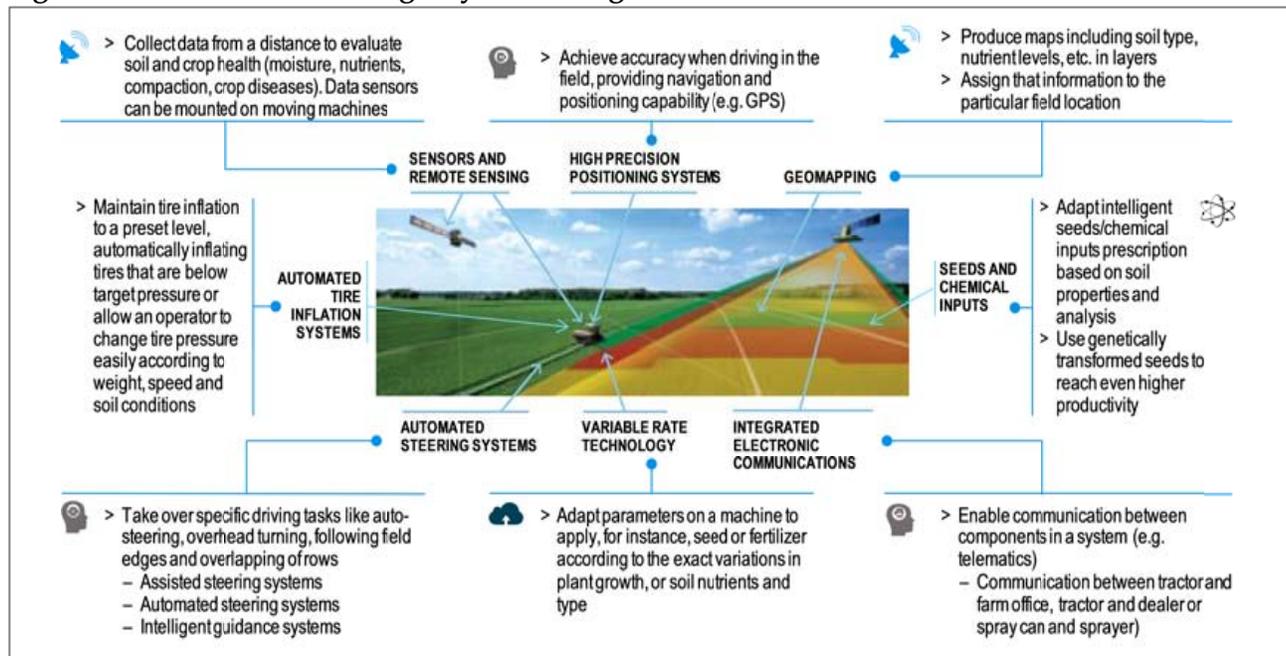
*Source: the authors unless otherwise specified.*

- 6.2.4.14 Combining water-saving irrigation technologies and product development with irrigation PPP projects could improve the investment model by creating synergies.** Although the market is still fragmented and market players tend to be small, the competition landscape is evolving as shown by of regional market leaders Xinjiang Tianye and Dayu Water-saving. The integration of the irrigation value chain helps to achieve cost efficiency. However, investors are monitoring the progress of water price reforms and the implementation of water-saving irrigation practices. These reforms typically take time. Thus, patient capital is required to catalyze investment in this area.

### **Investment Theme 3: Precision Agriculture**

- 6.2.4.15 Precision agriculture is a relatively new concept.** Precision agriculture started in the US in the 1990s, and was later introduced in Canada and Australia. The total market size of global precision agriculture was US\$1.99 billion in 2013, and is expected to rise to USD 4.54 billion by 2020. Key technologies of precision farming include: 1) automation and robotics; 2) imagery and sensors; 3) big data and digitization; and 4) bio-engineering (Figure 6.12).

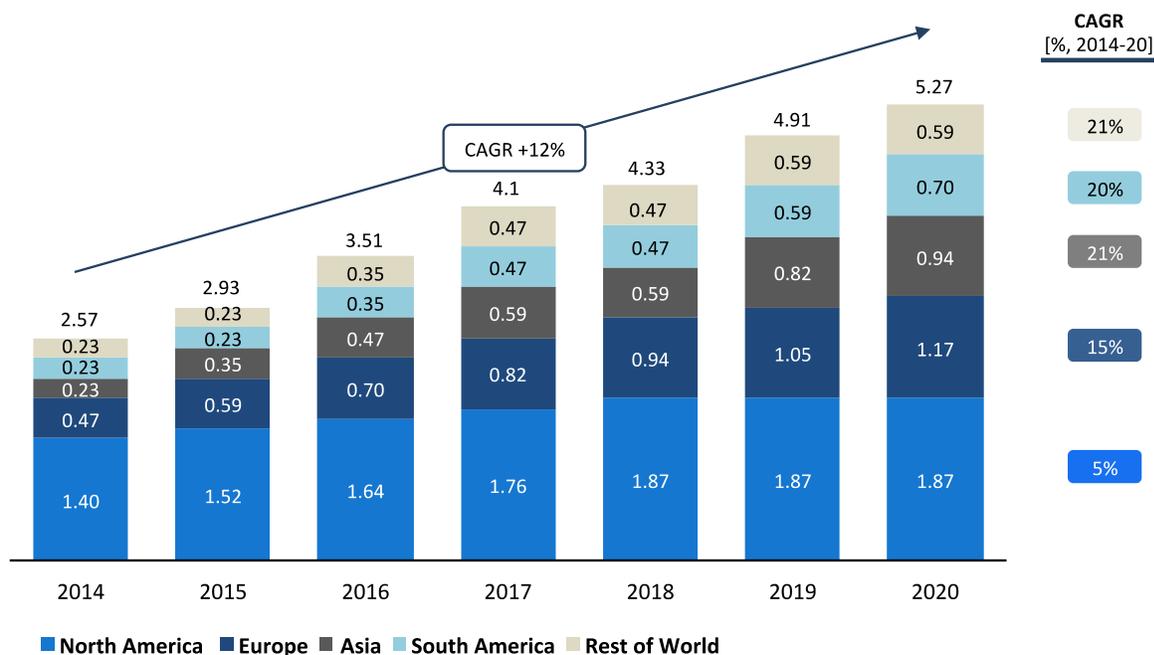
**Figure 6.12– Precision Farming Key Technologies**



Source: Roland Berger (2015)

**6.2.4.15 Precision farming is expected to quickly pick up in Asia.** For precision agriculture to deliver its full potential large scale farms are necessary. This, combined with farmers’ willingness and ability to learn and apply new technologies and access to private and public capital underlies the supremacy of the North American market versus the European market. Developing countries are lagging far behind since traditional farming practices and lack of capital hinder the adoption of new technologies. Nonetheless, experts expect a substantial growth in precision farming in Asia (Figure 6.13).

Figure 6.13 - Precision Farming Market size 2014-2020 (USD bn)



1) Market estimation includes software (e.g. data management systems, advisory services) and hardware (e.g. automation and control systems such as: guidance steering, displays, flow control services; sensing and monitoring such as: yield monitor, soil sensors)

Source: Recreated from Roland Berger (2015)

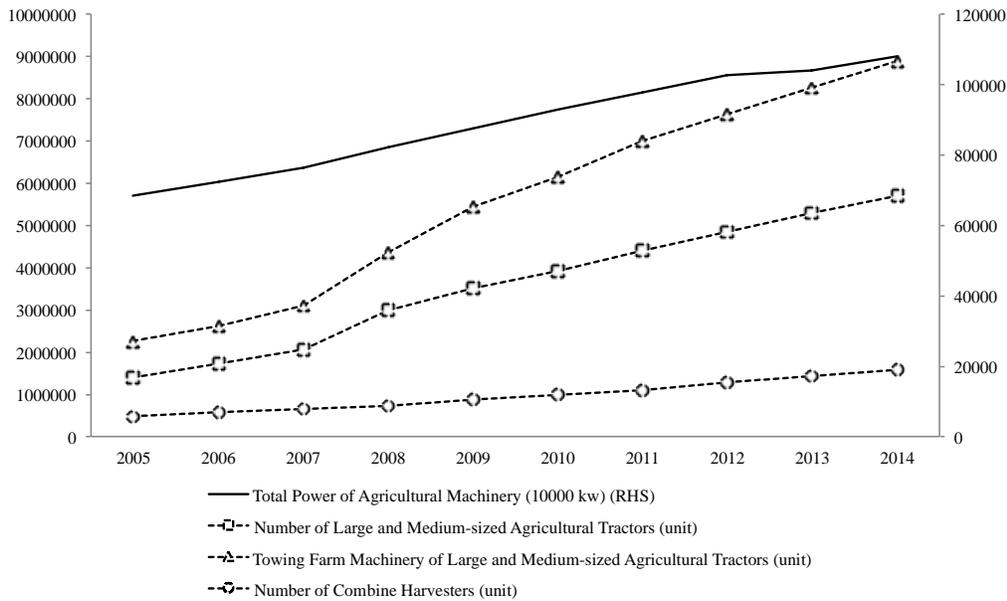
**6.2.4.16 Precision agriculture is still a nascent market in China.** Currently the precision agriculture market mainly focuses on automation of machine control and guidance system, e.g. auto-steering tractors, harvesters, tillage machines, spraying machines and are consisted of precision navigation and positioning manufacturers. Sub-markets for machinery based on more sophisticated geo-mapping and variable input applications are still to be formed. According to the Shanghai Industrial Technology Institute and Essence Securities China’s machine control application market stood at USD 67 million (RMB 451 million) in 2015.

**6.2.4.17 China precision agriculture market is expected to grow rapidly in near future with an estimated growth rate of 25.6 percent** The market will benefit from the solid technological foundation (in information technology, remote sensing and mapping, and etc.), accelerated rural land tenure reform, growing agricultural mechanization, digital network expansion and upgrade, and the increasing receptivity of information technologies in the rural area and among farmers.<sup>175</sup> Indeed the rate of farms’ mechanization has been on the rise as shown in Figure 6.14. China’s own global navigation satellite system, Beidou Navigation Satellite System, launched its

<sup>175</sup> D. Jia, 2016, “Precision agriculture industry has great potential in China,” Science Net (<http://news.sciencenet.cn/htmlnews/2016/11/361042.shtml>)

civilian use in 2014 and has experienced a fast growth since then.<sup>176</sup> Rural telecom and Internet connectivity are being strengthened under the government’s “Internet Plus” initiative, and the rural population has become increasingly receptive to digital lifestyles.<sup>177</sup> According to OCN, the total market size of hardware and network based smart agriculture of China is expected to grow to USD 18.4 billion by 2022.<sup>178</sup>

**Figure 6.14 – Growing Agricultural Mechanization in China**



Source: National Bureau of Statistics of China

**6.2.4.18 The leading domestic players in precision agriculture are still small. But consolidation and entry of larger size players from related technologies are expected.** Current leading players include Beijing UniStrong Science & Technology (UniStrong), Shanghai Huace Navigation Technology (Huace), ComNav Technology and Hi-Target Surveying Instrument. There are also a few smaller players. In addition, larger players of related technological areas (such as manufacturers of

<sup>176</sup> For example, Beidou Navigation Satellite System has been applied in domestic smartphone and bike-sharing positioning related functions. More from <http://news.pedaily.cn/201705/20170525414098.shtml>

<sup>177</sup> The Government of China announced the Internet Plus initiative in March 2015, which aims at using the Internet and related technologies to spur the next stage of economic development. Rural Internet and telecom infrastructure strengthening, mobile commerce and rural e-commerce are high on the agenda. China Academy of Telecommunication Research indicated that as of September 2016 Fiber To The Home (FTTH) has been extended to over 80percent of administrative villages, with over 50 percent on speeds above 12Mbps, and rural connections account for 31.6percent of the nation’s total FTTH subscriber base. The China Tower Company, a joint venture by China’s three biggest telecom operators, is building new towers with a strong focus on rural expansion (GMSA). According to the China Internet Network Information Center, as of June 2015, the number of Internet users in rural areas rose to 186 million, accounting for 27.9 percent of the total Internet population. The number of online shoppers in rural areas reached 77.14 million, a 40.6 percent yoy increase against the 16.9 percent yoy growth in urban areas. The rise of affordable smartphones has contributed to the rapid growth of mobile penetration in rural areas. Within the rural online population, 81.9 percent are able to access the Internet via mobile devices.

<sup>178</sup> Snow Sky, 2016, “Forecast of China’s Wisdom Agriculture Market Size” (<http://snowsky0001.com/2101/a/shi6/nongshi/2016/0806/5729.html>)

unmanned aerial vehicles (UAV), also known as drones, for aerial photography and videography, gimbals, flight platforms, cameras, propulsion systems, camera stabilizers, and flight controllers) have started to explore the precision agriculture market in China. For example, Da-Jiang Innovations (DJI) is reported to start expansion in precision agriculture. DJI is based in Shenzhen, China, and is the world's leading company in civilian-drone industry, accounting for 70 percent of the global consumer drone market. The company appears to be interested in long term investment in precision agriculture, although currently this business line is barely at break-even.<sup>179</sup>

**6.2.4.19 Precision agriculture is still a novel concept to mainstream investors. Innovative financing mechanisms could accelerate the uptake of this important area for agri-resilience.** Currently investment in precision agriculture faces considerable risks given the uncertainties in the promotion of precision agriculture technologies among farmers and agriculture companies. Strategically deployed venture capital could be used to incentivize large players in related technologies to expand into precision agriculture. Long-term patient capital and strategic partnership will be important. In the near future, investment opportunities mainly lie with GNSS downstream agricultural machine control applications, as sub-market for the more advanced high precision agriculture data collection and analytics (e.g. for soil moisture, type and nutrients information obtained through remote sensing) and variable-input applications barely exist.

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<sup>179</sup> Caixin, 2017, "Xinjiang Innovation and Dow Agents enter into agreement on precision agriculture" (<http://companies.caixin.com/2017-06-27/101106113.html>)

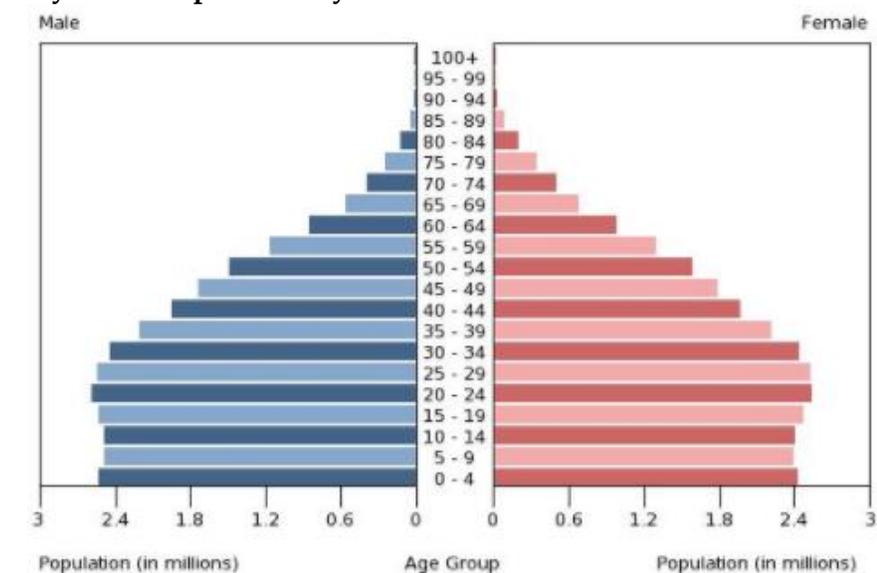
## 6.3 Myanmar

*The challenge is to identify ways to leverage abundant natural resources and favorable geographic position with limited capital resources and capacity.*

### 6.3.1 Agriculture Market Analysis

6.3.1.1 **Myanmar's agriculture sector has strong potential for development due to the country's geography and endowments.** Myanmar is at an historic stage in its development trajectory. It has been growing rapidly, at an average rate of 7.5 percent per year from 2012 to 2016 – and it is forecasted to grow by 7.7 percent in 2017 and 8.0 percent in 2018.<sup>180</sup> The country is endowed with abundant land, of which 12.8 million hectares (ha) are cultivated, with potential for increasing by nearly 50 percent (Figure 6.15).<sup>181</sup> However, only 19 percent of the crop land is irrigated.<sup>182</sup> With a median age of 28.6 years, Myanmar has a favorable “expansive” population pyramid that could deliver a demographic dividend (Figure 6.16).<sup>183</sup> Myanmar's proximity to the major emerging food markets of China and India gives the country a distinct competitive advantage for doing business.

**Figure 6.15 - Myanmar Population Pyramid**



Source: CIA Factbook

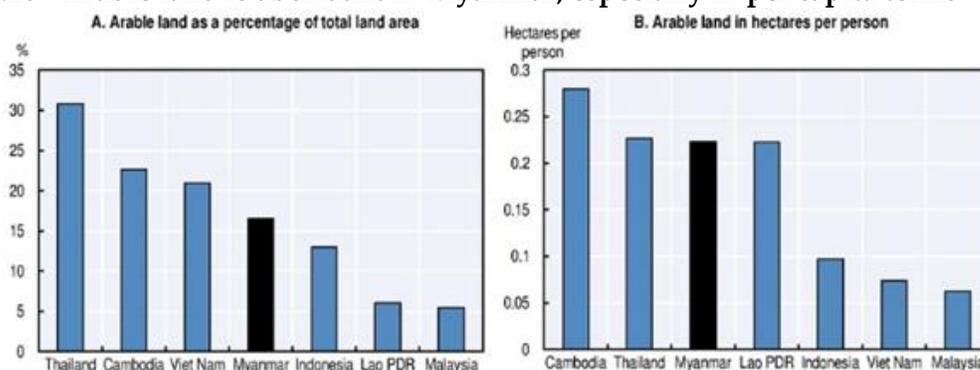
<sup>180</sup> Asian Development Bank (ADB), “Myanmar: Economy” (<https://www.adb.org/countries/myanmar/economy>)

<sup>181</sup> Asian Development Bank (ADB), 2016, “Member Fact Sheet: Myanmar” (<https://www.adb.org/sites/default/files/publication/27782/mya-2016.pdf>)

<sup>182</sup> AWBA Report and MSU Report (Unpublished)

<sup>183</sup> U.S. Central Intelligence Agency (CIA) World Factbook (<https://www.cia.gov/library/publications/the-world-factbook/geos/bm.html>)

**Figure 6.16 - Arable land is abundant in Myanmar, especially in per capita terms**



Source: CSO Myanmar Data and World Bank (2013)

6.3.1.2 **Myanmar is still a relatively underdeveloped country.** It is ranked 150 out of 187 countries on the Human Development Index, and its per capita income was US\$1,190 in 2016 – considerably lower than other Asian countries like Lao PDR (US\$2,150) and Thailand (US\$5,640).<sup>184</sup> About 26 percent of the population lives in poverty, particularly in rural areas where 70 percent of the population lives.

6.3.1.3 **Agriculture accounts for 29 percent of Myanmar’s GDP, 60 percent of total employment, and 20 percent of exports.** The development of the agricultural sector is thus important to the government of Myanmar who looks at it through the lens of food security and economic and social contribution (output, export earnings, and employment). To this end, the government has been promoting productivity, sustainable and climate-smart agriculture, by encouraging the transition from conventional to mechanized agriculture, and the extension of irrigated farming areas (Thant and Win, 2016). Myanmar’s top agricultural exports include rice, maize, black gram, green gram, pigeon pea, chick pea, sesame, onion, tamarind, raw rubber, vegetables, and fruits.

6.3.1.4 **Smallholder paddy production accounts for about half of all cropped area – although other cultivars are gradually emerging.** Pulses and oilseeds account for 20 percent each, while horticulture crops, root crops, and other cereals account for the remaining part. Farmers generally grow staple crops like paddy, pulses, and oil seeds on large surfaces (about 1.5-2.0 ha per holding), while high-value horticulture and fruit crops take place on much smaller plots. For example, onions, garlic, and potato fields average about 0.6 ha each, while vegetables and cut flowers are grown on plots ranging between 0.25 and 0.3 ha in size, which is rather small compared to average

<sup>184</sup> United Nations Development Programme (UNDP), “About Myanmar” (<http://www.mm.undp.org/content/myanmar/en/home/countryinfo.html>); and World Bank, “Gross National Income per capita 2016, Atlas method and PPP” (<http://databank.worldbank.org/data/download/GNIPC.pdf>).

farm land size in other countries.<sup>185</sup> Please refer to Figure 6.4 in the earlier section for farm land size of selected countries.

- 6.3.1.5 **Myanmar is vulnerable to natural disaster and climate risks, which will be exacerbated by climate change.** The Global Climate Risk Index lists Myanmar as the second-most vulnerable country to weather-related extreme events that occurred between 1995 and 2014 (Kreft et al., 2016). Although this ranking is, in large part, due to the devastation of Cyclone Nargis in 2008, tropical cyclones will continue to pose a threat. Furthermore, floods occur regularly during the mid-monsoon season (June to August) in areas traversed by rivers and large streams. The country is also prone to droughts and landslides. Droughts occur frequently in the dry zone region of central Myanmar and western parts of South Shan State. As for climate change, it is cited by experts as the reason for late and lower rainfall, longer dry spells, and increased temperatures (FAO, 2012). These conditions have a direct impact on the livelihoods and safety of the population, especially for resource-poor farmers that grow crops on shallow, depleted, and erosion-prone soils.
- 6.3.1.6 **Since agriculture is the main industry in Myanmar, the country's exposure to natural disaster and climate risks is a resilience priority.** Experts predict that temperatures will increase by 1.3 to 2.7 degrees Celsius above historical levels by the middle of the century in every region in Myanmar. During 1981-2010, about one day of extreme heat per month was observed – by the middle of the 21<sup>st</sup> century, Myanmar could experience anywhere from four to 17 days of extreme heat each month. Coastal flooding during and independent of cyclones are predicted to worsen as sea levels will rise from anywhere between 20 to 41 centimeters by mid-century. With increasing rainfall variability and intensity of extreme weather events, steady, predictable seasonal water flows are unlikely to be maintained in the future (Horton et al., 2017). There are existing options and technologies to build resilience in the agriculture sector, including improving water efficiency, best management practices to reduce soil loss, and the cultivation of species with greater tolerance to extreme weather conditions. Proper management of water resources is critical to prevent flooding of settlements and to cope with drought. Maintaining forests and other ecosystems while following resilient forest management practices (e.g., planting native species resilient to projected climate conditions) would provide services like erosion control. Furthermore, changing practices in specific sectors would build further resilience, such as in changing planting patterns and crop choices (Horton et al., 2017).
- 6.3.1.7 **Over the past decade, the government has allocated nearly 0.8 million ha of land to large concessions to local agribusiness companies.** Foreign investors have also

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<sup>185</sup> Embassy of the Kingdom of the Netherlands, Yangon, 2016, "Agriculture in Myanmar" (<https://goo.gl/k3G8En>)

benefited from this policy since 2010. Some of these large concessions are commercially successful businesses. However, the full potential remains to be seen because some concessionaires obtained land rights for speculative purposes or to rent to smallholder sharecroppers. Overall, there is scope for more FDI: the share of approved foreign investment in agriculture, livestock, and fisheries has been steadily increasing since 1988 when it averaged 1.4 percent of the total foreign investment.<sup>186</sup> By December 2015, the total amount of approved FDI in these sectors reached US\$700 million; rising to 20 percent of total FDI.<sup>187</sup>

- 6.3.1.8 **Foreign investors will now be allowed to invest in brownfield projects.** Before the 2016 reform, there was a restrictive requirement for all foreign direct investment (FDI) or joint venture (JV) initiatives to be greenfield, which inevitably take longer to deliver returns (let alone free cash flow). The Investment Law of 2016 allows for brownfield investment by FDI/JV with an existing entity with the intent to upgrade or build additional processing capacity, or a JV involving a combination of brownfield and greenfield investments in selected sectors. The Law will become effective in April 2017. The quick adoption of by-laws and related regulations could help spur private investment (World Bank, 2016).
- 6.3.1.9 **Despite recent land reforms, land disputes are one of the most significant risks identified by foreign investors.** Most smallholders do not have land ownership documents and the country has a weak system of land administration. The rules and procedures for obtaining, keeping, and transferring land use rights are complicated, non-transparent, and uncertain (Burnley et al., 2017). These problems are compounded by weaknesses in dispute resolution institutions and mechanisms. Investors are proceeding with caution to avoid being involved in land disputes with local people – at least until the new National Land Use Policy comes into force and weaknesses in dispute resolution institutions and mechanisms are overhauled.<sup>188</sup>
- 6.3.1.10 **The government has opened up a new possibility to FDI in agriculture and agro-processing.** According to the Ministry of Commerce Notification No. 96/2015 dated November 11, 2015, foreigners can trade in products such as fertilizers, insemination seeds, and pesticides as JVs with Myanmar citizens with no minimum share percentage for the local citizens.<sup>189</sup> This includes investments in fertilizer manufacturing and seeds, both of which have been traditional constraints to crop production. There is also increased investment in the production of animal feed,

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<sup>186</sup> Embassy of the Kingdom of the Netherlands, Yangon, 2016, "Agriculture in Myanmar" (<https://goo.gl/k3G8En>)

<sup>187</sup> M. Matsui, 2017, "Myanmar's foreign direct investment rush recedes" (<https://www.ft.com/content/f7bda5bc-e150-11e6-8405-9e5580d6e5fb>)

<sup>188</sup> Financial Times, 2016, "The great land rush – Myanmar: The dispossessed" (<https://ig.ft.com/sites/land-rush-investment/myanmar/>)

<sup>189</sup> U.S. International Trade Administration (ITA), 2017, "Burma – Agriculture" (<https://www.export.gov/article?id=Burma-Agriculture>)

which could fuel future growth prospects of the livestock and fisheries sectors (World Bank, 2016).

6.3.1.11 **Myanmar has strong prospects for growth in agriculture and agribusiness.** Experts expect growth in the agriculture sector to come from higher value products like vegetable oils, fish, and processed foods to supply a changing diet resulting from rising incomes – particularly in neighboring countries like China. With abundant land, diverse agro-climatic conditions, low labor costs, and favorable geographic position, Myanmar should be well placed to capture market opportunities at home and abroad.<sup>190</sup>

## 6.3.2 Agriculture Resilience Investors' Universe

### Key Players

6.3.2.1 **Given the paucity of reliable data on the agriculture sector, FDI, transactions, and other relevant indicators, identifying key players is challenging.** Much foreign and domestic investment in Myanmar goes unreported due to strained relations between the government and the military as well as between political centers and peripheral or minority areas. Formally, foreign investments will typically require approval or oversight from the Myanmar Investment Commission or another relevant authority, but anecdotally many market observers report a significant number of transactions concluded privately.

6.3.2.2 **Regional corporates are beginning to pursue opportunities in Myanmar's agriculture sector.** For example, Chinese companies are making inroads into Myanmar, as are investors from Thailand, South Korea, and Japan. China's CITIC is examining a US\$400 million partnership to establish 33 agricultural business centers around the country that will lend to farmers for equipment and input purchases.<sup>191</sup> Singapore-based Japfa Comfeed Myanmar recently received approval to invest US\$7 million in a poultry breeder farm.<sup>192</sup> South Korea's CJ Feed intends to invest US\$16.7 million in a feed facility, complementing its existing US\$8.3 million investment in an edible oil plant.<sup>193</sup>

6.3.2.3 **Some local corporates have begun to invest in value-added processing.** For example, the Myanmar Agribusiness Public Corporation (MAPCO), one of the

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<sup>190</sup> MSU Report, 2016 (Unpublished)

<sup>191</sup> J.S. Gaung, 2017, "China's CITIC, Myanmar Rice Federation partner for \$400m agribusiness plan" Deal Street Asia (<https://www.dealstreetasia.com/stories/china-citic-myanmar-rice-fed-agri-plan-79074/>)

<sup>192</sup> J.S. Gaung, 2017, "Myanmar okays investments from Singapore's Japfa, Korea's CJ Feed in farm sector," Deal Street Asia (<https://www.dealstreetasia.com/stories/myanmar-digest-japfa-invest-7-07-breeder-farm-hatchery-mandalay-cj-feed-myanmar-put-16-7m-animal-feed-business-80362/>)

<sup>193</sup> [Ibid.](#)

largest rice traders, began operations earlier this year at its new US\$6 million processing facility in Kyaiklat.<sup>194</sup>

- 6.3.2.4 **The IFC is the largest financial investor in Myanmar’s private sector.** It is seeking to reach a portfolio of up to US\$800 million through 2017. The IFC currently has a portfolio of US\$566 million invested in a variety of sectors, including agriculture. Its Myanmar portfolio includes: a US\$10 million financing facility provided to the Myanma Awba Group for a crop protection plant; US\$6 million in debt and US\$1.5 million in Myanma Awba Group subsidiary Maha Agriculture Public Company; a US\$6.5 million debt investment in Bel Ga Myanmar, a greenfield poultry breeding farm; and a US\$7.5 million investment in the Cambodia-Laos-Myanmar Development Fund II.<sup>195</sup>
- 6.3.2.5 **Private equity in Myanmar is still in its infancy.** Institutional investors – primarily led by local investors – completed a few transactions. TPG invested an estimated US\$200 million in telecommunications infrastructure provider Apollo Towers as well as in Myanmar Distillery Company, but local institutional investors are the primary participants. Several investors raised Myanmar-specific funds. Private equity investors include: Golden Rock, Andaman Capital Partners, Asian Frontier Capital, Bagan Capital, Mandalay Capital/Silk Road, Myanmar Investment Group, Delta Capital Myanmar, PMM Partners, Credera Group, and Rising Dragon Singapore. Some of these firms are investing directly from their balance sheets on a deal-by-deal basis, while others are in various stages of raising dedicated funds. These funds range in size from US\$30-US\$100 million and have focused on energy, ICT, and digital ventures; it does not appear that any agricultural investment has been made by an institutional investor in Myanmar to date. InfraCoAsia, mandated to develop sustainable, socially responsible, and commercially viable infrastructure projects in South and Southeast Asia, has launched InfraCapital Myanmar in partnership with ADL Capital, a cleantech and sustainability investor developing an agricultural project pipeline in Myanmar.<sup>196</sup>

## Challenges

- 6.3.2.6 **The agriculture sector exhibits some of the same characteristics as its regional peers, but is less developed.** Myanmar agricultural production is characterized by a preponderance of smallholder farmers growing staple crops, low levels of mechanization and fertilizer usage, and lack of access to capital. It is further limited by very poor infrastructure. Myanmar has few highways and paved roads where

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<sup>194</sup> M. Matsui, 2017, “Myanmar sees boost in private investment in agriculture” Nikkei (<https://asia.nikkei.com/Business/Trends/Myanmar-sees-boost-in-private-investment-in-agriculture>)

<sup>195</sup> J.S. Gaung, 2016, “IFC to double its investment portfolio to \$600m by end of 2016 in Myanmar,” Deal Street Asia (<https://www.dealstreetasia.com/stories/ifc-to-reach-portfolio-of-600-million-investment-by-end-of-2016-53535/>)

<sup>196</sup> ADL Capital Group (<http://adlcap.com/>)

they exist are often of poor quality. The country has only nine ports with an estimated 1 million TEU capacity per year. Ninety five percent of shipping volumes go through the port of Yangon, which is spread across multiple sites belonging to different owners.

- 6.3.2.7 **Land rights are unclear, and land disputes are increasing.** There appear to be conflicts between the 2016 Myanmar Investment Law – which allows up to a 50-year lease on agricultural lands – and the 2012 Vacant, Virgin, and Fallow Lands Management Law, which provides for 30-year leases. Land confiscations that took place previously under the military junta have stirred vocal protests at the government’s lack of protection for farmers.<sup>197</sup> Disputes have also arisen over large tracts of land that have been given as concessions to private companies for industrial or agricultural endeavors with little or no public input or oversight (Burnley et al., 2017). This creates a potential long-term enterprise risk for agriculture investors.
- 6.3.2.8 **Political risks from fractious politics, ethnic conflict, extensive corruption, and weak government deter investment, including in agriculture.** The new democratically elected government has a tenuous relationship with a persistent and powerfully entrenched military-business ecosystem that still controls swaths of the economy. Some regions are controlled by ethnic groups with adversarial relationships to the state, which renders an organized national trade policy difficult to undertake. The cattle industry is instructive in this regard. Myanmar has 15 million head of cattle, the largest herd in Southeast Asia and larger than those of Thailand, Cambodia, Laos, and Vietnam combined. Its herd is primarily used for draft on Myanmar’s largely non-mechanized farms, and consumption is low among the majority Buddhist population. Although Myanmar law bans the export of live cattle, the ethnic Karen group – embroiled in a longstanding civil conflict with the government – facilitates the annual crossing of approximately 150,000 head into Thailand each year, and the revenue it collects from this activity is outside the purview of the central government.<sup>198</sup>

## Opportunities

- 6.3.2.9 Improving land aggregation and basic mechanization can have a significant impact on productivity. Myanmar is starting from a very low base of mechanization and farm consolidation. Although the aforementioned regulatory and political challenges are formidable, there is much potential upside in “quick win” capital investments in farmland. For example, the implementation of drip or center-pivot irrigation, or the

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<sup>197</sup> The Straits Times, 2017, “Myanmar farmers stage week-long protest over land grabs” Straits Times (<http://www.straitstimes.com/asia/se-asia/myanmar-farmers-stage-week-long-protest-over-land-grabs>)

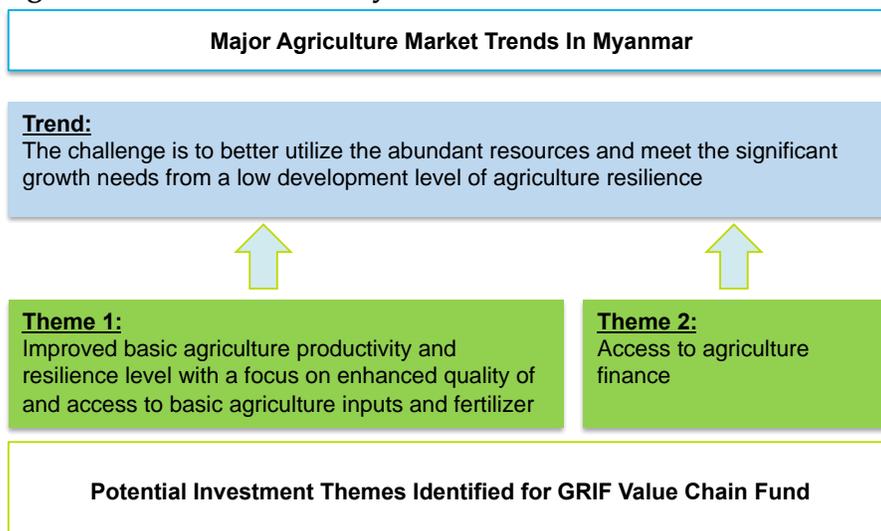
<sup>198</sup> R. Ainsworth, 2016, “Myanmar’s enigmatic beef cattle industry: Please ring back in 2026,” Beef Central (<https://www.beefcentral.com/live-export/se-asia-report/myanmars-enigmatic-beef-cattle-industry-please-ring-back-in-2026/>)

introduction of planting or harvesting machinery. However, such mechanization will require consolidation of farmland to be viable.

### 6.3.3 Agriculture Resilience Investment Themes: Examples

6.3.3.1 **The following investment themes have been identified for in-depth study:** (i) improved basic agriculture productivity and resilience with a focus on enhanced quality of and access to basic agriculture inputs and fertilizer; and (ii) access to agricultural finance. See Figure 6.17 for a summary. Basic agricultural infrastructure, also much needed in Myanmar, has not been analyzed in this study.

**Figure 6.17 - Overview of Myanmar’s Market Trends and Investment Themes**



Source: Authors

#### **Investment theme 1: Quality of and access to resilient agriculture inputs and fertilizer**

6.3.3.2 **Improving the crop productivity and variety is the first building block towards bettering resilience.** Myanmar’s dependence on commodities (including the agricultural sector’s focus on rice) and vulnerability to natural disasters pose a great risk to stable growth and poverty reduction (World Bank, 2016). Despite a strong endowment in water and fertile land, productivity is low compared to other countries in the region (US\$1,300/worker/year vs US\$2,500 in Thailand and Indonesia). Over 80 percent of Myanmar’s population are subsistence farmers and live on US\$2 or less per day.<sup>199</sup> GDP increases in the past 20 years are largely due to an expanding population, not productivity growth. Low use of inputs like seeds, fertilizer, water, and machinery suggests great potential for productivity improvements within crops. Crop diversification to higher-value crops and agriculture could also raise incomes and reduce dependence on rice production

<sup>199</sup> Vikram Kumar, Resident Representative in Myanmar, IFC (<https://sustainbusiness.org/myanmar/>)

(Chhor et al., 2013). Low productivity has trapped large agriculture population in poverty, making it unaffordable for them to invest in resilience. Thus, increasing crop productivity and variety in the agriculture sector – particularly for smallholders – is an important first step towards promoting resilient agriculture value chains

**6.3.3.3 Investing in education and training of small and medium farmers may be necessary to support the uptake of resilient techniques and inputs.** Increasing fertilizer use (especially fertilizers best able to withstand heavy rain), improving available seed varieties, and delivering farm equipment could all provide opportunities for investment. But demonstrating the benefits of these investments to small and medium producers that often struggle to balance their budgets could be challenging. However:

- Myanmar uses relatively less fertilizer (60 kg/ha) than other Southeast Asian countries like Thailand (300 kg/ha) and Vietnam (700 kg/ha).
- The costs of inputs are higher in Myanmar due to high interest rates and cost of transportation.
- The hybrid seed industry is quickly developing in Myanmar, led by maize – followed by cotton, and vegetables, and potential for hybrid rice. But rice seeds production is dominated by the state with little innovation, resulting in farmers’ use of older varieties.
- The lack of reliable or existing infrastructure negatively impacts crop and/or input transportation, leading to losses and discouraging farmers from scaling up operations.
- Farming equipment is often primitive. Consequently, and labor represents a large percentage of production costs (Figure 6.18).

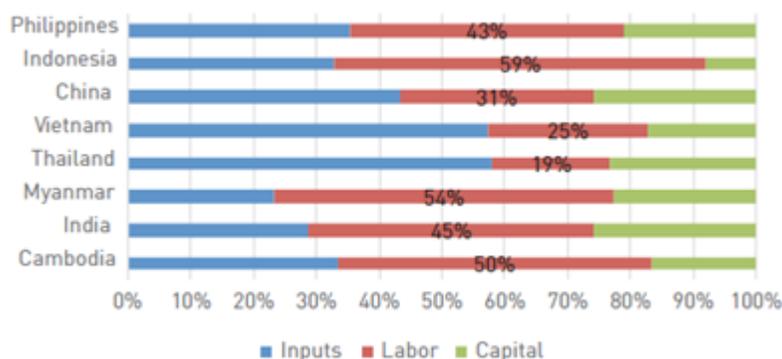
Mechanization could promote consolidation and growth of farm size operations.<sup>200</sup> Agricultural extension services that reach more farmers and cover more crops to accelerate adoption of technologies is one potential strategy. Additionally, irrigation systems could be made more flexible, for example through on-demand irrigation services to enable farmers to produce different crops in different areas, putting them in a better position to respond to market opportunities.<sup>201</sup>

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<sup>200</sup> AWBA Report (Unpublished)

<sup>201</sup> S. Zorya, 2016, “Unleashing Myanmar’s agricultural potential” World Bank (<http://blogs.worldbank.org/eastasiapacific/unleashing-myanmar-agricultural-potential>)

**Figure 6.18 - Structure of Production Costs, Monsoon Rice, International Comparison**



Source: World Bank

6.3.3.4 **Recent investments by DFIs offer examples of sustainable investment models in basic agriculture inputs.** IFC’s investment in Myanmar Awba Group is a point in case. It is a broad-scale agribusiness company active across the country’s agriculture value-chain with upstream and downstream assets and capabilities, and is particularly active in agro-chemicals and fertilizers. Its business lines cover crop protection, crop nutrition, crop seeds, manufacturing & logistics, and microfinance (by providing agriculture finance to farmers with its own balance sheet). IFC’s investment provides long-term capital otherwise not available from local banks (underdeveloped) or investors (cautious about the country risk) despite Awba’s size and market share. It also provides technical assistance on ESG standards, corporate governance, and capacity building on microfinance to support demand.

Theme 2: Access to agriculture finance

6.3.3.5 **Myanmar’s banking system is underdeveloped and access to finance has been one of the key constraints for development.** Only 30 percent of adults have formal access to credit, deposit, and other financial services – while only five percent have a bank account in their name.<sup>202</sup> Lack of access to finance is one of the main barriers to growth for businesses in Myanmar.<sup>203</sup> The main source of financing for Myanmar’s agriculture sector is the Myanmar Agricultural Development Bank (MADB). The MADB has the most widely-available banking network (reaching 1.85 million households), and rice accounts for 88 percent of its portfolio. But it provides short term loans only (maximum one year), which are not suitable to finance equipment or diversification into higher-yield/resilient crops. As a result, farmers have to resort to informal money-lenders and endure high rates of interest. Micro-credit and mobile

<sup>202</sup> International Finance Corporation (IFC), 2014, “IFC and Yoma Bank Ink Deal to Expand Financing for Small and Medium Enterprises in Myanmar”

(<http://ifcextapps.ifc.org/ifcext/Pressroom/IFCPressRoom.nsf/0/DA68A4369A7ED58185257D55002561CE?opendocument>)

<sup>203</sup> A.C. Wynn, 2014, “IFC Investment to Hit \$1 Billion in Next Three Years,” Myanmar Business Today

(<https://www.mmbiztoday.com/articles/ifc-investment-hit-1-billion-next-three-years>)

money are also currently available to 2.5 million people only, out of a total population of 54.7 million.<sup>204</sup>

**6.3.3.6 Companies in Myanmar also face challenges in raising funds from foreign investors who are cautious about the country risks.** Even large corporations in Myanmar like the Awba Group faces financing difficulties, not to mention the large number of SMEs across the agriculture value chain and farmers. Recent efforts to ease access to finance constraints include:

- *The Central Bank makes it compulsory for private banks to grant a minimum percentage of loans to agriculture.* Loans are required to be uncollateralized; however, the loan interest rate may be very high, exceeding 13 percent (the current legal maximum).<sup>205</sup>
- *Other emerging formal channels for agriculture finance* include: the PACT Global Microfinance Fund, Proximity Design, World Vision, the Global Treasure Bank (formerly Myanmar Livestock and Fisheries Development Bank), the Central Cooperative Society, and input dealers (such as AWBA), which offer formal credit (Evans et al., 2015).

**6.3.3.7 Digital payment solutions for agriculture finance is a promising area for investment:**

- *Cellphone ownership and telecom infrastructure are rapidly improving.* There is a very high rate of ownership, even in rural agricultural areas: 87 percent of farmers own a mobile phone, with 51 percent of the total owning smartphones. However, data usage is low, and often purchased in small, expensive quantities (Evans et al., 2015). Use of social media is high, suggesting an opportunity for low-data mobile solutions.<sup>206</sup> Myanmar is currently receiving large investments in telecom infrastructure, which will improve the fundamental conditions for digital technology. But so far there have been limited investment in technologies for farmers. Yet solutions exists that could transform this landscape, if they can be made commercial, such as real time information about weather and commodity pricing to farmers — an innovation that could potentially revolutionize productivity while maximizing rural incomes for years to come".<sup>207</sup>

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<sup>204</sup> The Economist, 2017, "A country mile: Rescuing Myanmar's farmers from the debt trap" (<http://www.economist.com/news/finance-and-economics/21720632-microfinance-its-infancy-hopes-still-depend-lumbering-state?zid=306&ah=1b164dbd43b0cb27ba0d4c3b12a5e227>)

<sup>205</sup> C.M. Htwe, 2017, "Agricultural sector and SMEs to receive private bank loans," Myanmar Times (<http://www.mmtimes.com/index.php/business/25141-agricultural-sector-and-smes-to-receive-private-bank-loans.html>)

<sup>206</sup> C. Mod, 2016, "The Facebook-Loving Farmers of Myanmar," The Atlantic (<https://www.theatlantic.com/technology/archive/2016/01/the-facebook-loving-farmers-of-myanmar/424812/>)

<sup>207</sup> V. Kumar, "Myanmar: Open for agribusiness," Sustain Business Solutions (<https://sustainbusiness.org/myanmar/>)

- *Preparations are underway to make such investments commercial, particularly in the field of Digital Financial Services (DFS). These are financial services delivered and accessed through digital channels and instruments such as mobile phones, cards, point-of-sale (POS) devices, and agent outlets, and can play a critical role in supporting achievement of the Government’s priority objectives by economically, securely, and transparently delivering the financial services that the agriculture sector requires to improve productivity and raise rural incomes (Evans et al., 2015). At least 6 DFS Mobile Money and Payment solutions have been launched or are being planned in Myanmar (Myanmar Mobile Money, MyKyat, MYWALLET plus, Wave Money, Ooredoo, Myanmar Payment Solution Services (MPSS)), with partners (including banks and telecommunications companies) both collaborating with existing players, and establishing their own proprietary payment platforms (Evans et al., 2015).*
- *Pay-as-you-go financing delivered through digital channels could bridge the infrastructure gaps for the use of equipment such as solar panels and solar pumps. A pay-as-you-go model for solar energy would enable rural households and businesses to receive a solar product and pre-pay for energy credits using a card or mobile-based instrument and channel (Evans et al., 2015).*

**6.3.3.8 Expanding access to finance has also been the priority for IFC investments in Myanmar.** IFC has invested in improving infrastructure, expanding access to finance, supporting reforms and attracting investment, as well as promoting job creation and improved productivity since it reengaged with Myanmar in 2012. IBRD is also providing technical assistance in Myanmar’s banking system reforms. On agriculture finance, IFC provided financing and advisory services to Yoma Bank to expand access to finance for SMEs, from which many agricultural firms will benefit (see Annex 6.B). IFC is advising Yoma Bank and Myanmar Oriental Bank, along with US\$21 million to 4-6 microfinance institutions “to improve corporate governance, risk management and trade finance while also providing capital to boost scale and expand services to those without banking connections”. This is expected to enable disbursement of 112,500 to 127,500 loans to low income households in the country. Further cooperation and investment in reforming the banking system with a focus on agriculture resilience facilities could be potential investment targets by the proposed fund. Investment and assistance opportunities could also be identified with large corporations that provide microfinance (like the Awba case discussed above).

## 6.4 Vietnam

*To produce “more from less” the sector will need to create more economic value (farmer and consumer welfare) and use less natural, human, and other resources.*

### 6.4.1 Agriculture Market Analysis

6.4.1.1 **Agriculture accounts for a significant part of Vietnam’s economy.** Agriculture represents 17 percent of Vietnam’s GDP, and 44 percent of its labor force by occupation.<sup>208</sup> Agricultural products rank at the top of all Vietnamese exports.<sup>209</sup> Six percent of total exports (US\$11 billion) are agricultural products, including coffee (24 percent), rice (21 percent), nuts (20 percent), and pepper (12 percent).<sup>210</sup> Vietnam is the world’s third-largest exporter of rice (6.61 million metric tons, or 15 percent of the global total of rice), and the second largest exporter of coffee with a 20 percent market share.<sup>211</sup>

6.4.1.2 **Vietnam is still at a low level of adaptive capacity, which increases the country’s vulnerability to climate change stressors such as floods and droughts.**

- *Vietnam is vulnerable to natural disaster risks such as floods and droughts* (Smyle and Cooke, 2012). Starting in October 2016, five consecutive floods affected Vietnam, resulting in crop and livestock damage/loss.<sup>212</sup> Those floods followed two years of drought and saltwater intrusion starting in late 2014, which impacted two million people and 660,000 hectares of crops, resulting in US\$674 million in economic losses.<sup>213</sup> The 2015-2016 drought prompted a state of emergency in 18 provinces and seriously affected 22 of them (Grosjean et al., 2016).
- *Climate change will exacerbate the natural disaster risks by giving rise to more erratic weather patterns.* Annual rainfall changes across Vietnam are projected to range between -16 percent and +36 percent by 2050. Summer rainfall is projected to decrease throughout Vietnam -- but in central Vietnam, rainfall will increase for all other seasons. This will increase water stress in the dry season, and

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<sup>208</sup> General Statistics Office Of Viet Nam, accessed March 6, 2017, (<https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=15507>)

<sup>209</sup> CIA World Factbook, “Vietnam” (<https://www.cia.gov/library/publications/the-world-factbook/geos/vm.html>)

<sup>210</sup> MIT Observatory of Economic Complexity, (<http://atlas.media.mit.edu/en/profile/country/vnm/>)

<sup>211</sup> United States Department of Agriculture, “World Agricultural Supply and Demand Estimates Report (WASDE)” <https://www.usda.gov/oce/commodity/wasde/>, accessed April 28, 2017, p.24; and C. Summers, 2014, “How Vietnam became a coffee giant” BBC (<http://www.bbc.com/news/magazine-25811724>)

<sup>212</sup> UN Viet Nam, 2016, “Floods Central Viet Nam Office of the Resident Coordinator Situation Report No. 1” ([http://www.un.org.vn/en/publications/government-agency-publications/doc\\_details/533-viet-nam-floods-central-viet-nam-office-of-the-resident-coordinator-situation-report-no-1.html](http://www.un.org.vn/en/publications/government-agency-publications/doc_details/533-viet-nam-floods-central-viet-nam-office-of-the-resident-coordinator-situation-report-no-1.html))

<sup>213</sup> UN Vietnam, 2016, Vietnam Drought Status Infographic, accessed 6 March 2017 ([http://www.un.org.vn/images/stories/pub\\_trans/VietNam\\_Infographic\\_081116\\_ENG.pdf](http://www.un.org.vn/images/stories/pub_trans/VietNam_Infographic_081116_ENG.pdf))

increase the likelihood of floods in other seasons. Furthermore, sea levels are expected to rise 100-400mm by 2050, with storm surges affecting coastal communities and ecosystems.<sup>214</sup>

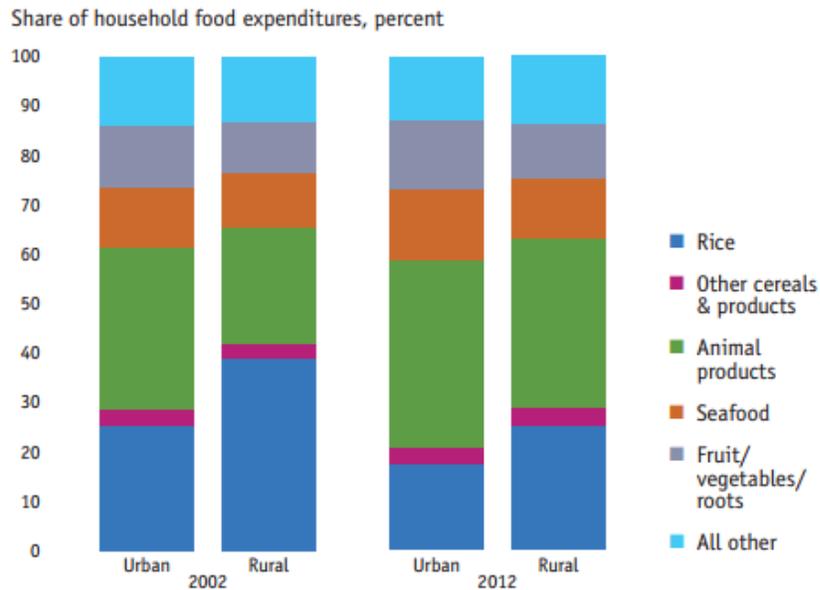
- *These climate and natural disaster risks will threaten agricultural output, incomes, and food security.* The lack of water supply for irrigation from the 2015-2016 drought reduced agricultural production. In another case affecting the Mekong Delta, further agricultural damage resulted from some of the most extensive saltwater intrusion into agricultural areas recorded for the country. Future projections indicate that the affected regions of Vietnam will be exposed to more severe drought conditions and flooding due to climate change (Smyle and Cooke, 2012). These risks were already features of Vietnam's climate due to El Niño-related events, and as the variability and intensity of these issues increase over time, they will be exacerbated by the reduction in natural forest areas as a result of competing land use pressures like agriculture (Grosjean et al., 2016).

6.4.1.3 **Financial projections suggest that the share of primary agriculture in gross domestic product (GDP) will decline; yet the share of the broader agri-food complex will not.** Similar to its neighbors (Indonesia, the Philippines, and Thailand) Vietnam's society is in transition, with a growing part of the population moving to the cities, the expansion of its middle class, the reduction in agricultural labor, and related socio-economic changes (Figure 6.19) (Reardon et al., 2014). The GDP share of primary agriculture is expected to decline over the coming two decades, perhaps by 0.5 percent per year. By the early 2030s, primary agriculture will then account for some eight to nine percent of Vietnam's GDP. However, agri-industry, together with food distribution and logistical (and other) services could account for nearly double this share (15 percent of GDP). This means that the agri-food complex will still account for one-fourth of total GDP (World Bank Group, 2016).

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<sup>214</sup> IMHEN, 2017, "High-resolution Climate Projections for Vietnam - Policy Summary" accessed Feb 20, 2017, ([http://vnclimate.vn/uploads/publications/2016\\_05/POLICYSUMMARY\\_ENGLISH.pdf](http://vnclimate.vn/uploads/publications/2016_05/POLICYSUMMARY_ENGLISH.pdf))

**Figure 6.19 - Urban and Rural Food Expenditures**



Source: World Bank, based on Vietnam's Institute for Policy and Strategy for Agriculture and Rural Development

- 6.4.1.4 **Much of Vietnam's agricultural growth comes from expanded or more intensive use of land and fertilizer, resulting in degradation and resource inefficiencies.** Although Vietnam once had problems with hunger, the country is now in the top tier middle-income countries in terms of per capita food availability, and is a lead exporter of rice, shrimp, and coffee (The World Bank in Vietnam, 2016). The country's agricultural success has come at the expense of the environment, such as deforestation and water pollution. The rising intensity of input and natural resource usage are hurting not only the environment, but also profitability as land degradation diminishes output quality and quantity (World Bank, 2017). Environmental problems are negatively impacting farm productivity and thus the competitiveness of Vietnam's agricultural exports (Scherr et al., 2015). To sustain its food security and agricultural export competitiveness, the sector will need to adapt to market and climate realities (World Bank Group, 2016).
- 6.4.1.5 **There are regional contrasts in Vietnam's agriculture sector structure.** In the Red River Delta (in the Northern part of the country), 97 percent of holdings in 2011 were under 0.5 ha – and these holdings typically consisted of multiple (three to seven) plots of roughly similar size or quality under management. In contrast, 23 percent of households in the Central Highlands have more than two hectares (although they vary in quality). In the Mekong Delta in the South, over 10 percent of land holdings are larger than two hectares, and 23 percent fall in the same category in the Southeast (World Bank Group, 2016).

**6.4.1.6 Except for perennial crops, production is dominated by smallholder households.**

In many parts of the country, households raise small clusters of fruit and special purpose trees. Export-oriented production of coffee, black pepper, and cashews is prominent in the Southeast and Central Highlands, where some 20 percent of growers have more than two hectares planted and the average planting is one hectare-wide. Some 25,000 medium or large farms grow perennial crops, the production of which exhibits a clear trend toward concentration. In 2006, about 31 percent of such farms had plantings of less than three hectares and only 14 percent had plantings of more than 10 ha -- by 2011, less than five percent of farms had plantings of less than three hectares and 37 percent had more than 10 ha. Vietnamese rubber production is now about evenly split between several thousand smallholders on one hand, and a small number of state-owned enterprises on the other (World Bank Group, 2016).

**6.4.1.7 Climate-Smart Agriculture (CSA) is a growing practice.** CSA refers to the management of managing landscapes (cropland, livestock, forests, and fisheries) with the goals of 1) increased productivity to improve food security and boost farmers' incomes; 2) improved resilience to drought, pests, disease, and other shocks linked to climate change impacts; and 3) reduced greenhouse-gas emissions. In Vietnam, current CSA efforts include:

- Increasing the productivity of animal protein producers while reducing greenhouse-gas emissions per kilogram of meat or milk or hectare. This includes various measures, including manure management; and building the capacity of agriculture input suppliers;
- Increasing crop and trees variety that can address droughts and floods; and
- Reducing post-harvest losses in the food value chain.

**6.4.1.8 Productivity improvement is one of the key market trends in Vietnam's agriculture sector:**

- *Vietnam suffers from very low agricultural productivity, almost at the bottom in Asia and the lower end globally.* Agricultural productivity is defined as the agricultural GDP divided by the number of the agricultural workers. According to The Global Economy agriculture productivity country ranking data, the global average for 2015 was 15750.61 USD, while Vietnam was 805.73 USD, ranked at 131th in the world – almost at the bottom of all Asian countries in the list.<sup>215</sup> Table 6.2 ranks Vietnam and other Asian countries on the basis of their productivity in 2015.

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<sup>215</sup> The Global Economy, "Agriculture value added per worker, constant USD, 2015" ([http://www.theglobaleconomy.com/rankings/Agriculture\\_productivity/](http://www.theglobaleconomy.com/rankings/Agriculture_productivity/))

- Yet there has been marginal improvement in agricultural productivity in Vietnam. Agriculture productivity in Vietnam grew at a compound annual growth rate (CAGR) of 2.2 percent between 1985 and 2015 (Figure 6.20). According to SDG target for small-scale food producers, agricultural productivity should double every 15 years, and the annual growth rate should be 4.7 percent (United Nations Viet Nam, 2016). But Vietnam is growing at a much slower pace.

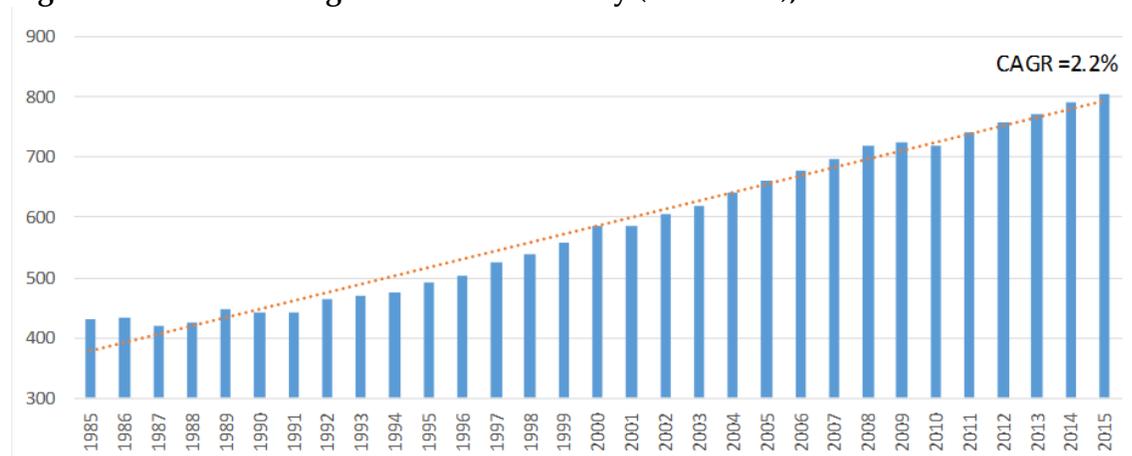
**Table 6.2 - Agriculture Productivity of Asian Countries (2015), calculated at constant USD**

Country	Agriculture Productivity (2015)	Global Ranking (2015)
Singapore	103,264	2
South Korea	26,501	27
Malaysia	19,868	31
Indonesia	2,629	103
Thailand	2,109	107
Philippines	1,942	109
China	1,465	117
India	1,147	122
Vietnam	806	131
Cambodia	798	132
Bangladesh	743	133
Nepal	449	144

Source: TheGlobalEconomy.com, the World Bank

Note: Data is available at [http://www.theglobaleconomy.com/Vietnam/Agriculture\\_productivity/](http://www.theglobaleconomy.com/Vietnam/Agriculture_productivity/)

**Figure 6.20 - Vietnam Agriculture Productivity (1985 -2015), calculated at constant USD**



Source: TheGlobalEconomy.com, the World Bank

Note: Data is available at [http://www.theglobaleconomy.com/Vietnam/Agriculture\\_productivity/](http://www.theglobaleconomy.com/Vietnam/Agriculture_productivity/)

#### 6.4.1.9 Overall, agricultural land consolidation is at an early stage in Vietnam, while the consolidation of commercial agricultural production is gathering pace.

- Vietnam's agricultural land-use reflects the historical importance of and dominant policy and public investment attention to rice from the mid-1990s onward. Although some 700,000 hectares (ha) have been converted from agricultural to non-agricultural uses, the total area under agriculture has grown by about 15 percent since 2000, from an average of 8.9 million ha in 2001-2003 to an average 10.2 million ha during the 2011-2013 period (World Bank Group, 2016). The total harvested area for rice increased by an average of 1.7 percent per year between 2000 and 2010, with the total harvested area for rice exceeding 7.5 million hectares in some of those years. On the other hand, the area under other annual crops grew little in the period up through the mid-2000s, covering two million ha in the early 2000s to about 2.3 million ha in 2011-2013.
- The biggest change in land-use reflects a new and growing focus on export-oriented crops. The planted area for perennial crops increased by about seven percent per year, from 2.2 million ha in the early 2000s to 3.8 million ha in 2011-2013. As opposed to annual crops, the perennial category includes coffee, rubber, and aquaculture.<sup>216</sup> The latter grew rapidly in Vietnam during the 1990s until the mid-2000s, when it stabilized near one million ha. The agricultural expansion described here is mostly oriented towards exports.
- Food crop diversification is still a new approach. Crop diversification has been constrained by land-use policies, whereby much of the irrigated lowland areas have been designated as rice-growing land -- with restrictions placed on alternative uses. At the national level, about 90 percent of paddy cultivation occurs on designated land (Giesecke et al., 2017). Most of Vietnam's expansion of irrigation and a large proportion of its public research and advisory service resources have been geared towards maximizing national or provincial rice output. Figure 6.21 provides a breakdown of Vietnam's food crop area and a comparison to China.
- Agricultural land is highly fragmented in Vietnam. Nearly 90 percent of agricultural land falls under heavily-fragmented agricultural households or farms, about six percent under enterprises, and the balance held by other entities – a situation that has negative implications for efficiency and risk management. The agricultural household segment is dominated by small farms, which has changed very little from 2001 to 2011 (Figure 6.22). The smallest farm size category (less than 0.2 ha) applied to 35 percent of

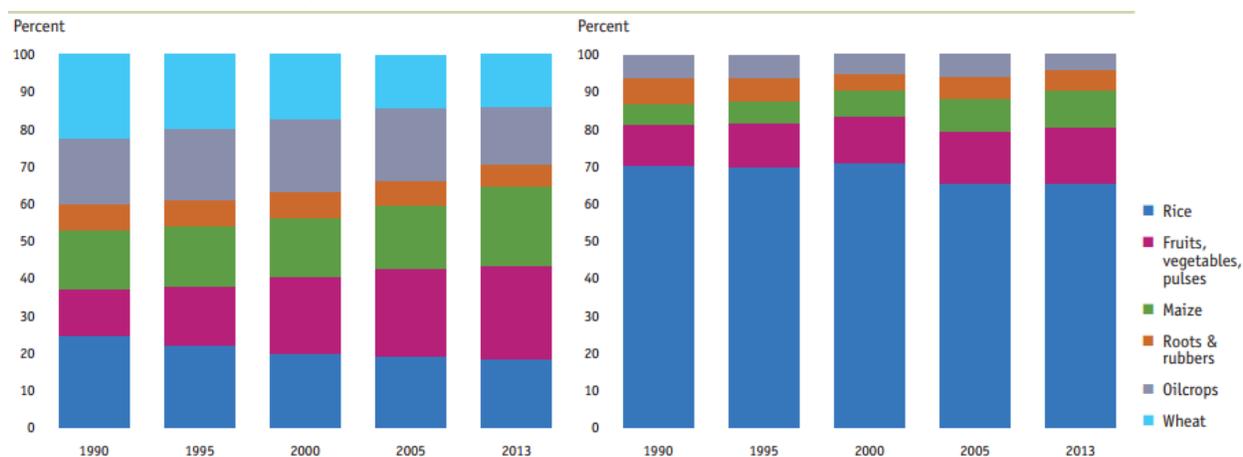
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<sup>216</sup> An annual plant is one that completes its life cycle within one year, while perennial crops are alive year-round and are harvested multiple times before dying. Annual plant examples are corn, wheat, and rice. Perennials include apples and alfalfa. For more info, see [http://web.mit.edu/12.000/www/m2015/2015/perennial\\_agriculture.html](http://web.mit.edu/12.000/www/m2015/2015/perennial_agriculture.html)

households in 2011, while farms larger than 2 ha only applied to six percent. Small household landholdings often consist of three, four, or many smaller, noncontiguous plots, sometimes separated by considerable distance (Hung et al., 2007). Furthermore, small farms can be ill-prepared to manage risks, not to mention the market inefficiencies of transaction costs associated with aggregating the supply of large numbers of small farms. Since farmland fragmentation is greater for annual crop land, this affects Vietnam given that it has focused on annual crops (World Bank Group, 2016).

- A distinction must be made between subsistence-oriented rice production and commercial rice production: Since 2000, the Mekong Delta (to the South) accounted for two-thirds of the growth in national rice production, and most of this growth has taken place in about twenty districts that comprise the “core rice belt.”<sup>217</sup> While some 1.4 million households grew paddy in 2008, two-thirds of the net surplus were produced by the top 20 percent of growers, whose average landholding was 2.74 ha. Some 85 percent of the surplus was accounted for by the top two quintiles. These statistics reflect a trend toward greater concentration in commercial rice production. To put this into perspective, about 300,000 of Vietnam’s nine million rice-growing households account for most of the country’s rice exports. This could make the promotion of competitiveness and value-addition in rice value chains more manageable (World Bank Group, 2016).

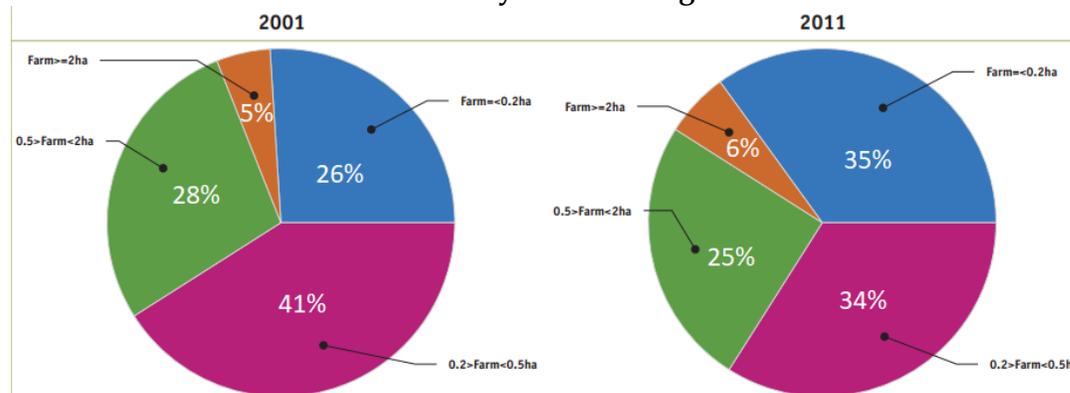
**Figure 6.21 - Share of Food Crop Area under Selected Crops in Vietnam and China**



Source: World Bank, based on FAOSTAT data.

<sup>217</sup> S. Jaffee, 2011, “From Rice Bowl to Rural Development: Challenges and Opportunities Facing Vietnam’s Mekong Delta Region” ASAE Presentation ([http://7thasae.ipsard.gov.vn/ppt/presentation/A4/A4\\_ASAE\\_Steve\\_percent20Jaffee\\_Vietnam.pdf](http://7thasae.ipsard.gov.vn/ppt/presentation/A4/A4_ASAE_Steve_percent20Jaffee_Vietnam.pdf))

**Figure 6.22 - Distribution of Farm Units by Landholding Size**



*Source: World Bank Group, based on GSO census 2001, 2006, and 2010*

**6.4.1.10 Existing regulations hinder the development of medium scale farming operations.**

The government of Vietnam is trying to reduce land fragmentation by implementing land consolidation in communes. These programs involve facilitating plot exchanges between households and promoting cooperative farming. In some cases, households have leased out their land to companies and arranged for family members to continue working on professionally-managed farms. These programs have had some effect: the number of plots per household has fallen from 4.27 in 2004 to 2.83 in 2014 (Markussen et al., 2009). However, in most parts of Vietnam, the land rental market remains underdeveloped due to limits or restrictions on land holding sizes (3 ha for cropland with a few exceptions under the 2016 Land Law) (JICA, 2013) and uses (best land designated to rice) (World Bank, 2012), high transaction costs in land transfers, and the setting of land price values by provincial bodies (World Bank in Vietnam, 2016). These factors hinder the development of specialized, medium-scale farming operations by enterprises and individuals who want to invest in agriculture (Giesecke et al., 2017).

**6.4.1.11 Rural and smallholder farmers could benefit more from Vietnam’s economic growth, if they could diversify their plantings.**

According to the IMF Article IV 2016 report, Vietnam’s real GDP growth has maintained above six percent in the past three years (6.0 percent in 2014, 6.7 percent in 2015, and 6.1 percent in 2016), which is among the highest in Asian countries. The unemployment rate is kept below 2.5 percent, and inflation is below 4 percent in the recent three years. The favorable macroeconomic conditions provide a supporting environment for resilience investments in Vietnam. However, landholding restrictions prevent many farmers from growing more value-added crops. In An Giang Province (in the Mekong Delta),

an average family earns about US\$100 a month from cultivating rice— which is a fifth of what coffee-growers earn in the Central Highlands.<sup>218</sup>

- 6.4.1.12 **Reforms are necessary to keep up with increasing demand from export partners and from its own demographic changes.** Vietnam has undertaken market reform over the past 20 years that have resulted in notable economic growth, including in the agriculture sector. Foreign trade in general has grown steadily as Vietnam entered ASEAN in 1995, normalized relations with the United States in 2001, and acceded to the WTO in 2007. In agriculture, the re-opening of trade with China in 1989 combined with a switch from a fixed exchange rate that overvalued the *dong* turned Vietnam from importer of rice in 1988 to the world's 3<sup>rd</sup> largest exporter in 1989 (World Bank Group, 2016). Steady advances in smallholder productivity and intensification through the present have made Vietnam a top-five global exporter of shrimp, coffee, cashews, rice, and pepper (World Bank Group, 2016).
- 6.4.1.13 **The government is starting to address climate change challenges in a systematic and comprehensive way.** Recent policies (2623/QD-TTG, Dec 2013) call for a number of measures to prepare the country. The recent Agricultural Restructuring Plan is an ambitious move to enhance the agriculture sector's competitiveness and better position Vietnam to respond to international market opportunities. This involves a market-based agriculture sector, and limited direct intervention by the government (i.e. the government is the facilitator of investment and services rather than the provider). The process aims to safeguard the rights and livelihoods of its largely small producers and to ensure green growth and sustainability.<sup>219</sup> Addressing agriculture, aquaculture and forestry, it aims to encourage investments from the private sector and improve the efficiency of public investments through decentralization (Thang and Linh, 2015). The Plan calls for a shift in sectorial goals beyond physical (output or trade) targets to include a broader set of indicators related to the 'triple bottom line' of sustainable development.

## 6.4.2 Agriculture Resilience Investors' Universe

### Key Players

- 6.4.2.1 **The Vietnamese state continues to play a prominent operational role in the agricultural sector.** The state owns all agricultural land, has placed restrictions on farm size and land use, and controls bulk water delivery via irrigation SOEs. Public institutions dominate agricultural research and intellectual property rights are difficult to protect. SOEs compete with private sector companies at many stages of

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<sup>218</sup> The Economist, 2014, "Rice Farming in Vietnam: Against the grain" (<https://www.economist.com/news/asia/21594338-vietnams-farmers-are-growing-crop-no-longer-pays-its-way-against-grain>)

<sup>219</sup> K. Urban and G Feiler, 2014, "Vietnam aspires to a sustainable agricultural transformation," Hunger Explained ([http://www.hungerexplained.org/Hungerexplained/ARP\\_Vietnam.html](http://www.hungerexplained.org/Hungerexplained/ARP_Vietnam.html))

the value chain, and until the late 2000s, only a handful of national and provincial SOEs were active in agricultural exports (World Bank Group, 2016).

- 6.4.2.2 **Going forward, the Vietnamese government intends to reduce its direct investment in agriculture and agribusiness and focus on facilitating investment.** According to the 2014 Agriculture Restructuring Plan (ARP), the Vietnamese government seeks to transition to market-based mechanisms and to evolve from an operator/investor into a facilitator.<sup>220</sup> The State Capital Investment Corporation (SCIC) has committed to a ranging divestment program which is proceeding, if slowly.<sup>221</sup>
- 6.4.2.3 **Local corporates are playing a first-mover role in the agricultural investment environment.** In a trend similar to that witnessed in China, well-resourced and well-connected local conglomerates have begun to enter the agriculture space, working with local governments to lease and farm aggregated tracts. Vingroup, Vietnam's largest developer, launched VinEco with US\$92 million in 2015 in order to invest in organic agriculture, importing techniques from Israel, Holland, and Japan. In 2015, VinEco and real estate developer FLC Group both received approval to invest in 1,000+ hectare farms in the central Thanh Hoa province.<sup>222</sup> Truong Hai Auto Corporation (THAC) has invested in a technology-centered rice paddy. Hoa Phat Group, comprising steel, real estate, and other interests, and real estate conglomerate Hoang Anh Gia Lai have both announced that agriculture and agribusiness will be a part of its long-term investment plan.
- 6.4.2.4 **Vietnamese corporate investors are also looking to neighboring countries for agricultural acquisitions.** Vietnamese SOEs and private companies represented a significant amount of FDI into the agriculture sector in Laos, Cambodia, and Myanmar, and Laos, Cambodia, and Myanmar are the 1<sup>st</sup>, 2<sup>nd</sup>, and 9<sup>th</sup> largest destinations for Vietnamese FDI (Oxfam, 2016). These markets have proven attractive for their ample natural resources, low labor costs, and familiar business environments. Moreover, companies can often extract favorable concession terms from local governments, who sometimes negotiate deals directly instead of through the national government. Aggregate Vietnamese FDI into agriculture in Cambodia as of June 2016 is estimated at US\$2 billion, of which 94 percent was for rubber ventures through land concessions. In Laos, Vietnamese investors are the largest single investor in land concessions (Oxfam, 2016).

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<sup>220</sup> K. Urban and G Feiler, 2014, "Vietnam aspires to a sustainable agricultural transformation," Hunger Explained ([http://www.hungerexplained.org/Hungerexplained/ARP\\_Vietnam.html](http://www.hungerexplained.org/Hungerexplained/ARP_Vietnam.html))

<sup>221</sup> R. Jennings, 2016, "Vietnam's Biggest Investor Is Quietly Quitting The Market," Forbes (<https://www.forbes.com/sites/ralphjennings/2016/10/13/what-to-expect-as-vietnams-biggest-investor-edges-out-of-the-market/#6239f268cc36>)

<sup>222</sup> Viet Nam News, 2015, "FLC Group, Vingroup invest in agriculture" (<http://vietnamnews.vn/economy/270484/flc-group-vingroup-invest-in-agriculture.html#Z6CkRu5hpVQOBzjI.97>)

- 6.4.2.5 **Regional and global corporates are also present in Vietnam, but agricultural projects still represented just 1 percent of FDI in 2016.** In the first quarter of 2017, South Korea, Singapore, and China were the largest sources of FDI into Vietnam, but most of these investments have gone to processing and manufacturing industries, such as garments, chemicals, cement, and steel.<sup>223</sup> Cargill has invested in multiple feed mills in Vietnam, as well as in specialty aqua feed facility in Dong Thap, its tenth aqua feed line in Vietnam since acquiring the first in 1998.<sup>224</sup> Bunge and Wilmar have created a joint venture in soybean crushing, and Bunge began production at its US\$100 million soybean crushing operation in Feb 2017. In Feb 2017, CJ Group inaugurated a US\$19.4 million feed plant in Binh Dinh, its sixth in the country.
- 6.4.2.6 **A small number of local fund managers are the most active institutional investors in Vietnam.** A small number of local investment firms including VinaCapital, Mekong Capital, Dragon Capital, Vietnam Investments Group, and others are thought to account for 75 percent of transactions in Vietnam.<sup>225</sup> These firms have a better understanding of local market dynamics, a specific mandate to invest in Vietnam, and a larger opportunity set of smaller-size transactions that are less attractive to global institutional investors. They have also begun to realize profitable exits, which will serve to attract more attention from larger global firms.<sup>226</sup>
- 6.4.2.7 **Few global institutional private equity investors have entered Vietnamese markets, although the outlook is increasingly positive.** Although KKR, Warburg Pincus, TPG, and Standard Chartered have transacted in Vietnam, foreign institutional investors have yet to enter in significant numbers. A track record is slowly developing. In 2016, KKR fully exited its position in Masan Group, a major seafood producer, into which it first invested US\$159 million in 2011. Standard Chartered has invested in two large deals in Vietnam -- US\$90 million in 2014 into An Gian Plant Protection, a maker of agricultural chemicals and seeds, which it purchased from VinaCapital; and US\$35 million in the same year into restaurant chain Golden Gate. Nonetheless, deal sizes are small, equity markets underdeveloped, and exchange rates volatile (although stability is increasing), which will restrain internationals from coming into the market.

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<sup>223</sup> B.H. Nhung, 2016, "Foreign investors show little interest in Vietnam's agriculture sector," VN Express (<http://e.vnexpress.net/news/business/foreign-investors-show-little-interest-in-vietnam-s-agriculture-sector-3491102.html>); VN Express, 2017, "South Korea becomes Vietnam's biggest foreign investor in Q1" (<http://e.vnexpress.net/news/business/south-korea-becomes-vietnam-s-biggest-foreign-investor-in-q13560501.html>); and Dtinews, 2017, "Chinese investment into Vietnam on the sharp rise" (<http://english.vietnamnet.vn/fms/business/172454/chinese-investment-into-vietnam-on-the-sharp-rise.html>)

<sup>224</sup> Undercurrent News, 2017, "Cargill opens tenth aqua feed line in Vietnam" (<https://www.undercurrentnews.com/2017/05/03/cargill-opens-tenth-aqua-feed-line-in-vietnam/>)

<sup>225</sup> N.T.B. Ngoc, 2016, "Entry-exit terms are crucial to deal-making in Vietnam: VinaCapital MD Andy Ho," Deal Street Asia (<https://www.dealstreetasia.com/stories/meet-andy-ho-cio-at-vinacapital-and-our-pe-vc-summit-speaker-51798/>)

<sup>226</sup> N.T.B. Ngoc, 2017, "Vietnam 2016: Mekong, KKR, Vinacapital record PE exits," Deal Street Asia (<https://www.dealstreetasia.com/stories/vietnam-top-private-equity-exits-in-2016-61369/>)

6.4.2.8 **MDB's are active investors in Vietnam, and the most prominent investors in climate change resilience, but concessional finance is increasingly limited as Vietnam moves up the income ladder.** The IFC has partnered with SCIC to advise on its divestment strategy and seek co-investment opportunities in agribusiness. It has also made investments in a variety of sectors including agribusiness, as with the recent US\$10 million investment into Pan Group and last year's partnership with chemical maker Loc Troi Group, and last year's US\$15 million investment in Anova Corporation. The ADB has approved over US\$3 billion for agriculture and water projects in Vietnam, and has an explicit focus on improving environmental sustainability and climate change response in Vietnam. Much of its focus has been on water management, such as the US\$100 million Strengthening Water Management and Irrigation Systems Rehabilitation Project, the US\$300 million Asia Environmental Partners II Fund. However, as of June 2017 Vietnam no longer qualifies for most concessional financing from the World Bank or the Asian Development Bank, further underscoring the need for private sector contributions to agriculture resilience.<sup>227</sup>

### Challenges

6.4.2.9 **Land fragmentation and ownership restrictions remain the primary obstacle to agriculture investment.** The Land Law of 2013 limits the size of holdings for both individual and commercial farmers. Commercial enterprises seeking to consolidate holdings face a daunting process of innumerable negotiations with small holders. Reportedly, VinEco had to negotiate with 3,000 households to aggregate just 140 hectares of land in Nam Dinh province for an organic vegetable operation.<sup>228</sup> Private sector and government officials have spoken openly of the need to reform the law, and the national assembly has requested to revisit the law, but the present regulatory regime continues to deter investors in the sector. As noted above, local Vietnamese firms often choose to invest in neighboring Laos, Cambodia, and Myanmar, instead of in Vietnam.

6.4.2.10 **Declining soil conditions also restrict the possibilities of the agricultural sector.** Although Vietnam has achieved significant increases in production and productivity over the past quarter century, much of these gains were achieved through overuse of pesticides and fertilizers, as well as from deforestation. This has had a negative effect on soil quality and the environment. The extent of degradation appears to be less than that found in China, but Vietnam's industrialization path is similar to China's, and concerns have begun to arise locally about the quality of Vietnam's food production (World Bank Group, 2016).

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<sup>227</sup> N. Kim and G. Nguen, 2017, "Vietnam Learns Becoming a Tiger Economy Comes With a Cost," Bloomberg (<https://www.bloomberg.com/news/articles/2017-08-06/vietnam-s-success-comes-with-a-price-cheap-financing-is-over>)

<sup>228</sup> N. Chi, 2017, "Parceled together," Vietnam Economic Times (<http://vneconomicstimes.com/article/business/parceled-together>)

6.4.2.11 **Vietnam’s demographics and economic trajectory also present challenges to the agriculture sector.** Vietnam is urbanizing and becoming wealthier. Its workforce is transitioning to higher value activities in manufacturing and services, and its richer people are changing their consumption habits and demanding higher-quality food products. It is increasingly difficult for farmers to earn a living, as income inequality is rising within rural areas, as well as between farm and non-farm incomes, and external investors are more interested in ICT, retail, and other sectors that address the purchasing power of Vietnam’s growing urban middle class (World Bank Group, 2016). This further highlights the importance of improving agricultural productivity and improve income of farmers.

### Opportunities

6.4.2.12 **Mechanization and downstream processing represent significant opportunities for Vietnamese agriculture, providing that progress is made on land reform.** Most of Vietnam’s agro-food exports are primary commodities or initially processed products, and its agriculture sector is highly land-constrained. This means that further growth must come from increased productivity per unit of arable land (World Bank Group, 2016).

6.4.2.13 **Certain land aggregation programs have demonstrated success in attracting investment.** The northern province of Ha Nam has implanted a pilot project led by Ha Nam High-tech Agricultural Development and Investment JSC whereby smallholder give their land rights to the local government in exchange for a payment and a promise of employment. The land is then sub-let out at scale to commercial enterprises. The province has attracted investment into farms from VinEco, Vinaseed, as well as Japanese group Showa Denko, which has built a facility producing pesticide-free vegetables.<sup>229</sup>

6.4.2.14 **Although Vietnam can still extract efficiency gains from improving basic levels of mechanization and economies of scale, conditions are comparatively better for AgTech investment than in other EMDEs.** Vietnam must improve its productivity, but the challenges of land aggregation restrict the relative value of gains to be had from large-scale farming. As has been demonstrated in the Ha Nam district, agribusinesses are exploring ways to enhance productivity on smaller plots of land. Moreover, the Vietnamese government is a vocal proponent of value-added technology in the agriculture sector.

6.4.2.15 **Privatizations will continue to be a source of deal flow, including in agriculture.** Private equity players in Vietnam expect privatizations (aka “equitizations”) to be a

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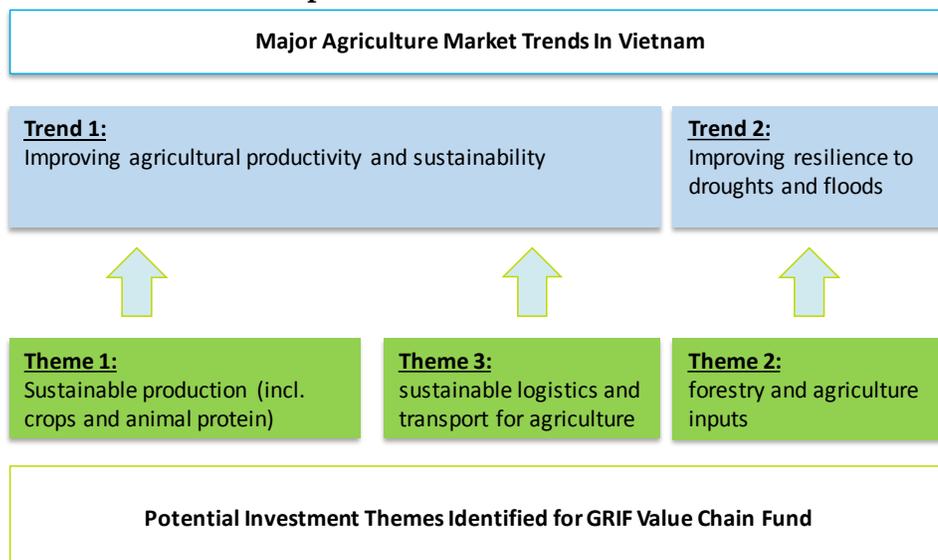
<sup>229</sup> H. Lien, 2015, “Farming foreign agri-investments,” Vietnam Investment Review (<http://www.vir.com.vn/farming-foreign-agri-investments.html>)

strong source of deal flow in the near term.<sup>230</sup> Meanwhile, the government sold an incremental stake in the biggest listed dairy firm, Vinamilk, last year, and has indicated it will seek to fast-track the privatization of Vinafood II and the Vietnam Rubber Group.<sup>231</sup>

### 6.4.3 Agriculture Resilience Investment Themes: Examples

Three potential investment themes are discussed in this section: sustainable production, including sustainable production of higher value-added animal protein; forestry and agriculture inputs to enhance resilience to droughts and floods; sustainable logistics and transport for agriculture. Theme 1 and Theme 3 address Vietnam’s low productivity challenges, and Theme 2 addresses its vulnerability to floods and droughts (Figure 6.23).

**Figure 6.23 – Market trends and potential investment themes for Vietnam**



Source: the authors

### Investment Theme 1: Sustainable Production with Higher Productivity

#### 6.4.3.1 Food production systems are facing sustainability challenges in Vietnam.

According to the UN Vietnam’s *Common Country Assessment for Viet Nam*: Agricultural development in Vietnam has been geared toward soil exploitation through the extensive use of fertilizers and basic technology. Current farming practices are linked to high post-harvest losses, inconsistent crop quality and unsafe agricultural products, with little to no investment in high value-added productions. The lack of investment in sustainable and resilient agriculture has also been

<sup>230</sup> Grant Thornton, 2017, “What is in store for PE investors in 2017?” (<http://www.grantthornton.com.vn/globalassets/1.-member-firms/vietnam/media/pe-2017---eng---22042017-final.pdf>)

<sup>231</sup> Vietnamnet Bridge, 2017, “Abundant attractive deals make huge contribution to M&A market” (<http://english.vietnamnet.vn/fms/business/183583/abundant-attractive-deals-make-huge-contribution-to-m-a-market.html>)

aggravated by price volatility on agricultural markets, increasing competition, and a decline in demand for low-value commodities such as rice. Vietnam ranks among the top three countries with the highest number of import rejections of fish and fishery products in Europe, the United States and Japan (United Nations Vietnam, 2016). Despite these challenges, foreign direct investment (FDI) in the agriculture sector rose significantly in 2016, particularly in agro-forestry and fishery, where it reached US\$53 million.<sup>232</sup>

- 6.4.3.2 **Investing in productivity enhancement is a priority.** In the past in Vietnam's agricultural production, more output has come from more and more inputs, at increasing environmental cost - from more intensive use of land and other natural resources, and relatively heavy use of fertilizer and other agro-chemicals.
- 6.4.3.3 **Technical assistance and other forms of cooperation are also important tools to promote agriculture productivity in Vietnam.** The promotion of sustainable and productive practice in agricultural production is as important as the provision of financing: with leading agricultural players that have a wide network among farms and farmers, technical assistance on resilient practice may achieve a significant impact. Technical assistance is vital to support business development, corporate governance as well as resilience, particularly with small players. Such technical support may need separate donor funding or financial support and should not be measured at typical commercial return requirements. Please see Box 6.3 for a recent example of IFC assisting Vietnam's leading rice producer.
- 6.4.3.4 **Multiple cases of investments or advisory services to agriculture production companies in Vietnam indicate a strong market trend for potential agriculture resilience investments,** proving this theme is viable and has a strong investment pipeline A few cases are included in later sections, including IFC's investment in Anova Feed, an animal feed supplier (see Annex 6.C for case studies).

**Box 6.3 - IFC supports the Loc Troi Group in sustainable rice production**

IFC is supporting the Loc Troi Group to roll out sustainable agricultural standards and practices throughout its rice-production value chain in the Mekong Delta, as announced by IFC on March 8, 2017. Improving rice production will help Vietnam's agri-sector expand its global market share, increase profitability sustainably, and improve farmer livelihoods.

Despite being a leading rice exporter, Vietnam faces competition in price and quality from market players such as Thailand, India, Pakistan, and emerging countries like Cambodia and Myanmar.

Loc Troi Group, a leading provider of agricultural services and products in Vietnam, introduced the project to local stakeholders in Ho Chi Minh City. The Loc Troi Group pioneered the building up of the rice-production value-chain model in Vietnam and has around 25,000 farmer households in its

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<sup>232</sup> L. Quach, 2017, "Planting the Seed: A Guide to Opportunities in Vietnamese Agriculture," Vietnam Briefing, Dezan Shira & Associates (<http://www.vietnam-briefing.com/news/vietnamese-agriculture.html/>)

fold. The group is looking to manage a sustainable rice supply-chain in the Mekong Delta, which is known as the "rice bowl" of Vietnam.

IFC is working with the Loc Troi Group over the next two years to help it conform to agricultural standards and practices developed by the Sustainable Rice Platform (SRP), a multi-stakeholder partnership to promote resource efficiency and sustainability, both on-farm and throughout the rice value-chain. About 4,000 farmers will learn about new farming practices that will help them grow high-quality, high-yielding, and sustainable rice. The project will be implemented first as a pilot and subsequently scaled up. IFC is partnering with the International Rice Research Institute (IRRI), which will provide technical support to Loc Troi and the farmers within its supply chain. This new initiative is in line with Vietnam's recent Agricultural Restructuring Plan (ARP), an ambitious move to enhance the sector's competitiveness and better position it to respond to international market opportunities.

The project is being supported by the Government of Canada.

Source: Edited from IFC news:

<http://ifcextapps.ifc.org/IFCExt/Pressroom/IFCPressRoom.nsf/0/D1A29EBCA87D0443852580DD000D8FD3>

## Investment Theme 2: Resilient Forestry and Agriculture Inputs Against Floods and Droughts<sup>233</sup>

- 6.4.3.5 **Natural and agro-forests provide an ecosystem to mitigate the impacts of droughts and floods.** Drought-inflicted damage in the Central Highlands, South Central Coast, and Mekong Delta highlights how vulnerable these regions are to climate change related impacts. Agroforestry, along with other practices, can contribute to increasing farmers' incomes, improving watersheds, and protecting against agricultural drought and flood impacts. Specifically, forests and agroforests can lead to: (i) decreased erosion that preserves soil quality and reduces crop loss; (ii) maintained or improved water infiltration into soil, and water storage capacity; (iii) decreased sedimentation and improved water quality; (iv) reduced local flash flooding; (v) coastal protection, soil build up, and reduced coastal erosion from mangrove forests; (vii) carbon sequestration that could provide supplemental income from carbon payments.
- 6.4.3.6 **Forestry and agricultural variety that are important anti-drought and anti-flood measures are falling behind in Vietnam.** The Central Highlands, South Central Coast, and Mekong Delta have all seen expansion of monoculture practices coupled with deforestation of natural forests (Box 6.4). Although plantations more than tripled nation-wide between 1995 and 2010, overall forest quality has worsened: evergreen broadleaf forest area declined by 20 percent and mangrove forest by nearly 30 percent during the same time frame. Similarly, in other regions such as the North Central Coast, overlogging dominates the landscape with a tendency from locals to

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<sup>233</sup> This section draws heavily from: CGIAR, 2016, "Increasing Resilience to Droughts in Viet Nam: the Role of Forests, Agroforestry, and Climate Smart Agriculture" (<https://cgspace.cgiar.org/rest/bitstreams/87443/retrieve>)

convert forests into acacia plantation. As a result, many areas lack the broad protective ecosystem that diversified forests and agroforestry landscapes provide. Plantations for pulp and paper production have comparatively little biodiversity, low carbon stocks, and limited water and soil protection potential.

**Box 6.4 - Coffee monoculture plantations in the Central Highlands – An Example of Deforestation**

Coffee monoculture plantations in the Central Highlands in Vietnam are an example of how landscapes have become more vulnerable to drought because of loss of natural buffers. In this region, high coffee prices have driven expansion of coffee plantations, often into the forest. Monoculture practices render land less productive than surrounding areas, motivating farmers to deforest land for new coffee growing areas. As up to 30 percent of coffee plantations are expected to be replanted in the next five years, it is expected that without regulatory changes, coffee monoculture may result in further illegal deforestation – and in coffee plantations that are themselves more vulnerable to drought, flood, and climate change impacts due to the loss of buffers that forested landscapes provide.

*Source:* CGIAR, 2016

- 6.4.3.7 **Modern agricultural products, such as improved seeds and fertilizers that resist both floods and droughts, will be necessary.** Ideally, a comprehensive agricultural strategy would include seeds which are both flood-, drought- and salt-resistant, as well as flood defenses and drip irrigation. In practice, private-sector actors will have to prioritize these initiatives. Technical assistance input may be required to direct their choices or subsidize products which would otherwise be unaffordable. Given the low fixed costs of improved seeds vs. irrigation/flood infrastructure, it is likely that seeds will be considered the “low-hanging fruit” in the Vietnamese agriculture value chain
- 6.4.3.8 **Effective drought and flood management is necessary to protect and improve agricultural livelihoods and food security.** This requires the combination of the three strategies that would reinforce and complement each other to provide optimum ecosystem benefits at farm and landscape levels: appropriate climate smart agriculture, which increase resilience, improve productivity and reduce GHG emissions (see the discussion above in Theme 1 as well as agri-inputs in Theme 2); agroforestry that plays an important role (Theme 2); along with improved (natural) forest management. There are however near term challenges. These are listed in Table 6.3.

**Table 6.3 - Near-term challenges of improving droughts (and floods) resilience**

Farm Scale Challenges	Landscape Scale Challenges
Central Highlands & South Central Coast	
<ul style="list-style-type: none"> <li>• Potentially high initial investment costs</li> <li>• Returns to investment delayed or income gap during the establishment stage (for some practices)</li> <li>• Knowledge gap for farmers adopting new crops, varieties, and practices</li> <li>• Access to drought-resistant varieties</li> </ul>	<ul style="list-style-type: none"> <li>• Monoculture often economically preferred over conserving forest/reforestation in the short-term</li> <li>• Land degradation renders existing farmland less productive, leading to forest encroachment</li> <li>• Ineffective enforcement can lead to illegal agricultural expansion into natural forest land</li> </ul>
Mekong Delta	
<ul style="list-style-type: none"> <li>• Current policies promote 3-season and intensive rice monoculture</li> <li>• High switching costs</li> <li>• Limited access to drought-/salt tolerant varieties</li> <li>• Environmental impacts of some practices (shrimp farming)</li> </ul>	<ul style="list-style-type: none"> <li>• Regional coordination is complex and involves many stakeholders</li> <li>• Upstream households have little incentive to conserve water</li> </ul>

Source: CGIAR, 2016

**6.4.3.9 Development finance, coupled with policy dialogues, is crucial to promote drought and flood resilient agro-forestry and agri-inputs in Vietnam.** Development finance can help alleviate short-term constraints, as well as channel private capital to transition to an ecosystem that promotes droughts and floods resilience. For example, concessional finance may be necessary in the initial stage of the switch to agro-forestry, alleviating the short-term cost constraint, while both public and private capital could invest when there is a supporting business environment for such sectors. Policy dialogues with central and local governments are critical to create policy changes that support the switch such as water price reforms and coordination among various stakeholders. Examples of this type of intervention include IFC's equity investment in Sumitomo Forestry and Pan Group, originally known as Pan Pacific Corporation (Annex 6.C).

### Investment Theme 3: Sustainable Logistics and Transportation for Agriculture

**6.4.3.10 Post-harvest losses are high in the food value chain in Vietnam, further reducing agricultural productivity.** During the distribution process, each year Vietnam loses over US\$2.5bn in farming products and seafood. The loss rate for fruits and vegetables are 25 percent and 30 percent, respectively, which is extremely high compared to other countries, such as India (3-3.5 percent); Bangladesh (7 percent),

and Indonesia (6-17 percent). Seafood, a key exporting industry, has a loss rate of about 20-30 percent, equivalent to 400,000 tons or US\$352 million (VND 8,000bn).

**6.4.3.11 The underdeveloped food transport logistics, cold chain, and storage infrastructure, are the principal reasons behind post-harvest losses.** Vietnam's major crops need to be transported in dry and cool conditions (rice 12-14 percent moisture and below 25°C, green coffee 11-13 percent moisture and 10-20°C). Therefore, ensuring that they stay within their needed heat and moisture ranges is crucial to ensuring their value to the end consumer. Cold chains could ensure that a higher proportion of Vietnam's agricultural products reach their final destinations – this would be especially effective if it were combined with transport systems which minimize the amount of time that products spend on the fields after harvest. Lower loss rates are also expected to raise the quality of the end-product, which could then command a higher price. Beyond coffee and rice, preservation and packaging technologies, can be deployed in combination with cold chains for vegetables.<sup>234</sup>

**6.4.3.12 Smarter, integrated transport systems (transport value chains) for agriculture would ensure that farmers' products reach their markets.** Despite improvements, Vietnam ranked 48th out of 160 countries in World Bank's 2014 Logistics Performance Index (LPI). Logistics service is poor and cold chains are inadequate to ensure the minimization of post-harvest losses, especially during the rainy months when proper drying is not possible (only 15 percent in some areas of the Mekong Delta) (Arvis et al., 2014). The quality of transport infrastructure is ranked 86th out of 148 countries in the World Economic Forum Global Competitiveness index (Schwab et al., 2016). Reviews of agriculture-product transportation reveal significant overlap between driver routes, and opportunities for efficiency improvements through coordination. Better coordination has been achieved in some countries through single-ownership trucking fleets, but this is unlikely to prove financially competitive in Vietnam, as many trucking services are provided by SMEs with relationships to farmers. Instead, coordination could be achieved by service providers who connect drivers and farmers ("Uber for truckers"), ensuring that demand and supply can be better matched. While this would need to fit within the constraints of local mobile-phone services, it could also lead to more opportunities to collect products at a lower cost as part of better-integrated routes, thereby reducing product wastage.

**6.4.3.13 Optimizing food transport logistics and developing cold chain and storage infrastructure are still in the early stage, but the market consensus is that they have high growth potential.** Systems once featuring many small, loosely connected

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<sup>234</sup> StoxPlus, 2016, "Vietnam Cold Storage Market Report," (<https://www.linkedin.com/pulse/vietnam-cold-storage-market-2016-report-stoxplus-corporation>); and StoxPlus, 2017, "Vietnam cold storage market: huge potential but fierce competition" (<http://stoxplus.com/News/Detail/253500?lang=en-US>)

players are giving way to or are supplemented by more integrated, consolidated, and differentiated value chains characterized by higher levels of investment – such as in cold chains to maintain the quality and safety of high value perishable foods.

- *Vietnam's logistics market was worth US\$60 billion in 2014. In total, there are around 1,000 logistics firms – 25 of which are foreign firms.*<sup>235</sup>
- *Foreign logistics firms have a strong presence in Vietnam, capturing 80 percent of market share worth US\$48 billion. While ocean shipping services are dominated by joint ventures, domestic firms mostly handle road-shipping services. Foreign firms of note are Maersk Logistics, APL Logistics, NYK Logistics and MOL Logistics. Most foreign firms can offer third or fourth party logistics (3PL or 4PL) services while Vietnam domestic firms can only handle 2PL services.*
- *Cold chain has been identified as one of the key growth opportunities for investors in Vietnam. However, efforts are required to target such investments to agricultural sectors.*<sup>236</sup> The market inefficiencies that needs to be addressed is to help producers and traders to reduce post-harvest losses in the food value chain by, optimizing food transport logistics and developing cold chain and storage infrastructure, which typically will not interest large international players.<sup>237</sup> Assisting local players to connect farmers to a more efficient logistics system including reducing post-harvest losses by developing cold chain logistics, will be an investment theme for the proposed fund.
- *The Vietnamese government has taken a proactive step to promote cold chain infrastructure by introducing financial incentives to attract foreign investment. Vietnam's government has also made it a policy initiative to promote the rapid growth of infrastructure and attract many of the world's largest infrastructure companies; as a result, many 3PLs have benefited.*<sup>238</sup>

## **6.5 The Agriculture Sector Resilience Investment Fund for Asia (ASRIF)**

### **6.5.1 The Rationale for a Regional Agri-Resilience Value Chain Fund**

#### **6.5.1.1 Crowding in private capital is critical in promoting agriculture resilience in Asia. Few private investors have made agriculture resilience their investment theme. Governments have played the major role in promoting agriculture resilience.**

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<sup>235</sup> Vietnam Briefing, 2014, "Foreign Logistics Firms See Success in Vietnam" (<http://www.vietnam-briefing.com/news/foreign-logistics-firms-see-success-vietnam.html/>)

<sup>236</sup> [http://www.trade.gov/topmarkets/pdf/Cold\\_Chain\\_Vietnam.pdf](http://www.trade.gov/topmarkets/pdf/Cold_Chain_Vietnam.pdf)

<sup>237</sup> [http://www.ifc.org/wps/wcm/connect/51183b2d-c82e-443e-bb9b-68d9572dd48d/3503-IFC-Climate\\_Investment\\_Opportunity-Report-FINAL-11\\_6\\_16.pdf?MOD=AJPERES](http://www.ifc.org/wps/wcm/connect/51183b2d-c82e-443e-bb9b-68d9572dd48d/3503-IFC-Climate_Investment_Opportunity-Report-FINAL-11_6_16.pdf?MOD=AJPERES), p.94

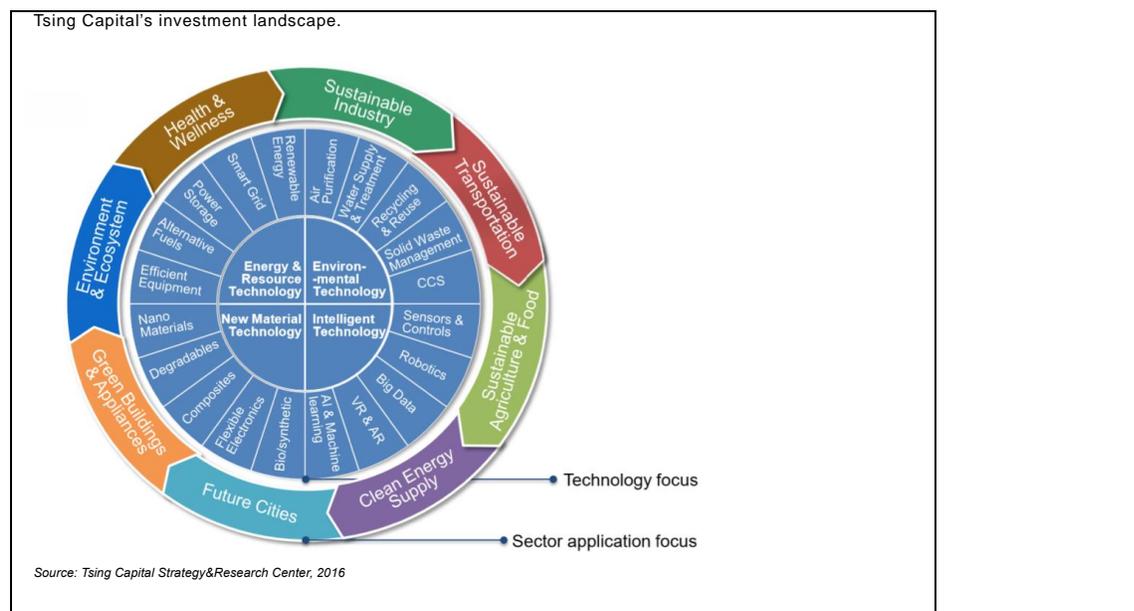
<sup>238</sup> U.S. International Trade Administration (ITA), 2016, "2016 Top Markets Report Cold Chain – Country Case Study: Vietnam" ([http://www.trade.gov/topmarkets/pdf/Cold\\_Chain\\_Vietnam.pdf](http://www.trade.gov/topmarkets/pdf/Cold_Chain_Vietnam.pdf))

However, the growing investment needs cannot be addressed by public capital alone. Today there are still only a handful of agriculture funds with an Asia focus. But none of them makes resilience an investment requirement. Investors like Tsing Capital (China) that have a resilience theme as part of its dedication to environmental protection and sustainable development, are actually venture capital impact investors. Box 6.5 for a brief overview of Tsing Capital.

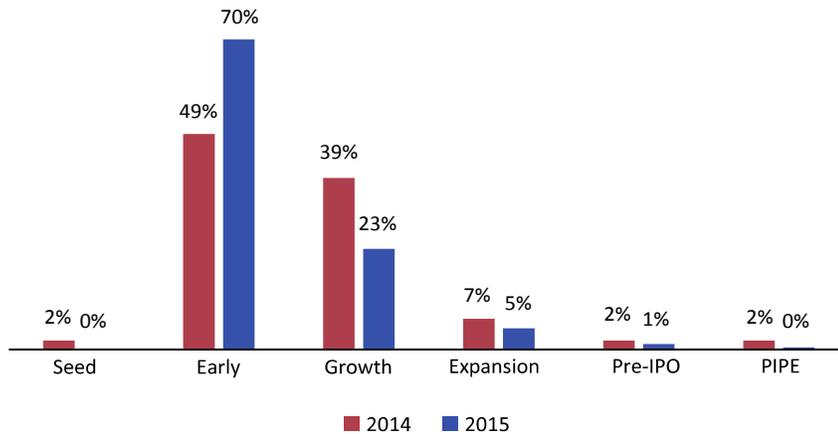
**Box 6.5 - Tsing Capital**

Beijing Tsing Venture Capital Management Company (“Tsing Capital”) was founded in 2001 as a venture capital impact investor dedicated to environment protection and sustainable development. As of April 2017, the total assets under management was about USD 700 million and spans from energy efficiency, clean energy, new material, and sustainable mobility to intelligent technology. It manages a series of USD funds focusing on investing in growth stage sustainable technology companies globally, with investors including multinational corporations, international financial institutions like IFC, regional pension funds, sovereign wealth funds and family offices. In addition, it also manages a smaller Yiyun Clean Tech RMB fund as well as the 2016 established Smart-tech Innovation Fund, which focuses on investing in early stage smart technologies such as Internet of Things and artificial intelligence in the U.S., Israel and China.

Tsing Capital adheres to financial, environment and social “triple” bottom lines. Its investment strategy has shifted from the capex heavy, policy driven environment businesses such as waste management and solar PV, to R&D dependent, capex efficient clean-tech businesses like LED, new materials, and then to market demand driven, technology and business model innovation enabled sustainable technologies such as autonomous driving, smart homes and **smart agriculture**, as manifested in the newly established Smart-tech Innovation Fund.



Percentage of Tsing Capital's new deal volume by stage



Source: Tsing Capital analysis

### Relevance to Resilience Financing

Although the Company does not explicitly target investments related to climate change or natural disaster resilience, some of its investments in the realm of clean and sustainable technological solutions are relevant to climate and natural hazards resilience, especially in areas related to energy efficiency, materials, ICT and artificial intelligence applications. See below the examples of its agriculture resilience related investments.

Sub-Sector	Company	Business Model	Relevance to Agriculture Resilience
Sustainable Mobility	EHang	A technology-oriented enterprise that is specializing in smart drone R&D, manufacturing and sales	The drone products can be applied in resilience-enhancing scenarios such as landscape mapping, surveying and monitoring.
Data Solution	VionTech (Wen'an)	A leading computer vision and artificial intelligence technology provider, specializing in the research and development of core algorithms and products of artificial intelligence.	The software and hardware solutions for image recognition, transportation, and security can be potentially applied to disaster monitoring and pre-warning.

Source: Company website, discussions with the company management.

**6.5.1.2 An investment fund specialized in agri-finance with focus on resilience would mobilize private capital with patient, non-profit driven public capital with transformational implications.** The fund design would be based on the following key elements:

- *Hybrid funding.* Limited public capital would be deployed to crowd in private investors. Public capital participation at fund level would help to reduce investors' perception of regulatory risk.
- *Focus on agriculture resilience.* The proposed fund should be very specific in defining its investment strategy to ensure that all the investments are made in agriculture resilience. Performance monitoring will be geared to avoid deviations from the funds' objectives. For example, there could be one or two designated member(s) in the Investment Committee who will have veto rights to investment opportunities that deviate from the specified investment strategy. See later discussions in this Chapter on resilience investment standards, investment mandate and investment strategy of the proposed Asia focuses PE/VC fund.
- *Patient capital.* Current private investment in the agriculture sector is guided by the objective of achieving quick wins. This is at odds with the long-term nature of resilience investment. With patient, public capital, the risk-adjusted return of resilience enhancing investment could be adjusted to attract private capital. Consequently, the proposed fund should be designed with long-term commitments in mind. Section 6.5.3 reviews fund term options.
- *Return cascade.* To accommodate different investment objectives of the public and private investors, the fund would have an investment arm targeting normal commercial returns (while satisfying resilience and ESG requirements), and a business development and technical assistance facility to promote the development of innovative agriculture resilience technologies with concessional finance.
- *Risk management.* The long-term nature of the target investments, the prevalence of SMEs, and uncertainties associated with agriculture resilience development require strong risk management. Risk mitigation and risk management are discussed later in this section.

## 6.5.2 The Agriculture Resilience Investment Fund (ASRIF)- Asia: Concept

### ASRIF-Asia Structure

**6.5.2.1 Fund Objectives.** The fund's development objectives are three-fold.

- 1) To crowd in private capital to agriculture resilience investments across the value chain, including water saving irrigation (such as rainwater collection, boreholes and tube wells), precision agriculture and monitoring, crop management, soil

management, livestock adaptation, agroforestry, crop insurance, agricultural loans focused on resilience, urban agriculture, market access and transportation, food processing, food engineering and sustainable protein, agricultural waste use, bioenergy (biofuels and biomass power)

- 2) To contribute to the establishment of resilience investment as an asset class or investment category by setting up clear standards and criteria for resilience investments, and transparent and professional selection and reporting mechanism which will benefit both domestic and international investors.
- 3) To create innovative financing structures to support growing resilience investment needs.

**6.5.2.2 Fund Mandate.** The mandate of the fund will be to invest in businesses that operate in the defined agriculture resilience space in Asia, to achieve the double goals of agriculture resilience improvement and commercial viability. The fund management will work closely with second-opinion providers / external reviewers who will play an instrumental role in certifying that individual investment opportunities fulfill the Resilience Investment Standards (RIS).

**6.5.2.3 Resilience Investment Standards (RIS):** The RIS are a comprehensive set of criteria, and standards that will be operational documents for investors and fund managers to follow throughout the resilience investment cycle as described in Table 6.4. RIS will need to be developed by the fund manager.

**Table 6.4 – RIS and investment life-cycle**

Stage	Resilience Investment Standards
Project screening and selection	Detailed set of eligibility criteria
Appraisal	Standard procedure, methodologies and indicators for ex-ante quantification of resilience performance and risk assessments
Implementation monitoring	Monitoring methodologies
Reporting and evaluation	Periodic and end-of-cycle reporting templates and third-party evaluation protocol and guidelines

- *RIS will consist of both general resilience investment cycle protocols as well as sectoral specific methodologies and guidelines.* External reviewers or third-party entities are expected to play an important role in this cycle to provide impartial review and verification on fund performance in order to certify the investment ‘resilient’.
- *RIS will be based on internationally-accepted best available practices.* The information will be drawn from international accreditation/certification bodies, from the principles and criteria being used by financial agents (if any), and from lessons

learned from World Bank projects implemented and studies carried out around the world.

**6.5.2.4 The proposed fund will have the characteristics of a strategic investment fund (SIF).** SIFs are special purpose investment funds that exhibit all of the following six characteristics:

- Are sponsored and/or fully or partly capitalized by a government, by several governments, or by government-owned global or regional finance institutions;
- Invest to achieve financial as well as economic returns, in accordance with a double bottom-line objective;
- Aim to crowd in private capital to investment in key economic sectors;
- Operate as expert investors on behalf of their sponsors;
- Provide long-term patient capital, primarily as equity. May also invest in quasi-equity or debt.
- Are established as investment funds or investment corporations (Halland, et al., 2016).

**6.5.2.5 For more information on SIFs, how they work, and how they can contribute to the World Bank’s mandate, see Annex 6.D for the WBG Engagement Note on SIFs, prepared by the Finance and Markets Global Practice.**

#### *ASRIF-Asia Preparation Principles*

**6.5.2.6 Pragmatism:** Given its innovative nature, ASRIF-Asia will follow a staggered approach by setting up the fund in a pilot locality after a thorough study of (i) fundamental fund development analysis, including key aspects such as the rationale, mandate, legal/regulatory framework, governance structure, investment/exit strategy or project selection criteria (Pillar I); and (ii) fund feasibility and business plan analysis including funding needs analysis, investor landscape and appetite analysis, detailed fund design, and preliminary sounding with potential investors together with the selected Fund manager (Pillar II) Following proof of concept of the business model and market opportunity in the pilot locality, the Fund will be scaled up in the initial locality and/or launched in other localities, or be used to setup a global fund.

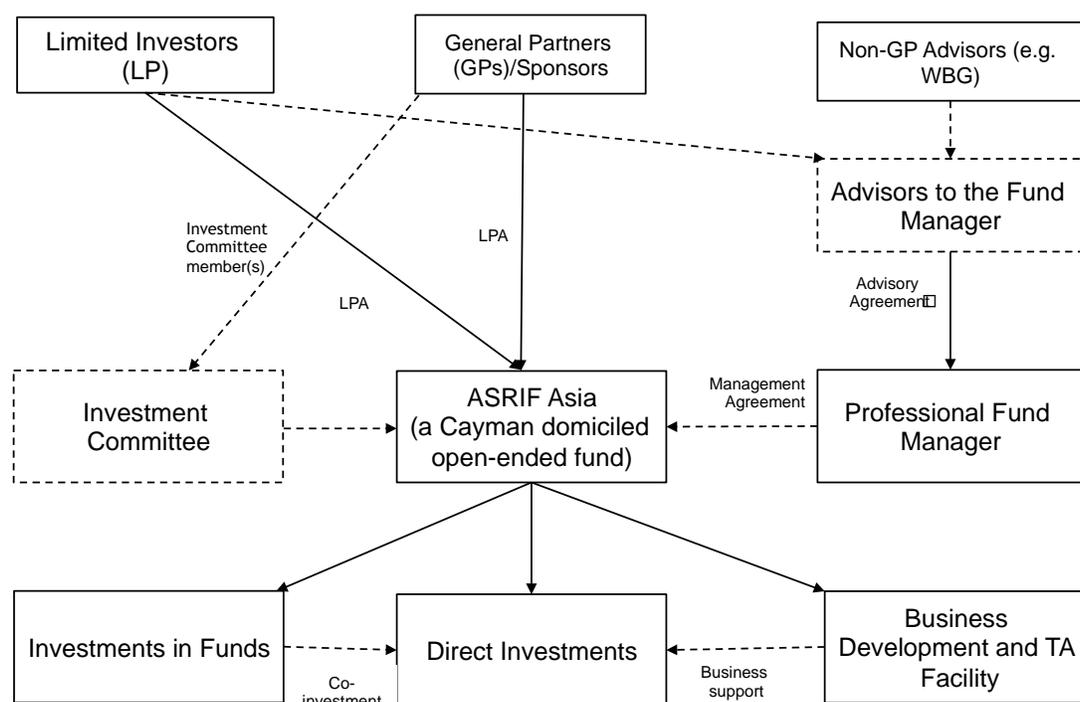
**6.5.2.7 Efficiency and simplicity:** The ASRIF-Asia will have a simple structure for better management and lower administrative costs. A relatively small fund size would also help to alleviate the pressure of capital drawdown and initial management complexity. A coordinated regulatory and supervisory framework is important for the efficient operation of ASRIF-Asia.

## 6.5.3 Fund Structure Options

### Overview

6.5.3.1 **ASRIF-Asia is designed as a legal form of limited partnership.** It could also be established as a company, with shareholder investors under shareholders' agreement instead of general partners (GPs) and limited partners (LPs) under Limited Partner Agreement (LPA). The proposed structure of ASRIF-Asia is shown in figure 6.24.

**Figure 6.24 – ASRIF-Asia: structure**



Source: the authors.

### Geographic coverage

6.5.3.2 **Geographic structure options to address the global resilience challenges could be a global fund with regional teams, or several regional funds.** One of the key challenges of the agriculture value chain investments is to identify a solid pipeline. Resilience investments, especially those across the agriculture value chain, require deep local knowledge and wide local connections. Unlike major PPP projects in which single investment could be of a large scale, resulting in a manageable number of projects for a global fund, value chain investments are small. Therefore, a greater number of projects is necessary for efficiency and impact. A regional fund that benefits from its local presence or at least proximity to the local markets, is likely to

be a more effective and cost efficient solution. Table 6.5 provides a general comparison of pros and cons of a global fund versus regional funds.

**Table 6.5: High level comparison of geographic options**

	<b>A Global Fund</b>	<b>Several Regional Funds</b>
Pros	<ul style="list-style-type: none"> <li>• Easier to balance the portfolio to control performance volatility</li> <li>• Simpler fund structure for a global initiative</li> <li>• Wider target investor base (investors interested in any region could be attracted with the opt-out clause)</li> </ul>	<ul style="list-style-type: none"> <li>• More targeted investor base and thus easier to convince investors interested in a specific region</li> <li>• Easier to find fund managers with local knowledge in the region</li> <li>• Easier to manager at the fund level</li> </ul>
Cons (and mitigating factors)	<ul style="list-style-type: none"> <li>• Tendency to have small (if any) local offices, and thus less local capacity</li> <li>• If there are large local teams, coordination and management costs tend to be high</li> <li>• More difficult to find appropriate fund managers with global experience</li> </ul>	<ul style="list-style-type: none"> <li>• A single region fund may be subject to the economic and financial interconnection within the region, and thus diversification efforts may not work well and the performance of such a regional fund could be volatile</li> <li>• A single region fund may appeal to a narrower range of investors</li> <li>• Cannot achieve the global goal in one fund, yet not every region has a market that can support its own regional fund</li> </ul>

Source: Authors.

**6.5.3.3 ASRIF-Asia is proposed as the first step of the global resilience investment initiative, because:**

- Resilience investments, especially those across the agriculture value chain, are challenging and thus require deep local knowledge and wide local connections. Unlike major PPP projects in which single investment could be of a large scale and thus the total number of projects in the global portfolio may not be massive, value chain investments could be smaller but of a greater quantity, and thus it will be more efficient and effective to specialize in one region for value chain investments.
- Preliminary pilot country analysis suggests substantial demand for resilience finance in Asia, the great variety of development levels, and the huge potential for possible investment opportunities. As such, it is feasible to construct and maintain a balanced portfolio within Asia.
- Also, the active investment trends in Asia also indicate strong potential interest among investors focusing on Asia. Yet it is important to test the market as part of the more advanced feasibility study.

- Using ASRIF-Asia as pilot, the global initiative can replicate the pilot into several regional funds at a later stage, or scale up the regional fund into a global fund. Given the potential challenges of agriculture resilience investments, it is prudent and pragmatic to start with a pilot than committing significant capital into a global market.

#### Fund of Funds vs Direct Investments within the Investment Arm

**6.5.3.4 ASRIF-Asia will act as a combination of Fund of Funds (FoF) and direct-investment fund.** The Fund will need to cover a broad range of investible assets in the defined agriculture resilience sectors and thus should have two investment compartments, with a first compartment focusing on direct investments in businesses, and the second compartment focusing on investments in funds that invest in agriculture resilience.

#### Investment Arm vs. Business Development and Technical Assistance Facility

**6.5.3.5 ASRIF-Asia will include a Business Development and Technical Assistance Facility (BD & TA Facility).** The facility will be designed to:

- promote innovative technologies in agriculture resilience;
- assist SMEs to develop and apply new technologies;
- provide concessional financing and credit support and technical assistance in businesses with significant agriculture resilience implications but without short-term commercial returns; and
- eventually help transfer technologies and businesses into viable investment opportunities and generate future investment pipelines for the two investment compartments

#### Domiciliation and Headquarter Options

**6.5.3.6 ASRIF-Asia’s domiciliation will be chosen to achieve tax efficiency and attract investors.** Key considerations include: tax environment, market landscape, regulatory environment, costs of setting up a fund, and other regulatory and cost considerations.<sup>239</sup> Typical domiciles for investment funds include: Abu Dhabi, Bermuda, British Virgin Islands, Cayman Islands, Dubai, Guernsey, Hong Kong, Ireland, Japan, Jersey, Luxembourg, Malta, Mauritius, Singapore, and UK. Popular

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<sup>239</sup> An interactive web tool of global comparison of major domiciles prepared by PWC is available at: <http://www.fundjurisdictions.com/comparison-tool>

domiciles of an Asia fund include UK, Cayman Islands, and the Asian domiciles (such as Hong Kong, Singapore, and Japan).

**6.5.3.7 The Cayman Islands is a popular choice of domiciliation for Asian funds.** The Delaware LLP and Cayman fund structures are popular options for North and South American managers for both funds and investment corporations. The UK and Channel Islands have been the principal domiciles for Private Equity and Real Estate funds for many years within Europe. Luxembourg has become more popular in recent years and the likes of Malta and others are trying hard. The Cayman Islands remains the most popular choice in many Asian regions (Box 6.6).<sup>240</sup>

**Box 6.6 – Popular fund jurisdictions in Asia**

- *China:* Mainland Chinese GPs raising USD funds will almost always structure the fund in the form of a Cayman LP. Domestic managers deploying RMB funds will use mainland vehicles such as investment trusts or domestic limited partnerships. Hong Kong based GPs either investing Pan-Asia funds or investing into China are for the most part using Cayman LPs although with the extension of the profit tax exemption to include offshore Private Equity funds we may see more Hong Kong domiciled fund structures being used.
- *India:* GPs have typically used Mauritius to domicile their funds, but managers have been looking at alternative domiciles; notably Singapore because of its attractive tax treaties and exemption, as well as the high quality of supporting system.
- *Singapore:* The typical fund structure for Singapore based GPs investing into South/South East Asia is a Cayman (more often than not) or Singapore LP (not nearly as often as Cayman) with a Singapore master fund (a Singapore corporate) underneath.
- *Australia:* Domestic GPs will always use Australian open ended unit trusts and occasionally a Cayman LP as a feeder for offshore investors although, this is not common.
- *Malaysia:* Labuan, Malaysia's equivalent of the Channel Islands has a Limited Partnership that we have seen used by some Malaysian GPs, but most continue to use Cayman.

Source: Authors.

**6.5.3.8 A Cayman-domiciled fund will need to meet the requirements to market in the US, where there could be interests in agriculture resilience among institutional investors.** Many subsectors are most developed in the US, and US agriculture investors in such subsectors could be most active, too. According to AgTech Investing Report 2016, although startups in the US now represent less than half of deal flow down from 58 percent in 2015 and 90 percent in 2014, they still account for 48 percent of deal activity in 2016. For a non-US fund to successfully market in the US, it should:

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<sup>240</sup> This section is based on <https://www.imdda.org/downloads/where-should-i-domicile-my-next-fund/12/> and feedback received from Asia fund lawyers

- Understand regulatory requirements including tax implications
- Consult with external professional parties in the US, including legal counsels and outside marketers such as placement agents, to develop marketing plans
- Review and revise marketing materials to ensure compliance with US regulations. For example, marketing materials may need to include additional legal disclosures to address the fund’s US marketing, and the sponsor may wish to understand how the business sections of its marketing materials (e.g., description of investment strategy, market opportunity and any prior track record or performance information) compare to US private fund marketing norms.
- Understand the US investors’ preference and review the fund terms

**6.5.3.9 A Cayman-domiciled fund will also need to be qualified to market in Europe.**

According to the EU Alternative Investment Funds Directive (AIFMD):

- *Passport to market in EU for Cayman Islands-domiciled funds:* “at present Cayman-domiciled regulated alternative investment funds are marketed in individual EU member states under national private placement regimes. This arrangement is planned to continue until 2018.” “In the meantime, the Cayman Islands is taking steps to enable it to satisfy the European Securities and Markets Authority (“ESMA”) that it has the legal and regulatory frameworks in place that are deemed necessary for a passport extension.”
- *Eu or non-EU managers:* Once the AIFMD passport is extended to non-EU jurisdictions, existing EU managers that are already authorized as AIFMs will have the option to market their Cayman funds into the EU using the passport, although such managers would need to comply with all the requirements of the AIFMD. In respect of non-EU managers, provided the passport is also extended to the jurisdiction in which the manager is based, then such managers would also have the option to apply for a passport in respect of their Cayman funds. However, such managers would need to become authorized as an AIFM in their “member state of reference” (determined in accordance with the AIFMD), which can pose a significant regulatory and compliance burden. Non-EU managers based in jurisdictions to which the passport is not extended are unlikely to be able to apply for a passport. In both cases, utilizing the services of a third party “host AIFM” may provide a neat solution.<sup>241</sup>

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<sup>241</sup> ARC Directors, 2015, “AIFMD: The Cayman Islands approach to the AIFMD passport extension” ([http://www.arcdirectors.com/news/AIFMD\\_percent20Update.pdf](http://www.arcdirectors.com/news/AIFMD_percent20Update.pdf)); and AIMA, 2015, “AIFMD passport and Cayman Islands funds” (<https://www.aima.org/journal/aima-journal--q4-2015-edition/article/aifmd-passport-and-cayman-islands-funds.html>)

**6.5.3.10 ASRIF-Asia will have its execution headquarter in an Asian city that has developed financial markets and regulatory system and is close to the major target markets of the proposed fund.** For example, Hong Kong SAR and Singapore are possible candidates. Both cities have highly developed legal infrastructure and financial markets. Geographically, Hong Kong SAR is close to both East Asia (such as mainland China) and to Southeast Asia and is thus chosen as the Asian headquarter location of many investors, while Singapore is typically the Southeast Asia hub. However, the costs (especially high property prices) have made Hong Kong less attractive than Singapore in some indicators.

*Fund Terms: a Typical Fund or a Permanent Capital Vehicle (PCV)*

**6.5.3.11 PE and VC funds in Asia (China in particular) seem to be less than a “patient capital” with a shorter average term.** This is at odds with agriculture resilience investment that requires long-term capital commitment. According to an on-going World Bank research, the term of PE and VC funds in China is typically 7 years (5 years of investment period plus 2 years of exit period), which is shorter than the prevailing investment life of 10 or more years in developed markets.<sup>242</sup> Some fund in China have an even shorter fund life of 5 years and are pressured to seek shorter-term returns.

**6.5.3.12 The term of ASRIF-Asia should be long enough to attract and retain patient capital and match the life cycle of its investee projects.** Further study is required as part of the fund development analysis and as part of the subsequent feasibility study and business plan together with the selected Fund Manager to explore whether a PCV form is applicable and suitable in this context.

**6.5.3.13 The typical legal entity of such a fund is a limited partnership with a limited term, however, permanent capital vehicles (PCV) have recently gained much attention in the investment community and is proposed to be adopted by ASRIF Asia.** PCVs, also known as evergreen investment vehicles, are not a brand-new concept: for example, several European investment funds are structured as PCVs. IFC has also structured some of its investment funds as PCVs. The following features are worth considering:

- The increasingly competitive private equity market is a contributing factor for the rise of PCVs, as asset managers look to more flexible opportunities to raise money and invest in perpetuity, akin to an organic growth strategy.

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<sup>242</sup> D. Mulcahy, 2015, “The New Reality of the 14-Year Venture Capital Fund,” Institutional Investor (<http://www.institutionalinvestor.com/blogarticle/3428857/blog/the-new-reality-of-the-14-year-venture-capital-fund.html#.WOPJGhiZNAY>)

- These structures also come with fee premiums and higher protection to fund managers, which is attractive given existing pressure on fees in more traditional alternative asset management vehicles. Closed-end funds are listing, to protect against shareholder cash out, by requiring share-sells on Exchanges, rather than withdrawing from the fund.
- Alternative asset managers also see PCVs as an answer to the stock market’s reluctance to value their businesses as highly as traditional fund management companies, due to reasons of volatility of fee income. PCVs pay management fees perpetuity, and are therefore less vulnerable to client redemptions or reliant on unpredictable performance fees.
- For the DFI community and hybrid investors, PCVs offer protection to “limited partners” who are looking for robust valuation of assets of the holding vehicle. When PCVs list on a stock exchange, the valuation ties into market price and perceptions of market considerations.

**6.5.3.14 A PCV is an investment vehicle that manages capital for an unlimited life, and differs from a typical fund in several key areas.** PCVs can be open or closed ended fund, and are typically structured as an investment company (in this case, it is called a Permanent Capital Corporation, or PCC), although limited partnerships are also used. A “typical fund” is a private equity fund structured as a limited life and self-liquidating limited partnership. Table 6.6 lists key differences between a typical fund and a PCV, and Figure 6.25 demonstrates a typical PCV structure.

**Table 6.6 - Alternative Option Analysis – Typical funds vs PCVs**

	<b>Typical fund</b>	<b>PCV</b>
<b>Legal entity</b>	<ul style="list-style-type: none"> <li>• A limited partnership in which investors are Limited Partners (LPs) or General Partners (GPs)</li> <li>• Can set up sub-funds or compartments</li> </ul>	<ul style="list-style-type: none"> <li>• An investment company in which investors are shareholders</li> <li>• Can set up subsidiaries</li> <li>• Limited partnerships can also be used</li> </ul>
<b>Fundraising period</b>	<ul style="list-style-type: none"> <li>• A set timeframe (typically 12-18 months) after which no new commitments are sought</li> </ul>	<ul style="list-style-type: none"> <li>• May fundraise either on an on-going basis or in several rounds of fundraising (by way of capital injection)</li> </ul>
<b>Term and investment cycles</b>	<ul style="list-style-type: none"> <li>• Limited life – typically 10 years with 1 or 2 year extensions (in some cases, fund life can be 15 years with extensions)</li> <li>• Profitability peak as investment period ends and the fund begins winding down</li> <li>• Difficult to match the long investment period of infrastructure projects</li> </ul>	<ul style="list-style-type: none"> <li>• Unlimited life – may continue indefinitely</li> </ul>
<b>Distribution and use of proceeds</b>	<ul style="list-style-type: none"> <li>• Will usually distribute realized proceeds with approval</li> </ul>	<ul style="list-style-type: none"> <li>• May have the flexibility to reinvest some (i.e. the acquisition cost base) or all proceeds into future projects</li> </ul>

<b>Redemption rights</b>	<ul style="list-style-type: none"> <li>• Will not usually contain redemption rights (other than in terms of an investor-driven termination)</li> </ul>	<ul style="list-style-type: none"> <li>• May allow investors (often restricted) rights to redeem their interests, or at least achieve liquidity</li> </ul>
<b>Management economics</b>	<ul style="list-style-type: none"> <li>• Management fees are often calculated in full on asset under management, with incentives on performance by way of sharing carried interest</li> <li>• A standard distribution waterfall: typically fund managers – 2 percent of AUM per annum; GPs – 20 percent of carried interest</li> </ul>	<ul style="list-style-type: none"> <li>• Management fees are often calculated in full or in part on net asset value (NAV)</li> <li>• An example: an advisory fee - 2 percent per annum of total capital commitments during the commitment period; 2 percent per annum of total net asset value thereafter</li> <li>• Valuation is thus critical</li> </ul>
<b>Costs</b>	<ul style="list-style-type: none"> <li>• High cost of fund raising, set up, sourcing and training of staff relative to the limited life of the fund</li> <li>• Duplication of cost of setting up both fund and fund manager in each country/region</li> </ul>	<ul style="list-style-type: none"> <li>• More cost efficient given its perpetuity</li> </ul>
<b>Tax</b>	<ul style="list-style-type: none"> <li>• Tax leakage and inefficiency in the parallel structures</li> <li>• Tax implication relating to domiciliation</li> </ul>	<ul style="list-style-type: none"> <li>• Corporate tax applies, which might result in higher tax burden in certain tax jurisdictions where capital gains are free of tax (but PCVs could also be structured as a limited partnership to avoid this issue)</li> </ul>
<b>Exit</b>	<ul style="list-style-type: none"> <li>• Fixed-termed funds provide certainty in liquidity, but can lead to high levels of reinvestment of original capital, requiring no additional paid-in capital</li> </ul>	<p>Exit mechanisms legally that could be structured:</p> <ul style="list-style-type: none"> <li>• Liquidation after a given number of years</li> <li>• Minority rights protection and conversion to preference shares</li> <li>• Option to convert to preference shares every few years</li> <li>• Tag-along clause</li> </ul> <p>Other potential exits:</p> <ul style="list-style-type: none"> <li>• Trade sale/sale to third party</li> <li>• Cash distribution through dividend payments – would require long term investment</li> <li>• Initial Public Offerings (IPOs)</li> </ul>

Source: Authors.

Figure 6.25 - Example of a PCC structure



Source: Cindy Valentine & Ravi Chopra (December 2015 & July 2016); WBG knowledge including IFC experience)

**6.5.3.15 PCVs have been gaining increasing popularity in certain investment sectors and regions.** Familiarity with limited partnership structures of a typical fund and the relative certainty of proceeds being distributed within a certain period of time could explain the tendency to adopting a typical fund structure among DFIs. However, there are several incentives for setting up PCVs:

- a. *Term matching and a long-term mind set:* PCVs are gaining more popularity for sector focus investments where long-term capital needs are essential to match the longer development and operation period of infrastructure projects. This applies to agriculture resilience investments where long term capital commitment is important, [although few examples can be found because agriculture resilience has not become a major investment theme]. More importantly, the indefinite term allows the investment company to build a long-term relationship with the portfolio company with no pressure to exit before the end of the fund life as typical funds normally do.
- b. *Fundraising flexibility good for an innovative investment facility with a staggered approach and less track record:* PCVs have more flexibility in fundraising exercise, allowing multiple rounds or ongoing fundraisings without forcing the managers to return to the market on a fixed term to raise successor funds. This fits with an organic growth strategy and a pragmatic approach for a proposed investment vehicle, which is attractive if ASRIF-Asia intends to take a staggered approach by launching with a relatively small size and targeting at a larger size. Moreover, PCVs may be more marketable later as the portfolio and track record start to build. Given that there is no agriculture resilience fund in Asia (as we are aware of), it could also be challenging to find fund managers with agriculture resilience investment experience. So the fundraising flexibility is especially important where the proof of pipeline is critical in the successful marketing of the investment vehicle.

- c. *Cost efficiency:* Cost efficiency (such as costs for setup, marketing, trainings, and sourcing) is relatively high for PCVs with regards to their unlimited life. In addition, unlike the conventional 2 percent management fee charged by typical funds, the management fee level ranges from 0.9 percent to 1.8 percent for PCVs taking consideration of both total commitment and NAV, based on recent experience.
- d. *Liquidity concerns:* One key consideration for PCVs is exit options for investors compared to typical funds. Exit options, ranging from periodic liquidation, to trade sale, to an IPO (see Table 6.6 above for potential exit options) that largely improve the liquidity of investments into a PCV, need to be included in the designing feature.

**6.5.3.16 Key features that are common in typical funds can also work in a PCV, including dual domiciliation arrangements and excuse clauses (also known as “opt-out” arrangement).** (1) Dual domiciliation is common to appeal to both local and international investors. Choices of an offshore domicile include Luxembourg, UK, and Cayman Islands; and on-shore options include Hong Kong or Singapore. Although there could be tax implications for a PCV in such jurisdictions, a dual domiciliation structure is allowed by a PCV. (2) Excuse clause refers to the arrangement to allow investors to opt out from certain investments in pre-set agreements. In the case of a typical limited partnership structure, such a clause will be set forth in the Limited Partnership Agreement.

**6.5.3.17 In a layered structure where multiple investment vehicles are needed for different sub-regions and investment instruments, a unified legal structure will be preferred over a mixed one.** Three options are explored: (1) only use PCVs for all investment vehicles; (2) only use typical funds for all investment vehicles; (3) use a combination of PCVs and typical funds. Initial discussions with external legal experts suggest that option (3) would significantly complicate the structure and increase legal and administrative risks and costs, due to different legal structures and economics for managers even if such a mixed structure was theoretically feasible at all. ASRIF-Asia is initially structured at regional level, but could be scaled up to global if warranted.

**6.5.3.18 Challenges and key considerations of a PCV include:**

- *Lack of familiarity in the investment community:* PCVs are less known to investors, and it is thus important to start marketing sounding and explain the attractiveness of a PCV approach to potential investors.
- *Importance for a fair valuation:* (1) Investor admission – How to set a reasonable basis for investors participating at different times is subject to further discussions. In a typical fund, an “equal” basis is common, and subsequent

investors are drawn down proportionally to share the existing assets and expenses. Such an equal basis may not be appropriate for a PCV given the longer fundraising period. (2) Management fee: Management fees for PCVs should be calculated based on NAV instead of initial capital commitment, given the wider range of capital size and longer fundraising period. (3) Performance incentivization: unlike typical funds that are required to be realized during the limited life span, the investments of a PCV may not be realized for extended periods of time and thus incentives for managers need to be designed upon unrealized returns.

- *Legal and tax implications*: Further consultation with external lawyers is necessary on the implications to legal and tax issues. For example, the implications to a parallel structure (for double domiciliation, and/or dual currency).

#### **6.5.3.19 There are also options in between an evergreen PCV and a fixed term typical fund.**

The general principle is to allow for a predefined liquidity event. For example, there could be a periodic investor vote to decide whether the fund should continue, and if not, the fund will wind up like the end of a typical fund. Another option is to seek an IPO at a later stage, and the fund is split between a first stage of behaving like a typical fund and a second stage involving a listing. The hybrid structure addresses the liquidity concerns of a PCV, but may not be attractive from a cost perspective, and could present challenges to market to investors and managers that are less familiar with the concept.

**6.5.3.20 A singular form will significantly simplify the structure and avoid legal and administrative implications.** In the following discussions on fund structure, we will assume a limited partnership format as it is still the prevailing structure in the investment fund industry in Asia, although we should keep options open for further consultation with legal advisors, especially on the possibility of a tax efficient PCV structure. Structure design (including governance structure and economics) could vary for a PCV as suggested in Table 6.6, and experienced legal advisors should be appointed in an advanced evaluation of legal form options.

### **6.5.4 Risk Management and Mitigation**

Typical risks associated with a new fund and initial options for risk mitigation are listed below, while more specific risks and a comprehensive risk mitigation strategy will need to be assessed as part of fund development and feasibility study pillars.

## Risk Mitigation: Fund Risks

**6.5.4.1 Capable Fund Manager(s) will be the biggest overall risk mitigate for the proposed Fund.** The Fund Manager should conduct due diligence, supported by legal, technical and financial advice, to ensure that major risks are identified and appropriate mitigation measures applied, including but not limited to the following:

- There is a clear pipeline of projects in agriculture resilience present, including appropriate project screening, development and sensitivity analysis of the investment model and business plan;
- The businesses have technically competent management teams;
- Operating and financial requirements are met and consistent with the Fund's expectations;
- There is a clear product or service adoption, with tangible off-take agreements and long-term supply agreements;
- Strong contractual agreements, with robust creditworthiness of the off-taker (and where relevant, a guarantee regime);
- Continuous evaluation of project timelines and milestones;
- Legal permits are in place;
- Land tenure and usage right authorizations are present and enforceable;
- Environmental & Social impact assessments have been accomplished;
- The fund will have a carefully selected and balanced portfolio.

**6.5.4.2 Measures to avoid deviation by Fund Managers from the development mandate include:**

- ***Specified investment strategy:*** A clearly defined investment strategy will set the priority investment sectors, selection criteria, and the investment targets. Managers should closely follow the investment strategy following the RIS.
- ***Governance:*** A given number of members in the Investment Committee and/or the Advisory Committee should have a development/agriculture resilience background, and advise and monitor the implementation of the investment strategy. Such a "soft" mechanism, will control the risks of deviating from the strategy without sacrificing investment flexibility.

### Risk Mitigation: System and Regulatory Risks

**6.5.4.3 Although the improvement of institutions and market environment is a long-term task, the risks would be mitigated by:**

- *Strict selection of projects*
- The *BD and TA Facility* that will promote innovative technologies in agriculture resilience, assist SMEs to develop and apply new technologies, provide concessional financing and credit support and technical assistance, and thus eventually help transfer technologies and businesses into viable investment opportunities. The business development and technical assistance facility should not require the same commercial return as that of the investment arm, and cooperation with other impact investors and donors will be important for its financial sustainability
- *Continuous policy dialogues* between WBG and the relevant regulators to improve the enabling environment for agriculture resilience investments. The BD & TA Facility may also play a role in such policy dialogues.

### Risk Mitigation: Project/Business Risks

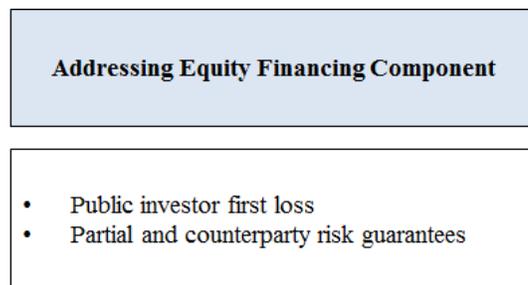
**6.5.4.4 Good fund managers should mitigate project/business risks by:**

- *Technical risks* – in the investment arm, looking only at proven technologies that have equipment and performance warranties and/or guaranties; in the business development and technical assistance facility, explore promising new technologies with concessional financing or guarantee support to move forward the development of innovative agriculture resilience technologies.
- *Financing risks* – securing long-term debt to reduce refinancing risk, seeking to match debt repayment flows with revenue flows, attempting to use short-term interest rate hedging where/when applicable, and gauging market depth. It will also be important for the selected Fund Managers to have a strong knowledge of tax laws and their implications when it comes to returning capital to investors.
- *Operational risks*-only investing where tariffs are predictable and seeking an investment-grade off-taker or credit. This may mean that projects cannot be done in some cases where the above is not possible. The management teams for the projects would need credible track records and experience, performance incentives would be appropriate for management teams that perform within expectations, and Operations and Maintenance (O&M) agreements would require performance warranties.

- *Exit risks* - thoroughly understanding of exit restrictions in the smaller economies targeted by the Fund

**6.5.4.5 De-risking instruments such as partial credit and/or partial risk guarantees are considered important risk mitigation tools for investment projects.** Some institutional investors would require embedded risk mitigation instruments to invest in infrastructure projects of which commercial viability could be marginal (Figure 6.26).

**Figure 6.26 - De-risking Instruments**



*Source: Authors*

**6.5.4.6 A public first loss offers risk mitigation to project financiers, and would often also attract better access to financing.** The amount of first loss would be identified later during the feasibility study, but it will basically entail public/donor capital covering a certain quantum of first loss (the First Tranche), with IFIs taking a Second Subordinated Tranche, and a Senior Tranche taken up by purely commercial investors. A first loss by public/donor investors would significantly reduce the risk exposure of equity investors by attributing losses first to the First Tranche that is subordinated to remaining debt and equity. A second sub-ordinated tranche that has select IFIs may also be present, and the safest slice will be occupied by Commercial investors.

## **6.5.5 Revenue-Enhancing Instruments and Return Cascade**

**6.5.5.1 Revenue enhancing instruments would include return caps for public investors, delayed draw-downs for commercial investors, and the use of leverage.**

- *Return Cap:* By capping public investor returns to a certain quantum, with the delta transferred to private investors, the private investors would be able to get additional alpha on their returns. This, combined with a public first loss, may serve to make the Fund attractive to certain commercial investors.
- *Delayed Draw-Down:* Public funds would be drawn first, implying that the IRR clocks for private investors would start later and stop faster, giving a slight IRR uptick to private money.

- *Leverage*: Even after interest payments, prudent use of leverage can result in a noticeable increase in ROI for the Fund's investors.

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# Annex 1.A – Global Climate Funds and IFI’s Strategic Investment Funds

Name	Description	Status
Green Climate Fund	Set up by parties to UNFCCC as part of the Convention’s financial mechanism, the fund invests in projects with the aim of catalyzing a flow of climate finance to invest in low-emission and climate-resilient development. Projects must be sponsored by accredited entities. The Fund aims to target 50% mitigation projects and 50% adaptation projects.	The Fund has committed US\$2.2 billion of US\$10.3 billion pledged to 43 projects, primarily in Africa and the Asia Pacific region. 27% of projects focus on adaptation, 41% focus on mitigation, with the remainder mixed. 53% of funds have gone to private sector projects, 43% to public sector projects, and 4% to mixed public/private projects. Fund distribution has been 42% grants, 39% loans, 18% equity, and 1% guarantees. The fund has approved 6 projects in irrigation.
Adaptation Fund	Multi-donor fund under the UNFCCC established to provide adaptation finance for the most vulnerable developing countries that are parties to the Kyoto Protocol. Funding is provided from donor governments and part of the proceeds from the Clean Development Mechanism (CDM). Grants have been disbursed to date for programs delivered by multilateral implementing entities and more recently national implementing entities (NIEs). There is a focus for sub-national programs at vulnerable communities and regions for smaller scale projects including direct funding to NGOs.	66 Projects funded since 2010, comprising a total approved grant amount of US\$436 million, of which US\$171 million has been disbursed. 23 projects in agriculture or food security. All disbursements are grants, and all executing entities are public sector.
Pilot Programme for Climate Resilience (PPCR)	Multi-donor US\$1.2 billion fund administered by the World Bank, which sits within the Strategic Climate Fund (SCF) as part of the Climate Investment Funds (CIF). Includes US\$137 million in private sector financing. Aims to pilot and demonstrate how climate risk and resilience can be integrated into country policies, planning and implementation to scale up climate resilient investment. Builds capacity at the national level and facilitates knowledge sharing. Focuses on 20 countries and groupings of small countries and is implemented by the World Bank and regional development banks. Funding is split between two phases: grant finance and technical assistance for Phase 1, to develop a Strategic Program for Climate Resilience (SPCR); and Phase 2 for detailed preparation of activities in the SPCR.	Approximately 80% of PPCR funding (US\$939 million) has been approved for 58 projects. Of this amount, 26% has gone to agriculture and land management projects and 18% to water resource management. The approved funds are anticipated to generate US\$2 billion in co-financing from other sources, primarily the implementing MDBs. 4.4% of cofinancing is expected to come from the private sector.

Name	Description	Status
PPCR Competitive Private Sector Set-Aside	Via a private sector "set-aside", US\$175 million in concessional financing has been allocated to be awarded across the Climate Investment Funds on a competitive basis to innovative projects within the Forestry Investment Program (FIP), Pilot Program for Climate Resilience (PPCR) and Scaling-Up Renewable Energy Program (SREP). Funding will be available for the same 20 priority countries as the broader PPCR and programs and projects will be implemented through the World Bank or one of the regional development banks.	The Set-Aside has approved 10 projects under the PPCR, for which a total of US\$40 million has been allocated.
Global Facility for Disaster Reduction and Recovery (GFDRR)	A partnership of 41 countries and eight international organizations managed by the World Bank, GFDRR provides analytical work, technical assistance, and capacity building to help vulnerable nations improve resilience and reduce risk. Supports implementation of the Hyogo Framework for Action (HFA). Focuses on: advocacy implemented through UNISDR (Track 1); grants and 3-year technical assistance programs to mainstream DRR into low and middle income country strategies and enhance investments in risk reduction and risk transfer mechanisms (Track 2); and a disaster recovery fund to support disaster recovery and ensure future risk reduction measures are incorporated into post disaster recovery plans and programs (Track 3). Designed to build national institutional capacity for DRR, develop new tools and methodologies for disaster reduction and recovery and share knowledge and good practice on mainstreaming DRR. Funding comes from a multi-donor trust fund, a Japan-World Bank program, the EU Africa Caribbean and Pacific Program, and the Climate Risk and Early Warning System (CREWS), a new financing window that will start operating in FY 2017.	As of FY 2016 the active portfolio of grants comprising GFDRR's Country Program rose 11 percent year-on- year to US\$240 million across 70 countries, 25 of which were fragile and conflict-affected states. Disbursements during FY16 amounted to US\$63 million.
Caribbean Catastrophe Risk Insurance Facility (CCRIF)	A risk pooling facility designed to provide the Caribbean national governments with access to affordable and effective coverage to limit the financial impact of natural disasters. Functions as a mutual insurance company controlled by the participating governments to which the participating members pay an annual premium. Developed through funding from the Japanese government and capitalized through contributions from a multi-donor trust fund and the participating member governments. CCRIF provides coverage to countries at a significantly lower cost if they had to maintain their own reserves or if they were to independently purchase insurance in the open market. The CCRIF transfers the risks it cannot retain by purchasing reinsurance and catastrophe swaps on traditional global markets.	21 payouts totaling US\$68 million have been made to 10 member governments.

Name	Description	Status
Adaptation for Smallholder Agriculture Program (SAP)	Multi-donor financing window to improve the climate resilience of IFAD's large scale rural development programs and build the capacity of at least eight million smallholder farmers. Offers fully blended co-financing alongside new and existing IFAD investments plus stand-alone ASAP grants in exceptional cases. Focus on improving land, water and climate risk management for agriculture. ASAP will also develop a knowledge management program to share and develop lessons and tools across IFAD's programs.	By the end of 2016 US\$314 million has been committed to 41 projects. Funding is in the form of grants; there does not appear to be a private sector window.
Least Developed Countries Fund (LCDF)	Multi-donor fund administered by the Global Environment Facility (GEF) offering both grants and technical assistance. Finances the preparation and implementation of National Adaptation Programmes of Action (NAPA). Based upon findings of country NAPAs the LDCF can also fund the design, development and implementation of certain projects on the ground, focused particularly on reducing vulnerability of sectors that are central to development such as water, agriculture, health and infrastructure.	As of September 2016, the LDCF had disbursed US\$1,036 million in grants to 223 projects, and secured US\$4,409 million in cofinancing, typically from partner MDB implementing agencies.
Special Climate Change Fund (SCCF)	Multi-donor fund administered by GEF offering both grants and technical assistance. Finances incremental adaptation costs of interventions relative to a development baseline for developing countries under the UNFCCC. Adaptation is the top priority although the fund also supports technology transfer and capacity building activities. 50 Projects and programs are designed and implemented by one of the 10 GEF Agencies in line with the recipient country's national development and poverty reduction strategies and NAPA, particularly around water and land management, agriculture, health, infrastructure and integrated coastal zone management.	As of Oct 2016 the SCCF portfolio consisted of 74 projects that have received disbursements of US\$333 million and cofinancing support of US\$2,470 million, typically from partner MDB implementing agencies.
Inter-American Development Bank's (IADB) PROADAPT Facility	Regional program designed to directly support MSMEs in Latin America and the Caribbean to build climate resilience and capitalize upon climate resilient business opportunities. Financed by the Multilateral Investment Fund (MIF) and the Nordic Development Fund (NDF). It will work with an estimated 2,000 MSMEs delivering technical assistance to develop new tools, identify business models and access knowledge that will increase their climate resilience. It will also work with MSME related institutions to improve awareness as well as creating a climate adaptation knowledge online platform.	The platform has committed US\$12 million to 8 projects in the LAC region.
Global Agriculture and Food Security Program (GAFSP)	A multilateral mechanism to assist in the implementation of pledges made by the G20 in Pittsburgh in September 2009. The objective is to improve incomes and food and nutrition security in low-income countries by boosting agricultural productivity. Approximately 75% of the poor live in rural areas and most depend on agriculture for their livelihoods. Does not have an explicit adaptation focus. The private sector window is managed separately by the IFC.	Since launch GAFSP has funded US\$1.02 billion in public sector projects and US\$223 million in private sector projects.

Source: World Bank from funds' websites.

# Annex 4.A – In-Depth Analysis of Green Finance Instruments

## The Universe of Green Finance Instruments

The objective of this section is to rationalize and segment the vast and expanding universe of DFI finance solutions applied to climate adaptation investments. The analysis is based on extensive research, data gathering and conversations with WBG and outside experts in the field. The analysis is confined to tools used by DFIs for the purpose of mobilizing private capital towards green projects.

Since climate adaptation is not yet identified as a standalone asset class (as is the case for renewable energy for instance), the green finance tools analyzed here apply to the broader spectrum of climate mitigation and adaptation. The analysis identified eight types of green finance instruments, summarized in Figure 4.A.1. They range from direct DFI investments in green projects, to investments via funds and other ad hoc vehicles such as green banks, to risk mitigation and return enhancement solutions.

**Figure 4.A.1 - Overview of Green Finance Instruments**

Tool	Description
<i>Green Banks</i>	Vehicles wholly-owned and funded by national or subnational governments to invest professionally in renewables and other green projects. Mostly funded through budget appropriations. They aim for commercial returns. None is an actual, regulated bank – some are ring-fenced as companies, others are pure ministerial units. Can invest in equity and/or debt. Sometimes provide guarantees.
<i>Investments in Private Equity Funds</i>	DFI investments in private equity funds run by professional managers. Funds usually have a geographic or sectorial focus. DFIs typically limit their investments to minority stakes (e.g. <20 percent for IFC). DFIs can seed new managers or back established ones. In general, DFIs expect full commercial returns, although in some instances private investors received preferential treatment.
<i>Investments in Private Equity Funds of Funds</i>	DFI investments in funds of funds ("FoFs") run by professional managers. FoFs in turn invest in private equity funds with a geographic or sectorial focus. DFIs usually limit their investments to minority stakes of FoF (e.g. <20 percent). DFIs can seed new managers or back established ones. In general, DFIs expect full commercial returns. Less common than straight private equity investments.
<i>Direct Investments</i>	DFI funds a company or project with a direct equity or debt injection. Investment in itself is on a commercial basis, but often other DFIs (or other divisions of same DFI) will offer return enhancement or risk mitigation solutions. Very established tool.
<i>Guarantees</i>	DFI offers private investors political risk insurance (against risk of expropriation, exchange controls, war, breach of contract), partial credit guarantees or partial risk guarantees. Usually in support of foreign (not domestic) investors. Guarantee can cover debt and/or equity. Guarantee can be priced on a commercial or concessional basis; in the latter case, it is usually backed by

	sovereign counter-guarantee. DFI disburses capital only if guarantee is called, but may set up reserves in advance.
<i>Green Bonds</i>	Securities issued by governments, DFIs and corporates, usually bearing the same credit risk as generic bonds of the issuer, but with a commitment to use proceeds to finance or re-finance green projects, assets or businesses.
<i>Blended Climate Finance</i>	DFI funds a portion of a project on a concessional basis, to enhance the risk/reward profile for private investors. Can take the form of soft loans (more flexible terms, e.g. pricing, tenor, currency, subordination), guarantees, equity, grants and other instruments. Often used as temporary subsidy for high-risk, early-stage projects, pre-commercial viability.
<i>Other Concessional Finance</i>	Traditional DFI tool. Brings capital to countries and projects unable to access private markets. Sometimes in the form of capital, sometimes guarantees, No/limited expectation of market returns. May ignite a virtuous circle of investment and growth, but may also cause market distortions.

### *Additionality and Multiplier Considerations*

**This section analyzes how the various green finance instruments achieve the private capital mobilization goal. The assessment is based on two criteria: additionality and capital multiplier.** The objective is not to rank or score instruments on a deterministic basis, but rather to gather insights applicable to the design of climate adaptation investments.

**Additionality provides an important perspective on the effectiveness of the various instruments.** If a project can take place without a public capital injection, the latter would be better directed elsewhere, regardless how high the project’s multiplier is. This part of the analysis focuses, in qualitative terms, on the “real” value added of the instruments under consideration.

**The multiplier is a useful quantitative reference, but needs to be contextualized.** The development finance sector, in recent years, has placed great emphasis on measures of private capital mobilized, without reaching a consensus on methodology. In this section, one definition is applied consistently across the product universe. The numerical analysis is complemented with a qualitative discussion that aims to capture the different instruments’ goals and features.

#### *On Additionality*

**When looking at additionality, the relevant question to answer is: “would a project have taken place regardless of public intervention?”** The analysis in this report is limited to the domain of projects that offer the potential for financial return – albeit not necessarily at full commercial levels. When projects do not have any commercial prospects, one could argue that public capital is by definition additional. Key findings are summarized in Figure 4.A.2.

**Demonstration, standardization and aggregation are the most common sources of additionality for green finance instruments.** Demonstration refers to investments in unproven sectors or regions, presenting risks that commercial investors find hard to quantify. For instance, early investments in offshore wind farms by the UK Green Investment Bank and many frontier market investments fall in this category. The African Development Bank expressly mentions its goal to demystify the risk perception of Africa through its private equity investments. Early

entrants usually lead the way in standardizing investment structures, documentation and procedures. Aggregation is relevant in markets where capital is allocated on a very fragmented basis – for instance the financing of residential solar panel installations.

**Investments in funds (and funds of funds) provide extra additionality when they seed new managers.** Institutional investors (pensions funds, insurance companies, endowments) are reluctant to back fund managers without a proven track record, regardless how sensible their investment strategies may be. Some DFIs try to cover this gap – the African Development Bank, for instance, has a stated goal of developing the private equity industry in the continent. At the same time, they also back established managers or new vintages of existing funds, hoping for more predictable returns.

**Guarantees offered by DFIs are a strong source of additionality.** Both MIGA, a commercial entity, and the IBRD guarantee unit, which operates on a concessional basis, are able to cover risks that private insurers are unwilling to take. For instance, they operate in frontier markets, or provide very long-dated coverage (15-20 years) for complex risks. They benefit from a strong underwriting track record and unique access, as World Bank Group entities, to local officials for transaction structuring and dispute resolution. In addition, Guarantees minimize crowding-out of the private sector by involving commercial co-insurers or re-insurers.

**Additionality considerations vary for blended finance and other concessional tools.** Blended climate finance is a return enhancement solution, on a concessional basis, for projects that are far from commercially-viable, and as such may prove to be a significant source of concessionality. Proceeds from green bond issuance, while dedicated to green, are allocated based on eligibility criteria set by the issuer – IBRD green bonds, for instance, are subject to tight criteria on use of proceeds. Green bond proceeds are not always used for financially viable projects. In some instances, they were used to refinance existing projects (e.g. hydro power in Scandinavia), which would have likely found other sources of funds in any case. Other concessional finance tools are generally aimed at non-commercial projects.

**Figure 4.A.2 - Summary Sources of Additionality**

Instrument	Sources of Additionality
Green Banks	Demonstration, standardization, aggregation.
Investments in Private Equity Funds	Demonstration, standardization, aggregation, seeding of unproven managers.
Investments in Private Equity Funds of Funds	Same as above (but indirectly through investee funds).
Direct Investments	Demonstration, standardization, aggregation.
Guarantees	Coverage of high-risk, frontier markets, Complex policies (hard-to-assess risks, long tenures).
Green Bonds	Dedicated use of proceeds, with low credit risk of issuing DFI.
Blended Climate Finance	Enhancement of sub-market returns.
Other Concessional Finance	Limited if applied exclusively to non-commercial projects.

## *On Multiplier*

**There is no generally accepted definition of multiplier, which makes comparisons across instruments difficult.** Some DFIs publish a ratio of private investments to public capital. Others include in the numerator capital provided by other public institutions. In some cases, the multiplier only captures a step in the process – for instance co-investments at fund level, but not at portfolio company level.

**Throughout this report the following definition is applied: multiplier = total investment volume / public capital invested.** Total investment volume refers to the total amount of capital (debt and equity) invested in projects or companies as a result of the initial public capital injection. If such injection is through a fund, which then invests in a portfolio of companies, total investment volume refers to the enterprise value of the entire portfolio.

**Project leverage (debt/equity ratio), size of the stake acquired by a DFI, and fund structure are key determinants.** Assume a project requires US\$300 million of funding, of which US\$200 million in loans and US\$100 million in equity. A DFI contributes 20 percent of the equity through a direct investment, or US\$20 million. In this case, the multiplier is  $300 / 20 = 15x$ . Alternatively, assume that the same US\$20 million investment comes from a private equity fund, 50 percent of whose assets come from a DFI. In this case, the DFI's effective capital injection is US\$10 million, resulting in a multiplier of 30x.

**A thorough assessment of the multiplier must consider project and instrument-specific factors.** For instance, it may be difficult to argue that public funds representing a very small portion of a project's capital structure are the primary catalyst for private investment – the multiplier would be optically high, but not very meaningful. Some projects may not be suitable for private investment due to their financial profile, but may still be essential from a development perspective; in these cases, concessional finance is a more appropriate tool even if it does not aim to crowd-in private capital. Risk mitigation tools such as guarantees can contribute to high multipliers, but do not play a proactive role in the pipeline origination phase – an essential first step in infrastructure investing.

**Figure 4.A.3 summarizes the key findings for the instruments in the universe analyzed.** The analysis is based on data disclosed by relevant institutions, if available; otherwise, a range was estimated based on reasonable assumptions. A detailed discussion follows.

**Figure 4.A.3 - Summary Overview of Multiplier**

Instrument	Multiplier	Source	Comments
Green Banks	2.8-4.8x	Green banks' disclosure.	Mostly direct investments (no fund-level multiplier). Leverage is limited in greenfield projects. As a result, multiplier tends to be low.
Investments in Private Equity Funds	5-60x	Indicative range.	Very wide range, depending on: (i) percent of public capital invested in fund, (ii) portfolio companies' leverage, (iii) fund's percent stake in portfolio companies.
Investments in Private Equity Funds of Funds	10-120x	Indicative range.	Same as above, but further amplified by private capital mobilization at fund of fund level.
Direct Investments	2-15x	Indicative range.	Wide range, depending on: (i) project/company leverage, (ii) public investor's percentage stake in project/company.
Guarantees	46x	Estimate for MIGA, based on latest annual report.	High, as a result of: (i) limited capital required by guarantor, (ii) re-insurance allows greater gross exposure, (iii) guarantees typically partial, (iv) guarantees may cover only one instrument (e.g. debt but not equity).
Green Bonds	N.A.	N.A.	No specific information on use of green bond proceeds (determined by issuing sovereigns/DFIs/corporates).
Blended Climate Finance	N.A.	Very project- specific	Involves mostly projects at sub-commercial level.
Other Concessional Finance	1.3-1.7x	Estimate for Global Environment Facility and Climate Investment Funds	Low, as concessional finance mostly crowds in public rather than private investments.

Source: Authors

**Funds (and funds of funds) generate higher multipliers than direct investments, but the range is wide.** The crowding in of private investors at fund (or fund of fund) level amplifies the multiplier of the underlying projects. At the same time, project leverage and minority vs. control stake considerations result in a wide range of multipliers.

**Green banks operate mainly through direct investments and with lower leverage, achieving relative low multipliers.** Green banks prefer to fund green field renewable projects, or early-stage clean technology companies. Limited cash flow generation hinders the ability to lever up these investments significantly. The relatively unproven nature of these investments means that green banks often take large stakes, acting as demonstrators for future private investors.

**Guarantees can produce a powerful multiplier effect.** Notwithstanding their limited role in project origination, guarantees have limited public capital requirements upfront. Guarantors do not disburse funds until risks materialize and guarantees are called – they set aside capital

reserves based on an actuarial assessment of these risks. In addition, through re-insurance they are able to take higher gross exposures. MIGA, for instance, has a gross exposure equivalent to 13x its equity capital. Finally, guarantees are usually partial; they make the risk/reward of an investment appealing enough to attract investors also for the uncovered portion.

**Unsurprisingly, concessional finance has the lowest multipliers.** Concessional finance facilitates projects that are not expected, from the outset, to generate market-level returns (but may still be very relevant from a development perspective). In most cases, DFI concessional finance crowds-in other public capital, from local or international sources.

*Snapshot on Infrastructure Projects: Investment Lifecycle Matrix*

**This section addresses the role played by each instrument in all phases of a typical infrastructure investment, recognizing that infrastructure is a component of many climate adaptation projects.** Not all instruments are meant to play a comprehensive role – some are in fact very specialized (guarantees, for instance). The purpose of this analysis is to highlight strengths and complementarities, rather than product gaps.

**The analysis identified six phases in the infrastructure investment lifecycle.** They encompass the whole process, from fund raising to investment exit. Figure 4.A.4 provides an overview, as well as the criteria that make an instrument stand out in a specific phase.

**Instruments (or combinations of instruments) that address financial, operational and political risks are more likely to produce successful projects.** These three risk factors surface in various phases of the investment cycle. Naturally, some events are just unpredictable. Barring this scenario, it is critical that all three areas are addressed both in planning and execution, and that the instrument mix is chosen accordingly.

**Figure 4.A.4 - Phases of the Infrastructure Investment Lifecycle**

Investment Phase	Criteria for Instrument Evaluation
Fund raising	- Is instrument effective in raising permanent capital? - Conversely, does it rely on discretionary budget allocations?
Pipeline origination	- Does instrument proactively source and build pipeline? - Does it constructively involve relevant public authorities?
Transaction structuring and execution	- Is instrument proactive in deal structuring and execution? - Is financial viability considered upfront?
Risk mitigation / return enhancement	- Important feature for many infrastructure projects - Does instrument provide relevant solutions?
Ongoing project operations	- Does instrument contribute to operational viability? - Key in greenfield projects with a construction phase
Market exit	- Does instrument assume a full market exit (sale, IPO)?

The matrix in Figure 4.A.5 summarizes the findings of the analysis, and is followed by detailed discussion of the instruments' value added in each phase. For simplicity, a check is used when an instrument does provide the service at a given phase, a cross when it does not, and an "S" if sometimes it does and sometimes it does not.

**Figure 4.A.5 - Infrastructure Investment Lifecycle Matrix**

Instrument	Availability of Capital	Pipeline Origination	Transaction Structuring & Execution	Risk Mitigation	Ongoing Project Operations	Market Exit
Green Banks	S	✓	✓	S	S	✓
Investments in Private Equity Funds	✓	✓	✓	X	S	✓
Investments in Private Equity Funds of Funds	✓	X	X	X	X	X
Direct Investments	S	✓	✓	X	X	✓
Guarantees	S	X	S	✓	X	X
Green Bonds	✓	X	X	X	X	X
Blended Climate Finance	S	X	S	✓	X	X
Other Concessional Finance	S	S	S	S	X	X

Note: "S" indicates that an instrument sometimes provides the service, and sometimes does not.

### Phase 1: Availability of Capital

The focus of the analysis is on the stability of the sources of capital, rather than the magnitude. The latter is affected by factors that do not necessarily pertain to the design of an instrument. From a stability standpoint, capital or capital commitments specifically dedicated to green infrastructure, contractually sanctioned, and long-term are preferable to those subject to the vagaries of national budgets and of the political cycle.

**Private equity funds, funds of funds and green bonds score highly on this metric.** Fund structures and bonds offer certainty of proceeds to, respectively, fund managers and issuers – albeit with a finite tenure or maturity. In general, private equity funds and funds of funds are exclusively dedicated to commercial projects, whereas green bonds may or may not have a commercial focus. Green bonds are subject to voluntary criteria to ensure the allocation of proceeds to green uses. The WBG green bond certification process, for instance, is very strict in determining the use of proceeds. The Climate Bond Initiative is actively promoting an industry effort to standardize green bond definitions and certifications.

**The other instruments rely on government/ donor budgets or other official sources for funding.** These are affected by the political cycle. DFIs rely at least in part on capital contributions and grants from governments, which are in turn affected by national budget decisions. Inside a DFI, different instruments compete for a finite pool of capital. Guarantees, while not requiring an upfront disbursement of funds, need to be backed by capital reserves of the DFI/guarantor and, as a result, are subject to the same issues as straight cash instruments; in particular, when guarantees are booked at face rather than actuarial value – as is the case for the IBRD – they compete for capital on a one-on-one basis with straight loans.

**Green banks, despite their misleading definition, are government-controlled entities that rely almost exclusively on budget appropriations.** The only exception to the rule is, perhaps, the UK Green Investment Bank, which has raised private capital for a separate Offshore Wind Fund and is also contemplating an IPO to reduce its reliance on the UK Treasury.

### Phase 2: Pipeline Origination

**All instruments with an explicit investment mandate play a proactive role in origination.** Green banks, funds and direct investments rank high. Their success hinges upon sourcing good projects, among other factors. Institutions with a granular presence on the ground, like the IFC, are able to screen a large number of projects, for both fund and direct investments.

**Funds of funds usually do not play a direct role in sourcing investable projects for their investee funds, although they have a strong indirect interest in the ultimate sourcing of good projects and deals.**

**Guarantees are passive in the origination phase, but synergistic with instruments that could feed deals.** MIGA, for instance, will commence its underwriting work only after receipt of a formal application by a lender or investor. Conversations with MIGA representatives indicated their strong desire to be presented with more deals, especially if compliance with the WBG ESG standards has already been confirmed by due diligence.

**Green bonds, blended climate finance and other concessional tools are generally passive on the origination front.** Some concessional finance tools offer project preparation facilities that can be helpful in the origination phase.

**Involving local policy-makers and regulators early in the process is an important aspect of deal sourcing.** The presence of sovereigns and DFIs in the investor base of a fund can be beneficial. The AfDB-seeded African Renewable Energy Fund has screened several projects referred by AfDB and other fund investors, although only one out of 10 investments currently in its portfolio is an AfDB originated project.

### Phase 3: Transaction Structuring and Execution

**Instruments with an explicit investment mandate are naturally focused on structuring and execution.** In the universe analyzed, these are the green banks, private equity funds, and direct investments. This is reflected in their management teams, which usually include finance and investment professionals. The UK Green Investment Bank, for instance, has former investment bankers, private equity investors and professionals from the renewables sector in its team.

**Fund of funds are not involved in structuring and execution at project level.** Their investee funds are primarily responsible for this, as part of their normal investment activities.

**Guarantors are sometimes involved early on in the process, if risk mitigation is key to a project's financial viability.** IBRD, for instance, works with host governments to assess project feasibility and design, including risk mitigation, from a relatively early stage. The issuance of guarantees is subject to deal closing.

**Green bonds and blended climate finance are passive when it comes to transaction structuring.** Recipient governments and institutions will be the primary project drivers.

**Other concessional finance tools do sometimes take a proactive role in structuring.** The Global Environment Facility, for instance, provides technical assistance to its private sector partners to prepare transactions, in addition to capital.

#### Phase 4: Risk Mitigation or Return Enhancement

**Guarantees are provided by several DFIs, typically through ad hoc units, with WBG entities in a clear leadership position.** Funds and direct investors are users – rather than providers – of guarantees. They find them particularly useful in high-risk frontier markets, where certain investments would otherwise be impossible.

**Blended climate finance is a form of return enhancement.** It uses concessional finance tranches to enhance returns for commercial investors in a project. It is meant to be temporary, targeting early-stage projects with limited evidence of financial viability.

**Green banks operate mostly as lenders and investors, but some offer guarantees and structured products.** GreenTech Malaysia, in particular, operates almost exclusively via guarantees and rebates on interest payments, attached to loans extended by Malaysian commercial and Islamic banks.

**Some concessional finance instruments operate occasionally through risk mitigation, rather than upfront capital.** Both the Climate Investment Funds and Global Environment Facility offer guarantees, structured products and other de-risking mechanisms to projects not yet commercially viable.

#### Phase 5: Ongoing Project Operations

**Infrastructure projects, especially green field ones, require heavy involvement in development, construction and ongoing management.** Most financial investors tend to delegate these aspects to project development teams, while providing board-level supervision. This appears to be mostly the case in the green finance universe analyzed.

**The only exceptions to this rule are some private equity funds, and possibly the UK Green Investment Bank.** Some renewable energy funds, such as the African Renewable Energy Fund, are hands-on project managers; they believe their competitive advantage is the detailed understanding of, and proactive involvement in, the technical, engineering and regulatory details of a project. The UK Green Investment Bank appears to be very proactive in the management of green field projects, in particular in the offshore wind sector.

**The other instruments in the universe analyzed are not typically involved in ongoing project operations.** Funds of funds are one step removed from the project portfolio. Direct investments by DFIs are usually minority stakes, not warranting full operational involvement, which is the responsibility of the client. Guarantees, green bonds, blended climate finance and other concessional finance are pure financial tools.

#### Phase 6: Market Exit

**“Handing over” a project or company to the private market via sale or IPO, for instance, is the ultimate seal of financial viability.** Some instruments in the universe analyzed work expressly for that objective, while others are less relevant.

**Green banks, private equity funds and direct investments are all actively working for the ultimate market validation.** Their time horizons may change, depending on their strategy, sector of focus and investor base, but an exit is their clear goal.

**Funds of funds share the same interest in market exits at project portfolio level, but leave the exit decisions and execution to investee funds.**

**Green bonds, blended finance and other concessional tools do not usually play any role in exit decisions and implementation.** Blended finance does have the expressed goal to make investments financially viable for commercial co-investors, but does not drive the exit decisions.

## Annex 4.B – Investor Database Summary

Investor Name	Manager	Investor Type	AUM (MUS\$)	Instruments
Fund IV	Paine Schwartz Partners	Commercial Fund	893	Equity
Proterra Investment Partners	n/a	Commercial Fund	782	Equity
Black River Capital Partners (Food) Fund	Proterra Investments	Commercial Fund	400	Equity
Pampa Agribusiness Fund	Pampa Capital	Commercial Fund	365	Equity
Agribusiness Latin America II Fund	Aqua Capital	Commercial Fund	349	Equity
Catalyst CEL Fund	China Everbright Limited (CEL)/Catalyst Private Equity	Commercial Fund	200	Equity
New Hope Agriculture and Food Fund II	Hosen Capital	Commercial Fund	180	Equity
Agribusiness & Food Fund	Aqua Capital	Commercial Fund	173	Equity
GEF Africa Sustainable Forestry Fund (GASFF)	Global Environment Fund	Commercial Fund	160	Equity
CMIA Capital Partners	n/a	Commercial Fund	150	Equity
India Agribusiness Fund	Rabo Equity Advisors	Commercial Fund	120	Equity
Agri-Vie Agribusiness Private Equity Fund I	Agri-Vie Investment Advisors	Commercial Fund	110	Equity
Credera Group Fund	Credera Group	Commercial Fund	100	Equity
Golden Rock Capital Fund	Golden Rock Capital	Commercial Fund	100	Equity
Myanmar Opportunities Fund II	Delta Capital Myanmar	Commercial Fund	100	Equity
Cambodia-Laos-Myanmar Development Fund II	Emerging Markets Investment Advisers Pte Ltd (EMIA)	Commercial Fund	70	Equity
Myanmar Opportunities Fund I	Delta Capital Myanmar	Commercial Fund	50	Equity

Horus Food & Agribusiness Fund	EFG Hermes	Commercial Fund	46	Equity
Myanmar Investment International	n/a	Commercial Fund	30	Equity
Black Soil Group Ltd.	n/a	Commercial Fund	n/a	Equity
BXR Group	n/a	Commercial Fund	n/a	Equity
Calyx Agro	LD Commodities (Louis Dreyfus)	Commercial Fund	n/a	Equity
Caudex Asia	n/a	Commercial Fund	n/a	Equity
China Growth Fund	Inventis Investment Holdings	Commercial Fund	n/a	Equity, Debt
CITIC Agri Fund	Citic	Commercial Fund	n/a	Equity
Continental Capital Limited	n/a	Commercial Fund	n/a	Equity, Debt
Infinity Group	n/a	Commercial Fund	n/a	Equity, Debt
Myanmar Investment Group	n/a	Commercial Fund	n/a	Equity
Olympus Capital Asia	n/a	Commercial Fund	n/a	Equity
PENM (Funds I-III)	Private Equity New Markets Partners	Commercial Fund	n/a	Equity
Radar Propiedades Agrícolas	Cosan	Commercial Fund	n/a	Equity
Sagamore	n/a	Commercial Fund	n/a	Equity
SIP Agriculture	n/a	Commercial Fund	n/a	Equity
Soil Capital	n/a	Commercial Fund	n/a	Equity
TAEL Two	TAEL Partners	Commercial Fund	n/a	Equity, Debt
VinaCapital Vietnam Opportunity Fund	VinaCapital	Commercial Fund	n/a	Equity
Agrostart	BASF	Corporate	n/a	Equity
al Marai	n/a	Corporate	n/a	Equity
Archer Daniels Midlands	n/a	Corporate	n/a	Equity
BASF Venture Capital	BASF	Corporate	n/a	Equity
Bayer	n/a	Corporate	n/a	Equity
Case New Holland	n/a	Corporate	n/a	Equity
Coca-Cola	n/a	Corporate	n/a	Equity
Danone Manifesto Ventures	Danone	Corporate	n/a	Equity

Generate Capital	n/a	Corporate	n/a	Equity, Debt, Asset-based financing, Equipment leasing, Project finance
Louis Dreyfus	n/a	Corporate	n/a	Equity
Mars	n/a	Corporate	n/a	Equity
Monsanto	n/a	Corporate	n/a	Equity
Monsanto Growth Ventures	Monsanto	Corporate	n/a	Equity
SUSTAIN (Land O' Lakes)	n/a	Corporate	n/a	Equity
Syngenta	n/a	Corporate	n/a	Equity
Syngenta Growth Ventures	Syngenta	Corporate	n/a	Equity
Xylem Inc.	n/a	Corporate	n/a	Equity
Ceniarth, LLC	n/a	F/FO	n/a	Equity
NatureVest	n/a	F/FO	n/a	Equity
Global Adaptation & Resilience Fund (GARF)	Lightsmith Group	Impact Fund	1,000	Equity
ResponsAbility Fair Agriculture Fund	responsAbility	Impact Fund	200	Equity, Debt
Sarona Frontier Markets Fund 1 & 2, MEDA Risk Capital Fund	Sarona Asset Management	Impact Fund	200	Equity, Debt
Root Capital	Root Capital	Impact Fund	106	Equity, Debt
Moringa Fund	Moringa Partnership SCA	Impact Fund	90	Equity
Injaro Agricultural Capital Holdings Limited	INJARO Investments Limited (IIL)	Impact Fund	49	Equity, Debt
Rural Impulse Fund I	Incofin	Impact Fund	38	Equity, Debt
EcoEnterprises Partners II	EcoEnterprises Capital Management, LLC	Impact Fund	35	Equity
Fund for Agricultural Finance in Nigeria (FAFIN)	Sahel Capital	Impact Fund	34	Equity
SEAF Blue Waters Growth Fund	Small Enterprise Assistance Funds (SEAF)	Impact Fund	25	Equity, Debt
Capital for Communities Fund	Working Capital for Community Needs	Impact Fund	13	Debt
Fondo EcoEmpresas	EcoEnterprises Capital Management, LLC	Impact Fund	6.3	Equity

Fondo para los Pequeños Productores Rurales (FOPEPRO)	Alterfin	Impact Fund	3.8	Debt
Asia IIX Growth Fund	IIX Global	Impact Fund	n/a	Equity
Climate Solutions Fund II	Generation Investment Management	Impact Fund	n/a	Equity
Developing World Markets	n/a	Impact Fund	n/a	Equity, Debt
Leapfrog Investments	n/a	Impact Fund	n/a	Equity
Rural Impulse Fund II	Incofin	Impact Fund	n/a	Equity, Debt
SEAF Bangladesh Ventures	Small Enterprise Assistance Funds (SEAF)	Impact Fund	n/a	Equity, Debt
Uberis Capital	n/a	Impact Fund	n/a	n/a
Low Carbon Agriculture Program (ABC)	Banco do Brasil	Lender	n/a	Loans
Global Agriculture and Food Security Program (GAFSP)	World Bank Group	MDB	1,577	Equity, Loans, Grants, Guarantees
Least Developed Countries Fund (LCDF)	Global Environmental Facility (GEF)	MDB	1,219	Grants
Adaptation for Smallholder Agriculture Program (ASAP)	IFAD	MDB	314	Grants
PROADAPT Facility	IADB	MDB	n/a	Loans, Grants
Public Private Infrastructure Advisory Facility (PPIAF)	World Bank Group	MDB	n/a	
Climate Ventures 2.0	Good Company Ventures	Other	n/a	Grants
NXTP Labs	n/a	Other	n/a	
Agriculture Investment Fund	Russia-Chia Investment Fund	SWI/SRI	2000	Equity
Saudi Arabian Livestock Investment Company (SALIC)	n/a	SWI/SRI	n/a	Equity
Funds I-III	Vietnam Investments Group	Commercial Fund	400	Equity, Debt
NGP Agribusiness Fund	Tilleridge Global Agribusiness Partners	Commercial Fund	285	Equity, Debt
Maj Invest Equity Vietnam	Maj Invest	Commercial Fund	n/a	Equity, Debt
Ultra Capital	n/a	Commercial Fund	n/a	Equity, Debt
Starbucks	n/a	Corporate	n/a	Equity
Terra Bella Fund	Terra Global Investment	Impact Fund	50	Equity, Debt

	Management LLC			
Grassroots Business Fund (GFB)	Grassroots Business Partners	Impact Fund	49	Equity, Debt, Guarantee
SEAF India Agribusiness International Fund	Small Enterprise Assistance Funds (SEAF)	Impact Fund	41.8	Equity, Debt
Impact Finance Fund SICAV-SIF	Impact Finance Management S.A.	Impact Fund	23	Equity, Debt
Fairtrade Access Fund	Incofin	Impact Fund	16.6	Debt
Annona Sustainable Investment Fund	Annona	Impact Fund	n/a	Equity, Debt
Global Environment Fund	n/a	Impact Fund	n/a	Equity, Debt
LGT Impact Ventures	n/a	Impact Fund	n/a	Equity, Debt
Green Climate Fund	United Nations	MDB	10,300	Equity, Debt, Grants, Guarantees
Pilot Program for Climate Resilience (PPCR)	Climate Investment Funds	MDB	1,200	Grants
Integrated Participatory Development and Management of Irrigation Project	Asian Development Bank (ADB)	MDB	852.9	Grants
Special Climate Change Fund (SCCF)	Global Environmental Facility (GEF)	MDB	350	Grants
Global Facility for Disaster Reduction and Recovery (GFDRR)	World Bank Group	MDB	240	Grants
Thrive AgTech	n/a	Other	n/a	Equity, Debt
Al Dahra Holding	n/a	SWI/SRI	n/a	Equity, Debt
Hassad	n/a	SWI/SRI	n/a	Equity, Debt
Jenaan Investment	n/a	SWI/SRI	n/a	Equity, Debt
Victoria Capital Partners	n/a	Commercial Fund	1,500	Equity, Debt
Andaman Capital Partners	n/a	Commercial Fund	n/a	Equity, Debt
Duxton Asset Management	n/a	Commercial Fund	n/a	Equity, Debt
Myanmar Transition Fund	Bagan Capital	Commercial Fund	n/a	Equity, Debt
Stafford Capital Partners	n/a	Commercial Fund	n/a	Equity, Debt
General Mills	n/a	Corporate	n/a	Equity, Debt
John Deere	n/a	Corporate	n/a	Equity, Debt
Vital Capital	n/a	Impact Fund	350	Equity, Debt
Triple Jump Innovation Fund	Triple Jump	Impact Fund	22	Debt

Rabo Rural Fund	Rabobank Foundation	Impact Fund	18	Debt, Guarantees
Affirmative Investment Management	n/a	Impact Fund	n/a	n/a
Capricorn Investments	n/a	Impact Fund	n/a	Equity, Debt
Cleanstar Ventures	n/a	Impact Fund	n/a	n/a
Invested Development	n/a	Impact Fund	n/a	n/a
Adaptation Fund	n/a	MDB	436	Equity, Debt
Soros Economic Development Fund	Soros Foundation	MDB	n/a	Equity, Debt
Nestle	n/a	Corporate	n/a	Equity, Debt
Pepsico	n/a	Corporate	n/a	Equity, Debt
AgFunder	n/a	Other	n/a	Equity, Debt

Note: Investor Types: Commercial Fund, Corporate, Multilateral Development Bank (“MDB”), Foundation/Family Office (“F/FO”), Impact Fund, Lender, Other, Sovereign Wealth Investor/Sovereign-Related Institution (“SWI/SRI”)

# Annex 6.A – China Case Studies

## Case 1: Anyou Biotechnology Group Co., Ltd.

### *Summary:*

Objective	The company aims to become a leading sustainable animal nutrition specialist.
Financing	It has relied on both equity and debt financing to support its growth. IFC provided both equity and long-term loans. To expand production capacity and gain more market share, the company is in need of additional growth capital.
Size	Small to medium size player in China’s animal feed sector with an annual capacity of about 92,000 tons animal feed.
Performance	Gross profit margin improved from 15.4percent to 17.4percent and was above industry average during 2012-14. Revenue continued to grow but dipped in 2015, mainly due to lower demand caused by the trough of China’s “pig cycle”.
Features	Solid R&D capability; specialized in quality creep and green pig feeds.

### *Description:*

**Anyou Group Co., Ltd. is a rising piglet feed producer in China.** Anyou Group Co., Ltd. (the Company or Anyou) was established in the Taicang City of Jingsu Province in 2009. It mainly develops, manufactures and sells high quality pig feeds, including creep feed, finishing pig feed and sow feed, which accounts for over 90percent of total revenue. In addition to the feed business, it also owns relatively small pig breeding and relevant industry (enzyme production and feed production equipment). The Company owns 64 subsidiaries and employs more than 3,600 staff. It is reported that 10percent of all the piglets born in China in 2013 were fed on Anyou feed.<sup>243</sup>

**The Company mainly serves small and medium size hog farms through its extensive rural network.** The high-quality pig feeds were sold to commercial hog farms. Its rural network comprises more than 35,000 rural hog farmers, the majority of which are small- and medium-sized farms with around 500-600 sows. The Company manages its wide distribution channels through the established subsidiaries in national animal husbandry focus areas. Its feed products now cover 26 provinces.

**The Company has developed a strong R&D facility over the years and became specialized in creep feed and green feed for pigs.** Technological advancement and product quality have been the cornerstones of the Company’s development strategy. Over the past decade, it has built seven in-house research institutes, with project research, pig nutrition and microorganism, feeding

<sup>243</sup> M. O’Neill, 2014, “Taiwan expert becomes China’s pig feedgrain king,” Ejinsight (<http://www.ejinsight.com/20140520-taiwan-expert-becomes-china-pig-feedgrain-king/>)

management and laboratory functions. Its creep feed and green feed (e.g. low-protein feed with less nitrogen excess) are of high quality in the animal feed industry.

**In recent years, the Company has expanded along the value chain to genetic pig farming and pig rearing.** Through leased farms and grandparent pig imports, the Company can supply high quality pig genetics in addition to its core feed businesses. The recent shift in its business model allows the Company to make bundle sales – quality pig genetics and feed – to pig farm clients, which can potentially expand its customer base, improve profitability and contribute to the enhanced farming efficiency of domestic pig rearing industry.

Strategic Vision:

**The Company aims to become a leading sustainable specialist animal nutrition provider.** Anyou has been committed to supplying high quality pig feed through feed and nutrition practice innovations. The Company also aims to develop “green” feed that adopts enzymes and other additives to increase phosphorous utilization and reduce GHG emissions.

**It plans to further expand its market share in China.** As a mid-size player in the pig feed industry, the Company plans to ramp up its feed production capacity and bring its quality feed and scientific rearing practices to more hog farmers.<sup>244</sup> As of September 2015, it planned to expand feed mill operations in provinces including Sichuan, Guangxi, Hubei, Henan and Heilongjiang.

Relevance to Resilience:

**Anyou’s pig feed and breeding techniques can improve pig-farming productivity, contributing to livestock sector resilience while reducing its environmental impact.** The Company is granted patents for a number of its pig breeding and pig feed techniques, including pig suckling creep feed technology, antibiotic substitution, high-yield pig feed formula, and artificial piglet feeding technology. The resultant balanced low-protein feed products can save raw materials, increase pig’s resistance to disease, and improve the feed conversion ratio.<sup>245</sup> In doing so, the feed will lead to less GHG emission and animal waste production.

Financing:

**The Company has raised multiple rounds of funding including from institutional investors such as the IFC since its establishment in 2009.** The Company has in effect raised funds seven times since 2009, and its registered capital went up from USD 7.5 million at establishment to USD 37.7 million as of June 2015. A few institutional investors, whose board of directors or partners are Anyou’s controlled shareholders, provided funds to the Company as early as 2013 and remained as major shareholders ever since. The IFC invested USD 15 million equity in March

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<sup>244</sup> Anyou, 2016, “IPO pre-announcement prospectus to China Securities Regulatory Commission” (<http://www.csrc.gov.cn/pub/zjhpublic/G00306202/201603/P020160325532202613750.pdf>)

<sup>245</sup> Detailed expositions can be found at: Evonik, “World Water Day: Protecting our Freshwater” (<http://corporate.evonik.de/en/pages/article.aspx?articleId=719>)

2015, followed by RMB 20 million (USD 3.2 million) in June 2015 from CDH Investments, one of the leading alternative investment fund managers that focused on China, marking the latest round of fundraising.

**The Company has also relied on debt financing to support its growth.** As of September 2015, the Company had RMB 5.9 million (USD 1 million) bank loans outstanding.<sup>246</sup> IFC disbursed an 8-year USD 20 million “A” loan to the Company in July 2013 and another USD 40 million 5-year senior “A” loan in 2016.

**The Company estimates that about USD192 million will be necessary to ramp up its operations.** Anyou has filed an application to list shares on the Shanghai Stock Exchange in March 2016. In its IPO application prospectus, the Company indicated about RMB 1.2 billion (USD 192 million) is needed to ramp up its pig feed production capacity and R&D investment, and to establish an information management platform and replenish cash reserves. However, the securities regulator’s tightening control over IPOs since mid-2015 and the recent IPO approval slowdown pose challenges to the Company’s current financing strategy.

*Performance:*

**The Company continues to grow with gross margin and operating margin improving during 2012-2014 period.** Total revenue and total assets are growing, reaching RMB 4.1 billion (USD 668 million) and RMB 1.9 billion (USD 313 million) by the end of 2014 (Table 6.A.1). The Company’s gross profit margin is higher than the sector average during 2012-2014 by 4.64percent, 5.78percent, and 5.8percent respectively. The gross margin for Anyou’s feed business exceeded the industry average by an even larger extent. Its feed business contributes 95percent of the total gross profit.

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<sup>246</sup> Anyou, 2016, “IPO pre-announcement prospectus to China Securities Regulatory Commission” (<http://www.csrc.gov.cn/pub/zjhppublic/G00306202/201603/P020160325532202613750.pdf>)

**Table 6.A.1 – Summary of Anyou’s Financial Statements (2012-2014)**

<b>CNY million</b>	<b>2012-12</b>	<b>2013-12</b>	<b>2014-12</b>
<b><u>Income Statement</u></b>			
Revenue	1,915	3,694	4,096
Operating Income	100	244	252
Net Income	88	201	193
<b><u>Balance Sheet</u></b>			
Current Assets	450	893	940
Non-current Assets	328	548	984
Total Assets	778	1,440	1,924
Current Liabilities	466	737	816
Short-Term Debt	104	254	380
Non-current Liabilities	1	125	243
Long-Term Debt	-	123	230
Total Liabilities	468	863	1,059
Total Equity	310	577	866
<b><u>Key Ratios</u></b>			
Gross Margin	15.4%	16.5%	17.4%
Operating Margin	5.2%	6.6%	6.2%
Net Margin	4.6%	5.4%	4.7%
Current Ratio	1.0	1.2	1.2
Debt to Asset Ratio	1.5	1.5	1.2

*Source: Anyou IPO Pre-Announcement Prospectus*

Takeaways:

**R&D capability, quality, and sustainable feed products, and sale service underpin Anyou’s solid performance and rising brand recognition.** The Company has built a 51-professional R&D team and owns multiple pig feed and pig rearing research institutes. Its R&D covers both basic and applied research, which can be adapted to small and large-scale productions. Anyou’s pig creep feed excels in both formula and processing technology. Research in feed related breeding practice also complements its sales services and helps clients improve pig farm management. Its feed products have received several national awards and the Company is recognized as a “Leading Enterprise of Agricultural Industrialization” in Jiangsu Province.

**Market development is instrumental for wider application of creep feed and sustainable feed.** Creep feed that is fed to animals that are still nursing can lead to better and more balanced pig nutrition, decrease the probability of contracting disease, and promotes rapid growth and a higher weaning weight. Yet many hog farmers are unaware of the productivity and potential environmental benefits of creep feed. China’s market coverage of pig creep feed stood at 50percent in 2014, as compared to 80-90percent in developed markets.<sup>247</sup> According to Anyou, even for farmers who adopt creep feed tend to supply less than the necessary amount, resulting in sub-optimal output. The economic benefits of “green” feed that uses less protein, and more acid amino and enzyme additives, likewise, are to be advertised to more pig farmers. Market education and promotion can improve sales and profitability for companies like Anyou and contribute to climate change adaption and mitigation.

<sup>247</sup> Anyou, 2016, “IPO pre-announcement prospectus to China Securities Regulatory Commission” (<http://www.csrc.gov.cn/pub/zjhpublish/G00306202/201603/P020160325532202613750.pdf>)

**Anyou is a small to medium size animal feed producer with good growth prospects and it can benefit from timely supply of growth capital.** With 92,000 tons production of animal feed in 2014, the Company is a leading animal feed producer among major small size players that have less than million tons production capacity.<sup>248</sup> By indicator of total feed sales, the Company ranks in the middle among major listed peers.<sup>249</sup> Yet with solid R&D capability, quality feed products, a comprehensive sales service system, and increasing market recognition, Anyou holds good growth prospects. As industry competition escalates and production scale becomes increasingly important, the Company would benefit from timely injection of growth capital.

Market Potential:

**The pig feed market is expected to continue growing, as pork dominates the country's meat consumption and the demand for animal protein increases.** China is the world's largest pork producer, representing about 50percent of world production. Pork is the preferred source of animal protein in China and accounts about two thirds of the country's meat consumption (McKinsey & Co., 2015). According to the National Bureau of Statistics, China's pork production capacity has been increasing at an annual rate of 2.5percent during 2005-2014, while pig feed production more than doubled during the same time period.<sup>250</sup> As living standards continue to improve and the demand for animal protein rises, the pork sector will continue to grow, which will create more market demand for pig feed.

**Demand for quality and sustainable feed products will increase as the pig-farming sector further consolidates and the government raises environmental standards for livestock breeding.** Despite backyard hog farms still dominating the pig production sector (Schneider and Sharma, 2014), medium- and large-sized scale hog farms are rapidly gaining market share. Rabobank estimates that the share of total pig production from backyard farms with less than 50 heads per farm has decreased from 57percent in 2005 to 27percent in 2015, while the share of specialized farms (50 to 1,000 heads/farm) and commercial farms (+1,000 heads/farm) increased significantly.<sup>251</sup> The scaled pig farms tend to place greater importance on pig nutrition and can be more receptive to creep feed and sustainable formulas. In addition, the ongoing implementation of *Regulation on the Prevention and Control of Pollution from Large-scale Breeding of Livestock and Poultry* at localities can encourage the wider adoption of scientific breeding practices as well as "greener" pig feeds.

**The increasing consolidation and intensifying competition within the animal feed industry can bring about more financing needs.** China's animal feed industry has become increasingly consolidated, and the number of large producers is on the rise. Animal feed producers with annual 100,000 tons capacity increased from 157 in 2008 to 423 in 2012, while the total number of

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<sup>248</sup> Anyou, 2016, "IPO pre-announcement prospectus to China Securities Regulatory Commission" (<http://www.csrc.gov.cn/pub/zjhpublic/G00306202/201603/P020160325532202613750.pdf>)

<sup>249</sup> *ibid*

<sup>250</sup> According to Anyou compiled data from China Feed Industry Yearbooks in its prospectus

<sup>251</sup> *ibid*

feed processors halved during 2008-2014.<sup>252</sup> The intra-industry competition is likely to intensify in the coming years. Large size players that have ample capital, a broad sales network, and advanced technology will gain more market share. Emerging feed producers with good growth prospects are likely to augment production capacity and improve technical advantages, which is likely to bring about more financing need and investment opportunities.

## Case 2: Xinjiang Tianye Water Saving Irrigation System Co., Ltd

### Summary.

Objective	Promote affordable water saving irrigation equipment to farmers in China
Investors	The company, based in Xinjiang, was listed on the Hong Kong Stock Exchange in 2016. It is owned by Tianye holdings, in turn owned by Tianye Company and Xinjiang Tianye Limited.
Size	Tianye is a leading player in China's water-saving irrigation market. Total annual revenues averaged to RMB 700 million in past five years.
Financing	The company finances its operations mainly through internally generated funds and cash reserves. Before 2012, it has also financed itself through short-term bank loans.
Performance	Operating margin averaged 8.2percent over the past five years. But operating income and net income are on downward trend since 2012, when market competition began to intensify and overall economic growth slowed. As such, the company is seeking new drivers of growth and began to provide integrated service, e.g. irrigation system design, construction, maintenance, in addition to manufacturing and selling equipment.
Company features	Affiliation with Xinjiang Production and Construction Corps has given the company an advantage in R&D capability and market expansion. Product quality, water-saving irrigation products, and technology upgrades have been high on the company's development agenda

### Description:

**Xinjiang Tianye Water Saving Irrigation System Company Limited (the Company or Tianye Water), together with its subsidiaries, engages in the design, manufacture, and sale of drip tapes, PVC/PE pipelines, and drip assemblies for use in water-saving irrigation systems in China.** The Company operates in the plastic product manufacturing industry. Its main business covers the production and sale of PVC materials for water supply pipes, PE piping materials and accessories, and drip tapes. In 2016, PVC pipes/PE pipes represented 48.44percent of operating income from principal business, followed by drip tape and drip assemblies (44.56percent), and installation services (2.36percent). Xinjiang Uyghur Autonomous Region has been its biggest market. As of December 2016, 70percent of its operating income was generated within Xinjiang. Like other water-saving irrigation companies, Tianye's major customers are local governments and local leading agriculture enterprises, which in Tianye's case are Xinjiang's large state-owned farms.

<sup>252</sup> According to Anyou compiled data from China Feed Industry Yearbooks in its prospectus

Strategic Vision:

**The Company is committed to developing and promoting affordable quality water-saving irrigation systems for farmers.** The Company was awarded 28 patents for its developed drip tapes and pipelines products. It also succeeded in developing tape- or pipe-based high-efficiency water-saving irrigation techniques, such as application of membrane-facilitated subsurface drip irrigation to grain plants and cash crops. The cost of the Company's drip irrigation equipment is reportedly only one-eighth of that of a similar product by foreign manufacturers and has been adopted in more than 29 provinces and a number of Asian countries such as Tajikistan, Kazakhstan, Uzbekistan, Pakistan, Mongolia, and Sub-Saharan African countries such as Zimbabwe, Angola and Togo.<sup>253</sup>

Relevance to Resilience:

**The Company's drip and pipe products and water-saving irrigation systems improve irrigation efficiency and water conservation,** especially in arid land areas in western China. The slow water delivery system of drip irrigation allows water to drip slowly to the plant roots. The company's products also play an important role in water conservation by reducing evaporation and deep drainage. In paramilitary farms in Xinjiang, where the Company's drip irrigation techniques are mostly deployed, the average agricultural irrigation water quota needed decreased from 700 cm<sup>3</sup> to 400 cm<sup>3</sup>.<sup>254</sup>

**Drip irrigation in Xinjiang has resulted in a substantial increase in crop yields.** For example, the Company's drip irrigation has doubled the unit yields for cotton and wheat in Xinjiang, and increased unit yields for chili pepper and grapes by 60percent.<sup>255</sup>

Performance:

**The Company has become the largest water-saving irrigation equipment provider in the domestic market after nearly two decades of development.** In the drip irrigation sub-market, the Company takes up about 60percent of the drip-irrigation equipment sub-market, followed by Dayu Water Saving Group and Ruisheng-Yameite Agricultural Company.<sup>256</sup> Tianye's annual production capacity is about 600 million mu (40 million ha) of film drip irrigation water-saving equipment, 60,000 tons of PVC pipe, and 500 tons of matching pipes. Its cumulative water-saving irrigated area exceeded 6000 million mu (400 million ha).<sup>257</sup>

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<sup>253</sup> Refer to Tianye website at <http://www.tianyejieshui.com.cn/index.php?m=content&c=index&a=lists&catid=2>; Refer to Shanghai Securities Daily at <http://money.163.com/09/0928/05/5K9AG5E400253B0H.html>

<sup>254</sup> XPCC, 2014, "Tianye (report)" ([http://bt.xinhuanet.com/2014-12/09/c\\_1113573153.htm](http://bt.xinhuanet.com/2014-12/09/c_1113573153.htm)); Note: Agriculture irrigation water quota refers to the amount of irrigation water needed per unit area (m<sup>3</sup>/mu) for crop during the full growth period (one year for perennial crop) or the total amount of irrigation water needed for multiple growth periods of a crop.

<sup>255</sup> XPCC, 2014, "Tianye (report)" ([http://bt.xinhuanet.com/2014-12/09/c\\_1113573153.htm](http://bt.xinhuanet.com/2014-12/09/c_1113573153.htm))

<sup>256</sup> Minsheng Securities news piece, 2011, (<http://money.163.com/11/0222/15/6TGN827200253HF4.html>)

<sup>257</sup> Tianye website (<http://www.tianyejieshui.com.cn/index.php?m=content&c=index&a=lists&catid=2>)

**Net income margin shrank while business expansion continued.** The intensified competition, fluctuation in crude oil prices, and economic slowdown cut into the operating profit margin in recent years. Meanwhile, capital expenditure grew steadily with PP&E acquisition averaging RMB 12.6 million annually. In 2016, the Company acquired three subsidiaries, which is believed to attribute to the operational loss in 2016.

**Table 6.A.2 – Summary of Tianye Water’s Consolidated Financial Statements (2011-2016)**

	2011-12	2012-12	2013-12	2014-12	2015-12	2016-12
<b>Income Statement (CNY Mil)</b>						
Revenue	690	763	692	701	667	671
Operating Income	23	6	5	2	-12	-62
Net Income	21	3	4	2	-7	-57
<b>Balance Sheet (CNY Mil)</b>						
Current Assets	872	878	813	680	623	794
Non-current Assets	231	222	220	267	265	189
Total Assets	1,103	1,100	1,033	947	888	983
Current Liabilities	389	359	291	303	200	310
Short-Term Debt	120	100	0	0	0	0
Non-current Liabilities	0	12	12	11	9	9
Total Liabilities	388	371	303	257	210	319
Total Equity	715	706	730	690	678	664
<b>Key Ratios</b>						
Gross Margin	12.3%	10.8%	5.2%	9.9%	8.8%	6.1%
Operating Margin	3.4%	0.8%	0.7%	0.3%	-1.8%	-9.3%
Net Margin	2.8%	0.4%	0.5%	0.3%	-1.0%	-8.5%
ROE	2.7%	0.5%	0.5%	0.3%	-1.0%	-8.4%
Current Ratio	2.24	2.45	2.8	2.77	2.76	2.56
Financial Leverage	1.58	1.55	1.44	1.46	1.45	1.5

Source: Morningstar; Tianye Water annual reports

**The newly acquired businesses in 2016 tend to be service-oriented and contain a heavy technological component,** signifying the Company’s possible strategic shift into the higher-end irrigation market and provision of integrated services, including irrigation system design, construction, and maintenance. Two of the new subsidiaries - Zhongxinnong Modern Water Saving Technology and Xinjiang Tianye Wisdom Agriculture Technology – focus on irrigation automation, while the partnership with Jiangsu Akcome Science & Technology focuses on developing solar-powered pumping systems for scaled water-saving irrigation systems.<sup>258</sup>

Financing:

**The Company finances its operations mainly through internally-generated funds, bank loans, and cash reserves.** Besides internally-generated funds and cash, the Company has only used short-term bank loans to finance its operations. As of end-2016, the Company’s capital reserve, surplus reserve, and undistributed products totaled RMB 133.8 million.

Takeaways:

<sup>258</sup> Z. Wang, 2016, “Jiangsu Aikang Technology Co. Ltd. and Xinjiang Tianye sign strategic cooperation framework agreement” Sina Weibo (<http://finance.sina.com.cn/roll/2016-06-23/doc-iftmwri4281335.shtml>)

**More comprehensive product and service provision and value-chain integration are expected.** As a water-saving irrigation pioneer, Tianye Water remains focused on the development and production of water-saving irrigation equipment since its establishment in 1999. Throughout the years, the Company maintained product quality and has diversified product lines. However, increasing competition and downward economic conditions will require some business diversification that can generate a higher profit margin, such as irrigation project construction. This is because, in the foreseeable future, there will be more comprehensive product and service providers and value-chain integration in China’s water-saving irrigation sector.

*Market Potential:*

**The national water-saving irrigation market is expected to continue to grow, with the Xinjiang market beginning to deepen.** The country’s agricultural water conservancy targets and the accelerating government investment in large-scale irrigation district infrastructure will generate higher demand soon. In addition, the land tenure reform and agricultural use water tariff reform promote further market development. Analysts have estimated that China’s high efficiency water-saving irrigation market can reach RMB 170 billion by the end of the 13th Five-Year-Plan period (2020).<sup>259</sup>

**PPPs are expected to become major financing models for water-saving irrigation projects in the future.** The Government of China has been promoting PPPs since late 2013, in part to alleviate the pressure of increasing constraints on local government budgets.<sup>260</sup> More than 11,000 PPP projects totaling RMB 13.5 trillion have been recorded as of end of 2016 and PPPs in the construction and operation of irrigation and farmland water conservancy projects are also encouraged.<sup>261</sup> Dayu Water Saving Group and Kingland Technology have already entered strategic partnerships with local governments to develop water-saving irrigation PPP demonstration projects. A surge in water-saving irrigation PPP deals is expected in the future.<sup>262</sup>

### Case 3: China’s Precision Agriculture Sector

*Summary:*

Objective	Several companies in the Global Navigation Satellite System (GNSS) industry are starting to shift towards the precision agriculture sector, aiming to gain strategic advantage in the potentially fast-growing market and to capitalize on China’s enhanced high-precision satellite navigation and positioning infrastructure.
Financing	Given the early development stage and small size of the precision agriculture market, smaller players tend to finance its operations through internally-generated funds and

<sup>259</sup> Huarong Securities (2017)

<sup>260</sup> <https://pppknowledgelab.org/countries/china>

<sup>261</sup> According to data from Ministry of Finance China PPP Center as of February 2017 (<http://www.cpppc.org/zh/pppyw/4684.jhtml>); and according to the Administrative Measures for the Use of Subsidies for in Irrigation Facilities Construction and Water and Soil Conservation (2015)

<sup>262</sup> Minsheng Securities (2016); Huarong Securities (2017)

	bank loans. Larger-scale and affordable growth capital will be needed as the market matures, technology advances, competition intensifies, and industry deepens.
Size	The precision agriculture market was about RMB 451 million in 2015. By conservative estimates, the market is expected grow to over RMB 18 billion in 2020.
Performance	UniStrong and Huace experienced steady growth in the last three years (UniStrong revenue grew at a CAGR of 54.5percent and Huace 27.8percent). Sales of agricultural machinery, navigation, and auto-steering systems are on an upward trend and contribute to overall operating profits (with profit margin standing above 40percent for both UniStrong and Huace).
Sector features	GNSS-enabled auto-steering agricultural systems developed by domestic companies have advanced over the years and are gaining market share that was dominated by foreign brands. The sector can benefit from strategic financing as a positive signal to attract private capital, as well as from a possible technical assistance facility to smooth the technology adoption process.

*Description:*

**Companies in the GNSS industry usually provide a suite of satellite navigation and positioning products and solutions that can be applied in diverse scenarios.** Common products include geographic information system data collection products, high-precision measurement, portable navigation products, systems engineering, automotive information technology, location-based services, and aviation. These products and services can cover (i) upstream and midstream navigation hardware and systems, e.g. receivers, sensors, correction and positioning boards; (ii) downstream professional applications, e.g. topographic surveys for infrastructure constructions (road, tunnel, bridge etc.), surveillance and management of public security, public transport, and machine controls; and (iii) downstream mass-market commercial applications, e.g. vehicle positioning and location services. Proprietary hardware and software technologies are key to companies’ competitive edge, and GNSS companies tend to be integrated satellite navigation and positioning solution providers.<sup>263</sup>

**Several major domestic GNSS companies accelerated GNSS enabled precision agriculture business deployment in recent years.** The high precision satellite navigation technology with centimeter-accuracy enables controlled and automated agricultural operations. Several major domestic GNSS companies have begun to move into the agriculture machinery navigation market, notably, UniStrong and Huace. UniStrong, once a Hemisphere OEM partner, purchased the high precision product business and related GNSS technology and intellectual property from Hemisphere GPS Inc. for USD 15 million in 2013. It started precision agriculture team building and deployed a sales network in 2014, and launched the proprietary “Huinong” Beidou agricultural machinery steering and control system in 2015. Huace started precision agriculture R&D in 2013 and purchased 90percent of Nanjing Gallop-Sky Electronic Technology, a Trimple

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<sup>263</sup> Major GNSS companies place great emphasis their R&D capabilities. For example, R&D expenditures for Beijing UniStrong Technology and Shanghai Huace Navigation Technology, account for 14.4percent and 10percent of their total revenue respectively in 2016.

and Topcon precision agriculture hardware OEM that has developed its own technology development capability over the years. Other GNSS companies active in realm of precision agriculture include ComNav Technology Ltd. and Hi-Target Surveying Instrument Co.<sup>264</sup> (Table 6.A.3).

**Table 6.A.3 – Major GNSS Players Active in the Precision Agriculture Market**

Company Name	Since	Revenue ('16 RMB)	Company Profile
Beijing UniStrong Science & Technology Co., Ltd.	1994	1,170,283,594.44	Beijing UniStrong Science & Technology Co., Ltd. provides satellite navigation and positioning services. The company's products and services include satellite navigation & positioning systems, geographic information acquisition systems, high-precision measurement, systems engineering, car navigation, automotive information technology, and avionics.
Shanghai Huace Navigation Technology Ltd.	2003	482,067,753.13	Shanghai Huace Navigation Technology Ltd. engages in the research, development, manufacture and sale satellite navigation and positioning related hardware and software technology products. The company operates through data acquisition equipment and data application and solutions segments.
ComNav Technology Ltd.	2012	105,919,347.32	ComNav Technology Ltd. develops and manufactures multi-constellation, multi-frequency GNSS measurement engine boards and receivers for ultimate high precision positioning applications.
Hi-Target Surveying Instrument Co., Ltd.	1999	765,641,123.96	Hi-Target Survey Instrument Co., Ltd. is a high-precision geographic instrument and solution provider, and covers satellite navigation and positioning and laser system hardware and applications in mapping, surveying and high-precision measurement and machine control.

Source: company websites, company reports

**Growing interest in precision agriculture and increased R&D investment have propelled the technological advancement of GNSS enabled auto-steering agricultural systems among domestic companies.** Despite the maturity of the key technologies involved in precision agriculture, in China the market has been dominated by foreign brands, including Trimble, Hemisphere, Topcon and Leica (Dong, 2014). Companies such as ComNav Technology are also ready to supply quality upstream hardware such as OEM boards, GNSS receivers and antennae. As more domestic GNSS companies move towards the precision agriculture sector, technology development of domestic agricultural machinery navigation system has made strides. Larger players such as UniStrong and Huace both developed and launched patented GNSS auto-steering farming systems. Smaller players, such as Beijing Outsmarting Roctec Technology, have also developed its proprietary land flattening systems. Domestic GNSS precision agriculture products are gradually gaining market share from foreign competitors.

**The high-precision GNSS agricultural auto-steering systems are mainly sold to large farms in the Northeast and Northwest of China.** Domestic GNSS companies have been actively seeking partnerships with major agricultural machinery manufacturers to develop and test matching auto-steering systems. The agricultural navigation and control products are mainly sold to large-size farms in Xinjiang, Heilongjiang, Inner Mongolia, and some large agricultural provinces, including Shandong, Hebei, and Hubei. Paramilitary farms in Xinjiang and state farms in Heilongjiang have larger cultivated areas (Figure 6.A.1) and more integrated farm management systems, which make it more economically efficient to install the GNSS navigation systems in these regions. Yet, in the coming years marked by the accelerated rural land tenure reform and

<sup>264</sup> The list of companies is based on Essence Securities' note on Huace in May 2017.

rural land circulation, corporate farms and rural cooperatives are expected to become major customers, with the market expanding into wider parts of China.

**Figure 6.A.1 - Average Cultivated Farmland Area in Chinese Rural Households in 2012**



Source: Huang et al (2017); China Statistics Yearbook 2013

Strategic Vision:

**Major GNSS companies plan to expand high precision navigation applications to capitalize on the fast-growing industry and the strengthening infrastructure.** The GNSS companies expect to capitalize on the growing commercial application of Beidou Satellite Navigation System and the ongoing China’s Continuous Operational Reference System establishment, which can enable three-dimensional positioning with centimeter or below accuracy. Furthermore, the companies also expect to allocate more resources to cultivate the more profitable downstream GNSS navigation businesses, as the GNSS industry value chain structure evolves and competition increases.

Relevance to Resilience:

**Auto-steering navigation systems can improve the eco-environment adaptive capability through improved agricultural productivity and more efficient use of agricultural resources.** Navigation auto-steering systems can standardize agricultural operation and increase the efficiency of land preparation, furrowing, seeding, and spraying, which would lead to higher yields. It can also increase the irrigation and fertilization efficiency (e.g. through automated land flattening and land formation), which can lead to a more efficient use of land, and prevent soil erosion and salinization. As the precision market and technological application progress, auto-steering navigation can achieve higher productivity and more precise farming management

through integration with site-specific data collection and analytics, which can further reduce resource inputs and improve yields.

*Financing:*

**GNSS companies active in the precision agriculture sector have mainly resorted to equity finance to support business expansion and technology upgrades.** The GNSS companies all sought funding through listing shares on the stock market: UniStrong was listed in 2010, Hi-Target in 2011, ComNav in 2015, and Huace in March 2017. The raised funds were used to finance business growth, R&D facility, marketing and sales network expansion, subsidiary acquisition, and product upgrades. Reports and industry analysis indicate that affordable, long-term growth capital will be necessary for companies in this nascent industry.<sup>265</sup>

*Performance:*

**GNSS companies that are active in the precision agriculture sector have experienced steady growth in recent years, and the agricultural machinery navigation system business has been on the rise.** Revenue and net profit of major GNSS companies that are active in the precision agriculture industry have been on the rise in recent years (Figure 6.A.2 and Figure 6.A.3). UniStrong's high precision navigation application business increased steadily during 2014-2016. Gross profit margin of its high-precision navigation application business averaged to 46.5percent. Revenue from precision agriculture amounted to RMB 65.7 million in 2016 and grew by 51percent from 2015. Sales of Huace agricultural machine auto-steering and navigation systems rose to RMB 48.3 million in 2015 and dipped to RMB 40.7 million in 2016 (Figure 6.A.5). Gross profit margin for Huace's agricultural machine auto-steering and navigation system has been on an upward trend and averaged to 44.12percent during 2014-2016. Beijing Outsmarting Roctec Technology, a smaller unlisted player active in China's precision agriculture sector, also indicated rapid growth of its agricultural auto-steering navigation system business and helped raise the company's overall operating profit.<sup>266</sup>

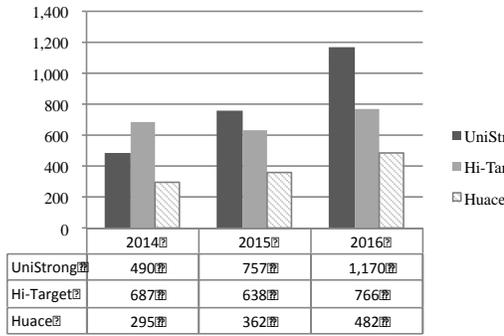
**Figure 6.A.2 – Revenue (2014-16, RMB million)**

**Figure 6.A.3 – Net Profit (2014-16, RMB million)**

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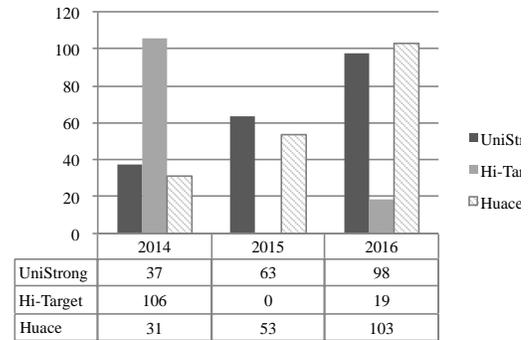
<sup>265</sup> According to Huace's IPO prospectus

<sup>266</sup> Partly caused by Nanjing Gallop-Sky Electronic Technology acquisition; based on interview with Beijing Outsmarting Roctec Technology Co., Ltd.



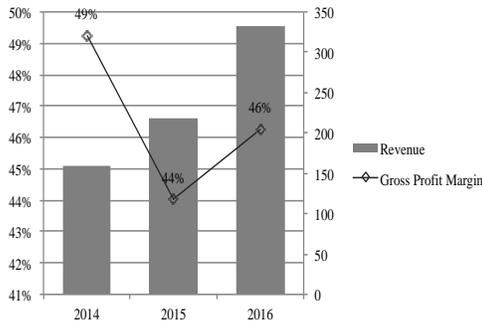
Source: company annual reports

**Figure 6.A.4 – UniStrong High-Precision Application Business Revenue & Gross Profit Margin (RMB million)**

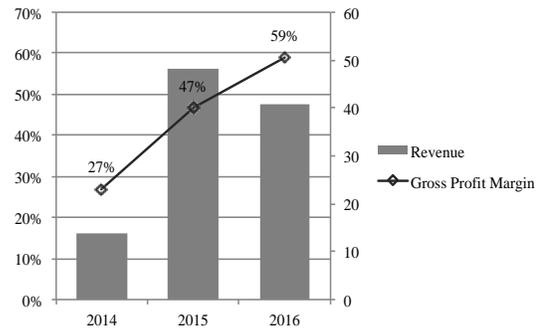


Source: company annual reports

**Figure 6.A.5 – Huace Agricultural Machinery Auto-Steering and Navigation System Revenue & Gross Profit Margin (RMB million)**



Source: company annual reports

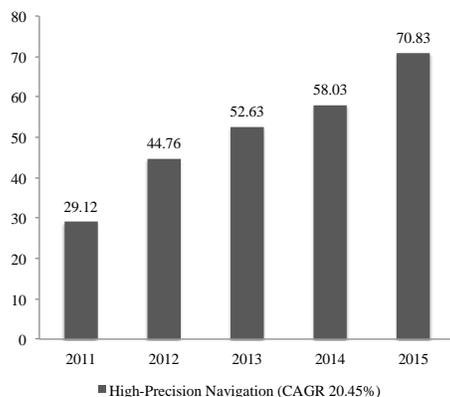


Source: company annual reports and prospectus

Market Potential:

**China’s precision agriculture market has experienced fast growth during 2011-2015.** The high-precision satellite navigation and positioning industry grew quickly over the 2011-2015 period. Although precision agriculture application (mainly the application of agriculture machinery satellite navigation and auto-steering systems) remained a small part of the high-precision satellite navigation and positioning sector (about 4percent), it has experienced faster growth equivalent to 36.3percent per annum during 2011-2015, compared to 19.4 percent of the overall high-precision navigation industry (Figure 6.A.6 and 6.A.7).

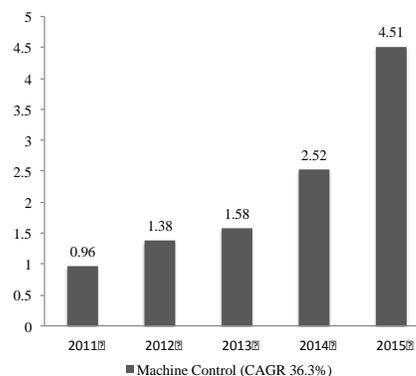
**Figure 6.A.6 - High-Precision Satellite Navigation and Positioning Market (RMB 100 million)**



Source: Shanghai Industrial Technology Institute

Note: <sup>1</sup> Machine control applications mainly comprise agriculture machine navigation and positioning systems

**Figure 6.A.7 -Machine Control Application Market (RMB 100 million)<sup>1</sup>**



Source: Shanghai Industrial Technology Institute

**Expanding commercial use of Beidou Satellite Navigation System and the construction of Continuous Operational Reference System, among others, enable the expansion and maturing of precision agriculture market.** China initiated Continuous Operational Reference System (CORS) construction in September 2014. CORS, as reference network Beidou Satellite Navigation System, can significantly improve navigation and positioning accuracy. As of January 2017, CORS I was complete, with 150 reference framework base stations and 1,269 regional encrypted base stations established, and a national online platform was launched (Ping An Securities, 2016). Construction of CORS can speed up the commercial application of Beidou systems, especially in the high-precision navigation and positioning industries. The future growth of the precision agriculture sector is thus promoted by the strengthening of infrastructure, accelerated rural land tenure reform, increased telecom and Internet connectivity in rural areas, and the increasingly-mechanized agricultural operations.

**The recent fast growth of the precision agriculture market is expected to continue, and the market for agricultural machinery navigation systems alone is expected to reach over RMB 18 billion in 2020.** China's agriculture machine navigation and positioning system penetration rate among tractors is about 1percent, far less than 8percent in Europe and 40percent in the U.S. (Ping An Securities, 2016). Precision agriculture's sub-market ratio of 4percent also lags behind the 15percent figure in most mature foreign markets (Ping An Securities, 2016). Meanwhile, the tractor volume is expected to maintain a steady growth rate, and the country aims to increase the average agricultural mechanization rate from current 60percent to 70percent by 2020.<sup>267</sup> As such,

<sup>267</sup> Ministry of Agriculture, "National Agriculture Mechanization Development Plan (2016-2020)" (<http://www.amic.agri.gov.cn/nxtwebfreamwork/upload/20170105103548215.pdf>)

it is estimated that the market for agricultural machinery navigation and auto-steering system alone will be more than RMB 18 billion in 2020.<sup>268</sup>

*Takeaways:*

**Despite rapid growth and good potential, precision agriculture is still a small and novel industry to mainstream investors.** Despite the fast growth, the sector is only 4percent of the high-precision navigation and positioning sector and 0.26percent the overall satellite navigation and positioning industry. Mainstream investors have not been particularly focused on agricultural machinery in recent years, as growth capital has been more interested in Internet, telecom, entertainment & media, biotech, and finance industries.<sup>269</sup> The industry novelty, together with the overall investment trends, may have contributed to emerging GNSS companies such as Huace to opt for listing through the stock market. Although it has received equity investments from several small asset management companies before going public, it has shared its growth plan and need for affordable, longer-term capital at a larger scale. As competition intensifies and the industry deepens, more financing need is likely to emerge.

**High-precision navigation and positioning technologies and equipment could still be a novel concept to farmers, especially for those who manage smaller plots.** Currently, major GNSS companies tend to focus on large farms in a few provinces for precision agriculture market development. In addition to benefits of farm size, state and paramilitary farms in Heilongjiang and Xinjiang tend to have more educated and open-minded farm owners and managers, who are more likely to adopt the high-precision navigation and auto-steering equipment. As these markets mature, the challenges of expanding into more regions and fostering wider client base can become more pronounced.

**Strategic investment with a technical assistance facility can help address the challenges listed above and catalyze the market.** Strategic financing from reputable investors can bring confidence to the embryonic market and help attract more of the needed capital. Possible technical assistance to farmers in areas that have good market potential but need a certain degree of cultivation can help expand the market horizon and benefit more farm and farmlands. This could be potentially administered through or combined with existing technical assistance project channels, such as the World Bank China Integrated Modern Agricultural Development Project.<sup>270</sup>

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<sup>268</sup> It is a conservative estimate by Ping An Securities Co., Ltd., which is based on the presumptions that (i) the number of large-size tractor would increase by 5percent annually, and (ii) the ratio large-size tractors that install satellite navigation and auto-steering remains as 4percent through 2020.

<sup>269</sup> According to Zero2IPO 2016 venture capital investment data

<sup>270</sup> World Bank, 2013, "China Integrated Modern Agriculture Development Project)  
(<http://projects.worldbank.org/P125496/integrated-modern-agriculture-development-project?lang=en>)

# Annex 6.B – Myanmar Case Studies

## Case Study 1: Myanma Awba Group

### General Description:

The Myanma Awba Group (Awba) was established in 1995 and is a broad-scale agribusiness company active across the country's agriculture value-chain with upstream and downstream assets and capabilities. Awba is particularly active in agro-chemicals and fertilizers with market shares of 42 percent and 9 percent respectively. Awba is one of the largest agricultural technology manufacturers and distributors in Myanmar, with a distribution network of about 400,000 farmers.

### Business Overview:

Awba's key products are premium fertilizers and chemicals that are based on the company's own blends and are sold under the Awba brand. Additionally, several imported products are re-sold under either the Awba brand or Syngenta, under license. Major targeted (cash) crops are corn, vegetables (potatoes, tomatoes, onions), pulses/beans, garlic, chili, and (moving forward) rice.

Awba services about 1.8 million farmers in Myanmar through its network of about 50 company-owned sales centers/depots, about 3,000 exclusive dealers/sub-dealers and about 10,000 selected key farmers. The farmers generally purchase Awba's products on credit, normally in the four months leading up to the end of the crop cycle in January. Awba manages farmer credit risk by diversifying between various crops and regions with exposure limits applied to dealers/sub-dealers who provide guarantees for their respective portfolios (Awba Report).

### Business Model:

Awba is not simply a trader of inputs. It also uses its balance sheet to finance farmers. This results in Awba having a high working capital. The business model's intangible aspects include the quality associated with the company's branded products, deep distribution network, and farmer loyalty/relationships. In 2014, the sales mix was 60 percent chemicals and 40 percent fertilizers. The current business model focuses on growing market share and improving profitability for chemicals and fertilizers.

- Chemical: About 95 percent of Awba's chemicals are formulated outside of Myanmar, while about 5 percent is developed within the country (in MPI). About 90 percent is packaged in Myanmar (Piti) and 10 percent is packed abroad and imported. Awba aims to grow the domestic formulation (MPI's current function) by acquiring another

formulation license for Piti and installing a new plant. The target is to increase its portion of domestic production from about 5 percent today to 50 percent over the next three years from July 2015. The intention is to underwrite or improve margins through this expansion.

- Fertilizers: Awba aims to grow its market share of its own brand of compound fertilizer products (e.g. Comet) with the aim of focusing on fruit and vegetable cash crops. This will be distributed through Awba while MSCN will continue to promote Nitrophoska branded products as a higher premium and margin product (Awba Report).

Business Lines:

Activity	Description	Brands/examples
Crop Protection	Production of agro-chemicals and provision of services to farmers on farm inputs	--Myanma Awba --Wisarra --Myanma Kaung Thu Kha --Evogro
Crop Nutrition	Fertilizer production	--Myanma Awba --Wisara --Myanma Kaung Thu Kha --Myanma San Pya
Crop Seeds	Production and introduction of hybrid corn, vegetable, and rice seeds	N.A.
Manufacturing & Logistics	Includes activities from manufacturing, packaging, and shipping	--Piti Pyae Zone Company manages Awba's manufacturing and logistics. --Collaboration with IFC on the construction of the Hmawbi Agricultural Inputs Complex
Microfinance	Provide farmers with financial services/loans with both brick-and-mortar and online presence	N.A.
Research and Development	Develop customized proprietary solutions as well as collaboration with other companies.	Demonstration farms to educate growers on crop programs and to showcase new technologies and practices Example: Yangon Citrus Farm to produce oranges in an unfavorable area for citrus farming
Business Development	Various units meant to either improve productivity, control resource use, or facilitate farmer engagement	--Digitization/data management --Adjacent technologies (drones, mechanization, etc.) --Mobile payment systems (for equipment rental, microfinance, etc.) --Offtaking, contract farming, and processing

Source: company website

IFC investment summary

Objective:	Capital expenditure to secure and grow market share
Financial Structure	12 various business operations
Investors	Complex Holding Company structure
Size	US\$10m IFC loan
Return on Investment	Unknown
Duration	Uses in 2016 and 2017, payback unknown

Source: IFC website.

Description of the project: A US\$10m IFC loan will be used by Awba for capital expenditure to secure and grow market share.

- Fertilizers – Warehouse storage facilities and working capital (budget of USD7MM).
- Piti Chemicals – Formulation plant equipment, packaging machinery and warehouse storage facilities (budget of USD8MM).
- Working Capital – Additional (budget of USD18MM)

Strategic visions and targets and how they relate to resilience to climate and natural hazards:

This company produces seeds and fertilizers (mostly outside of the country), and this loan will help improve their logistics in moving their products to market (mostly used for land and new plants) and help the development of agriculture inputs in Myanmar, which has resilience impact.

Takeaways:

There are distinctive features of this investment/company, success factors, and lessons learned from their experience. Given the potential for growth and development of the agricultural sector in MM and the Government initiatives to further open the economy, Awba is looking to expand its distribution resources and operations to consolidate its market share.

Market potentials:

- High potential for further growth of the Myanmar agricultural industry
- Trend to field/broad-acre crops vs cash crops
- Improvement in crop yields
- Further integration of current and new business lines

## Case Study 2: De Heus

### Company Summary:

De Heus is a family owned animal feed production conglomerate originating in the Netherlands in 1911.<sup>271</sup> Operating in 50 countries, it is a global top-15 feed supplier.<sup>272</sup>

In Myanmar, De Heus Animal Nutrition opened a €10m **greenfield feed factory** in Myaung Dagar in Yangon in October 2016 (General Manager: Johan van den Ban.) – which was previously importing products from Vietnam to Myanmar.<sup>273</sup> Its current 120,000 ton capacity can be increased up to 240,000 tons, focused mainly on the poultry sector (biggest sector in size) along with swine and cattle. Focused on independent livestock farms, De Heus organizes knowledge seminars and training courses for their customers, concerning feeding strategies, livestock farming and stable management.<sup>274</sup>

**Bal Ga Myanmar:** De Heus is also involved in the development of **hatchery operations** (49 percent), with Belgian company Belgabroed (51 percent), with multiple breeder farms to produce day-old chicks. The total cost of the new hatchery would be US\$10.5 million, will be subsidized US\$2.8 million by the Dutch government.<sup>275</sup> It is to be operational mid-2017.<sup>276</sup> In September 2016 the IFC proposed to provide a debt investment of about US\$6.5 million.

They will also be setting up the **Sustainable and Affordable Poultry for All (SAPA)**. Poultry training centers will be established in Yangon, Mandalay and Nay Pyi Taw to train about 250 broiler farmers. These centers will focus on training farmers of corn, the most important poultry feed in Myanmar. Such capacity building initiatives of livestock farmers is targeted to improve their performance and mitigate the risks of cheap imports.<sup>277</sup>

Myanmar's **poultry market** - broilers (for meat) and layers (for eggs) – is expected to grow by 15 percent annually, with dairy products expected to grow by 30+ percent (currently only 400,000 dairy cows in total). Consumption will rise from currently-low levels of consumption (6kg of poultry meat and 40 eggs per person per year), with dairy imports valued at US US\$75m/year in 2012.<sup>278</sup>

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<sup>271</sup> MyJobs, "De Heus Myanmar" (<http://www.myjobs.com.mm/en/company/de-heus-myanmar/61809>)

<sup>272</sup> De Heus Website (<https://www.deheus.com/>)

<sup>273</sup> J. Byrne, 2016, "De Heus opens feed facility in Myanmar," Feed Navigator (<http://www.feednavigator.com/Manufacturers/De-Heus-opens-feed-facility-in-Myanmar>)

<sup>274</sup> De Heus, 2016, "De Heus opens feed factory in Myanmar" (<https://www.deheus.com/news/de-heus-opens-feed-factory-in-myanmar-589>)

<sup>275</sup> J.S. Gaung, 2016, "Exclusive: Dutch firm De Heus invests \$11m in Myanmar animal feed operations," Deal Street Asia (<http://www.dealstreetasia.com/stories/exclusivede-heus-starts-ops-of-animal-nutrients-in-myanmar-with-euro-10-m-54371/>)

<sup>276</sup> J. Byrne, 2016, "De Heus opens feed facility in Myanmar," Feed Navigator (<http://www.feednavigator.com/Manufacturers/De-Heus-opens-feed-facility-in-Myanmar>)

<sup>277</sup> J.S. Gaung, 2016, "Exclusive: Dutch firm De Heus invests \$11m in Myanmar animal feed operations," Deal Street Asia (<http://www.dealstreetasia.com/stories/exclusivede-heus-starts-ops-of-animal-nutrients-in-myanmar-with-euro-10-m-54371/>)

<sup>278</sup> J. Byrne, 2016, "De Heus opens feed facility in Myanmar," Feed Navigator (<http://www.feednavigator.com/Manufacturers/De-Heus-opens-feed-facility-in-Myanmar>)

Major **competitors** include Charoen Phokphand Company (10 years, part of Thailand’s CP Group) and May Kha Industries Ltd (2 years, aka Japfa Comfeed Myanmar, part of Indonesia-based Japfa Group) – both of which are vertically integrated (including feed mills, poultry breeding farms, hatcheries and commercial/contract farms), New Hope, and Sunjin.<sup>279</sup>

Project Investment Summary:

Objective:	Expand hatchery operations
Financial Structure	Joint venture between Dutch De Heus and Belgian Belgabroed
Investors	De Heus is an International (Dutch) conglomerate
Size	US\$6.5 million IFC Loan
Return on Investment	Not available
Duration	Not available

Description of the project:

A US\$6.5m IFC loan will allow expansion of hatchery operations, and the establishment of poultry training centers.

Strategic visions and targets and how they relate to resilience to climate and natural hazards:

Improve the efficiency of production of a high-protein product in a country with rapidly increasing consumption.

Performance:

Operating and financial data: Information privately held

Financing structure:

US\$6.5 million IFC Loan

Takeaways:

There are distinctive features of this investment/company, success factors, and lessons learned from their experience. High capacity to manage complex operations in international locations

Market potentials: broilers (for meat) and layers (for eggs) – is expected to grow by 15 percent annually.

### Case Study 3: Yoma Strategic Holdings

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<sup>279</sup> J.S. Gaung, 2016, “Exclusive: Dutch firm De Heus invests \$11m in Myanmar animal feed operations,” Deal Street Asia (<http://www.dealstreetasia.com/stories/exclusivede-heus-starts-ops-of-animal-nutrients-in-myanmar-with-euro-10-m-54371/>)

### Project Summary:

Objective:	Company Objective: Expand into sectors of Myanmar’s economy with strong potential for future growth. Loan Objective: expand lending to small and medium enterprises via Yoma Bank.
Financial Structure	Yoma Strategic Holdings Ltd. is a conglomerate, owns Yoma Bank. <sup>280</sup>
Investors	IFC
Size	US\$5 million convertible loan from IFC to Yoma Bank.
Return on Investment	TBD
Duration	Open-ended.

### Description of the project:

In September 2014, IFC provided a US\$5 million convertible loan to Yoma Bank, which aims to provide an additional 1,000 loans worth US\$370 million to small and medium enterprises by 2019.<sup>281</sup> Founded in 1993, Yoma Bank is one of Myanmar’s leading fully licensed commercial banks with 2,300 employees and more than 50 branches covering 25 major cities nationwide.<sup>282</sup>

### Strategic visions and targets and how they relate to resilience to climate and natural hazards:

Limited – Standard Environmental and Social Policy on the Yoma Bank website, nothing specific to climate or hazards.<sup>283</sup>

### Performance:

Operating and financial data: Yoma Strategic Holdings Ltd. is listed on the Singapore Securities Exchange Trading Limited, but is mostly owned by founder and Chairman Serge Pun.<sup>284</sup> Most recent quarterly release shows:

- Gross Profit margins of 42.8 percent for most-recent quarter.
- Revenue and Gross Profit both up by 6 percent.<sup>285</sup>

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<sup>280</sup> Yoma Strategic Holdings, 2017, “Corporate Structure” (<http://www.yomastrategic.com/html/img/Structure.png>); and Yoma Holdings, 2016, “Annual Report” ([http://www.yomastrategic.com/attachment/201607111139551741058715\\_en.pdf](http://www.yomastrategic.com/attachment/201607111139551741058715_en.pdf))

<sup>281</sup> International Finance Corporation (IFC), “IFC in Myanmar” (<http://www.ifc.org/wps/wcm/connect/3974170043ba9348bab7ba869243d457/IFC+in+Myanmar.pdf?MOD=AJPERES>)

<sup>282</sup> International Finance Corporation (IFC), 2014, “IFC and Yoma Bank Ink Deal to Expand Financing for Small and Medium Enterprises in Myanmar”

(<http://ifcextapps.ifc.org/ifcext/Pressroom/IFCPressRoom.nsf/0/DA68A4369A7ED58185257D55002561CE?opendocument>)

<sup>283</sup> Yoma Bank, “Environmental and Social Policy” (<http://www.yomabank.com/environmental-and-social-policy.php>)

<sup>284</sup> Yoma Strategic Holdings, 2017, “Media Release: Yoma Strategic and METRO GROUP to build a one-stop food distribution platform in Myanmar” ([http://www.yomastrategic.com/attachment/201702241826021758248320\\_en.pdf](http://www.yomastrategic.com/attachment/201702241826021758248320_en.pdf)), and “Affiliation with the SPA Group” ([http://www.yomastrategic.com/html/about\\_affi.php](http://www.yomastrategic.com/html/about_affi.php))

<sup>285</sup> Yoma Strategic Holdings, 2017, “Media Release: Yoma Strategic’s 3Q2017 Revenue grew by 16.6% with improved Gross Profit margins” ([http://www.yomastrategic.com/attachment/201702101742281797657276\\_en.pdf](http://www.yomastrategic.com/attachment/201702101742281797657276_en.pdf))

Yoma Bank is part of the conglomerate of Yoma Strategic Holdings Ltd, which has made a number of investments in Myanmar's agriculture and logistics sectors:<sup>286</sup>

- Coffee: 85 percent joint-venture agreement with ED&F Man Holdings Ltd. to produce coffee on Yoma land. Four-year, US\$20m investment over 3,700 acres of coffee, where EDFM will guarantee offtake of entire crop.
- Dairy: 40 percent joint venture to supply UHT dairy products to the local consumer market, which will be a 5-year, US\$46 million investment.
- Cold Storage and Logistics: US\$12 million, 20 percent investment with Kokubu & Co., Ltd and FMI to enter the cold storage and logistics business for the agriculture industry. Two (2) key distribution centers to be built to distribute agricultural, seafood and processed products via high-specification vehicles with chill and refrigeration capacity (to cities and industrial parks).
- Commercial Vehicle Leasing via Yoma Fleet: vehicles to be used to support investments above.<sup>287</sup>
- 15 percent joint venture in a one-stop food distribution platform, with METRO Wholesale Myanmar Ltd., an internationally leading specialist in wholesale and food retail. Press releases state: "METRO Myanmar will leverage on METRO's procurement capabilities and Yoma Strategic's existing logistics, warehousing and fleet leasing businesses to fast track its growth."

#### Financing structure:

The IFC's investment in Yoma Bank is a US\$5 million convertible loan. Could be increased by up to US\$30 million in coming years in the form of equity, senior debt, and trade guarantee lines under IFC's Global Trade Finance Program.<sup>288</sup> One expansion has been started in coffee.<sup>289</sup>

#### Takeaways:

IFC will advise Yoma Bank on identifying and installing a core banking system, enhancing its risk management and corporate governance, and developing new products and delivery channels for small and medium enterprises over the next three years. Yoma Bank will also develop policies and procedures to identify and manage environmental and social risks associated with the business activities it finances.<sup>290</sup>

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<sup>286</sup> FMI, 2014, "Yoma Strategic Gaining Momentum in Myanmar's Agriculture and Logistics Sectors" (<http://fmi.com.mm/yoma-strategic-gaining-momentum-in-myanmars-agriculture-and-logistics-sectors/>)

<sup>287</sup> Ibid.

<sup>288</sup> International Finance Corporation (IFC), 2014, "IFC and Yoma Bank Ink Deal to Expand Financing for Small and Medium Enterprises in Myanmar"

(<http://ifcextapps.ifc.org/ifcext/Pressroom/IFCPressRoom.nsf/0/DA68A4369A7ED58185257D55002561CE?opendocument>)

<sup>289</sup> Yoma Strategic Holdings, 2017, "Factsheet" (<http://www.yomastrategic.com/download/factsheet2.pdf>)

<sup>290</sup> International Finance Corporation (IFC), 2014, "IFC and Yoma Bank Ink Deal to Expand Financing for Small and Medium Enterprises in Myanmar"

(<http://ifcextapps.ifc.org/ifcext/Pressroom/IFCPressRoom.nsf/0/DA68A4369A7ED58185257D55002561CE?opendocument>)

Market potentials: Foreign players are looking to increase their local investment in coffee, dairy products, and cold chain logistics for the agriculture sector.

# Annex 6.C – Vietnam Case Studies

## Case study 1: Anova Feed

### *Summary:*

Goal	Build 2 feed mills and a warehouse.
Description	US\$15 million five-year convertible bond to expand animal feed production.
Performance	Consistent expansion in volume and products.
Financial structure	Privately held – almost 90 percent by the chairman.
Success factors	Consumer demand for meat products must remain strong.
Market potential	Goal of providing 1 million tons of feed for cattle, poultry, and aqua in 2020. <sup>291</sup>

### *Project goal:*

The loan will allow the feed producer to expand its production and storage facilities.

### *Project description:*

Anova produces medicines, feed, and veterinary raw materials (including feed additives) and animal feeds: particularly fish and swine – its factories have a total production capacity of 250,000 tons, with distribution systems spread across 63 provinces.<sup>292</sup>

The US\$15 million, 5-year loan will help the feed producer construct two additional feed mills (it is currently constructing three in Dong Nai and Hung Yen provinces, and a warehouse in Long An province over the next two years.<sup>293</sup>) Anova may invest as much as US\$59 million into the project.<sup>294</sup> Once the new feed mills and warehouse come online (tripling the firm’s capacity), more than 500 new jobs will be created to supply products to nearly 40,000 farmers across Vietnam.<sup>295</sup>

The project is also expected to improve food safety, and the IFC will also provide technical assistance for international expansion, and strengthening corporate governance standards in preparation for a listing.<sup>296</sup>

### *Performance.*

<sup>291</sup> Anova Feed, “About Us” (<http://www.anovafeed.vn/en/about/introduction.html>)

<sup>292</sup> Anova Corporation, “About Us,” LinkedIn (<https://www.linkedin.com/company-beta/1379309/?pathWildcard=1379309>); and Anova Feed, “About Us” (<http://www.anovafeed.vn/en/about/introduction.html>)

<sup>293</sup> Ibid.

<sup>294</sup> N.T.B. Ngoc, 2015, “Vietnam: IFC to invest \$10m in livestock platform Anova Corp,” Deal Street Asia (<http://www.dealstreetasia.com/stories/vietnam-ifc-to-invest-10m-in-livestock-platform-anova-corp-14986/>)

<sup>295</sup> International Finance Corporation (IFC), 2016, “IFC Supports Anova Feed JSC’s Expansion of Sustainable Livestock Production in Vietnam” (<http://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/5E9B985A390CCA8985257FD4002565A2>)

<sup>296</sup> Ibid.

Based in Long An, Anova was established in 1992 as a pet-medicine company, and moved into agriculture production in 2009.<sup>297</sup> Its goal is to improve productivity, and supplies inputs to livestock, especially to raise breeding productivity through feed and veterinary drugs.<sup>298</sup> It also has trading and property arms through its parent company.<sup>299</sup> The company recently made a US\$50 million investment to expand into powdered milk imports.<sup>300</sup>

Company financial performance is not public, as the company is privately held.

#### Financial structure.

Anova Corp is 88.8 percent owned by its chairman Bui Thanh Nhon and his family. Duxton Asset Management (Singapore) holds a 6.8 percent stake, with the remaining 4.4 percent held by around 90 individuals, mainly current or former employees and key stakeholders of the company.<sup>301</sup>

#### Success factors

Domestic demand for meat has been on the rise given the country's growing population and higher standards of living.<sup>302</sup> In order for this investment to be successful, demand must remain strong: this depends on a continuing strong expansion of Vietnam's economy, and a consequent rise in living standards.

#### Market potential

Goal of providing 1 million tons of feed for cattle, poultry, and fish in 2020.<sup>303</sup>

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<sup>297</sup> Bloomberg, "Company Overview of Anova Corporation" (<https://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=118041584>)

<sup>298</sup> Anova Corp, "History" (<http://anovacorp.vn/en/history>); and Anova Corp, "Vision – Mission" (<http://anovacorp.vn/en/vision-mission>); and Anova Corp, "IFC poured \$15 million into the company Anova Feed – brother of Novaland" (<http://anovacorp.vn/en/node/163>)

<sup>299</sup> Anova Corp, "Members" (<http://anovacorp.vn/en/members>)

<sup>300</sup> Vietnam Breaking News, 2016, "Anova Feed JSC receives IFC support to expand sustainable livestock production" (<https://www.vietnambreakingnews.com/tag/anova-corporation/>)

<sup>301</sup> N.T.B. Ngoc, 2015, "Vietnam: IFC to invest \$10 million in livestock platform Anova Corp" (<http://www.dealstreetasia.com/stories/vietnam-ifc-to-invest-10m-in-livestock-platform-anova-corp-14986/>)

<sup>302</sup> International Finance Corporation (IFC), 2016, "IFC Supports Anova Feed JSC's Expansion of Sustainable Livestock Production in Vietnam" (<http://ifcextapps.ifc.org/ifcext/pressroom/ifcpressroom.nsf/0/5E9B985A390CCA8985257FD4002565A2>)

<sup>303</sup> Anova Feed, "About Us" (<http://www.anovafeed.vn/en/about/introduction.html>)

## Case study 2: Vinamilk

### Summary:

Goal	Achieve annual revenue of US\$3 billion by the end of 2017
Description	Potential Project Description – domestic efficiency improvements: Improved coordination of remote retailers. Upgrading of remote retailer facilities. Increasing the productivity of livestock. Company’s overall goal: International expansion through acquisition and organic growth
Performance	Very strong growth rate, and apparently excellent operations management. Annual dividend rate of 30 percent (historical and planned).
Financial structure	Publicly owned: 45.1 percent state ownership (reducing), 49 percent foreign ownership
Success factors	Control of value chain, efficiency of operations, strong goodwill, viewed as a model of Vietnamese business.
Market potential	Strong and growing: Sales of US\$1.7 billion (2015), 9 factories, 14,108 cows

### Project goal:

Although the company appears to be generally well-managed, efficiency improvements in both products (efficient lighting, heating/cooling) and process (ensuring the efficiency of production) are often possible, bringing in best practice from international experience. This would have “triple bottom-line benefits” of reducing energy costs, improving corporate responsibility, and improving environmental performance.

### Project description:

An investment in Vinamilk could provide an opportunity to a) participate in the growth of a well-managed company in the agriculture sector with broad ambitions, and b) open opportunities to improve the efficiency of the company’s agriculture processing activities.

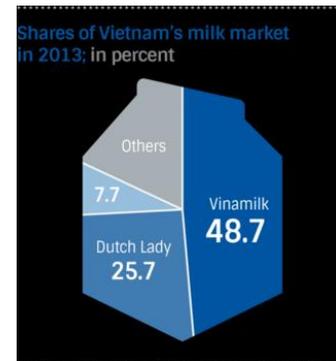
Specific investments at the company could be: efficiency improvements to factories and logistics (the opportunities expected of any developing-world producer, although the marketing for both makes them appear to be efficient).<sup>304</sup> Some identified opportunities include: (i) improved coordination of remote retailers, (ii) upgrading of remote retailer facilities, and (iii) Increasing the productivity of livestock could reduce import requirements.<sup>305</sup>

<sup>304</sup> Vinamilk, “Subordinate Units” (<https://www.vinamilk.com.vn/en/don-vi-truc-thuoc>)

<sup>305</sup> Univeristy of Hradec Kralove, Czech Republic, <https://www.slideshare.net/ssuser17491c/vinamilk-supply-chain-management-project-van-m-vu>, p.16

### Performance:

Vinamilk is the largest dairy company in Vietnam (9 factories, 14,108 cows), and is the 15th largest company in the country.<sup>306</sup> Established in 1976 from 3 dairy factories, it had an IPO on the Ho Chi Minh Stock Exchange in 2003.<sup>307</sup> The company has a plan to achieve annual revenue of US\$3 billion by the end of 2017 to maintain dividend payments to shareholders with an annual dividend rate of at least 30 percent on par value, and to become one of the world's 50 largest dairy companies.<sup>308</sup>



Its main competitors are Dutch Lady Vietnam (a division of Friesland Foods), Nestlé Vietnam, Abbott, Mead Johnson, Friso, and Nutifood.

### Financial structure:

Publicly traded, Vietnam's State Capital Investment Corporation (SCIC) holds 45.1 percent of the shares, and foreign investors hold just under 49 percent of the shares.<sup>309</sup> The government is planning to sell a 9 percent share of the company this year, and eventually divest its whole stake.<sup>310</sup>

### Success factors:

"Vinamilk is probably Vietnam's most familiar consumer brand, and it is widely considered to be the country's best-run firm."<sup>311</sup> However, this success means that opportunities for investment may be limited.

### Market potential:

The company has over 50 percent of the domestic market, with sales of US\$1.7 billion (14 percent annual increase and overseas sales of US\$340 million (39 percent annual increase) in 2015, and is expanding internationally through acquisitions and investments in local dairy plants, most recently into the US.<sup>312</sup>

<sup>306</sup> Vinamilk, 2016, "Development History" (<https://www.vinamilk.com.vn/en/lich-su-phat-trien>); and UNDP, 2007, "Top 200 largest firms in Vietnam report," accessed March 10, 2017, ([http://www.undp.org.vn/digitalAssets/7/7884\\_Top200\\_e.pdf](http://www.undp.org.vn/digitalAssets/7/7884_Top200_e.pdf))

<sup>307</sup> Vinamilk, "Vision" (<https://www.vinamilk.com.vn/en/ve-cong-ty>)

<sup>308</sup> Vinamilk, "Development Strategy," (<https://www.vinamilk.com.vn/en/chien-luoc-phat-trien>); and

Vinamilk, "Board of Directors" (<https://www.vinamilk.com.vn/en/nhan-su-chu-choi>); and

A. Tomiyama, 2015, "Vietnam's No. 1 dairy company eyes global rank," Nikkei Asian Review (<http://asia.nikkei.com/Business/AC/Vietnam-s-No.-1-dairy-company-eyes-global-rank>)

<sup>309</sup> Vietnam Economic Forum, 2012, "Vinamilk," accessed March 10 2017 (<http://vef.vn/2012/11/23/2012-11-23-ai-dang-so-huu-vinamilk-/>)

<sup>310</sup> The Economist, 2016, "Cream of the crop: Vinamilk is one of the attractive firms on sale from Vietnam's government" (<http://www.economist.com/news/business/21708713-vinamilk-one-attractive-firms-sale-vietnams-government-cream-crop>)

<sup>311</sup> Ibid.

<sup>312</sup> Nikkei Asian Review, 2016, "Vinamilk revenue up 14% in 2015 on strong overseas business" (<http://asia.nikkei.com/Business/AC/Vinamilk-revenue-up-14-in-2015-on-strong-overseas-business>);

There is a plan to achieve annual revenue of US\$3 billion by the end of 2017, maintain dividend payments to shareholders with an annual dividend rate of at least 30 percent on par value, and to become one of the world's 50 largest dairy companies.

### Case 3: Sumitomo Forestry

Summary:

Goal	Building a particleboard-processing plant
Description	Co-investment by IFC and Japan's Sumitomo Forestry Company Limited
Performance	Production capacity of 250,000m <sup>3</sup> , 11MW power plant, employ 200 people.
Financial structure	US\$9 million IFC equity investment
Success factors	Continuation of high demand, environmental and social sustainability
Market potential	Vietnam's wood-furniture manufacturing sector is the third-largest in the world, requires inputs.

Project goal:

This project will build a particleboard-processing plant for the country, supporting manufacturing (output) and farmers (input).

Project description:

This US\$9 million IFC equity co-investment with Japan's Sumitomo Forestry Company Limited, will build a US\$108 million particleboard-processing plant.<sup>313</sup> Benefits apply to both ends of the supply chain: (i) providing inputs in which 700 farmers along the wood supply chain will benefit, and (ii) receiving outputs, which supports Vietnam's wood-furniture manufacturing sector that depends on imports.<sup>314</sup>

The company will also expand Vietnamese sales of Medium-Density Fibreboard (MDF, an engineered wood product), manufactured in New Zealand and Australia, and of logs from Papua New Guinea.<sup>315</sup>

Performance:

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And G. Nguyen, 2016, "Vinamilk Seeks to Buy Second U.S. Dairy Company in Growth Push" Bloomberg (<https://www.bloomberg.com/news/articles/2016-09-07/vinamilk-in-talks-to-buy-another-u-s-company-ceo-says-issox038>)

<sup>313</sup> Sumitomo Forestry, 2012, "Commercial Particle Board Production to Commence in Vietnam" (<http://sfc.jp/english/pdf/20120516.pdf>)

<sup>314</sup> International Finance Corporation (IFC), 2011, "IFC, Sumitomo Forestry Invests in Vietnam's Forestry Sector, Creating Jobs and Cutting Carbon Emissions" (<http://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/1A41B2AE83C029AA852578C50055EAB5>)

<sup>315</sup> WBPI, 2010, "Sumitomo Forestry establishes Vietnamese particleboard subsidiary" (<http://www.wbpionline.com/news/sumitomo-forestry-establishes-vietnamese-particleboard-subsidiary/>)

When completed, the processing plant will have a particle board production capacity of 250,000m<sup>3</sup>, and includes an 11-megawatt biomass-based power station. It is expected to employ 200 people on a 20-hectare site at Phu An Thanh Industrial Park in Ben Luc District.<sup>316</sup>

The company will also receive technical assistance from IFC to advise on environmental and social performance and operational standards.<sup>317</sup>

Performance will be judged on whether the plant can meet expectations of construction time and total output.

From a social and environmental perspective, a review by Wood Based Panels International suggests that the plant is following best practice, with delivery of logs by barge (which is less polluting than by truck). Both yard and production area are kept very clean, with containment of dust and fumes meaning that the whole factory is fire-protected. There is on-the-line quality control, and a rigid laboratory testing regime.<sup>318</sup>

#### Financial structure:

The plant is owned and operated by Vina Eco Board Company Limited, a 50:50 joint venture of Sumitomo Forestry Company and Sumitomo Forestry (Singapore) Limited, and is located in Long An province, a less-developed region in southern Vietnam.<sup>319</sup> It represents a capital investment of US\$45million.

#### Success factors:

The investment will depend significantly on the sustained growth of the wood-furniture industry in Vietnam. A decrease in demand from its major markets could reduce the need for the product; a style shift to other manufacturing materials (plastic or metal) could also significantly reduce sales. Additionally, customer concerns about sustainable sourcing of wood (including requiring certification by the Forest Stewardship Council/FSC) may put pressure on Vietnam's wood producers to get certification, which could increase costs.

In terms of getting inputs, the plant will use local eucalyptus and cajuput trees which are abundant in the province (60,000 hectares of cajuput trees in the province), and the biomass power plant will use waste from those trees as fuel.<sup>320</sup>

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<sup>316</sup> WBPI, 2010, "Sumitomo Forestry establishes Vietnamese particleboard subsidiary" (<http://www.wbpionline.com/news/sumitomo-forestry-establishes-vietnamese-particleboard-subsidiary/>); and

Q. Hung, 2016, "Sumitomo Forestry to build plywood factory in Long An, Vietnam Breaking News" (<https://www.vietnambreakingnews.com/2016/10/sumitomo-forestry-to-build-plywood-factory-in-long-an/>)

<sup>317</sup> International Finance Corporation (IFC), 2011, "IFC, Sumitomo Forestry Invests in Vietnam's Forestry Sector, Creating Jobs and Cutting Carbon Emissions" (<http://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/1A41B2AE83C029AA852578C50055EAB5>)

<sup>318</sup> WBPI, 2013, "A new approach" (<http://www.wbpionline.com/features/a-new-approach/>)

<sup>319</sup> Sumitomo Forestry Co., "Our Business" (<http://sfc.jp/english/business/group.html>); and Sumitomo Forestry Co., 2016, "Sumitomo Forestry Group Overview" ([http://sfc.jp/information/ir/library/annual/pdf/ar\\_e\\_2016\\_9.pdf](http://sfc.jp/information/ir/library/annual/pdf/ar_e_2016_9.pdf)); and International Finance Corporation (IFC), 2011, "IFC, Sumitomo Forestry Invests in Vietnam's Forestry Sector, Creating Jobs and Cutting Carbon Emissions" (<http://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/1A41B2AE83C029AA852578C50055EAB5>)

<sup>320</sup> Q. Hung, 2016, "Sumitomo Forestry to build plywood factory in Long An, Vietnam Breaking News" (<https://www.vietnambreakingnews.com/2016/10/sumitomo-forestry-to-build-plywood-factory-in-long-an/>)

Market potential:

Vietnam's wood-furniture manufacturing sector is the third-largest in the world, but faces a shortage in locally-sourced particleboard, one of the major wood products used in furniture making, and imports 70 percent of its needs.<sup>321</sup>

## Case 4: The PAN Group Vietnam (formerly Pan Pacific Corporation)

Summary:

Goal	IFC Investment Goal: allow expansion by acquiring and consolidating agricultural and food businesses, and improve environmental and social practices. Company Goal: "two-year plan to three times double its capital and number of shares outstanding with the intent of pursuing a rollup and consolidation in agriculture, aquaculture and FMCG [Fast-moving consumer goods] food product companies." <sup>322</sup>
Description	January 2015: US\$6.5 million investment in the Agriculture conglomerate represents 5 percent of the share capital.
Performance	2016 Net sales: US\$121 million, Total assets: US\$165 million, Profit Before Tax: US\$17 million, Profit After Tax: US\$15 million.
Financial structure	Publicly owned, 54 percent domestic.
Success factors	Relies on a continued expansion of the Vietnamese economy, and revenues are very weather-dependent (impacted by 2016 floods, and climate change in future).
Market potential	Fast-growing company with strong sales growth (76 percent CAGR), total asset growth of 10X from 2012-2016.

Project goal.

The US\$6.5 million investment will allow expansion by acquiring and consolidating agricultural and food businesses, and improve environmental and social practices.

There is an additional 2017 proposal for US\$10 million of a US\$28 million expansion plan.<sup>323</sup>

Project description

The PAN Group (formerly Pan Pacific Corporation, new name as of October 2015) is a Vietnamese agri-/aqua-culture group founded in 1995 (for VND 250 million, or US\$11,000 USD).<sup>324</sup> The company has been public since 2006 (initially listed on the Hanoi stock exchange in 2006, then

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<sup>321</sup> International Finance Corporation (IFC), 2011, "IFC, Sumitomo Forestry Invests in Vietnam's Forestry Sector, Creating Jobs and Cutting Carbon Emissions" (<http://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/1A41B2AE83C029AA852578C50055EAB5>)

<sup>322</sup> The Pan Group, "Shareholding Structure" (<http://thepangroup.vn/investor-relations/shareholding-structure.htm>)

<sup>323</sup> T. Pandey, 2017, "IFC to invest \$10m in GIC-backed Vietnamese agri firm Pan Group," Deal Street Asia (<http://www.dealstreetasia.com/stories/ifc-proposes-to-invest-10-mn-in-pe-backed-vietnam-agri-firm-pan-group-65410/>)

<sup>324</sup> The Pan Group, "Our History" (<http://thepangroup.vn/about-us/our-history.htm>); and The Pan Group, "Mission" (<http://thepangroup.vn/en/home.htm>)

later moved to Ho Chi Minh Stock Exchange in 2010). The company has made acquisitions in fisheries, seeds and food processing, and has a market capitalization of US\$193 million as of December 2016.<sup>325</sup>

PAN has several subsidiaries: PAN’s seed business, VINASEED, focuses on increasing productivity in paddy (rice, 30 percent domestic market share), corn (20 percent), vegetables (10 percent) and others – it was voted as top 50 most effective businesses in Vietnam by Forbes Vietnam.<sup>326</sup> VINASEED contributes 48 percent of PAN Group revenue.<sup>327</sup> Southern Seed Company researches, produces and trades seeds, and designs and builds machines and facilities for agricultural processing. Aquatex Bentre processes and exports seafood, while PAN Food Manufacturing is a food processor (it achieved 2016 revenue of VND 422 billion in 2016, despite a difficult year in 2016 where many companies reduced production).

*Performance:*

With over 2,000 employees, PAN Group was recently ranked the 6<sup>th</sup>-fastest growing company in Vietnam.<sup>328</sup> It has had a Compound Annual Growth Rate of sales of 76 percent between 2012 and 2015, and a total asset growth of 10X from 2012-2016. In 2016, the company’s financial performance was as follows:<sup>329</sup>

Net sales	US\$121 million
Total assets	US\$165 million
EBITDA	US\$22 million
Shareholders Equity	US\$102 million
Profit Before Tax	US\$17 million
Profit After Tax	US\$15 million

Agriculture represents 47 percent of its sales, but 51 percent of after-tax profit. Food is 49 percent of sales and 25 percent of profit. In 2016, the company had a 12 percent profit-to-sales ratio.

*Financial structure:*

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<sup>325</sup> The Pan Group, “Our History” (<http://thepangroup.vn/about-us/our-history.htm>); and The Pan Group, 2016, “Group Highlights (pg. 11)” ([http://thepangroup.vn/Upload/Reports/PAN\\_Corp\\_percent20Profile\\_15March\\_2016.pdf](http://thepangroup.vn/Upload/Reports/PAN_Corp_percent20Profile_15March_2016.pdf))

<sup>326</sup> The Pan Group, “Organizational Chart of Subsidiaries” (<http://thepangroup.vn/about-us/organizational-chart-of-subsidiaries.htm>); and The Pan Group, “Market Position (pg. 20)” ([http://thepangroup.vn/Upload/Reports/PAN\\_Corp\\_percent20Profile\\_15March\\_2016.pdf](http://thepangroup.vn/Upload/Reports/PAN_Corp_percent20Profile_15March_2016.pdf)) – Note: some of the reported numbers from these Pan Group sources are different.

<sup>327</sup> The Pan Group, 2017, “2017 Annual General Shareholders’ Meeting Documents (pg. 15)” ([http://thepangroup.vn/Upload/News/2017/T4/EN\\_The\\_percent20PAN\\_percent20Group\\_AGM\\_percent202017\\_percent20Document\\_Full\\_percent20-Final.pdf](http://thepangroup.vn/Upload/News/2017/T4/EN_The_percent20PAN_percent20Group_AGM_percent202017_percent20Document_Full_percent20-Final.pdf))

<sup>328</sup> The Pan Group, 2016, “Group Highlights in 2016 (pg. 11)” ([http://thepangroup.vn/Upload/Reports/PAN\\_Corp\\_percent20Profile\\_15March\\_2016.pdf](http://thepangroup.vn/Upload/Reports/PAN_Corp_percent20Profile_15March_2016.pdf)); and The Pan Group, 2017, “The Pan Group breaks into top 10 fastest growers” (<http://thepangroup.vn/the-pan-group-breaks-into-top-10-fastest-growers-en158166.htm#.WQJJxlMrJhE>)

<sup>329</sup> The Pan Group, 2016, “Financial Indicators (pg. 11 and 37)” ([http://thepangroup.vn/Upload/Reports/PAN\\_Corp\\_percent20Profile\\_15March\\_2016.pdf](http://thepangroup.vn/Upload/Reports/PAN_Corp_percent20Profile_15March_2016.pdf))

With 102 million shares outstanding, the company is 54 percent owned domestically and 46 percent internationally by 1,100 shareholders.<sup>330</sup> Major shareholders include:<sup>331</sup>

- Saigon Securities Inc. (SSI), a Vietnamese financial corporation (founded by the chairman 20 percent);<sup>332</sup>
- Tael Partners, an investment management company based in Singapore (21 percent);
- NDH Invest (the firm of chairman Nguyen Duy Hung, 11 percent);
- Mutual Fund Elite (10 percent);
- The government of Singapore GIC investment fund (US\$100 billion in assets);
- The IFC; and
- Orix Corporation, a Japanese financial services group.

Net income growth to shareholders has been growing by 33 percent/year, and was VND 257 billion (USD US\$11 million) in 2016.<sup>333</sup>

In September 2016, it became the second firm in the food industry after dairy firm Vinamilk to lift the bar for foreign investors.<sup>334</sup>

Success factors:

Good performance will rely on a continued expansion of the Vietnamese economy, and revenues are very weather-dependent (impacted by 2016 floods, and climate change in future).

The company explicitly focuses on resistance to climate change in its products, although its revenue has been negatively impacted by bad weather in the country.<sup>335</sup>

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<sup>330</sup> The Pan Group, 2016, "Key Shareholders (pg. 7)" ([http://thepangroup.vn/Upload/Reports/PAN\\_Corp\\_percent20Profile\\_15March\\_2016.pdf](http://thepangroup.vn/Upload/Reports/PAN_Corp_percent20Profile_15March_2016.pdf)); and The Pan Group, "Shareholding Structure" (<http://thepangroup.vn/investor-relations/shareholding-structure.htm>)

<sup>331</sup> The Pan Group, 2016, "Our Shareholders (pg. 44)" ([http://thepangroup.vn/Upload/Reports/PAN\\_Corp\\_percent20Profile\\_15March\\_2016.pdf](http://thepangroup.vn/Upload/Reports/PAN_Corp_percent20Profile_15March_2016.pdf)); and The Pan Group, "Shareholding Structure" (<http://thepangroup.vn/investor-relations/shareholding-structure.htm>)

<sup>332</sup> T. Pandey, 2017, "IFC to invest \$10m in GIC-backed Vietnamese agri firm Pan Group" (<http://www.dealstreetasia.com/stories/ifc-proposes-to-invest-10-mn-in-pe-backed-vietnam-agri-firm-pan-group-65410/>)

<sup>333</sup> The Pan Group, 2017, "2017 Annual General Shareholders' Meeting Documents (pg. 14)" ([http://thepangroup.vn/Upload/News/2017/T4/EN\\_The\\_percent20PAN\\_percent20Group\\_AGM\\_percent202017\\_percent20Document\\_Full\\_percent20-Final.pdf](http://thepangroup.vn/Upload/News/2017/T4/EN_The_percent20PAN_percent20Group_AGM_percent202017_percent20Document_Full_percent20-Final.pdf)); and The Pan Group, "Financial Reports" (<http://thepangroup.vn/investor-relations/financial-information/financial-reports.htm>)

<sup>334</sup> Viet Nam News, 2016, "PAN Group to lift foreign ownership bar" (<http://vietnamnews.vn/economy/312344/pan-group-to-lift-foreign-ownership-bar.html#wfplwi1rzepREPZr.99>)

<sup>335</sup> The Pan Group, 2017, "2017 Annual Shareholders' Meeting Documents (pg. 12, 13)" ([http://thepangroup.vn/Upload/News/2017/T4/EN\\_The\\_percent20PAN\\_percent20Group\\_AGM\\_percent202017\\_percent20Document\\_Full\\_percent20-Final.pdf](http://thepangroup.vn/Upload/News/2017/T4/EN_The_percent20PAN_percent20Group_AGM_percent202017_percent20Document_Full_percent20-Final.pdf))

# Annex 6.D – WBG Engagement Note on Strategic Investment Funds (SIFs)

WBG Engagement Note – February 27, 2017

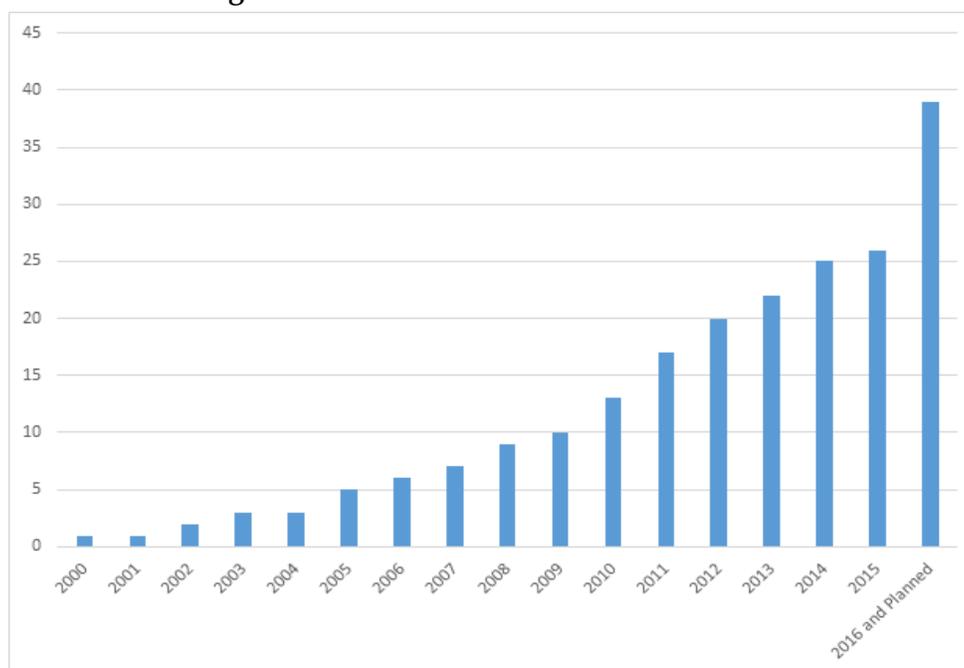
Prepared by:  
Finance & Markets Global Practice

*This Note discusses the development of strategic investment funds (SIFs) and the structuring of WBG engagement in SIFs.*

## **A. What are SIFs, how common are they, and what do they do?**

1. **Strategic Investment Funds (SIFs) are fast emerging as a major form of financial public-private partnership.** These vehicles can be defined as special purpose investment funds that exhibit all of the following six characteristics:
  - 1) Are sponsored and/or fully or partly capitalized by a government, by several governments, or by government-owned global or regional finance institutions;
  - 2) Invest to achieve financial as well as economic returns, in accordance with a double bottom-line objective;
  - 3) Aim to crowd-in private capital to investment in key economic sectors;
  - 4) Operate as expert investors on behalf of their sponsors;
  - 5) Provide long-term patient capital primarily as equity. But may also invest in quasi-equity or debt; and
  - 6) Are established as investment funds or investment corporations.
  
2. **Over the past 15 years, at least 26 SIFs have been established, and another 14 are under consideration or being planned globally (Figure 6.D.1).** SIFs are most frequently set up to undertake infrastructure investment, some with a green focus.

Figure 6.D.1. Growth in the Number of SIFs



3. **The fast growth in the number of SIFs is taking place in low-, middle-, and high-income countries alike.** High-income country examples of national SIFs include France, Ireland and Italy. In addition, Canada is considering the establishment of a large C\$40 billion infrastructure-focused SIF, and Norway plans a national climate-focused US\$2.5 billion fund. Middle income countries include Kazakhstan, Malaysia, Mexico, Morocco, the Philippines, and Vietnam, and others. Low-income countries include Nigeria and Senegal. Table 6.D.1 provides some examples.

Table 6.D.1. Some examples of SIFs in high-, middle-, and low-income countries.

Income category	Country	SIF name	Size	Main sector focus
High-income	Ireland	Ireland Strategic Investment Fund	EUR 8 billion	Infrastructure, energy, agriculture, waste, and water
	Italy	CDP Equity SPA	EUR 4.9 billion	Research and innovation, defense, financial industry, industrial, infrastructure
Middle-income	Mexico	FONADIN	US\$14 billion	Infrastructure
	Philippines	PINAI	US\$625 million	Infrastructure
Low-income	Nigeria	NIF	US\$500 million	Infrastructure
	Senegal	FONSIS	US\$8 million	Infrastructure

Whereas the majority of SIFs have been established by country governments, MDBs have taken a leading role in the establishment and/or management of several funds. This form of engagement has been led by the EIB and the AIB. The AfDB has participated in a SIF as an investor. See table 6.D.2 for an overview.

**Table 6.D.2 MDBs and SIFs**

SIF name	Sponsoring MDB	Size	Managed by
European Fund for Strategic Investment (EFSI)	EIB	EUR 21 billion	EIB
Global Energy Efficiency and Renewable Energy Fund (GEEREF)		EUR 222 million	EIB
Philippine Alliance for Infrastructure (PINAI)	ADB	US\$625 million	Macquarie Infrastructure and Real Assets
Asia Climate Partners (ACP)		US\$400 million	Private asset managers act as fund managers
Africa Renewable Energy Fund (AREF)	AfDB	US\$200 million	Berkeley Energy Partners

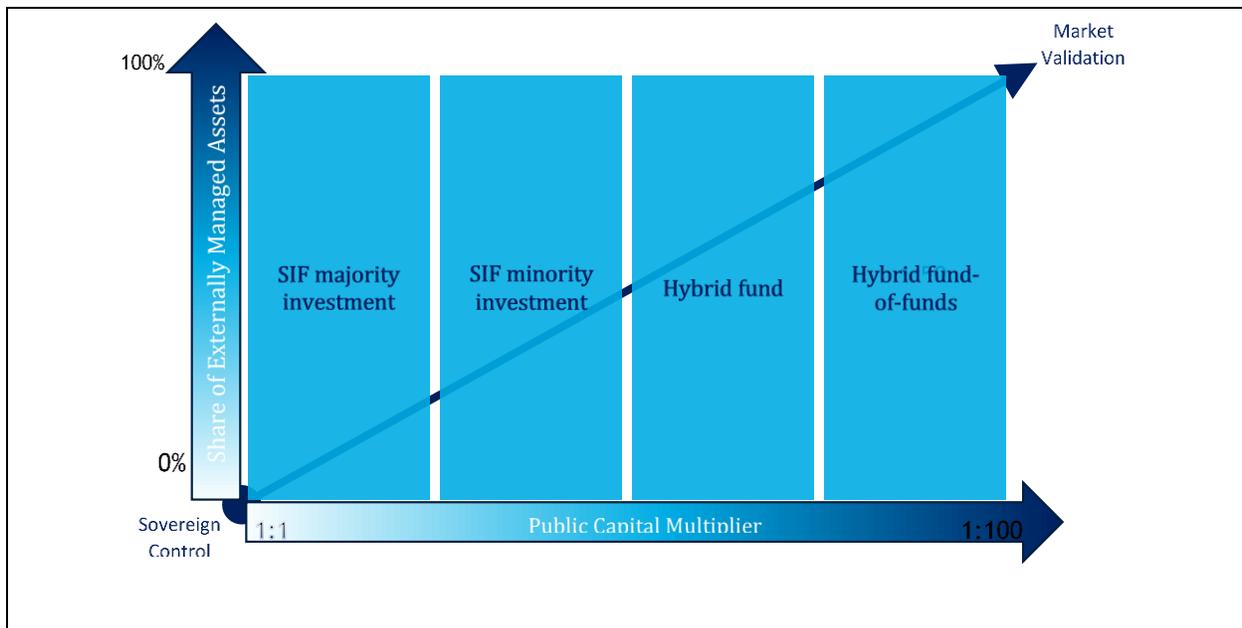
**SIFs’ main rationale is their capacity to crowd-in private investment to key sectors and projects that fulfill key policy objectives.** SIFs are specifically set up to act as financial intermediaries between the public and the private sectors. While benefiting from informational links to sectoral ministries and other public entities including in the PPP space, they operate as independent investors and are staffed with specialized investment managers recruited from the private sector. While aiming to achieve policy objectives such as increased infrastructure investment, SIFs must first meet financial return optimization requirements for investors.

- SIFs strategically deploy their public capital in ways that attract private co-investment, mainly through risk sharing or by offering risk mitigation.** In some funds, public investors accept return caps or first loss tranches to enhance the risk/reward profile of private investors, thus maximizing the internal rate of return for private investors subject to an economic rate of return threshold. An important measure of SIFs’ success is the amount of private investment generated for every unit of public capital invested. Such multiplier effects may differ widely, according to the SIF’s modus operandi. The multiplier effect may take place at fund level, through private co-investment in the SIF, or at project level, by SIFs acting as anchor co-investors in infrastructure projects. See table 6.D.3 for some estimates of fund multiplier for public-private hybrid SIFs.
- A main distinction in the structure and governance of SIFs is between fully publicly owned funds and public-private hybrid SIFs.** SIFs take on a diversity of forms along the public-

private spectrum. At one end are publicly owned SIFs, fully capitalized by public capital and governed by a public fund management entity at arms-length from government. At the other end are *hybrid* public-private SIFs with a mix of public and private capital, and a corresponding mixed governance structure – where private sector participation adds discipline to the investment process. In both cases, the day-to-day investment management may be outsourced to a private fund manager.

6. **The main advantages of hybrid SIFs are the high level of market validation of projects and the multiplier effect at fund level.** Hybrid SIFs are characterized by a combination of public and private capital at the fund level, and by a high level of private sector representation at the different levels of fund governance. A main concern regarding SIFs is these fund’s ability to resist political interference in investment decisions. To address such risks, hybrid SIFs can be set up to provide a high level of market validation of investments, either as limited liability structures with a private fund manager as the general partner, or as permanent capital corporations with a private fund manager. Figure 6.D.2 provides a schematic overview of the implications of SIF structure for multiplier and market validation. At the left are fully publicly owned SIFs that take majority stakes in projects, and therefore have a low level of market validation and a higher risk of political interference, but more sovereign control. At the right are hybrid funds and fund-of-funds, with a high level of market validation and a high multiplier.

**Figure 6.D.2. SIF structure, market validation, and public capital multiplier**



**Table 6.D.3 – Notable Hybrid SIF Examples**

	Geographic focus	Year Established	Description	Size	% Public/Private	Fund Multiplier	Investment Multiplier	Total Multiplier	Key Investors
PINAI (Philippine Investment Alliance for Infrastructure)	Philippines	2012	10-year closed-end private equity-type fund. Managed by private sector manager Macquarie Infrastructure and Real Assets (MIRA). Provides equity and quasi-equity (mezzanine debt) financing in core infrastructure assets exclusively in the Philippines.	\$625 million	4/96	25x	N.A.	~25x	-Philippines' Government Service Insurance System (\$400m) -Algemene Pensioen Groep (\$150m) -Asian Development Bank (\$25m) -Macquarie (\$50m)
MMIF (Macquarie Mexico Infrastructure Fund)	Mexico	2010	Focused on infrastructure assets in which the fund would have significant influence over management, operations and strategic direction.	\$408 million	20/80	5x	10.3x	51.7x	- FONADIN (\$81m) - Macquarie (\$59m) - Seven pension funds (\$268m)
ACP (Asia Climate Partners)	Asia-Pacific, w/ focus on China and India	2014	Equity investments across a variety of low-carbon companies and projects in renewable energy, resource efficiency, and environmental industries like water treatment and agribusiness.	\$400 million	Approx. 50/50	2x	N.A.	At least 2x	- ADB - ORIX - ROBECO
GEEREF (Green Energy Efficiency and Renewable Energy Fund)	Africa, Asia, and Latin America	2008	Fund of funds that supports a broad mix of energy efficiency and renewable energy projects.	€222 million	50.5/49.5	2x	35.8x	~71x (large multiplier due to being a fund of funds)	-Private Sector: €110m -EU, Germany, and Norway: €112m
AREF (Africa Renewable Energy Fund)	Sub-Saharan Africa	2014	Renewable energy private equity fund managed by Berkeley Energy. Invests in wind, solar, small hydro and other renewable projects across Africa.	\$200 million	At least 32.5% public	3x	N.A.	At least 3x	- GEEREF & AfDB (\$25m) - SEFA (\$25.5m) - Global Environment Facility (\$10m) - SEFA Project Support Facility (\$4.5m) - Other regional African development banks, European DFIs and institutional investors.

## **B. WBG Engagement with SIFs**

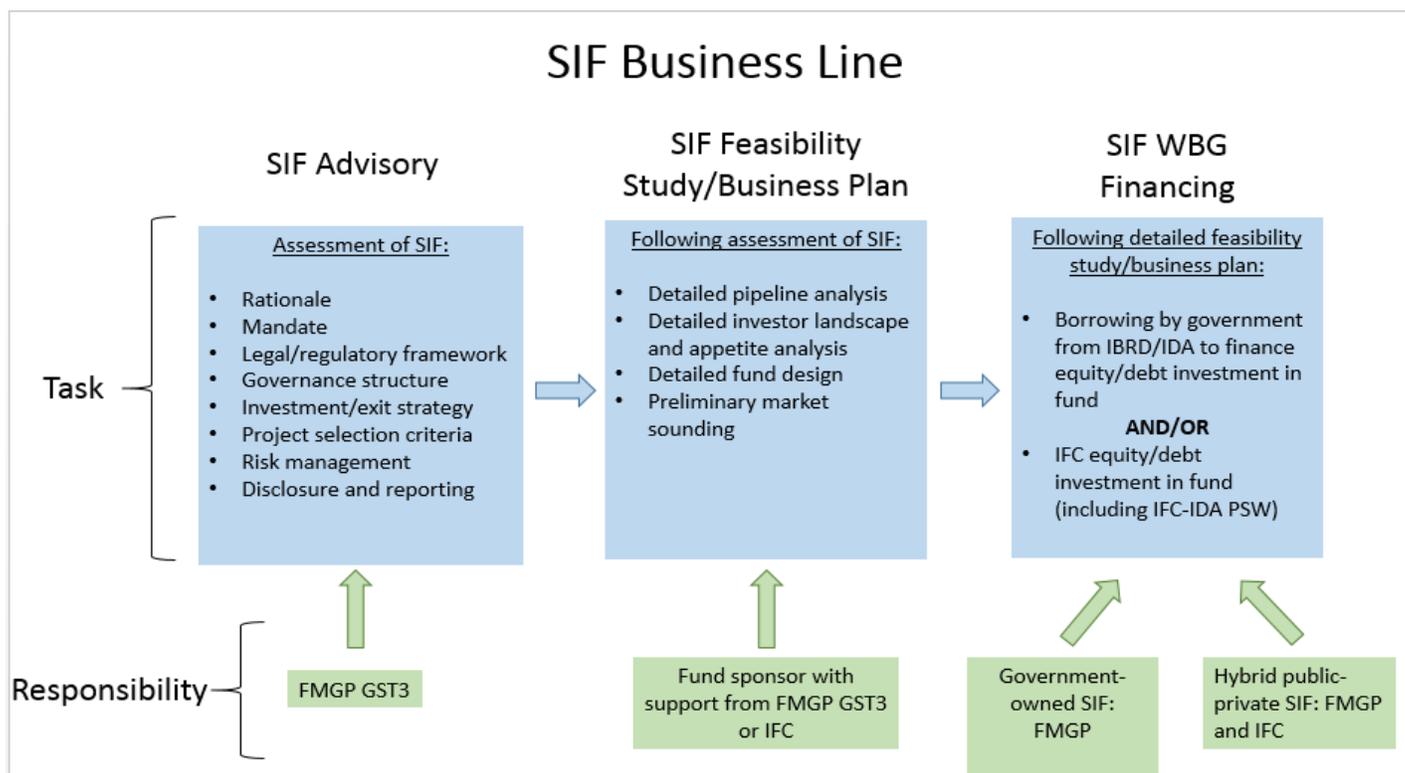
### **SIF as an instrument to maximize finance for development in infrastructure.**

7. SIFs are a useful instrument to maximize finance for development in infrastructure. They do so by crowding-in private investment in infrastructure PPP projects through the multiplier effect and by providing a strict selection of investment projects through the application of the double financial and economic bottom-line. SIFs can contribute to crowding in private investment in climate mitigation and adaptation PPP projects, thus helping countries towards achieving their INDCs.
8. By contributing to the financing of SIFs, MDBs in general and the World Bank Group can maximize the multiplier effect of scarce concessional financing and of concessional resources for risk instruments and credit enhancements, thus contributing to the objective of crowding-in commercial financing where it presents value for money.

### **WBG Support to SIFs**

9. For SIFs sponsored by Governments, all existing WBG instruments can be readily deployed to support SIFs sponsored by Governments, both on the TA/advisory side and on the financial side. For TA/advisory, this includes TFs/EFOs/RASes and IBRD/IDA TA loans/credits. For financing, this includes IBRD/IDA loans/credits to government to finance their equity investment in SIFs, and for hybrid public/private SIFs, IFC direct investment in SIFs including through the IFC/IDA PSW co-investment facility. The same applies to IBRD/IFC/MIGA guarantee products, including under the IDA PSW. The deployment of these instruments by WBG can be done as part of regular advisory engagements and/or lending/investment operations, and does not constitute a new business requiring special Board approval.
10. For regional or sub-regional SIFs, IBRD/IDA financial support would be conditional upon specific policy decisions regarding the provision of IBRD lending/IDA credits through specific Regional Development Banks (RDBs).
11. WBG engagements with SIFs will be structured around three pillars (See Figure 6.D.3)

Figure 6.D.3. WBG SIF Engagement Structure



- Pillar 1: SIF Advisory.** This will consist of advisory services to governments, government agencies and/or regional economic communities (RECs) for the establishment of new SIFs or the strengthening of existing SIFs. This will include SIF rationale, mandate, legal/regulatory framework, governance structure and processes, investment/exit strategy, project selection criteria, risk management, and disclosure and reporting. The responsibility for this Pillar will rest with FMGP GST3 Investment Funds Group (IFD).
- Pillar 2: SIF Feasibility Study-Business Plans.** This will include detailed pipeline analysis, investor landscape and appetite analysis, fund design analysis, and preliminary market sounding with investors. The responsibility for this Pillar will rest with the fund sponsor, with support from FMGP GST3 IFD or IFC.
- Pillar 3: SIF WBG Financing.** This will consist of borrowing by governments from IBRD/IDA to finance their equity/debt investment in SIFs, and/or IFC equity/debt investment in SIFs (including through IFC-IDA PSW). In case of government-owned SIFs, the responsibility will rest with FMGP. In case of hybrid public-private SIFs, the responsibility will rest jointly with FMGP and IFC.

12. In all cases, FMGP will work through cross-support with other GPs, CCSAs, IBRD and IFC Treasury, and relevant IFC units, as well as with external partners including the International Forum of Sovereign Wealth Funds (IFSWF).

### **Project-level Collaboration**

13. In addition, WBG units will also collaborate at project level through ways such as project-level advisory, co-development, co-investments, project pipeline information sharing, and PPP risk-sharing:

- WBG units could share project pipeline information during the TA activity as part of the feasibility study to assess potential financing gaps and project pipeline -- more importantly, project pipeline referrals will bring value to an operating hybrid SIF;
- Project-level advisory support could be provided by units like IFC PPP Advisory team;
- Co-development at project level could be explored with IFC InfraVentures team;
- Co-investment and co-lending could be explored for most WBG units that have a lending/investment mandate in the defined sectors and regions/countries;
- PPP project risk-sharing could be explored with various guarantee teams

# Annex 6.E – Guidance Notes on ASRIF’s Investment

Terms and details here are indicative: the typical terms for similar funds are included here for reference. The final terms of the proposed fund is subject to further discussions and negotiations among the sponsors, investors, and the selected fund manager(s).

## Fund Raising, Investment Strategy, Exit, and Return Allocation

### A. Fund Raising: A Hybrid Capital Structure

1. *ASRIF-Asia would be a SIF with a hybrid capital structure* – i.e. meaning it will be funded by both public and private capital, which provides a high degree of market validation, and is likely to generate a high overall multiplier.<sup>336</sup> Since private sector participation occurs at the fund level, hybrid SIFs are more likely to exhibit competitive financial returns.
2. *Public and DFI Funding.* Public capital will be provided from government budget resources and/or a loan to the sponsoring DFI or a Government from the World Bank or other multilateral or bilateral development financial institution to be used as initial capital injection into ASRIF-Asia.
3. *Private Investor.* ASRIF-Asia will seek participation from institutional investors including insurance companies, securities companies, professional third-party wealth management companies, investment subsidiaries of securities firms, PE/VC funds, sovereign investment funds, corporates, entrepreneurs, and high-net-worth-individuals. Participations of these institutions or qualified individuals shall comply with applicable laws and relevant financial regulatory rules, and are subject to a further thorough legal review.

### B. Investment Strategy

*Investment Focus.* ASRIF-Asia will invest in agriculture value chain in Asia with a climate and natural hazards resilience focus.

*Asset Classes.* ASRIF-Asia will invest in two assets classes: (i) businesses across the agriculture

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<sup>336</sup> The multiplier can be calculated at the fund level and at the project investment level. The combination of the two levels gives the total or overall multiplier as follows: fund (or investment vehicle) multiplier = fund size / public capital; investment multiplier = total investment volume / fund size; total multiplier = total investment volume / public capital (Public Capital Multipliers, Inderst 2016)

resilience value chain with a priority on SMEs; and (ii) PE/VC funds investing in SMEs in the green sectors defined under the guidelines.

**ASRIF-Asia will have the flexibility of employing various financial and investment instruments**, including but not limited to equity and quasi-equity investment, debt financing, and guarantees.

**Double-bottom Line.** The project selection criteria will include a double-bottom line approach. When selecting a project for investment, both the project's financial return (i.e. IRR) and the project's economic/social return (i.e. ERR or suitable proxy indicators) will be considered in making the investment decision.

**Environmental, Social and Governance Standards.** Social and governance (ESG) standards will be in place to ensure that ASRIF-Asia's investment will not cause unintentional negative social and/or environmental impacts. These ESG will be based on local systems, complemented by internationally accepted best practices like IFC's Environmental, Social and Trade Standard.

### **C. Exit Strategy and Return Allocation**

#### *Fees Standard Distribution Waterfall, Reinvestment, and Clawbacks*

**Management Fee:** ASRIF-Asia's management fee will be in line with market practice. The average fee for fund management is 2 percent of the total asset under management. During the commitment period, management fees will be charged on committed amount. The management fee percentage will be reduced for larger fund's compartments (and may be scaled upwards for smaller fund's compartments). After close of commitment period, fees will be charged on invested capital less dispositions and write-offs.

The management fee structure is typically valuation-based in PVCs.<sup>337</sup> This is due to the long-term nature of the PCV, differences in time and attention required to manage assets as the portfolio grows, and as assurance that assets are not over- or under- valued. A robust valuation process, tailored to asset classes being invested in, is important for the determination of the management fee in PCVs. However, the structure is flexible, and fees could be structured akin to a typical fund, where fees are structured on commitments during the investment period and on the acquisition cost of unrealized investments until the end of the fund.

**Distribution Waterfall:** ASRIF-Asia will have an aggregate waterfall (rather than a deal-by-deal or modified deal-by-deal waterfall) with a standard order of current income and distribution proceeds, which will be detailed in the Fund's prospectus and other legal documents. Typical waterfall is as follows:

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<sup>337</sup> C. Valentine and R. Chopra, 2016, "Permanent Capital Vehicles – Are they Worth it?" KWM MIA (<http://www.kwm.com/en/uk/knowledge/insights/permanent-capital-vehicles-are-they-worth-it-20160726>)

- 100 percent to investors until the aggregate of all amounts equal the sum of their capital contributions drawn down by the fund for the purposes of making investments or paying expenses (including management fees);
- 100 percent to investors until they have received an 8 percent internal rate of return (or other hurdle rate chosen for fund);
- Catchup to the fund managers until it equals 20 percent;
- Thereafter sharing of profits at an 80:20 ratio between investors and the fund Managers.

*Organizational expenses are usually be subject to a cap of the lesser of 1 percent of aggregate commitments (with a specified cap).*

**Cost and expenses:** ASRIF-Asia will bear and be charged all reasonable costs, expenses, liabilities and obligations relating directly to the Fund's activities, investments and business (to the extent not borne or reimbursed by a portfolio company). However, the Fund will not be responsible for expenses in respect of general overheads of the Fund Manager (including, but not limited to, remuneration and expenses paid to their employees, rent, equipment and utilities expenditure, as well as all salaries, expenses and fees of the Investment Committee); transaction-specific costs (including but not limited to travel) incurred prior to the date of Investment Committee approval of the transaction; or all Abort Costs incurred prior to the date of Investment Committee approval and 50 percent of Abort Costs incurred on or after the date of Investment Committee approval of a transaction.

The Fund Manager will be responsible for all overhead expenses relating to their business. The Fund Manager will have the right to receive transaction fees, breakup fees and directors' fees in connection with Fund activities provided that 100 percent of those fees will be applied, net of applicable expenses, to reduce future unpaid management fees payable by the Fund to the Fund Manager.

**Reinvestment will be allowed as it lowers the gross-net gap.** This will be evaluated as part of the preparation of the business plan with the selected Fund Managers. It should only apply to investments realized during the Commitment Period. Aggregate reinvestments should be limited so that the aggregate amount invested by the Fund in portfolio investments does not exceed 100 percent of the Fund's total commitments.

#### *Revenue Enhancing Instruments*

**Revenue enhancing instruments will include return caps for public investors, delayed draw-downs for commercial investors, and the use of leverage.** By capping public investor returns to a certain quantum, with the delta transferred to private investors, the private investors will be able to get additional alpha on their returns. This, combined with a public first loss, may serve to make ASRIF-Asia attractive to certain commercial investors. The proposed return-enhancing instrument is to set a cap for the net IRR of public investors, for example, at 4

percent. This arrangement will be set out in the LPA. The capped return for public capital will only change the distribution among partners of the Fund, but not affect the financial status of the proposed Fund itself.

## Fund Management and Governance

### **A. Fund Manager**

#### *Selection of Fund Manager(s)*

***A competitively selected professional Fund Manager is recommended.*** Country pilot analysis suggests that government plays a vital role in agriculture resilience. In the proposed fund, public funding includes that provided by governments in the region, as well as DFIs such as the WBG and regional entities (such as the Asia Development Bank (ADB) and the Asia Infrastructure Investment Bank (AIIB)). Public funding should take up to 50 percent of the total capital commitment in the proposed Fund and the remaining should be private capital, an external professional fund manager is preferred over internal management team within the public sector.

***The selection of Fund Manager is critical to the success of ASRIF-Asia.*** The criteria will be objective: track record, beneficial owners and directors fit and proper tests, team member's qualifications, fit and proper tests, sector and regional expertise, including with green investments, and investment philosophy should be carefully examined considering the mandate of the Fund. The process should be competitive. The Fund Managers' selection process will need to comply with government requirements, including on historical performance, investment expertise, internal and risk controls. The Fund Manager's selection processes will also comply with local government policies on public tenders, selection review and appraisals.

#### *Arrangements with Fund Manager(s)*

***Management Agreement:*** The Fund will enter into a Management Agreement with Fund Manager, pursuant to which the Fund Manager will be responsible for making and implementing investment and divestment decisions on behalf of the Fund, which will include overseeing, evaluating and monitoring investments made for the Fund, as well as providing day-to-day managerial services.

***Capital Commitment of the Fund Manager:*** The Fund Manager will make a cash capital commitment as General Partner (GP) directly into the Fund for the purpose of having their own capital at risk equally and without preference with the capital of the Investors. This commitment should be significant in relation to the GP's net worth, and in no case less than 1 percent of the Fund size.

***Advisory Agreement:*** Considering the investment segment and skills required to manage and operate a multi-sector fund for agriculture resilience investments, and to source, execute and

exit investments, the Fund Manager may enter into sub-advisory agreements with one or more fund management advisors, which would provide investment advice, operational support and administrative services in support of the Fund's investment activities. The WBG, or other multilateral or bilateral development institution, could potentially be an advisor. Any applicable advisory fee will be deducted from the management fee charged by the Fund Manager(s). In addition, it is advisable for the Fund Manager to explore cooperation with incubators and accelerators to identify financing needs and source transactions.

***Investment limitations and parameters include:***

- ***Limitation on investments in single portfolio company:*** The Fund should not make investments in a company that would result in the investment being larger than a set percentage (e.g.15 percent) of aggregate capital commitments. A waiver may be granted by a qualified majority of Fund's Investors.
- ***Limitation on investments in any agri-resilience value chain sub-sector:*** The Fund will invest in a company operating in a specific value chain sub-sector if such investment results in having a high exposure (e.g. 35 percent) of aggregate capital commitments in that industry. Waivers may be granted by qualified majority of Fund's Investors.
- ***Covenant relating to limited liability and taxation:*** The Fund will not make an investment in a company if by making such an investment the limited liability of the Limited Partners will, in any way, cease to be recognized as provided under Partnership Law. This may be waived in writing by a qualified majority of Investors.
- ***Additional investment limitations:*** Additional investment limitations will be incorporated in the Fund's legal documents, including but not limited to, limitations on the Fund investing in derivative instruments for speculative purposes, investments in blind-pool investments funds that provide for the Fund to pay a financial incentive to the vehicle, or investments into publicly traded securities above a ten percent aggregate commitment threshold. Such, and other limitations, will require approval by the Fund's Advisory Committee.

**B. Fund Governance**

*Investment Committee*

***The General Partner(s) will form an Investment Committee.*** The Investment Committee will comprise investment professionals whose responsibility is to review and approve all investment proposals, including the decision to sell, liquidate or otherwise dispose of or divest itself of all or any portion of a Portfolio Investment acquired by the Fund. The Investment Committee will not have Limited Partner's representation.

*Advisory Committee*

***The Fund will have an Advisory Committee.*** This will comprise individuals designated by the

Limited Partners (but not affiliated with the General Partner or any Key Person) and external advisors such as multilateral or bilateral development institutions. The legal documents will lay out the mandate and operations of the Advisory Committee. It is anticipated that the Advisory Committee will meet at least semi-annually with the General Partner, and may meet more frequently if a meeting is called by a majority of the members of the Advisory Committee or by the General Partner.

The approval of the Advisory Committee is required for transactions and matters involving any potential conflict of interest; valuations of Portfolio Companies; and any proposed waiver or modification of the Fund's investment objectives, guidelines or limitations; and any other matter for which Advisory Committee approval is required by this Agreement. The Advisory Committee will act by affirmative vote or written consent of a majority of its members, measured by the Commitment of the respective Limited Partner which the members represent.

***The General Partner will retain ultimate responsibility for all decisions relating to the operation and management of the Fund.*** No member of the Advisory Committee will owe any fiduciary or other duties to the Fund or any other Limited Partner in respect of the activities of the Advisory Committee, other than the duty to act in good faith. Should the Fund reimburse Advisory Committee members for reasonable and documented out-of-pocket expenses incurred in attending meetings of the Advisory Committee, such reimbursements will be considered ASRIF-Asia's expenses.

#### *Indemnifications/Standards of Care*

***Members of the Advisory Committee will be explicitly indemnified and exculpated from liability in the constitutive documents.*** The Fund's legal documents will state that Advisory Committee members do not have fiduciary obligations to the Fund or the Partners to the fullest extent permitted by applicable law. Indemnity and exculpation of sponsor entities will carve out indemnification and exculpation for fraud, willful misconduct, gross negligence and material breach of agreements.

#### *Reporting*

***Annual reports including GIS performance reporting, audited financial statements, and custodian bank reports will be sent to the ASRIF-Asia's sponsors within four months after end of each fiscal year.*** In addition, government sponsors, initiators and relevant supervising entities will be informed of important matters about Fund's operations in a timely fashion.

#### *Legal Opinions*

***An opinion will be issued confirming enforceability of the Fund documents (including Side Letters) and the limited liability of the Investors.*** The legal opinion will confirm that Advisory Committee members do not have fiduciary duties to the Fund or the Partners.

#### *Conflicts of Interest*

**Disclosure and Voting:** Considering other advisory activities of the GPs, the Managers and their respective affiliates, employees, partners, etc., it is critical to ascertain that all potential conflicts with the GPs and the Managers etc. are identified, mitigated, and approved by the Advisory Committee. Related parties will be disenfranchised from voting.

**Deal Flow Allocation:** The GPs/Managers will have an affirmative obligation to bring all deals that meet investment objectives to Fund first. The Advisory Committee will have to approve any exceptions.

**Related Party Transactions:** Transactions between the Fund and sponsor entities/personnel would be subject to Investor oversight, and made on an arm's length basis.

**Successor Funds:** The LPA will confirm that the raising of any new Fund with a similar investment objective is restricted until the present Fund is invested to a set percentage (e.g. 75 percent), or the Commitment Period expires, whichever is earlier.

**Co-Investment Policy:** Fund Managers will offer co-investment to major Investors on a pro rata basis unless it reasonably determines that bringing in a strategic investor is in the best interest of the Fund.

#### *Termination of Commitment Period and GP Removal*

**Key People/Persons:** The Fund's Commitment Period will be suspended automatically upon departure of Key Person. Management fee may continue to be charged for a limited period on step-down basis - that is, based on invested capital rather than total commitments. Investors should have right to approve replacement Key Persons, and to terminate the Fund if no replacement Key Person (or other continuation of the Fund) is approved by Investors within six months.

**GP Removal for Cause/No Cause:** Supermajority disinterested Investor vote for no-cause removal. Simple majority vote in the case of for cause removal. A "for cause" removal should not require conviction or final judgment, and material breach of the LPA and Manager Agreement would be included in the definition of "Cause."

**No Fault Termination of Commitment Period:** Investors by a supermajority vote should suffice to terminate the Commitment Period after a certain amount of time (e.g., 3 years), and in some cases, based on performance.

#### Potential WBG Roles

**Subject to a full legal opinion and the business decisions by various WBG units, the WBG could potentially play the following roles in the proposed Fund:**

- 1) **Technical assistance:** IBRD/IDA can assist member countries in advising the setup of Fund, and this report is part of the technical assistance provided by IBRD/IDA with cross support from IFC and MIGA.

- 2) **Lending/Investment:** IBRD/IDA could potentially lend to certain agencies to fund Fund, and IFC could potentially invest directly in Fund as a limited partner (LP) when Fund is structured as a limited partnership, or a shareholder when Fund is structured as a PCV. IDA could also potentially directly invest in Fund through a newly established direct investment channel (see Section B1 for detailed analysis). In this case, WBG could potentially act as:
- a. **Fund investor:** the WBG could invest directly in the fund, either as limited partner (LP) when the SIF takes the legal form of a limited partnership, or as a shareholder when the SIF takes the legal form of a corporation (e.g. a permanent capital corporation (PCC)). The WBG could also invest indirectly in the fund through financing the investment of member countries and/or Regional Development Banks (RDBs) in the fund. How funds flow from the WBG to the fund would be critical to the design and implementation of the SIF, in function of various investment vehicles managed by WBG entities and in function of various financial intermediaries at the level of Regional Economic Communities (RECs). A summary analysis of the possible flow of funds is presented below. In addition, the WBG could also co-invest with the SIF at project level through parallel country-level or RDB-level operations.
  - b. **Fund advisory committee (AC) member:** The WBG could seek seats on the board (in the case of a corporation) or the Advisory Committee (in the case of a fund) to ensure the implementation of the SIF's development mandate and investment strategy.<sup>338</sup> However, WBG units should NOT seek seats on the investment committee of the fund and thus will not be involved in individual investment and exit decisions.<sup>339</sup>
  - c. **Fund advisor:** The WBG could advise the SIF on issues such as calculation of economic rate of return (ERR), assessment of environment, social, and governance (ESG) standards, financial markets development, and share information on potential project pipeline under an investment management advisory agreement with the selected fund manager(s).
- 3) **Guarantee: Guarantees will be an important instrument with which WBG can add value to the SIFs.** Through MIGA and through IBRD and IFC guarantee units, the WBG is ideally suited to provide political risk insurance and partial credit and partial risk guarantees that are often essential in infrastructure projects invested by the SIFs

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<sup>338</sup> Advisory Committee is formed by representatives appointed by LPs of an investment fund for purposes of addressing conflict of interest, valuation and other important issues as identified in the limited partnership agreement (LPA) of the investment fund.

<sup>339</sup> In some cases, WBG units such as IFC Investment teams and IFC AMC, will also seek to sit on the Investment Committee (IC) and involve in project investment decisions. A full legal assessment will be required to determine WBG units' role in a hybrid SIF, including Board/AC seats and IC seats.

## Legal Assessment of WBG roles

### Introduction

The IBRD legal team reviewed the feasibility of IBRD performing certain roles in a proposed fund similar to ASRIF-Asia. Specifically, the legal team opined on whether IBRD could (i) provide sponsorship; (ii) participate in the board; (iii) recruit the fund manager; (iv) provide funding/loans to IBRD member countries to invest in the Fund; and (v) act as fund management advisor to the fund manager.

Two aspects are relevant for this analysis – first, IBRD’s internal requirements to perform each of these roles; and second, what local law implications, if any, would be applicable to IBRD based on the proposed structure.

### IBRD internal requirements

There are no direct or specific policies and procedures that address the proposed roles for IBRD in the FUND and/or other externally managed commercial funds of this type. In considering the feasibility of IBRD performing these various roles we have considered where and under which capacity/authorization IBRD has participated in similar activities in the past, and what if any, similarities/differences exist in the context of the FUND. The two instances where IBRD has recently participated in similar activities of an external fund are the Global Emerging Markets Local Currency Bond Fund (Gemloc) and the Issuer-Driven ETF (I-D ETF) initiatives.<sup>340</sup>

#### (i) Providing sponsorship to the fund

We have assumed that “sponsorship” involves developing and designing the Fund through a technical assistance arrangement rather than any direct equity participation or other such similar sponsorship.

#### (ii) Participating in the board of the Fund

Much will depend on how the fund board is structured – for instance, will it have both IBRD as well as private sector members? Or will the board be made up of solely IBRD staff? As a general matter, it would be unusual for IBRD staff to participate on the board of a commercial structured investment vehicle. Any design of the Fund in this manner would require further analysis of the capacity in which IBRD staff would participate on the FUND’s board. Assuming they would

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<sup>340</sup> Gemloc was an innovative project to assist member countries in developing capital markets – specifically local currency bond markets – in order to improve financial intermediation, enhance financial stability, facilitate broader policy reforms and improve access. The Gemloc project was approved by the Executive Directors of IBRD and the Board of Directors of IFC in October 2007.

The I-D ETF program was established to support economic development and enhance financial stability in emerging market economies. It utilizes a private sector product (exchange traded funds) to help develop domestic capital markets thereby enhancing public sector goals. IBRD’s involvement in the I-D ETF program was approved by the Audit Committee of the Executive Board of Directors of IBRD in October 2012.

participate in their capacity as IBRD staff, several aspects should be considered, including conflicts of interest and accounting implications for IBRD, if any.

**(iii) Recruiting the fund manager for the Fund**

IBRD has taken different approaches to the level of involvement in the procurement processes for fund managers in other similar initiatives. Under the I-D ETF initiative, IBRD is not engaged in the procurement process other than ensuring that the process is conducted in a manner that meets the initiative's minimum criteria. However, under the Gemloc initiative, IBRD conducted the fund manager procurement process itself. In the context of ASRIF-Asia, IBRD's participation in the procurement process and selection of the fund manager of ASRIF-Asia may be dependent upon any potential conflicts of interest that may arise as a result of performing this role at the same time as other roles envisaged.

**(iv) Providing funding to IBRD member countries to invest in the Fund**

There are no specific restrictions on IBRD providing funding/loans to IBRD member countries for the purposes of making particular investments and there are several examples of similar IBRD loan operations.<sup>341</sup> In the context of ASRIF-Asia however, given the other roles envisaged for IBRD in the fund structure, it would be important to consider any potential reputational/conflicts of interest issues that may arise from IBRD providing a loan to a member country to then invest in a Fund in which IBRD has substantial involvement as well.

**(v) Acting as fund management advisor to the Fund manager**

IBRD has not provided any advisory services to a fund manager of a commercial structured investment vehicle in the past. IBRD is not intended to participate in any investment committee decisions of ASRIF-Asia, and instead IBRD is expected to provide technical advice to the fund manager on project sourcing, economic rate of return analysis, structuring of guarantees and ESG analysis. IBRD's ability to provide such technical advice from an internal authorization perspective is dependent upon the nature of the advisory engagement with ASRIF-Asia. As ASRIF-Asia will be structured as a separate, private sector entity, it is unclear what existing instruments IBRD would be applicable to provide such advice and as such, this role may require additional internal steps to obtain the necessary approvals/create the appropriate instruments.

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<sup>341</sup> One example is the Croatia Innovation & Entrepreneurship VC Project (P152130)

## Local law implications

*Based on preliminary analysis of the structure, there are potential areas for liability and exposure based on IBRD's roles in the structure.* These could arise from (i) breach of applicable marketing/securities law requirements applicable to ASRIF-Asia and claims from investors for misselling/misrepresentation; (ii) improper performance of IBRD's obligations under any advisory agreement with the Fund or fund manager; (iii) contractual liability of IBRD representatives on the board of ASRIF-Asia for improper performance of their duties as directors of the Fund. Additional analysis will be required to fully understand the extent and scope of IBRD's liability and exposure in these areas as well as any possible ways to structure mitigating provisions. In addition, substantive analysis will be required to determine if IBRD's proposed roles (in particular its advisory role) could require a license or registration in any relevant jurisdiction.

## Risks and Risk Mitigation

### (i) Possible Conflicts of Interest and Management of Conflicts of Interest

The nature of IBRD's proposed engagement in the Fund raises the possibility of conflicts of interest or the perception of conflicts of interest in several areas. For example, IBRD is intended to provide advice on project sourcing for the Fund for a fee, which projects could be potentially projects in which IBRD/the World Bank Group have ongoing and/or proposed investments/participation as part of its regular operations. This could raise several conflicts of interest concerns. Much will depend on the extent to which ASRIF-Asia is required to follow the recommendations/advice from IBRD in this advisory capacity and/or what proportion of the Fund's investments will be based on projects sourced through IBRD advisory activities versus those that are sourced separately by the fund management team. This would also encompass IBRD's regular advisory operations which could potentially overlap with the projects being considered for investment by the Fund. Where IBRD is involved in providing regulatory advice in an area where ASRIF-Asia is contemplating investment, there could be a perceived conflicts of interest. In addition, given the proportion of fees anticipated for IBRD's advisory role as compared to the overall fees of the Fund, it would be important to clarify the scope of IBRD's advisory activities clearly vis-à-vis the Fund and the extent to which IBRD's advisory activities contribute towards the independent Fund's performance. Another area of potential conflict of interest relates to placing IBRD staff on the board of ASRIF-Asia. These staff could potentially be participating in investment/strategy decisions of the Fund that could have an impact on regular IBRD/World Bank Group operations. These conflicts would need to be disclosed and managed through appropriate tools depending on the final structure of the Fund. Specifically, under the Luxembourg rules, IBRD will be

required to disclosure in the Fund's public disclosure documents any conflicts which may affect the Fund and its investors.

**(ii) Structural Risk**

Given the anticipated close involvement of IBRD in the Fund on many levels, it would be critical to clarify the independence of the Fund's investment decisions and performance from IBRD's regular operations. In particular, the Fund Manager and investors should have a clear indication that IBRD's extensive roles/participation in ASRIF-Asia does not presume that IBRD would also intervene to provide, prefer, or expedite any IBRD instrument or product for the benefit of a project invested in or targeted by the Fund, including with IBRD guarantees or the use of the World Bank Group stamp to accelerate regulatory change/approvals.

**(iii) Reputational Risk**

Based on the number of roles intended for IBRD and the World Bank Group in the Fund, the reputation of the World Bank Group would be closely linked with the Fund. It would be essential that the procurement process for the fund manager be managed to select a manager with an impeccable reputation and governance practices. It would be important to include explicit disclosure language related to the roles of IBRD. It should be made clear that the Fund Manager would have full operational independence and accountability for governance and performance of the Fund. The Fund Manager should be in compliance with all applicable policies of the World Bank Group, which are subject to annual review.<sup>342</sup> While the Fund Manager would have ultimate legal responsibility for all representations to actual or potential clients, IBRD should retain the right to review and approve offering documentation to ensure its accuracy with respect to the role of IBRD. It should also be made clear that IBRD is not providing any assurances regarding the performance of the Fund.

**(iv) Regulatory Risk**

Regulators may take an interest in the Fund, therefore it is critical to seek internal discussions with the regulators in the relevant jurisdiction to establish and monitor clear and transparent operation and to follow and review good governance. The Fund Manager would be responsible for all regulatory approvals required by the Fund and the Fund's compliance with relevant investment management rules in such jurisdiction. However, given the broad scope of roles proposed for IBRD,

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<sup>342</sup> Further analysis will be required to see which of IFC's or IBRD's policies and procedures would be applicable in this instance.

IBRD's roles in the Fund would also need to be managed carefully to ensure that it does not subject IBRD to investment management and other regulations.

**IBRD authorizations and internal process**

*IBRD's participation in the FUND would be innovative in many respects and require approval by the Executive Directors of IBRD.* This would particularly apply to the following aspects: (i) any participation by IBRD staff on the Fund board; (ii) IBRD participation in the recruitment process of the fund manager; and (iii) providing certain advisory services to the Fund, a private sector entity. Prior to any board process, however, it would be important for the full proposal of IBRD's engagement in this initiative to be submitted for review to IBRD's New Business Committee (NBC) and Finance Risk Committee (FRC).