Food and Agriculture Organization of the United Nations

European Bank for Reconstruction and Development

TOWARDS A NEW GENERATION OF CLIMATE-EFFICIENT AGRIFOOD SYSTEMS INFRASTRUCTURE

CONCEPTUAL FRAMEWORK AND ANALYTICAL REVIEW

Nature –based agroforestry solutions

Controlled environment agriculture facilities

Modern irrigation infrastructure

What is climate-efficient agrifood system infrastructure?

Climate-efficient Agrifood System Infrastructure is defined as:

A long-lived, capital intensive and strategically important class of physical assets, which enables the functioning of competitive, sustainable and inclusive agrifood systems and provides essential ecosystem services.

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AGENDA

FAO-EBRD joint project
"*Towards a new generation of climate-efficient agrifood systems infrastructure: conceptual framework and analytical review*"

The project: a strategic and iterative process to identify investment opportunities in climate-efficient agrifood systems (AFS) infrastructure

Objective: provide analytical support for the identification and prioritization of investment opportunities in upgrading agrifood systems infrastructure, through:

I. a definition and typology of agrifood systems infrastructure, and

II. the design of a conceptual framework

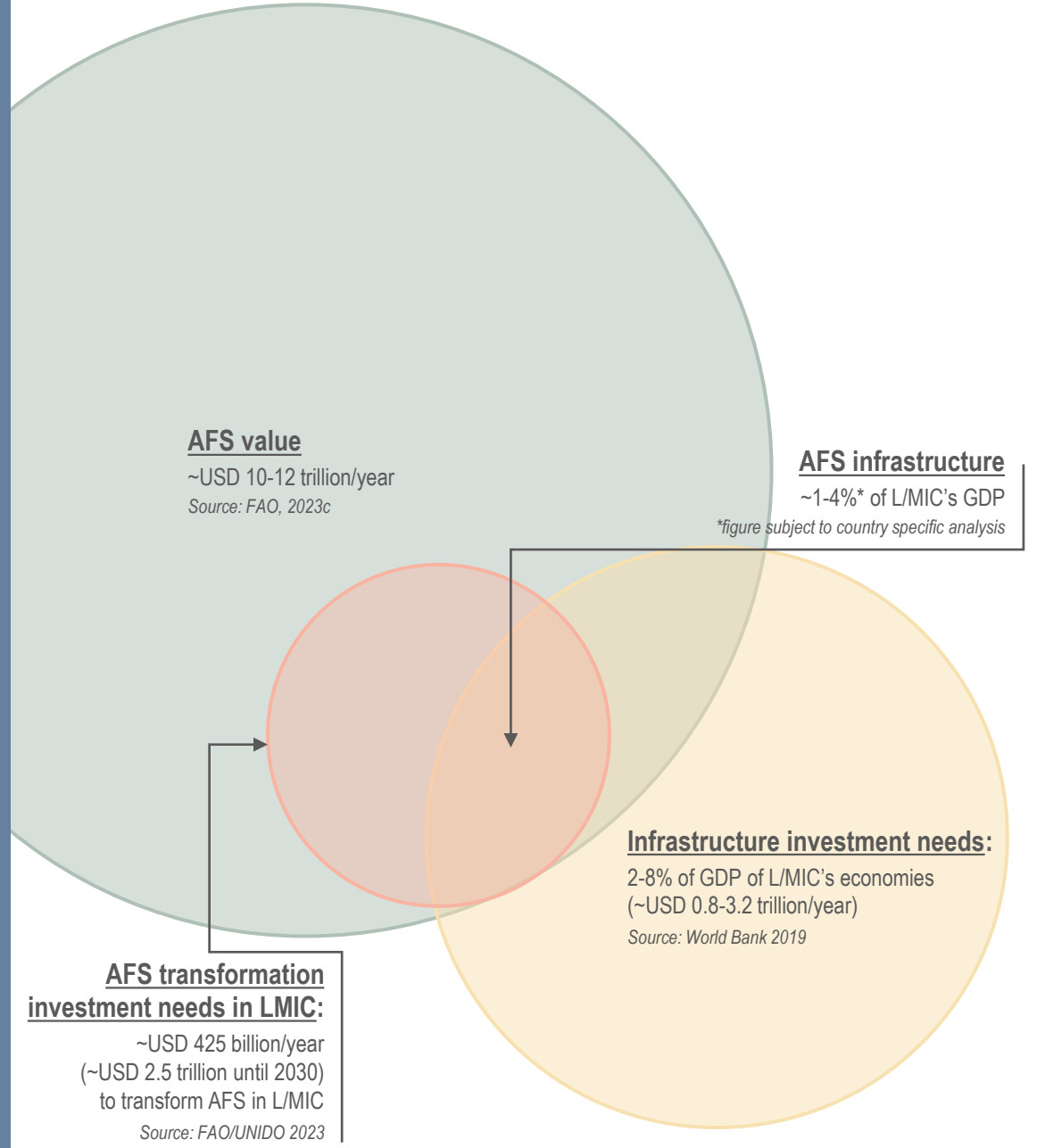
Table of Contents:

An opportunity for economic growth, with environment and equity gains:

- **Agrifood Systems (AFS)** encompass the entire range of actors, and their interlinked value-adding activities, engaged in the primary production of food and non-food agricultural products, as well as in storage, aggregation, post-harvest handling, transportation, processing, distribution, marketing, disposal and consumption of all food products including those of non-agricultural origin (FAO: 2021, 2022).

- **Infrastructure** is a key agrifood systems driver. Infrastructure dedicated to production, harvesting, processing, distribution, etc. provides an important entry point **to advance effective AFS functioning, sustainability, resilience** and **inclusiveness** (adapted from FAO-EU-CIRAD 2022).

- **A missed opportunity?** Employing 25% of the world's workforce, AFS are valued at USD10 trillion (FAO et al 2023), with a vital climate-facing role. Despite the emergence of climate-friendly and sustainable infrastructure debate (e.g., COP28), literature and reports tend to focus on the broader infrastructure categories, such as transport, energy, water (e.g., GIH 2023, IaDB 2020, ADB 2022, WB 2019). Limited attention is dedicated to specific, smart and efficient infrastructure necessary for the sustainability and transformation of AFS.



Estimating new generation AFS infrastructure investment needs

I. Why does agrifood systems infrastructure matter?

Background and rationale

Economic and financial impacts

7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Environmental and climate impacts

7 AFFORDABLE AND CLEAN ENERGY
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION

Equity and social inclusion impacts

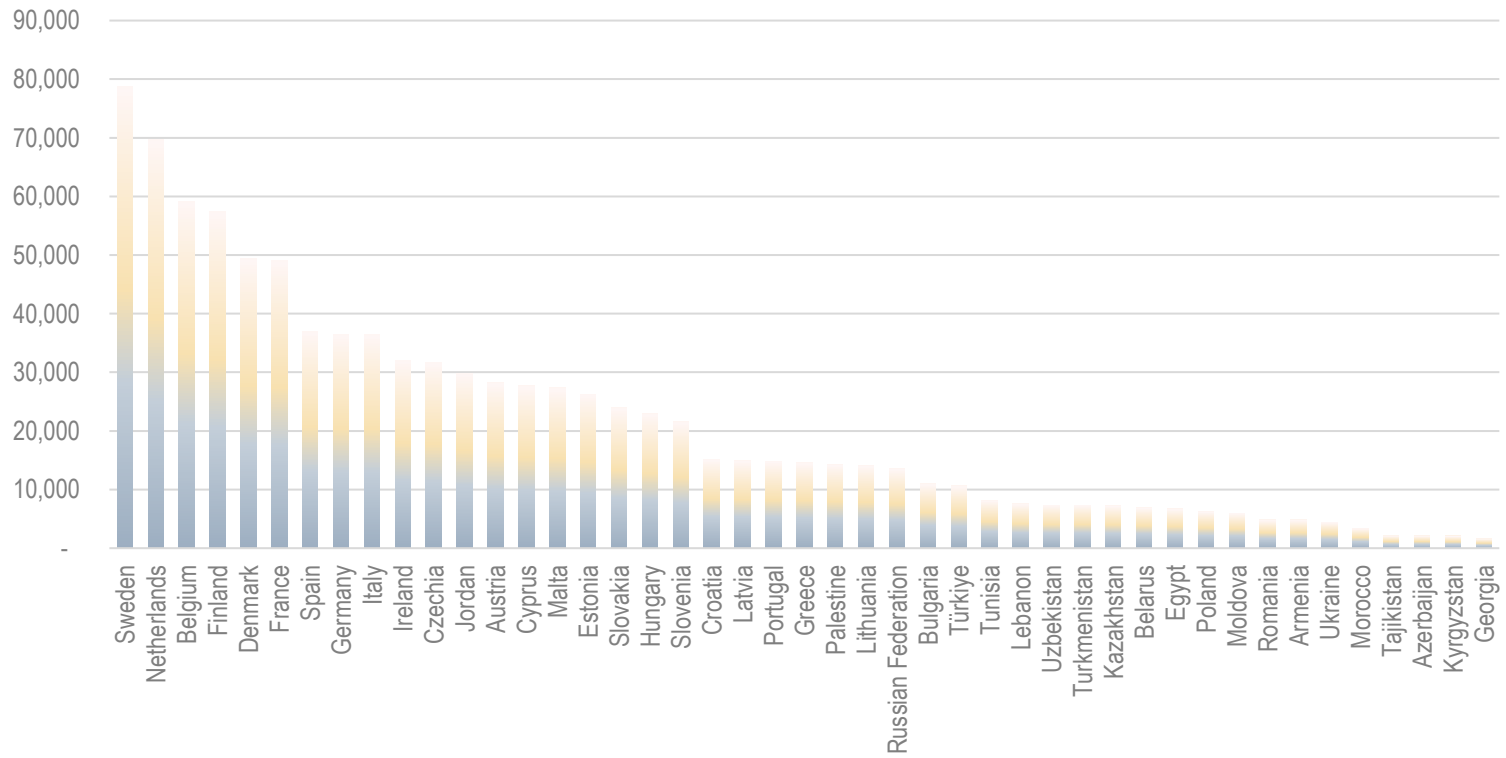
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
5 GENDER EQUALITY
8 DECENT WORK AND ECONOMIC GROWTH
10 REDUCED INEQUALITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Why does agrifood systems infrastructure matter?

Economic and financial dimension

In spite of sustained economic growth across most of the EBRD region in the last decades, **development gaps are still evident** in terms of rural incomes, productivity and value added per worker, input and energy use efficiency etc.

Agricultural GDP per capita (USD), 2019



Source: World Bank and author's calculations

Note: Agricultural GDP per capita is calculated by dividing agriculture value added to GDP by the number of people employed in agriculture in each country (2019 data).

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Why does agrifood systems infrastructure matter?

Economic and financial dimension

Agrifood systems infrastructure (and related technologies and enabling elements) has a key role to play with potential benefits on many levels, including:

- **productivity and value addition**
- **efficient resource (including inputs) use**
- **well-functioning markets and access**
- **profitability; price stability**

Change in value of agricultural production generated per unit of fertilizer (N+K2O+P2O5 combined) in %, 2001-2010 vs 2011-2020

Source: authors' calculations based on FAOSTAT data

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Why does agrifood systems infrastructure matter?

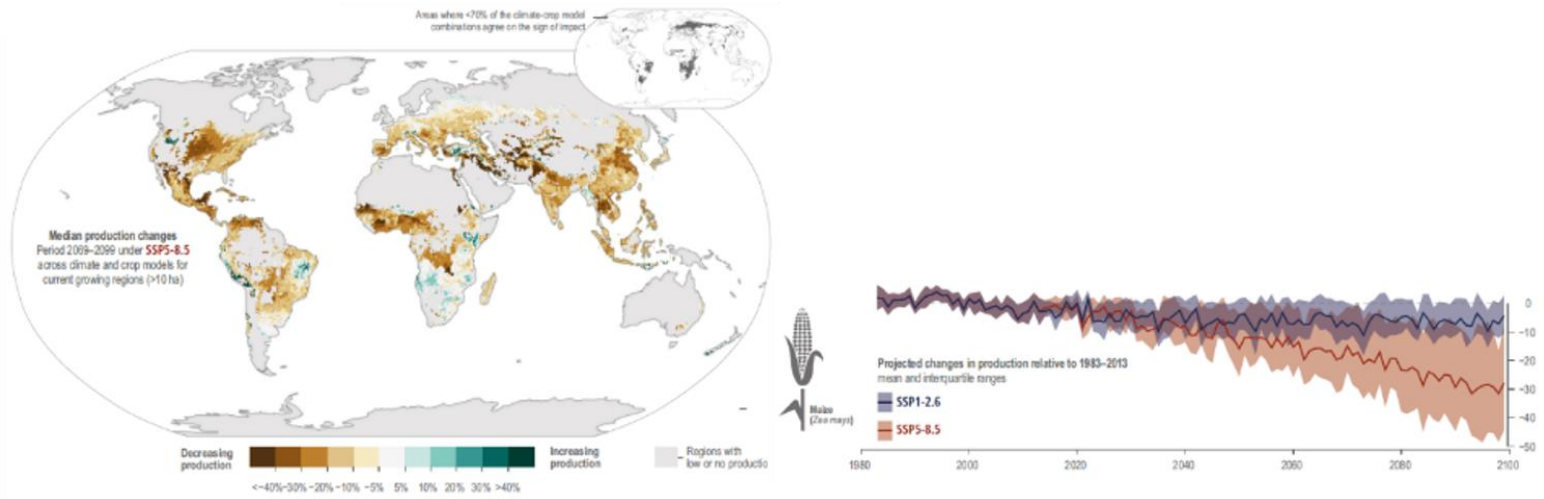
Environment and climate dimension

Agroclimatic conditions across EBRD's region are diverse with IPCC reporting distinguishing seven climate reference zones: most notably the Mediterranean (including North Africa), Eastern Europe and West Central Asia. Climate impacts will vary, but will affect the occurrence of droughts and other rapid-onset events, such as floods (pluvial and/or riverine) throughout the region.This will impact levels of production of key commodities and require investments to (a) offset additional climate stress, while (b) narrowing the existing productivity gap.

Agrifood infrastructure can play an important role at the mitigation and adaptation levels, including through:

- Reducing GHG emissions through improved energy efficiency, input and food production and use, and improved waste management
- Improved water availability through increased water use efficiency
- Improved water quality through a better management of waste
- Improved soil health and quality

Project changes in global maize production



Source: IPCC, Climate Change 2022: Impacts, Adaptation and Vulnerability (ARG): Global to Regional Atlas

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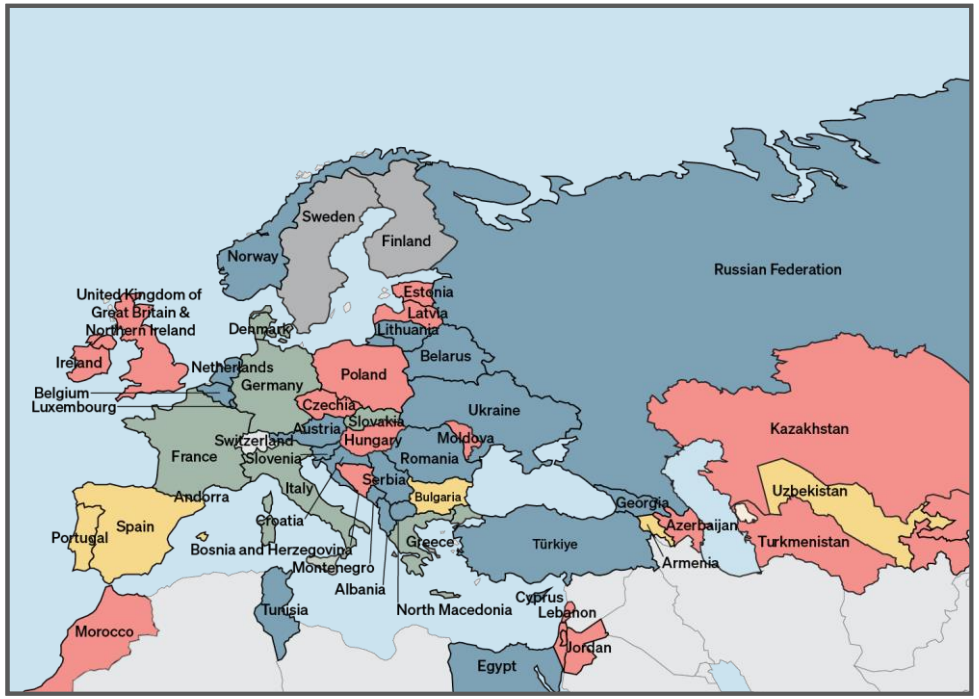
Environment and climate dimension

Globally, the agrifood sector accounts for 31% of anthropogenic GHG emissions.
Comparing changes in the three-year periods of 2007-09 vs 2017-19, persistent differences in GHG emissions changes are still found both (a) in emission intensity, and (b) in trends in variations. This is valid both within the EBRD region, and compared to EU countries.
Two main groups amongst EBRD countries emerge:

- **Group 1** – post-production driving the emissions up, while farm-gate emissions are decreasing (blue)
- **Group 2** – Emissions increasing both at the farm-gate level and at post-production (red)

Change in emissions (2007-2009 vs 2017-2019) by level of the agrifood systems



Decrease in both farm gate and pre- and post-production emissions

Decrease in farm-gate emissions, but increase in pre- and post- production emissions

Decrease in pre- and post-production emissions, but increase in farm-gate emissions

Increase in both pre- and post-production and farm-gate emissions

Insignificant change in both

Source: FAOSTAT and author's calculations

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Why does agrifood systems infrastructure matter?

Equity and social inclusion dimension

The economic benefits of investment in infrastructure will be likely to translate into positive social externalities:

- Improved **economic, food and nutrition security**
- Increase in **employment opportunities**, including **women and youth employment**
- More **equitable distribution** of gains and a reduction in **income inequality**
- Improved **opportunities and access to services, technologies, markets**
- Improved overall agribusiness sector **inclusiveness**

Necessary safeguards need to be put in place to ensure the social sustainability of each investment.

Share of the labour force employed in agriculture, 2019

Share of people of working age who were engaged in any activity to produce goods or provide services for pay or profit in the agriculture sector (agriculture, hunting, forestry and fishing).

Source: Our World in Data based on International Labour Organization (via the World Bank) and historical sources
OurWorldData.org/employment-in-agriculture • CC BY

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Why does agrifood systems infrastructure matter?

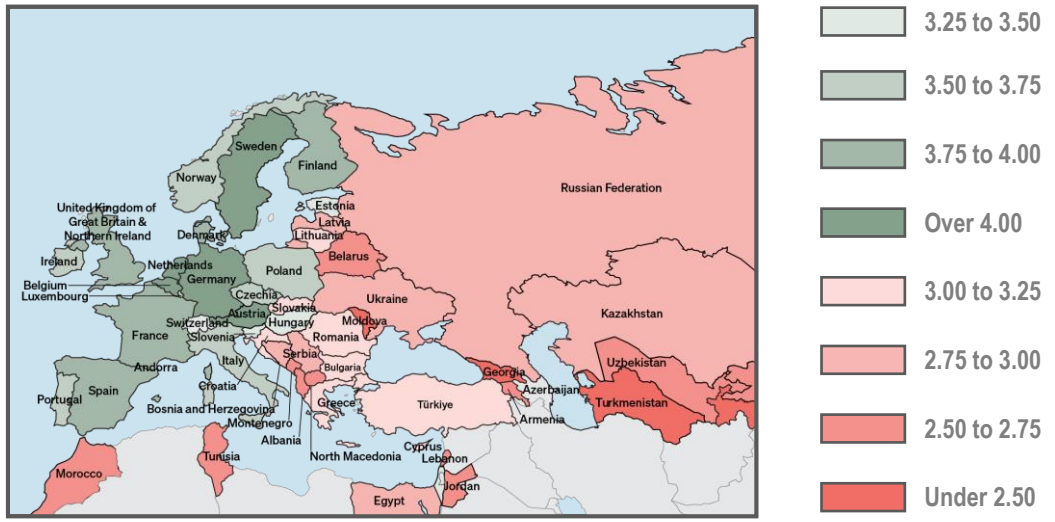
Equity and social inclusion dimension

Food availability and access: key role of logistics and trade

Recent food price spikes and adverse climate change-related impacts on yields highlight even more strongly the importance of efficient import and export infrastructure (and the related trade regulatory framework) to alleviate food cost pressure on national budgets and final consumers. Nearly one billion people globally are at risk of remaining food insecure by 2030 if appropriate action is not taken. In this sense, infrastructure has a key role to play on several levels:

- Supporting enhanced **production** levels in key producing countries
- Ensuring adequate **export** infrastructure allowing export in times of crisis
- Ensuring that importing countries have adequate and efficient **import** infrastructure
- Ensuring the efficiency of **storage** (silos, grain elevators), **cold chain facilities** and **milling** infrastructure (mills) to reduce energy use, processing costs and **food loss.**

Logistics Performance Index score, 2018



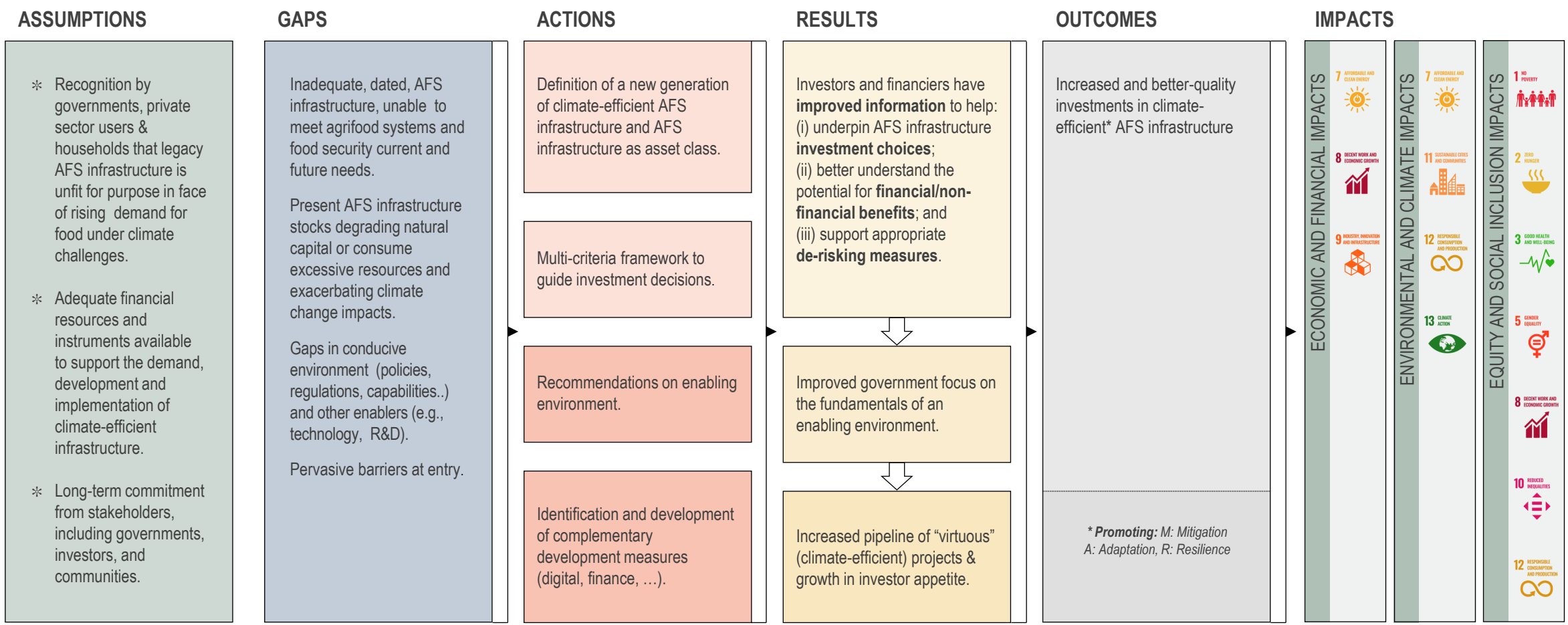
Source: World Bank, Logistics Performance Index (https://lpi.worldbank.org/2018)

II. Conceptual framework

Key concepts and definitions

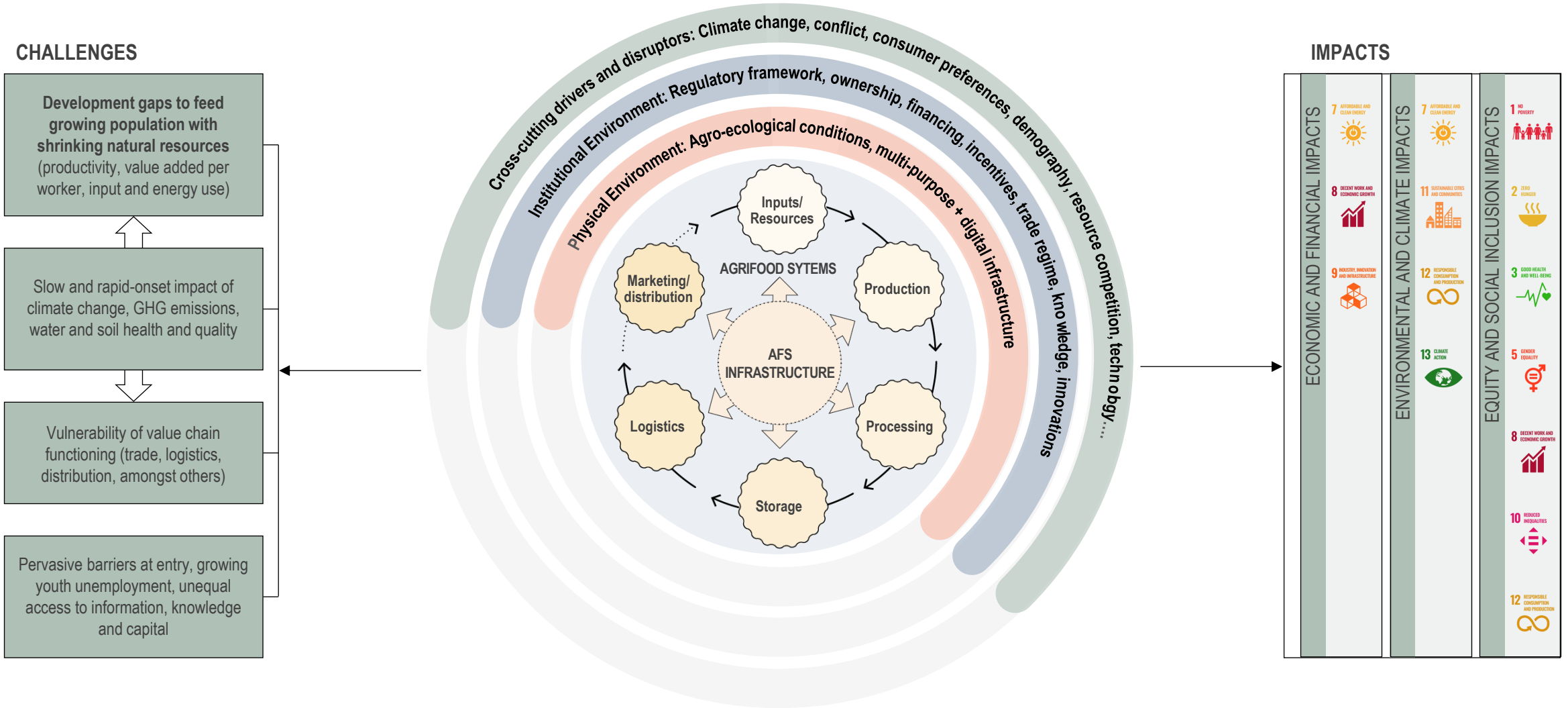
Conceptual framework

Directions in investment



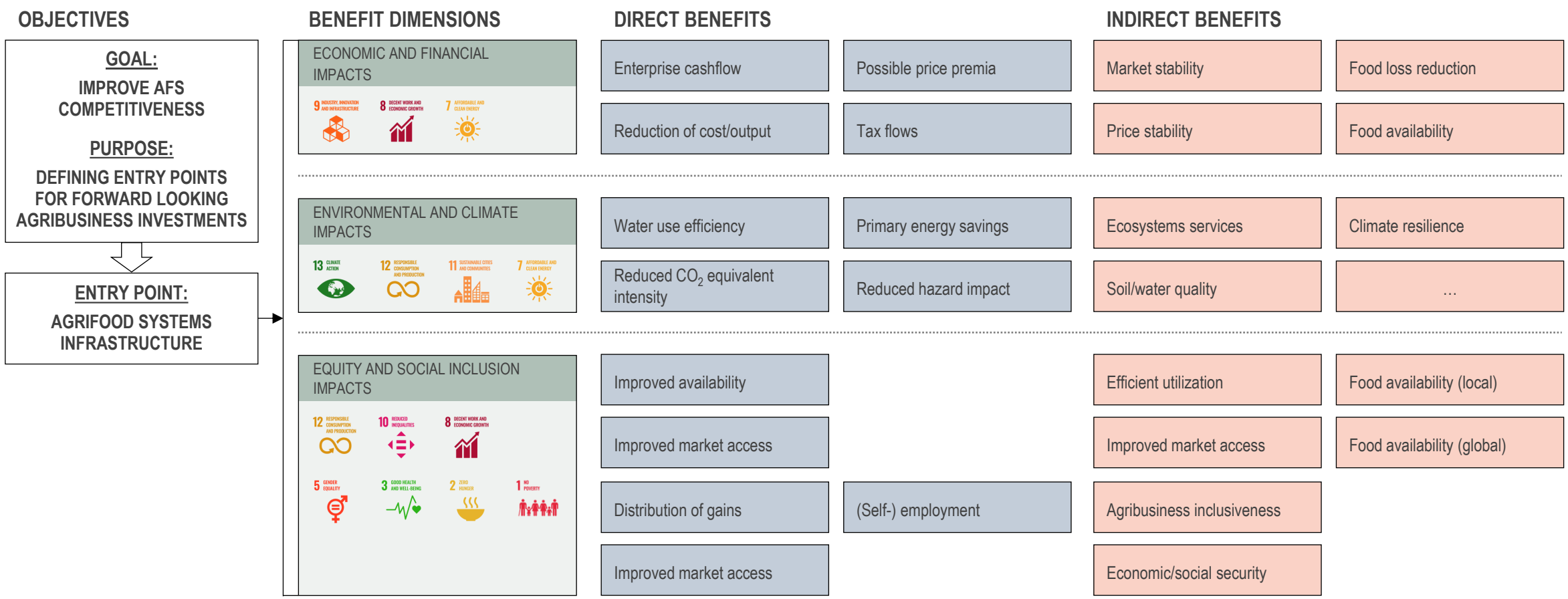
Conceptual framework

Challenges and impacts



Conceptual framework

Benefit areas



Conceptual framework

Towards a working definition of AFS Infrastructure ecosystem

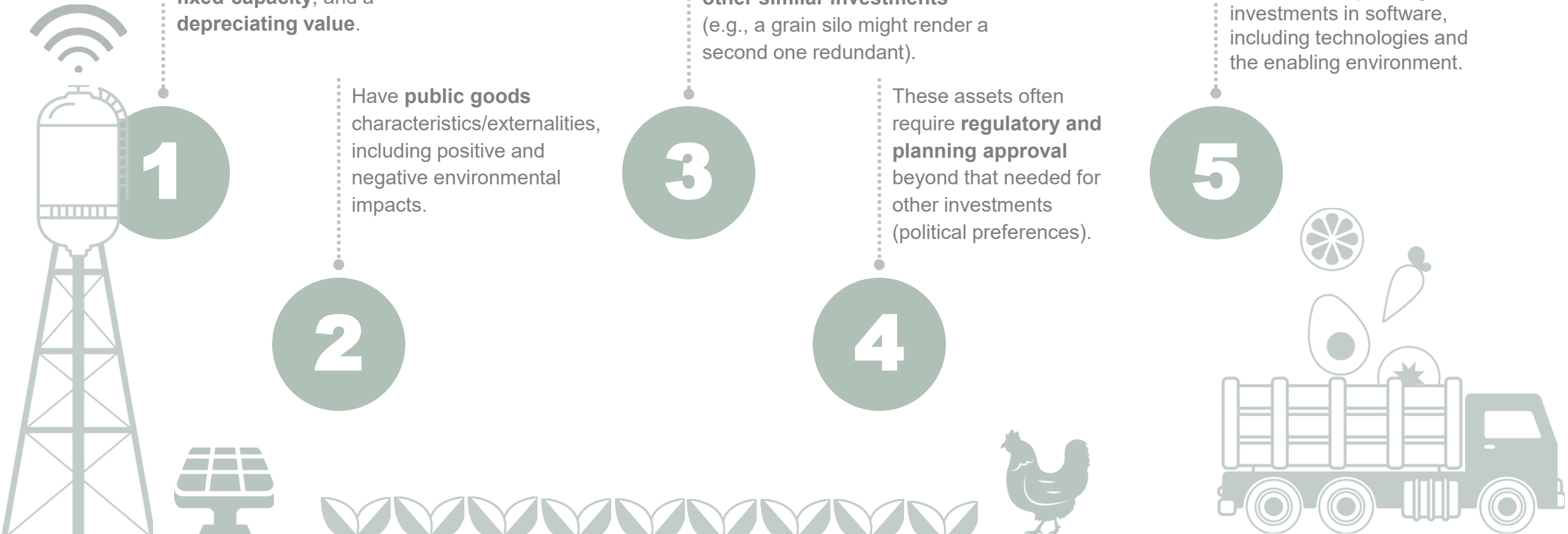
1. Infrastructure is constituted of **significant-sized, long-lived physical assets** with **fixed-capacity**, and a **depreciating value**.

2. Have **public goods** characteristics/externalities, including positive and negative environmental impacts.

3. AFS infrastructure is constituted of assets that are not easily duplicated, and **might preclude other similar investments** (e.g., a grain silo might render a second one redundant).

4. These assets often require **regulatory and planning approval** beyond that needed for other investments (political preferences).

5. Capital assets alone will not contribute to improved and climate-efficient food systems without corresponding investments in software, including technologies and the enabling environment.



Conceptual framework

A draft definition of the climate-efficient agrifood system infrastructure

”A long-lived, capital intensive and strategically important class of physical assets, which enables the functioning of competitive, sustainable and inclusive agrifood systems and provides essential ecosystem services.”

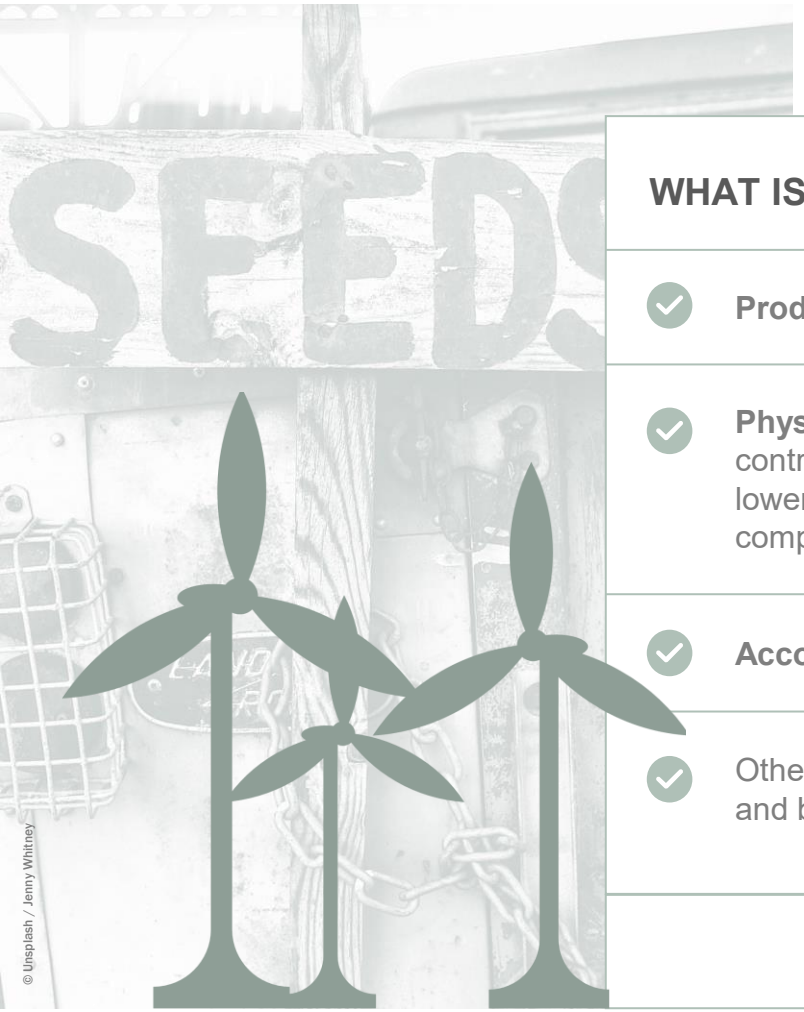
Climate-efficiency, as a critical dimension of AFS infrastructure, will refer to the potential of contributing to reducing greenhouse gas emissions, conserving the natural resources base, adapting and being resilient to a changing climate.

Agrifood systems infrastructure can enhance ecosystem services by contributing to sustainable management of natural resources (water, soil and air), biodiversity conservation/restoration and reduction of greenhouse gas emissions.

Improving access and opportunities for the vulnerable (including small producers, women and youth), AFS infrastructure can lead to greater equity and well-being. Together, with the provision of core economic/productive services, AFS infrastructure can deliver positive externalities and global public goods.

Conceptual framework

Narrowing down perspectives towards a working definition



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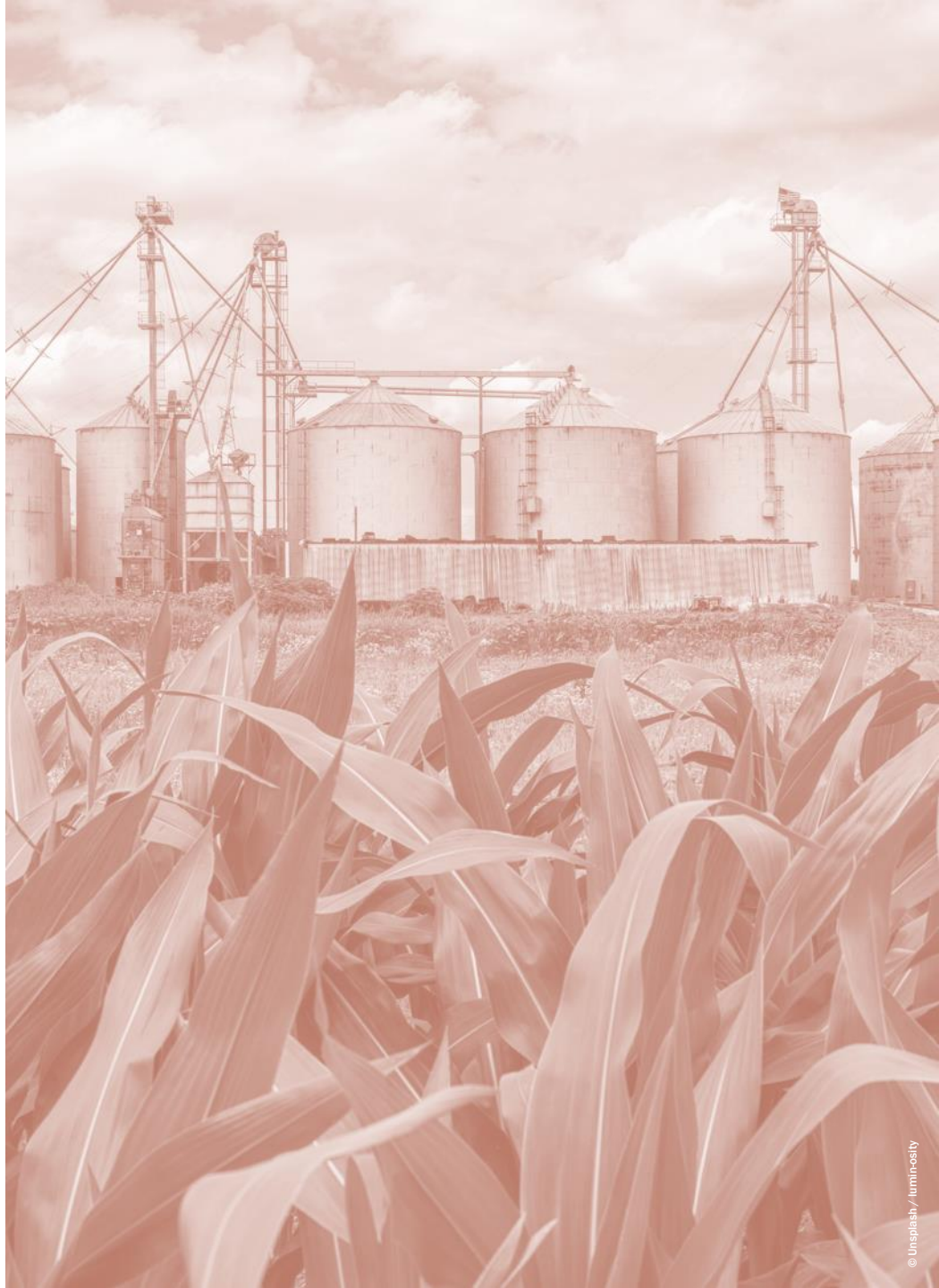
WHAT IS *IN*:	WHAT IS *OUT*:
✓ **Productive infrastructure**	✗ **Social infrastructure** (e.g., education, health, public administration…)
✓ **Physical infrastructure** directly and substantially contributing to the agrifood value chain efficiency, lowering production and transaction costs and competitiveness	✗ General infrastructure that is benefitting the agrifood sector as on of many others (e.g. roads)
✓ **Accompanying technologies**	✗ Physical infrastructure only indirectly contributing to the agrifood sector
✓ Other **enabling factors** that minimize carbon and blue water footprint and build resilience	✗ Non-physical (‘soft’) infrastructure such as financial infrastructure (except when part of the enabling factors)

NB: railroads, ports, airports *out*, but **handling infrastructure** *in*

III. Agrifood systems infrastructure typology and metrics

A comprehensive approach to measure Economic, Environmental and Social Inclusiveness impact



Agrifood systems infrastructure typology and metrics

Entry points and typologies

OBJECTIVES

GOAL:

IMPROVE AFS COMPETITIVENESS

PURPOSE:

DEFINING ENTRY POINTS FOR FORWARD LOOKING AGRIBUSINESS INVESTMENTS

ENTRY POINT:

AGRIFOOD SYSTEMS INFRASTRUCTURE

CHALLENGES

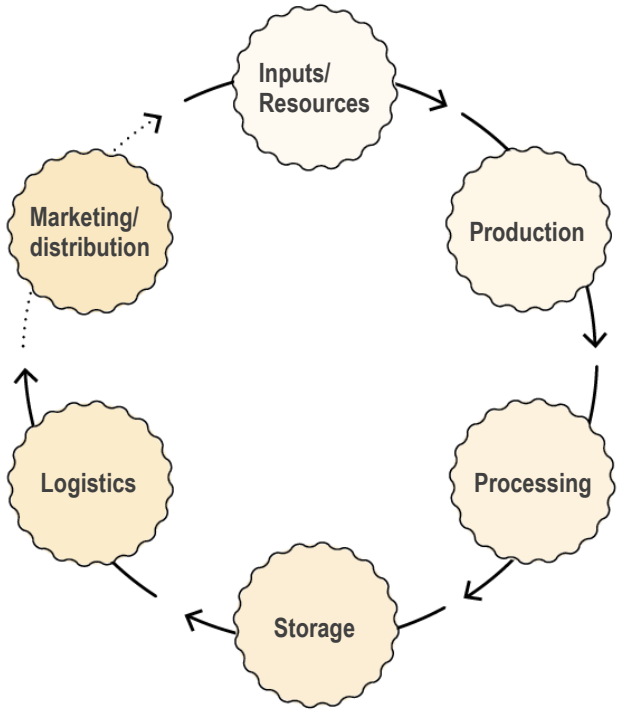
Development gaps to feed growing population with shrinking natural resources (productivity, value added per worker, input and energy use)

Slow and rapid-onset impact of climate change, GHG emissions, water and soil health and quality

Vulnerability of value chain functioning (trade, logistics, distribution)

Pervasive barriers at entry, growing youth unemployment, unequal access to info, knowledge and capital

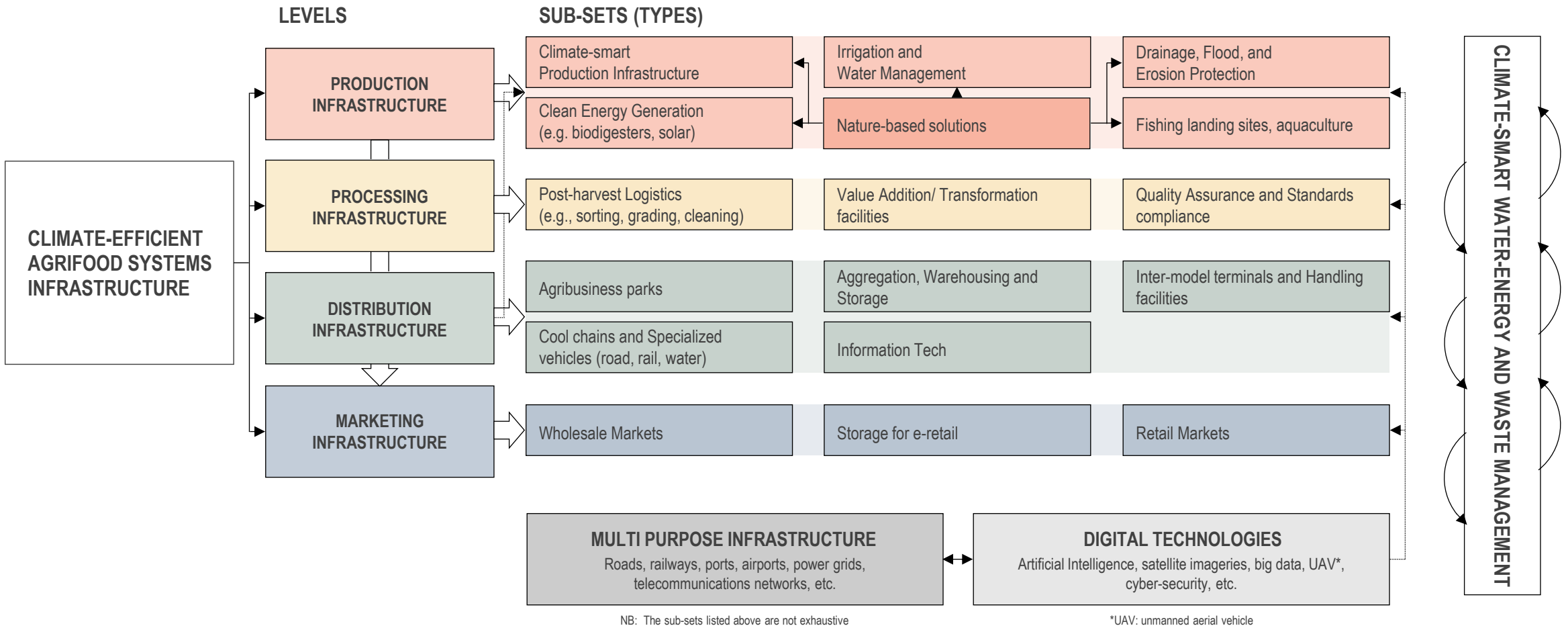
ENTRY POINTS



TRADITIONAL	EXPANDED PERSPECTIVE
Irrigation	Primary production infrastructure (food and energy)
Storage	Processing
	Nature-based solutions
Markets	Transport and logistics
	Markets and distribution
Roads	Regulatory framework, enabling environment
	Digital technologies
Communication	Economic/social security

Agrifood systems infrastructure typology and metrics

Infrastructure levels and types



NB: The sub-sets listed above are not exhaustive

*UAV: unmanned aerial vehicle

Agrifood systems infrastructure typology and metrics

Climate-efficient agrifood systems infrastructure: key terminology

CLIMATE-EFFICIENT AFS INFRASTRUCTURE	AFS INFRASTRUCTURE TYPOLOGY	AFS INFRASTRUCTURE ASSET	AFS INFRASTRUCTURE ASSET CLASS	INFRASTRUCTURE TYPES
Long-lived, capital intensive, strategically important class of physical assets, that enable the functioning of competitive, sustainable and inclusive agrifood systems and provide essential ecosystem services.	Compendium of the most representative AFS infrastructure types, structured around the key stages of the AFS cycle: production, processing, distribution and marketing, mainstreaming climate-smart water-energy-waste management nexus.	Comprising physical immobile structures with vital role for AFS functioning economic activities, transport, information and other public services (irrigation networks, roads, storage facilities, warehouses…).	Investments that exhibit similar characteristics, including **physical** infrastructure, **technologies** and other **enabling** factors that maximize the desired multi-dimensional impact. In the AFS infrastructure conceptual framework they are divided into four major classes: (pre-) production, processing, distribution, and marketing (each subdivided in types).	Sub-sets of infrastructure encompassing a vast range of physical and intangible capital with specific purposes, offering different capabilities and levels of sophistication (e.g., drainage systems, post-harvest logistics, warehouses, …).

Agrifood systems infrastructure typology and metrics

Performance measurement: seventeen performance indicators

A set of **seventeen performance indicators** are proposed divided into the three areas of: Economic and financial, Environmental and climate, and Equity and social inclusion. **Seven indicators (bolded)** are identified as **applicable to all proposed new generation AFS infrastructure** investments. It is proposed that for any scheme, an additional select number of indicators would be selected from the remaining sub-set, as well as other custom indicators (particularly related to the intervention's technical and operational aspects) would be added, as relevant, according to the type of scheme.

Economic and financial indicators

E1.1 **Economic Internal Rate of Return (%)** or equivalent cost-benefit metric, internalising greenhouse gas emission changes using a standardised carbon price (all projects).

E1.2 Financial Performance (disaggregated for investors, operators and suppliers, etc..), comprising one or more of the following:

- E1.2.a **Financial Internal Rate of Return (%)** for investors over the project life cycle (all projects).
- E1.2.b Positive cashflow for operators (where different from investors).
- E1.2.c Positive cashflow for suppliers (small producers and agribusinesses).

E1.3 Fiscal impact (net % increase in public revenues).

Environment and climate indicators

E2.1 **Net greenhouse gas emissions/carbon sequestration (tonnes CO_2eq.)** over project life cycle (all projects).

E2.2 Net impact on water extraction (m^3/year) also referred to as "annual water savings" (EBRD 2018) over the project life-cycle.

E2.3 Adaptation, measured by 3 sub-indicators (also recommended by the Joint MDB Common Framework - AfDB et al, 2019):

- E2.3.a **Climate Adaptation Finance**, as % of the project cost that can be considered as adaptation finance (all projects) (EBRD 2018).
- E2.3.b **Residual Physical Climate Risk** (all projects).
- E2.3.c **Climate Resilience Benefit**, estimating the monetary value of climate-related losses avoided over the lifetime of the project (EBRD 2018) and / or the monetary value of physical assets made more resilient to the effects of climate change and/or more able to reduce GHG emissions (GCF, 2021).

E2.4 Net reduction in quantity of food loss and waste (tonnes/year).

E2.5 Net impact on air and / or water pollution and on solid waste sent to landfill.

E2.6 Impact on biodiversity (possibly expressed as hectares of biodiverse habitat protected/conserved or restored).

Agrifood systems infrastructure typology and metrics

Performance measurement: seventeen performance indicators

Equity and social inclusion indicators

E3.1 Net impact on food availability (kcal/year).
E3.2 Net impact on physical and/or financial access to food for vulnerable populations (number of food insecure people with improved access).
E3.3 **Number of full-time decent jobs created with equitable access to employment** (all projects).
E3.4 Number of entities with enhanced access to markets (small farms and small and medium agribusinesses).

Additional areas

- Contributions to Nationally Determined Contributions (NDCs), logistics performance index; cost of affordable and healthy diets .
- Indicators expressed in numbers of people (food access, employment, market access) should be disaggregated by gender and other relevant characteristics.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BENEFIT DIMENSIONS

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Performance measurement: economic and financial impact

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E1.1 **Economic Internal Rate of Return (%)** or equivalent cost-benefit metric, internalising greenhouse gas emission changes using a standardised carbon price (all projects).

E1.2 Financial Performance (disaggregated for investors, operators and suppliers, etc.), comprising one or more of the following:

- E1.2.a **Financial Internal Rate of Return (%)** for investors over the project life cycle (all projects).
- E1.2.b Positive cashflow for operators (where different from investors).
- E1.2.c Positive cashflow for suppliers (small producers and agribusiness).

E1.3 Fiscal impact (net % increase in public revenues).

How are MDBs measuring “sustainable infrastructure” (additional areas)

* Job creation (see: equity and social inclusion impacts).

BENEFIT DIMENSIONS

Economic and financial impacts

Environmental and climate impacts

Equity and social inclusion impacts

Agrifood systems infrastructure typology and metrics

Performance measurement: environment and climate impact

Environment and climate Indicators

E2.1 **Net greenhouse gas emissions (tonnes CO_2eq.)** over project life cycle (all projects).

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E2.4 Net reduction in quantity of food loss and waste (tonnes/year).

E2.5 Net impact on air and / or water pollution and on solid waste sent to landfill.

E2.6 Impact on biodiversity (possibly expressed as hectares of biodiverse habitat protected/conserved or restored).

How are MDBs measuring “sustainable infrastructure” (additional areas)

- Efficient use of materials and waste reduction.
- Disaster risk management.

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Agrifood systems infrastructure typology and metrics

Performance measurement: equity and social inclusion impact

Equity and social inclusion indicators

E3.1 Net impact on food availability (kcal/year).

E3.2 Net impact on physical and/or financial access to food for vulnerable populations (number of food insecure people with improved access).

E3.3 **Number of full-time decent jobs created with equitable access to employment** (all projects).

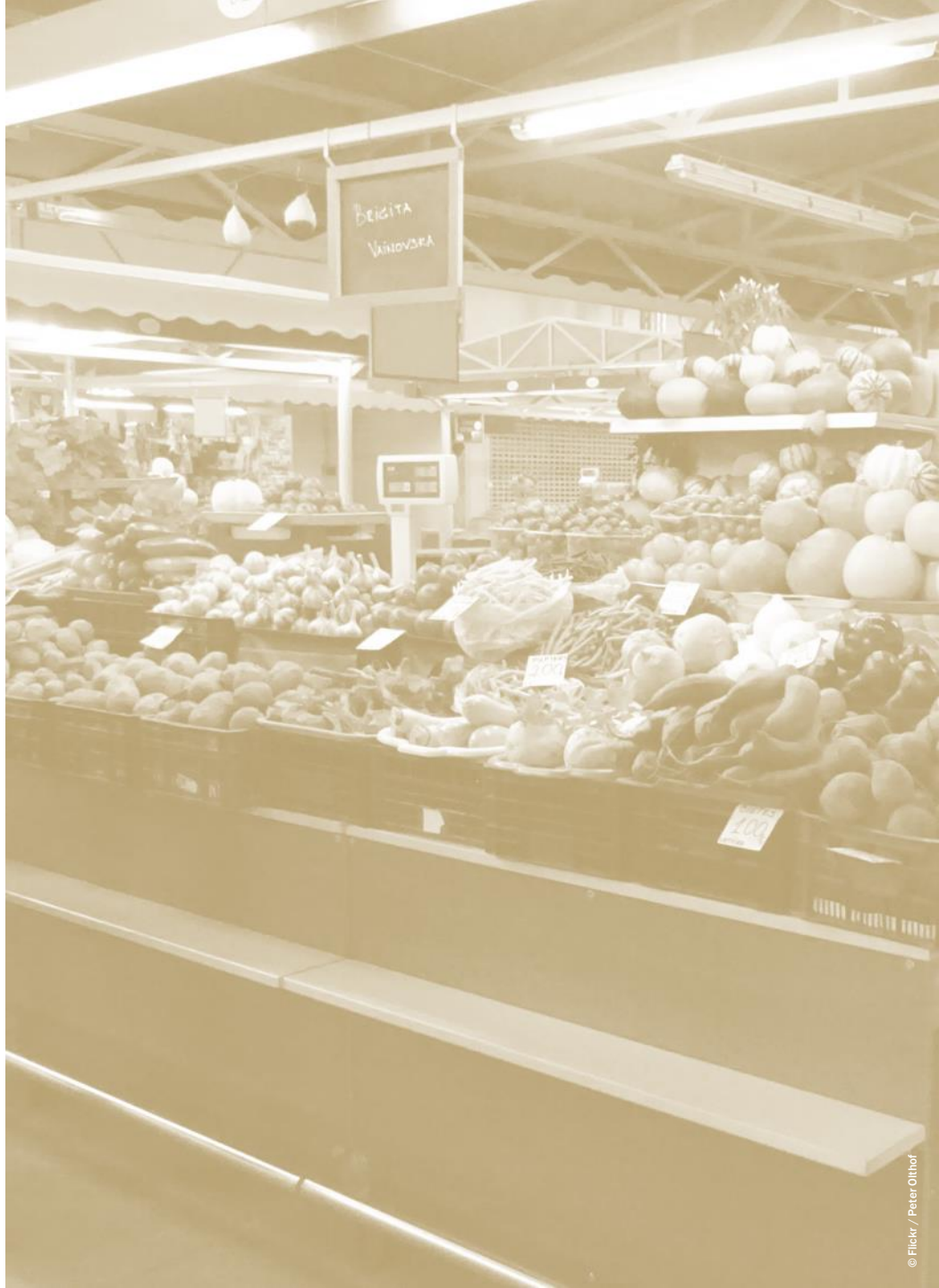
E3.4 Number of entities with enhanced access to markets (small farms and small and medium agribusinesses).

How are MDBs measuring “sustainable infrastructure” (additional areas)

- Social: access to services, stakeholder engagement, gender integration…
- Food security: n/a (area not covered).

IV. A call to action

Unlocking investment in climate-efficient AFS infrastructure



A call to action

Financial landscape: the investment opportunity dimension

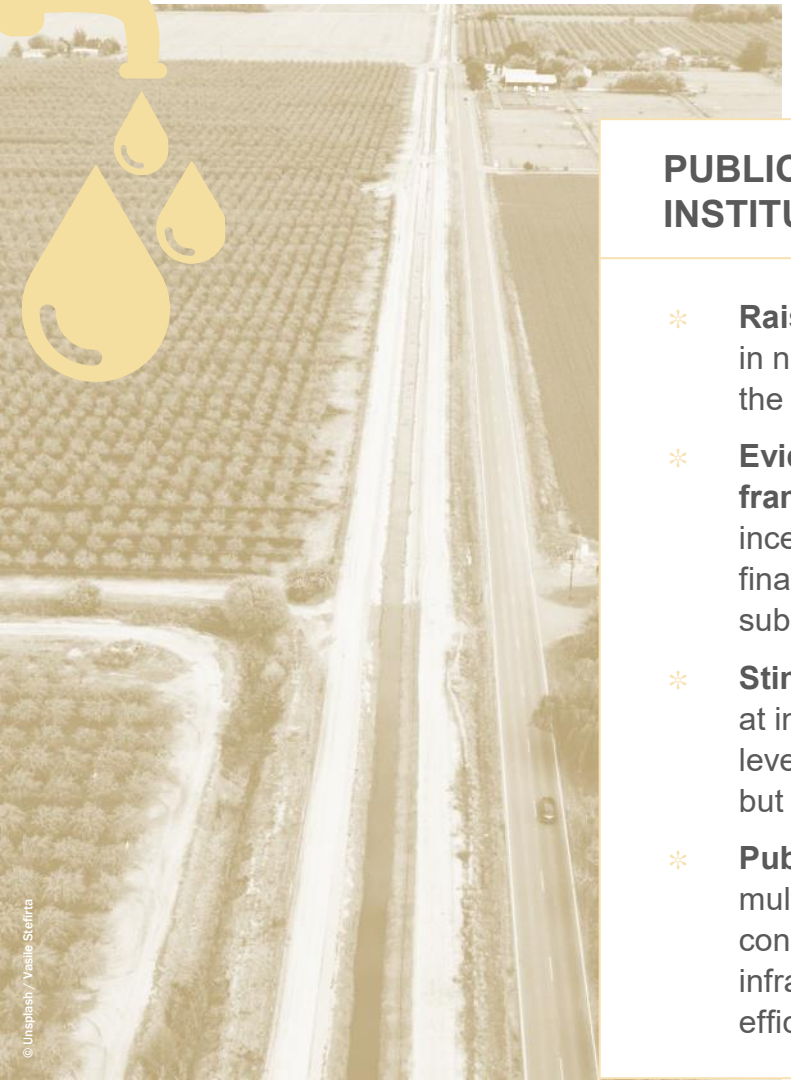
- A global estimate (OECD, 2017) reports that USD **6.3 trillion per year** "need to be invested in infrastructure globally between 2016 and 2030 to keep pace with development". Investment in sustainable and resilient infrastructure are monitored by international coalitions (e.g., G20 Global Infrastructure Hub, ICSI…).
- Achieving sustainability in agrifood systems **will require investment in fixed, durable assets** (new generation agrifood infrastructure) – in line with the identified typologies (production, NbS, processing, marketing, distribution…).
- Estimating the overall size of investment in agrifood infrastructure is challenging. In absence of an international/peer-reviewed methodology, an estimate can be provided by assessing the fix**ed capital formation in agrifood sector** as proportionate to fixed capital formation in agriculture. ➔ Estimate of scale of investment needed – based upon (i) agrifood share of GDP; (ii) OECD estimates of infra needs; (iii) capital intensity of agrifood sector, if figures available; (iv) agrifood share of WB infrastructure financing.

INDICATOR	EGYPT	SERBIA	UZBEKISTAN
Gross fixed capital formation in agriculture, current USD	2,174,156,357	607,890,450	1,452,455,035
Gross fixed capital formation in agriculture as % of GDP	0.5%	1.0%	2.1%

- Most of this investment will be by private investors, but public policy action, financing and direct public investment will be needed to overcome barriers including:
  - Investments have positive externalities / public goods nature, so full benefits not captured by investors, leading to under-financing
  - Existing policy regimes (e.g. subsidies) further misalign financial and economic benefits
  - Willingness to invest further reduced by (i) lack of knowledge of opportunities and long-term benefits; (ii) inherent riskiness of long-term investments with high sunk costs; (iii) underestimation of costs of business-as-usual

A call to action

Unlocking investment: avenues to unlock climate-efficient agrifood infrastructure investment



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PUBLIC AND REGULATORY SECTOR INSTITUTIONS

- **Raising awareness** of benefits of investment in new-generation agrifood infrastructure, and the risks and costs of inaction.
- **Evidence based Policy and regulatory framework adjustments**, to improve incentives to invest by aligning economic and financial benefits (can include re-structuring subsidies to be non-distorting).
- **Stimulate measurement and data collection** at infrastructure level and linkages with country level targets (for GHG emissions specifically, but also resilience).
- **Public investments**, including in enabling multi-purpose infrastructure (rural roads, grids, connectivity) and in types of agrifood infrastructure where the state can manage efficiently (e.g. irrigation).

IFI AND PRIVATE SECTOR

- Driving technology development and demonstration projects (OECD).
- Support piloting of appropriately structured financing (sustainability linked lending, green bonds) through policy / development banks.
- Coverage on agreed and clear definitions, eligibility criteria and performance indicator.
- Planning support to create synergies and efficient clustering of agrifood infrastructure investments.

A call to action

Ensuring an adequate enabling environment for AFS infrastructure investment

CHECKLIST: POLICY AND REGULATORY INCENTIVES FOR SUSTAINABLE AFS INFRASTRUCTURE INVESTMENT

- Efficient pricing of power and water.
- Pricing of greenhouse gas emissions and other negative environmental impacts.
- Food trade tariffs and controls.
- Food safety, labelling and origin tracing.
- Planning laws including environmental and social impact assessments.

OUTLINE CHARACTERISTICS OF APPROPRIATE FINANCING FOR SUSTAINABLE AFS INFRASTRUCTURE

- Long repayment period.
- Interest and repayment schedule aligned with the expected cashflow (including a grace period for construction and start-up operation).
- Securing financing on assets (or potentially on cashflow).
- Options for risk-sharing through equity stake financing (by banks) or public-private partnership model).
- De-risking without direct financing, including credit guarantees and insurance linked to potential long-term risk.
- Option for value-chain financing to overcome the high transaction costs of providing credit directly to a large number of smaller producers or enterprises.

A call to action

Possible follow-up actions

Building on the approach provided to gauge the quality of proposals, the proposed conceptual framework and related key indicators could be used to support in-country project investment identification or appraisal, and identification of related financing decisions.

Specifically, opportunities for follow-up from an international financial institution's standpoint, in collaboration with technical partners, encompass the following strategic imperatives:

1. **Advocacy and partnership building**
2. **Targeted engagements with investors and financiers**
3. **Outreach to relevant client (public) institutions**
4. **Address highly food insecure fragile contexts affected by an infrastructure deficit**
5. **Strengthen food security and AFS resilience perspective**

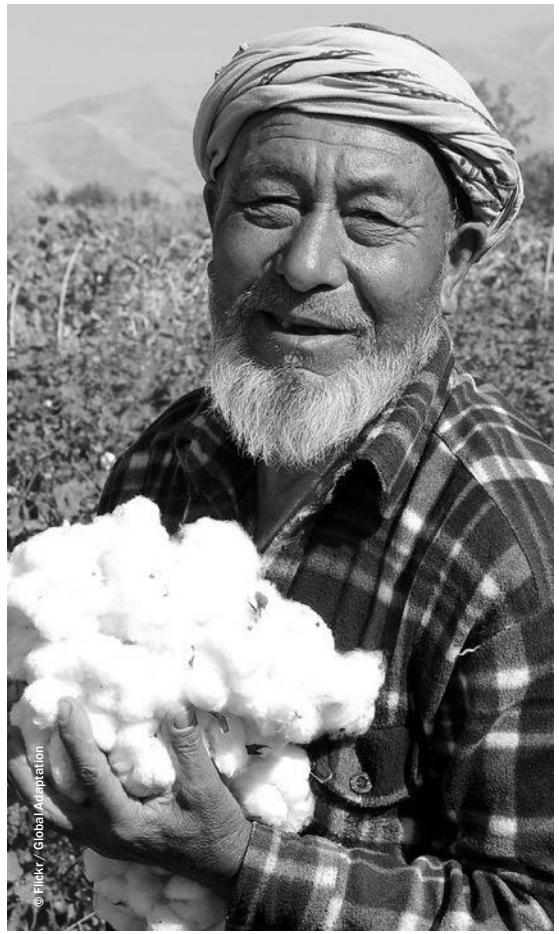
V. Annex

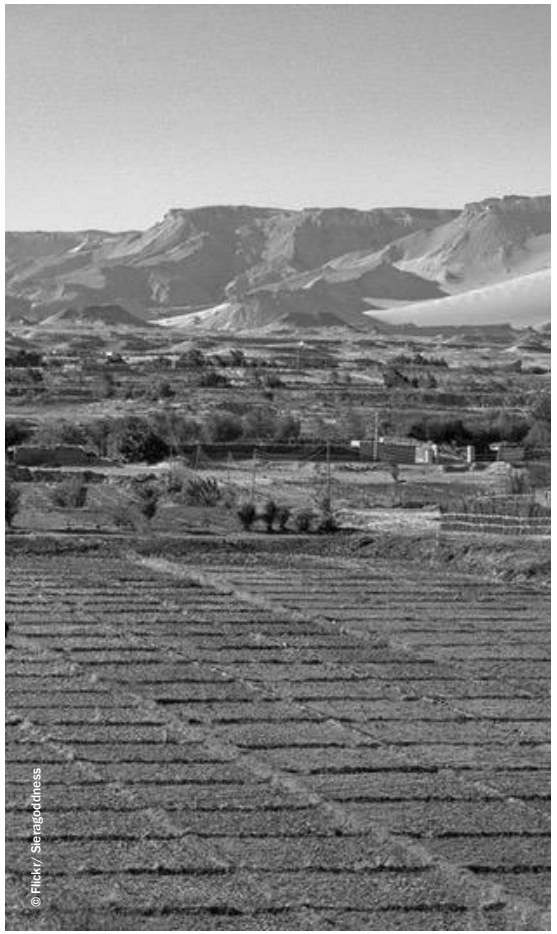
Preliminary results: three pilot countries

Examples of climate-efficient AFS infrastructure and technologies

Preliminary results: three pilot countries

Egypt, Serbia, Uzbekistan





198 AGRIBUSINESS FIRMS SURVEYED,WITH PRIMARY ACTIVITIES BEING:

Crop production, 81 firms

Livestock, 22 firms

Agrifood logistics, 19 firms

HIGH DEGREE OF VERTICAL INTEGRATION:

57% of logistic firms

40% of processing firms also engage in primary production

Preliminary results: three pilot countries

Egypt, Serbia, Uzbekistan

a

Relatively sizeable EBRD investment

b

Representative of different sub-regional diversities

c

Representative of different prominent agrifood sub-sectors/value chains

Preliminary results: three pilot countries

Sample description by type of infrastructure owned/used

TYPE OF INFRASTRUCTURE	EGYPT	SERBIA	UZBEKISTAN
#Firms in Primary Production	64	22	25
Water Storage	25	11	20
Irrigation System	51	14	7
Soil water monitoring	40	11	2
Flood protection	1	4	3
Manure management	4	2	7
Pollution and waste management	7	6	1
Farm roads	50	15	29
On-farm storage	50	13	8
Nature-based interventions	49	9	4

Preliminary results: three pilot countries

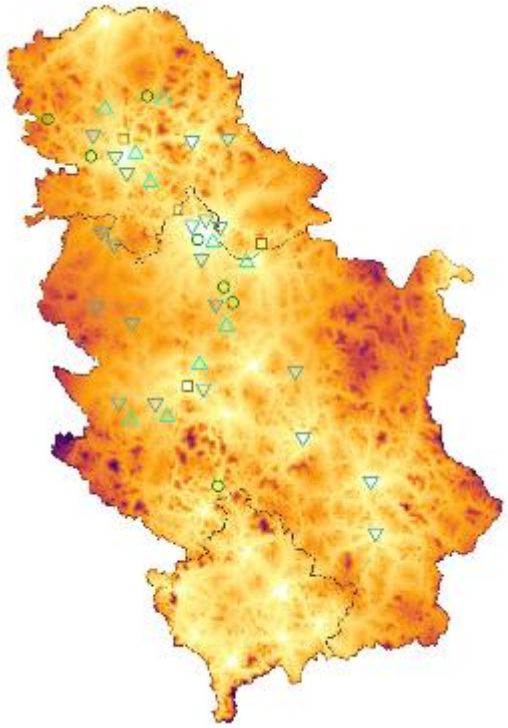
Sample description by activity type, value chain and size

TYPE OF INFRASTRUCTURE	EGYPT	SERBIA	UZBEKISTAN
Total Sample	112	43	43
Primary Activity			
* Primary production: crops	51	15	15
* Primary production: livestock and poultry	13	3	6
* Import, export and distribution	12	7	
* Processing	36	18	5
Primary value chain			
* Fruit and Vegetables	62	24	16
* Grains and Oilseeds	40	8	6
* Dairy	9	7	3
* Meat	19	4	4
* Aquaculture	7	0	0
* Other	8	0	14
Primary value chain			
* >10	15	7	8
* 11<50	31	12	19
* 51<100	14	2	8
* >100	52	22	8

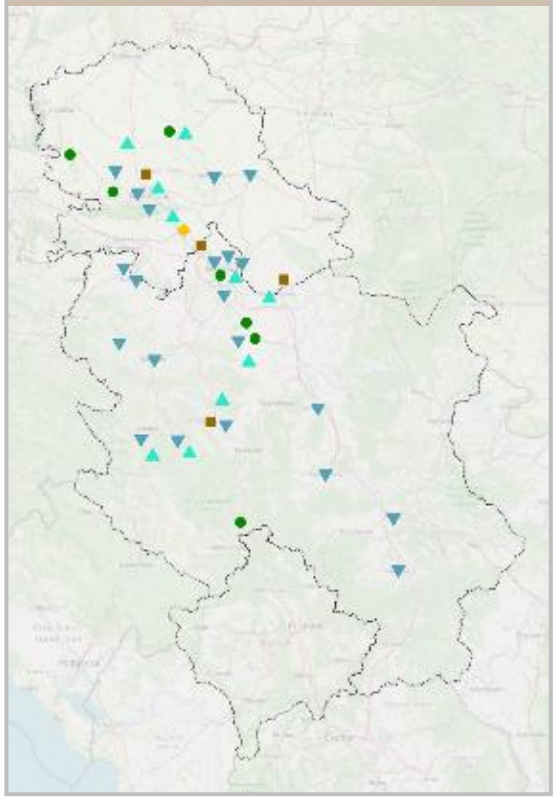
Preliminary results: three pilot countries

Serbia: example of some results

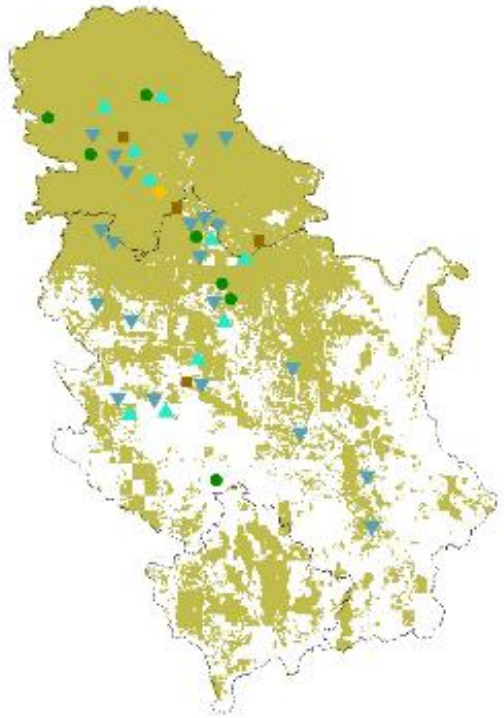
Time to major cities (hours)



Activities of surveyed agribusiness



Croplands



Map Legend

Farming

Farming + Storage

Farming + Processing

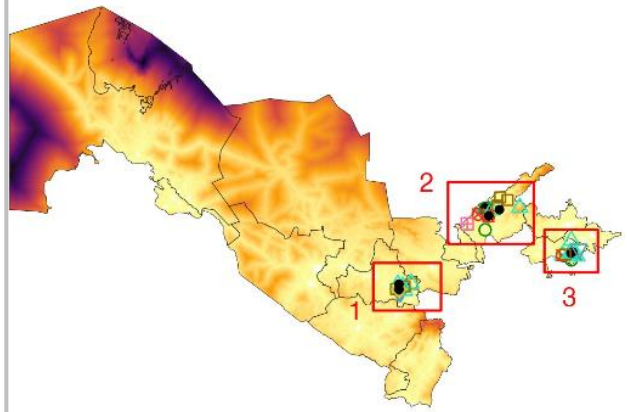
Farming + Storage + Processing

Storage + Processing only

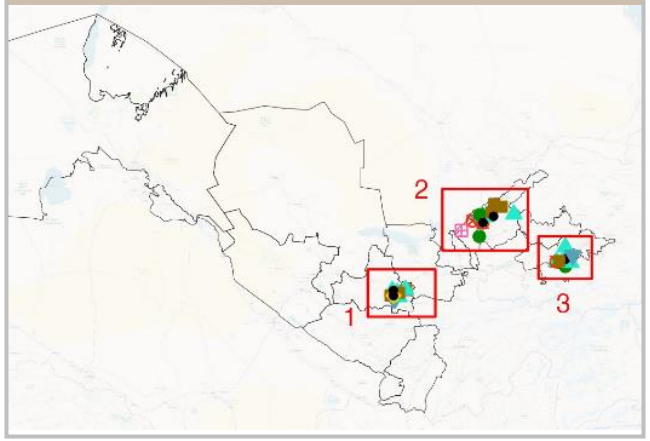
Preliminary results: three pilot countries

Uzbekistan: example of some results

Time to major cities (hours)



Activities of surveyed agribusiness



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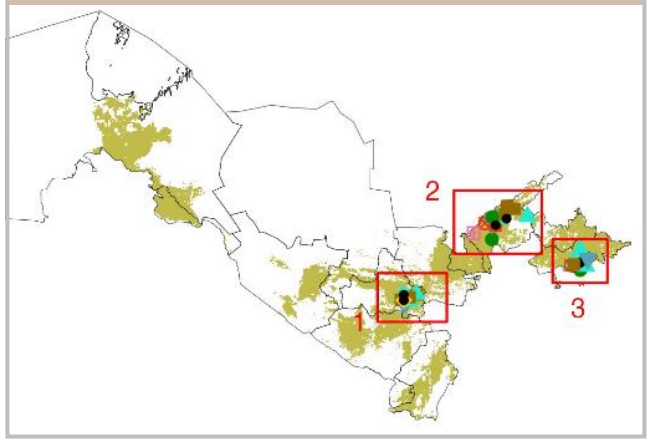


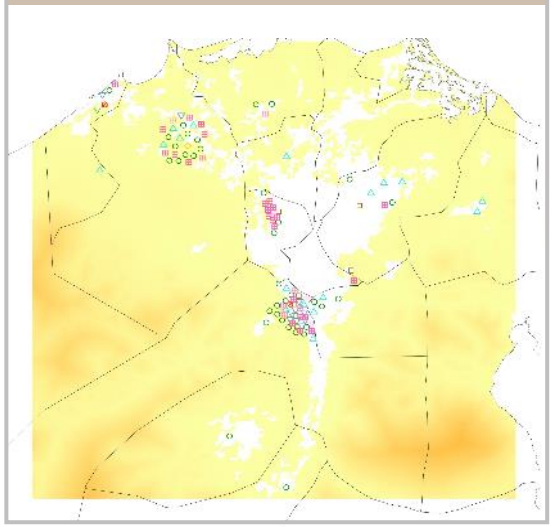
Map Legend

- Farming
- Farming + Processing
- Storage only
- Storage + Processing only
- Farming + Storage
- Farming + Storage + Processing
- Processing only
- Other

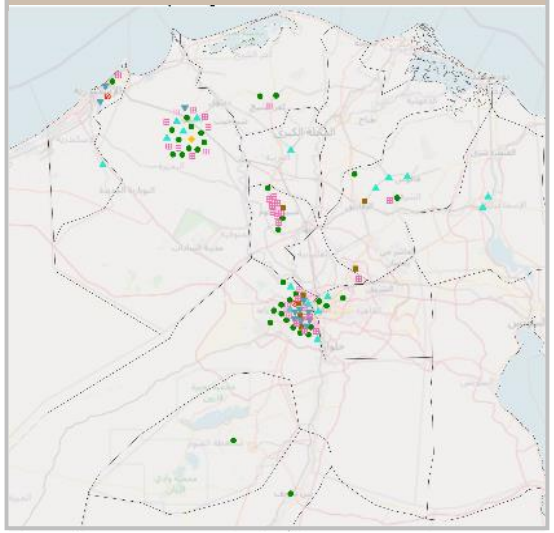
Preliminary results: three pilot countries

Egypt: examples of some results

Time to major cities (hours)



Activities of surveyed agribusiness



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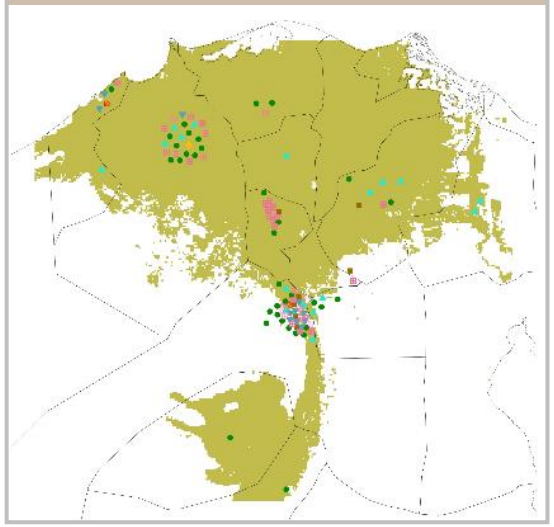

Map Legend

- Farming
- Farming + Processing
- Storage only
- Storage + Processing only
- Farming + Storage
- Farming + Storage + Processing
- Processing only

Preliminary results: three pilot countries

Overview of existing infrastructure assets

© Unsplash / Loren King

- As expected, agrifood firms own a range of infrastructure and durable asset types including irrigation and water management, farm roads, storage, processing, etc.
- Ownership/use of pollution and waste management/recycling facilities is not widespread.
- Most firms have electricity generation equipment to backup to grid power. Most is diesel but there is widespread interest in solar.
- Most primary production firms in Egypt and Serbia invest in advanced irrigation equipment. In Uzbekistan, traditional gravity/ flood irrigation systems remain more widespread.
- Adoption of digital technology is fairly low. Small firms lag behind, leading to risk of a digital divide.
- Digital technology is not integrated with infrastructure except perhaps for advanced irrigation.
- Adoption of **nature-based solutions** is limited, mainly smaller producers in Egypt. (40/64 primary producers in Egypt reported use of at least one nature-based intervention; these included 36 uses of trees as wind breaks, 24 wind panels/shades and 12 firms with tree plantations along canals.)

Preliminary results: three pilot countries

Awareness and corporate strategy for climate change

© Flickr / Bernard Fidel

- Awareness of public policy measures encouraging investment in renewables was surprisingly low, even amongst firms that have invested or plan to invest in solar energy.
- Only 22 firms (19 in Egypt) reported having a decarbonisation strategy in place
- 8% of firms have carbon emissions certificates and a further 8% say they plan to obtain certificates; again, most of these firms are in the Egyptian sample.
- Primary production companies are strongly aware of climate change risks, but have few concrete plans for adaptation measures.

Preliminary results: three pilot countries

Opportunities for new-generation investments

- In all three countries, there is a clear economic case for investing in new generation sustainable agrifood infrastructure, particularly for water efficiency, renewable energy and the circular economy (e.g. uses of organic waste).
- However, awareness of these options and potential long-term benefits is relatively weak.
- Financial incentives for sustainable investments are affected by the public policy regime.
- All three countries have policies to encourage investments in renewables and water efficiency, but energy subsidies and a lack of effective water pricing reduce incentives. This problem is particularly acute in Uzbekistan.
- Lack of access to suitably structured finance is also likely to constrain investment in new generation infrastructure.

Examples of climate-efficient AFS infrastructure and technologies

Infrastructure sectors and technologies

Production Infrastructure

Processing Infrastructure

Distribution Infrastructure

Marketing Infrastructure

Enabling Digital Technologies

Production Infrastructure

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Production infrastructure

Irrigation infrastructure

Investment potential

A portfolio of investments to address increased levels of scarcity, variability and impacts of generally reduced available water allocations to the agrifood sector, potentially including:

- **Storage** (including on-farm), groundwater development and aquifer recharge enhancement, closed loop - and recycling (reuse of urban wastewater for crop production), pollution control (to ensure return flows remain of sufficiently high quality), inter-basin transfer (**supply side**).
- Reducing water losses (monitoring, leakage control, closing circuits, pressurized conveyance and application); improved scheduling and moisture control, canal lining (**demand side**).
- Increasing water productivity through better water control and through improved production processes. Better water control entails, improved water management in irrigated agriculture, enhanced predictability of supply and early warning, improved water delivery services in irrigation (reliability and flexibility through modernization of infrastructure and management), precision irrigation, deficit irrigation, drainage in irrigation (**demand side**).

Management

- Public sector, Private sector and/or blends of co-management.
- Interconnection between scales of investment (national, basin, scheme, farm) increasingly critical.

Beneficiaries

- **Nationally** in public goods: improved food security, improved resilience, agricultural productivity, stabilization of variability in production and tax returns, and maintenance of natural resources.
- **Area effect** or club goods, with the benefits including: more stable yields, incomes and jobs as well as strengthened and protect natural resources.
- **Private goods** for landowners: product output to be better maintained during extreme climate events, offset projected impacts of climate change on yields.

Benefits

- **Financial/economic**: reduced production costs by narrowing down the existing productivity and performance gap, increased resilience through reduced exposure of farmers, their irrigation and related value chains to short-term risks, including climate risks (e.g. improved price stability, including through reduced yield variability).
- **Environmental and climate**: reduced GHG emissions for each calorie/kilogram of food, fibre or feed produced from irrigated cropping systems, and resilience to various types of shocks, including climate-related ones.
- **Equity and social**: enhanced food availability, access and stability through improved yields, yield stability, production costs and prices.

Production infrastructure

Rainfed cultivation infrastructure

Investment potential

Investments to reduce increased production risks from increased variability and drought exposure to (a) improve water-use efficiency by increasing water availability to the plant roots and (b) improve water productivity by increasing productivity per unit of water consumed. Specifically, this may include:

- Soil water conservation (planting pits, terracing, contour cultivation, conservation agriculture, dead furrows, staggered trenches).
- Water Harvesting (surface dams, subsurface tanks, farm ponds, diversion and recharge structures).
- Reduce non-productive ET (dry planting, mulching, conservation agriculture, intercropping, windbreaks, agroforestry, early plant vigor, vegetative bunds).
- Integrated soil, crop and water management (more crop per drop, i.e. measures to increase plant water uptake capacity such as conservation agriculture, dry planting, improved varieties, crop spacing improvements, soil fertility management, optimum crop rotation, intercropping, pest control and organic matter management).
- Expand irrigation (see previous slide), in niches where supply augmentation remains an option.

Management

- Private sector, farmers.

Beneficiaries

- **Nationally** in public goods: improved food security, improved resilience, agricultural productivity, stabilization of variability in production and tax returns, and maintenance of natural resources.
- **Area effect** or club goods, with the benefits including: more stable yields, incomes and jobs as well as strengthened and protected natural resources.
- **Private goods** for landowners: product output to be better maintained during extreme climate events, offset projected impacts of climate change on yields.

Benefits

- **Financial and economic**: taxation and multiplier effects from irrigated agriculture, direct financial returns to producers.
- **Environmental and climate**: protection from volatile climate stressors (both slow and rapid onset); more efficient water use may translate into higher allocations for environmental flows to maintain critical water services that are already compromised.
- **Equity and social**: more stable jobs and livelihoods, food prices are stabilised.

Production infrastructure

Natural resources infrastructure

Investment potential

A portfolio of investments aiming to strengthen natural resources such as:

- Regenerative farming improved soil health – through no/minimal tillage, cover crops, leading to greater drought resistance, and improved plant nutrition.
- **Investment in dams and rainwater catchment systems**.
- Planting of **trees to buffer water resources**, as part of agro-forestry silvo-pasture systems, including the provision of shade and windbreaks.
- May include investment in **hail nets, partial and small dams, planting pits**, farmer managed regeneration of vegetation, early warning systems, flood protection.

Management

- Large farms will self invest and manage.
- Management might be by a group of farmers.
- Alternatively, by local government/public institutions.

Beneficiaries

- A mix of public (dams, rainwater catchment systems, flood protection), club (rainwater catchment systems, silvo-pasture systems) and private goods (hail nets, windbreaks, small dams, planting pits).

Benefits

- **Financial and economic**: extra profits during periods of diminished supply and quicker recovery after extreme weather events.
- **Environmental and climate**: protection from volatile climate stressors (both slow and rapid onset), protected and conserved water resources, enabled and conserved carbon sequestering, lessened impact of heat, drought, floods etc.; lower GHG emissions.
- **Food security**: enhanced availability, access and stability through improved yields and stable production and prices.
- **Equity and social**: more stable jobs and livelihoods.

Production infrastructure

Nature-based solutions

Investment potential

- A portfolio of investments that ensures the better management of landscapes and ecosystem services which are critical for the agrifood systems and respond to impacts of climate change. NBS solutions are available for a wide variety of challenges and may comprise viable substitutes or complementary investments to tradition (grey) infrastructure. These issues include:
- Water supply regulation.
- Water quality regulation.
- Moderation of extreme events (such as floods).
- Typical approaches at various scales of intervention may include: reforestation, re-connecting rivers to floodplains, restoring wetlands, construction of wetlands, water harvesting, green spaces, permeable pavements, green roofs, flood bypasses and Bio-Energy Carbon Capture and Storage (BECCS: crops used for biomass capture CO_2 while growing; when that biomass is burned to generate energy, the CO_2 is captured and stored geologically, resulting in a negative emissions balance), amongst others.

Management

- Public or common (communities).

Beneficiaries

- Nationally / public goods: food security, improved resilience, agricultural productivity, stabilization of variability in production and tax returns, and maintenance of natural resources.
- Area effect or club goods include more stable yields, incomes and jobs as well as strengthened and protect natural resources.
- Private goods: for landowners, product output to be better maintained during extreme .climate events, offset projected impacts of climate change on yields.

Benefits

- **Financial and economic**: taxation, and multiplier effects from irrigated agriculture, direct financial returns to producers.
- **Environmental and climate**: protection from volatile climate stressors (both slow and rapid onset), more efficient water use may translate into higher allocations for environmental flows, to maintain critical water services already.
- **Equity and social**: higher stability of jobs and livelihoods, contribution to food prices stability.

Production infrastructure

Climate-smart / precision agriculture infrastructure

Investment potential

A portfolio of investments aiming to deliver improved input: output ratios as well as environmental and social externalities, including:

- Investment in precision agriculture techniques leading to improved input to output ratios, meshing **digital technologies and improved application machinery**.
- Integrated Pest and Disease Management (IPM) systems.
- Switch away from fossil energy and heavy machinery, and investment in **alternative powered technology** for production, storage and primary processing, coupled **improved energy efficiency of infrastructure/equipment**.

Management

- Techniques and technologies managed by farm/agribusiness managers.
- The businesses developing, delivering the products and services will be privately self managed.

Beneficiaries

- A mix of public, club and private goods.

Benefits

- **Financial and economic**: lower variable costs, higher profits, plus new business opportunities for suppliers of products and services.
- **Environmental and climate**: reduced pollution through lower GHG emissions.
- **Equity and social**: livelihood and business opportunities.

Investment potential

- Utilize organic biomass from the agrifood industry (fruit residues, residues from the meat and dairy industry, post-slaughter waste, distillery waste).
- Agricultural biogas can be used in several ways, but most commonly it is processed into electricity and heat in cogeneration (combined heat and power—CHP). Agricultural biogas can also be conditioned to the parameters of natural gas and injected into the gas network or used to power motor vehicles (compression and bottling of biogas).
- Gap: low level of agricultural concentration (decrease in livestock production) and significant economies of scale in constructing biogas plants. Due to fragmentation of farms, most manure cannot be processed in an economically viable way (high transportation and logistics costs) . In addition, inability of farms to comply with requirements regarding production processes, quality and safety of products.

Management

- Private.

Beneficiaries

- Private: small-scale, medium and large farms, agricultural cooperatives/enterprises, processing centres.

Benefits

- **Financial and economic**: Farm income diversification and decreased dependency on external power supply, Purchase investments, operating costs, levelized costs of electricity generation; E.g.: *1 m3 of biogas transforms into 1.44 kWh of electricity. As an example, a dairy farm with 400 dairy cows could produce between 400 to 500 kWh using CHP. The electricity produced will exceed by far the farm needs for cooling and milking (350,000 kWh produced from biogas per year, around 12,000 kWh used per year for cooling and milking*.
- **Environmental and climate**: Significant decrease in methane emissions of the dairy value chain by manure management, and by offsetting fossil fuels and fertilizers, Solid and waste management technology; Digestate can displace chemical fertilizer consumption; use of surplus biogas at household level can reduce indoor air pollution.
- Profile and level of energy yield, system flexibility, Availability of surplus thermal energy, at commercial scale, that could be used for on-farm or milk processing operations.
- **Equity and social**: Employment generation – emerging sector of the economy.

Processing Infrastructure

Processing infrastructure
Processing units

Investment potential

- Infrastructure for processing of agriculture products.
- Processing lines + storage + packaging.
- Infrastructure can be located within larger infrastructure:
  - Agro logistic centres (ALC).
  - Wholesale Food Markets (WFM).
- Gap: Efficient business model, renewable energy, energy efficient processing plants/machineries, green building.

Management

- Private investments.
- Semi-public investment through concession agreement (e.g. consortium for olive oil production).

Beneficiaries

- Private good.

Benefits

- **Financial and economic**: value added to products, increase/diversification of farmers resources and outlets..
- **Environmental and climate**: reduction of food losses and waste (FLW).
- **Equity and social**: creation of direct jobs, indirect jobs mainly for production, food safety, market access, inclusion of small holder farmers.

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Processing infrastructure
Packing houses

Investment potential

- Sorting, grading, packing line and cold storage.
- Infrastructure can be located within larger infrastructure:
  - Agro logistic centres (ALC).
  - Wholesale Food Markets (WFM).
- Gap : Efficient business model[1], renewable energy, energy efficient processing plants/ machineries, green buildings.

Management

- Mainly Private investments.
- Semi-public investment through concession agreements[2] in emerging/transitional food economies.

Beneficiaries

- Private good.
- Public good if under concession agreement (inclusion dimension).

Benefits

- **Financial and economic**: improve shelf life, marketability and pricing of food products (off season selling), aggregation costs, better price for smallholder.
- **Environmental and climate**: reduction of FLW - reduction of transport impacts through aggregation.
- **Equity and social**: creation of direct jobs, indirect jobs mainly for production and commercialization, food safety, market access, inclusion of small holder farmers.

Distribution Infrastructure

Distribution infrastructure

Grain storage infrastructure

Investment potential

- **Improvement in the quality of existing grain storage** (both on-farm and larger scale, e.g. regarding insulation) to reduce food losses and prevent food safety hazards (e.g. aflatoxins in maize): it is estimated that in certain countries, such as Egypt, up to 25% of wheat is lost due to improper storage and transportation; food safety can also be an issue in certain countries (e.g. aflatoxin contamination of maize in Serbia in 2013).
- Investment in **new state-of-the art grain bins and silos** to (a) reduce food losses, (b) tackle problems related to insufficient grain storage capacity, especially in key grain exporting and importing countries (e.g. Serbia, Egypt, Lebanon) and (c) reduce food safety hazards.
- Investment in **port storage capacity** to improve trade efficiency and lower trade costs (e.g. reduce waiting times, allow for longer term import contracts as well as for imports when prices are lower etc.).
- Improvements in the **energy efficiency of grain drying silos** or grain dryers (e.g. in terms of insulation, heat recovery etc.).

Management

- Private investments for on-farm storage (grain “bins”) and grain dryers.
- Private and public investment in large grain elevators/silos and in-port storage.
- Public investment for storage of grain stocks for food security purposes in some countries as well as for large-scale in-port storage.

Beneficiaries

- Private good.
- Public good if for food security purposes.

Benefits

- **Financial and economic**: reduced storage and drying costs and potential economies of scale if larger storage is replacing obsolete existing smaller one; potential reduction in trade costs.
- **Environmental and climate**: reduced GHG emissions from energy use; in countries with increasing yield variability (e.g. Morocco) it can also be seen as an adaptation measure.
- **Equity and social**: reduced food losses, improved food safety, improved stocks, improved trade efficiency and potentially reduced costs (access) for final consumers.

Distribution infrastructure

In-port infrastructure

Investment potential

- Investment in **berth capacity** in congested ports to reduce waiting times and related trade costs for staple commodities (FAO-EBRD 2016 Grain Sector Review reported waiting times for grain shipments in Egypt of up to 17-18 days compared to 1-3 days in European ports).
- Investment in **expanded or new grain river port infrastructure** (berths, storage and loading/unloading infrastructure/equipment) in certain key exporting and importing countries with internal waterways (Serbia, Ukraine, Egypt) can improve value chain efficiency by reducing transportation costs (existing FAO case study in Ukraine).
- Investment in **port storage capacity** to improve trade efficiency and lower trade costs (e.g. reduce waiting times, allow for longer term import contracts as well as for imports when prices are lower etc.).
- Investment in **handling infrastructure** (such as grain loading/unloading infrastructure/equipment) can reduce waiting times and improve the overall efficiency of imports/exports, reducing trade costs and prices.
- Improvements in the **energy efficiency of handling infrastructure/equipment** can reduce GHG emissions and reduce operational costs.

Management

- Mostly private investments regarding handling infrastructure/equipment and storage infrastructure.
- Private or public investment regarding port berths.

Beneficiaries

- Private good.
- Public good if for food security purposes.

Benefits

- **Financial and economic**: reduced import/export costs through improved trade efficiency.
- **Environmental and climate**: reduction in GHG emissions from equipment energy use and potentially from using internal waterways as an alternative to other means of transport (but this needs to be assessed on a case-by-case basis).
- **Equity and social**: improved capacity to export and import staple commodities, lower prices for importing countries.

Distribution infrastructure

In-port infrastructure

Investment potential

- **Storage of food products** to improve shelf life and selling price (can be dry or cold or including cold cells rooms and serve as an aggregation point).
- Usually provide a minimum of primary processing services (sorting, grading, packing).
- Post storage infrastructure can be located within larger infrastructure (depending on the proximity from production areas):
  - Post harvest storage: collection point/assembly market/agrologistics center.
- Important gap for Post harvest storage close to rural area in emerging/transition food economies.
- Gap : **Efficient management model**, renewable energy (for cold storage warehouse).

Management

- Mainly Private investments (e.g. cooperatives, association of producers).
- Public investment for post harvest storage in some countries for food security purposes.

Beneficiaries

- Private good.
- Public good if for food security purposes.

Benefits

- **Financial and economic**: improved shelf life, improved marketability and pricing of food products (off season selling), reduction of aggregation costs.
- **Environmental and climate**: reduction of FLW, reduction of transport impacts through aggregation, GHG emission reduction (EE tech).
- **Equity and social**: creation of direct jobs, indirect jobs mainly for production, improved food safety, improved market access.

Distribution infrastructure

Storage infrastructure: logistics storage warehouses

Investment potential

- Logistics storage warehouse : handling, packing, grouping and delivery preparation activities.
- Infrastructure can be located within larger infrastructure:
  - Logistics storage: WFM
- Gap : Efficient management model, renewable energy (cold storage + electric fork lift truck), green buildings.

Management

- Mainly Private investments.
- Semi public investment through concession agreements in emerging/transitional food economies to be more inclusive.

Beneficiaries

- Private good.
- Public good if under concession agreement.

Benefits

- **Financial and economic**: improved shelf life, improved marketability and pricing of food products (off season selling), reduction of aggregation costs.
- **Environmental and climate**: reduction of FLW, reduction of transport impacts through aggregation, GHG emission reduction (EE tech).
- **Equity and social**: creation of direct jobs, indirect jobs mainly for production, improved food safety, improved market access.

Distribution infrastructure
Agro-logistics centres

Investment potential

- An agrilogistics hub providing different kinds of activities according to the scale and the users:
  - Primary processing.
  - Storage (dry and cold).
  - Processing.
  - Cross docking and dispatchment platform.
  - Multimodal platform.
- Distinction between:
  - Small/medium ALC, more similar to packing houses providing aggregation, storage and primary processing services.
  - Large ALC, logistics platform providing crossdocking, multimodal and processing services.
- Infrastructure can be located within larger infrastructure: WFM.
- Gap : Efficient management and business model, renewable energy , green buildings, efficient cooling systems traceability, inclusion of smaller actors.

Management

- Private investments (small scale usually).
- Semi public investment through concession agreements (large ALCs).

Beneficiaries

- Private good.
- Public good if under concession agreement.

Benefits

- **Financial and economic**: improved shelf life, improved marketability and pricing of food products (off season selling), reduction of aggregation costs.
- **Environmental and climate**: reduction of FLW, reduction of transport impacts through aggregation, GHG emission reduction (EE tech).
- **Equity and social**: creation of direct jobs, indirect jobs mainly for production, improved food safety, improved market access.

Marketing Infrastructure

Marketing infrastructure

Rural Wholesale Food Market / Assembly Market

Investment potential

- **Small marketplaces** located in rural areas serving as aggregators of food products from producers or as intermediaries between producers and markets. Rural WFM supply urban wholesale markets in agricultural and food products.
- Food products are aggregated in bulk for their primary commercialization.
- Activities: Primary processing, Storage (dry and cold), Market place, Price information.
- Gap : **Efficient management and business model**, waste management and renewable energy , primary processing units, traceability, (mainly in emerging/transitional food economies).

Management

- Semi public through concession agreement (mainly).
- Public.

Beneficiaries

- Public good.

Benefits

- **Financial and economic**: reduction of transaction costs, better marketability, transmission of price and grade in value chains, business growth of vendors/farmers, support traditional sector (HoReCa), support resiliency of food distribution systems.
- **Environmental and climate**: reduction of FLW, promotion of short supply chain/local products.
- **Equity and social**: creation of direct jobs, indirect jobs in food systems, inclusion of small holder farmers, improved food safety, improved market access, formalization of trade.

Marketing infrastructure

Market Infrastructure: Urban Wholesale Food Market

Investment potential

- Large marketplaces facilitating the physical exchange of food. They combine the provision of infrastructure and services in a regulated business environment, gathering professional vendors and buyers for transactions to supply food to urban areas.
- Functions: aggregation, agrologistics and dispatchment, urban food supply.
- Activities: Primary processing, Storage (dry and cold), Processing, Cross docking and dispatchment platform, Multimodal platform, Market place, Price information, Last mile delivery.
- Gap : Efficient management and business model, waste management and renewable energy, traceability, inclusion of smaller actors, last miles logistics solutions.

Management

- Private.
- Semi public through concession agreement (mainly).
- Public.

Beneficiaries

- Public good.
- Private good (when private investment-exclusion of competitors).

Benefits

- **Financial and economic**: value added products, marketability, reduction of transaction costs, economic multiplier (socioeconomic development tool), transmission of price and grade in value chains, business growth of vendors, support traditional sector (HoReCa), support resiliency of food distribution systems.
- **Environmental and climate**: reduction of FLW, reduction of traffic, reduction of gas emissions, promotion of short supply chain/local products, circular economy, last miles solutions.
- **Equity and social**: creation of direct jobs, indirect jobs in food systems, inclusion of numerous actors of value chains, food safety, market access, formalization of trade.

Investment potential

- Urban retail marketplaces for fresh food distribution and urban centers vitality, small retailers and farmers.
- Functions: food retail direct to consumers.
- Activities: Direct sales to consumers.
- Gap : Efficient management and business model, waste management, cold cells, omnichannel solutions.

Management

- Private.
- Public.

Beneficiaries

- Public good.
- Private good.

Benefits

- **Financial and economic**: support to traditional sector (HoReCa).
- **Environmental and climate**: promotion of short supply chain/local products, circular economy.
- **Equity and social**: creation of indirect jobs in food system, vitality of urban centres, healthy diet.

Marketing infrastructure

Zoom-in on Wholesale Food Markets

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1. Market access and distribution – operational links between production and consumption areas:

- Give market access to local agrifood producers, formalizing trade, aggregating and facilitating the physical exchange of volumes and varieties of agricultural products.
- Provide commercial platforms that allow for regulated, formalized and uninterrupted trade in products that are delivered in a timely way to urban and rural populations.
- Establish food safety conditions and improve the dissemination of food safety standards in the supply chain, through applying these standards to products aggregated and distributed for consumption.

2. Price formation – information exchange for transparent transactions:

- Enhance product information exchange and transparent price discovery, as well as dissemination of quality standards among stakeholders on the same market platform.
- Reduce marketing costs of food-related transactions by gathering agrifood products and actors in one place, facilitating intermediary functions in food distribution and contributing to regulating operations that ultimately affect prices for the consumer.
- Generate information on local, national or international food supply and demand conditions relevant for production and trade, including through digital solutions.

Marketing infrastructure

Zoom-in on Wholesale Food Markets

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3. Adaptability in facing disruptions – infrastructural flexibility for market development:

- Provide facilities for safe handling of products, ensuring conditions for the preservation of food items, before distribution, and reduction of food loss and waste.
- Provide value-added services for aggregated products, and develop offers with enhanced stability, increasing the profitability and viability of market businesses, as well as increasing the reach of such nutritional products to consumers.
- Offer trading infrastructure and logistics in the middle of the value chain, shaping operations around the need to link production to consumption, reduce congestion and pollution, and improving overall sustainable urban infrastructure.

4. Food systems governance – participation in coordination and regulation of food supply chains:

- Contribute to the coordination of supply chains, through their intermediary functions and actors, enhancing competitiveness and strengthening food economies.
- Encourage public authorities' engagement in facilitating the regulation and delivery of products in local food systems.
- Encourage private actors, at different scales of operation, to participate in investment and management of active food business environments, offering strategic entry points for engaging with current and prospective business opportunities.

Marketing infrastructure

Case study I: Centro Agroalimentare – Rome, Italy

Urban Wholesale Food Market

- Urban food supply of Rome Metropolitan Area.
- Aggregation and dispatchment to North Italy and Northern Europe.
- 1, 2 M tonnes traded in 2021 (Fruit and Vegetables).
- 300 000 sqm built.
- 415 Vendors -1200 employees.
- Energy consumption: 22 M Kwh.
- Green Utility company in charge of distribution and maintenance.

- Energy cost (total) : 2.8 M euro in 2021 – 532 000 euro saved (energy resold to CAR discounted from public electrical network).
- Energy cost August and September 2022: 2M Euro - expected 5 M Euro energy cost by the end of 2022.
- CAR buys electricity for all the tenants at wholesale price (not to concessionaires) and through national procurement with other WFM members of Italmercati (national network of WFM).

Marketing infrastructure

Case study II: The International Market of Rungis – Paris, France

SEMMARIS, an example of green infrastructure

- SEMMARIS operates the largest wholesale food market (WFM) in the world.
- The WFM was created in 1969 and extends over 234 ha for 980,000 sqm built.
- It presents a combination of: a **physical market** (fruits and vegetables, fish, meat, flowers and dairy products), an **agrologistics area** (storage, dispatching, processing/value added services) and a **multimodal platform** (truck/train).
- In 2018, 2.8 million tons of products were introduced, 1.666 million tons for the physical market and 1.143 million tons for logistics.
- 1200 vendors – 12 000 employees.

Marketing infrastructure

Case study II: The International Market of Rungis – Paris, France

SEMMARIS, and example of green infrastructure

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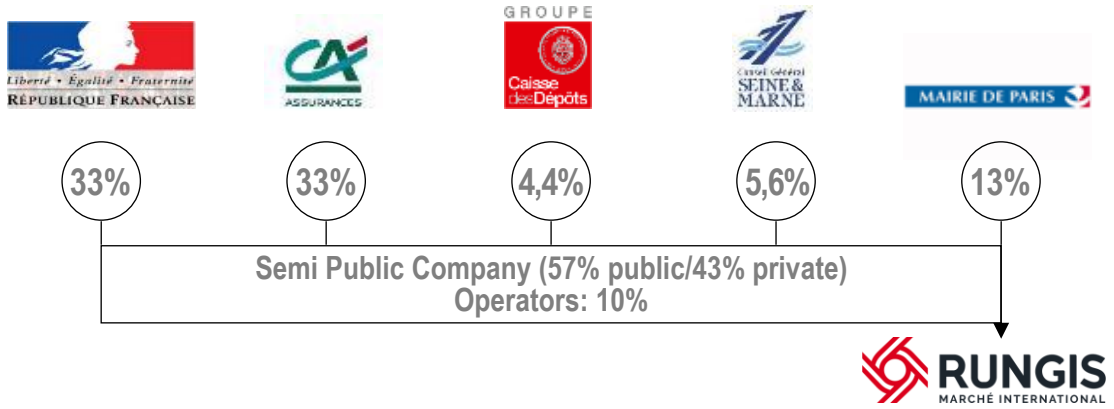
MAIN FIGURES	2018
Total area	234 ha
Entrances/year	6,7 M
Firms	1 200
Consumption basin	18 M
Turnover vendors	10 Billion Euro



Marketing infrastructure

Case study II: The International Market of Rungis – Paris, France

SEMMARIS, and example of green infrastructure

Infrastructure and services

- Sustainable facilities.
  - ICPE standards.
  - Cold rooms with gas more respectful of environment.
- Waste management and renewable energy production.
  - 100% of the waste is sorted and separated to feed two energy production channels. 78 000 tonnes of waste.
  - Food waste is used for methanization. The gas produced by this process is used as biofuel to power market vehicles, including pallet trucks and forklifts.
  - Non-food waste recovered for incineration.
  - Biomass heating plant generate no less than 200,000 MWh of energy per year.
  - Heating network largely heating needs of the market's buildings.
  - Furnishment of 2 cities in the neighbourhood.
- Engagement in reduction of carbon footprint by 30% in 2030.
  - Hydrogen for trucks (1st green hydrogen station on the market).
  - Use of train for transport between Perpiginan and Rungis 5 times a week.
  - CNG station for freight carriers (about 20,000 vehicles circulate every day, and among them 6,000 trucks using gas as fuel).
  - CO_2 and nitrogen gas station for the refrigeration units.
  - Photovoltaic recharging station.

Governance/policy

- CSR policy – 4 years plan for responsible food distribution.
- Inclusive management.
  - Professionals as share holders.
  - Capacity building of professionals (9000 sq dedicated to trainings – Catering schools – Rungis Academie).
- Rungis Green Business plan, launched in 2014 by SEMMARIS: aim is to develop alternative solutions to optimize energy potential of Rungis Market.
- Circular economy.
  - 60 associations benefiting from donations of market vendors every day – 1280 tons.
  - Association ANDES developed sorting and packing lines for unsold food products.
- Support to local and organic products.
  - Hall of producers.
  - Pavilion Bio.

Information systems – optimization of operations

- Digitalization of processes for efficient management.
- National Food price information system.
- Centralization of payments.
- Emarket place for BtoB activities.

Enabling Digital Technologies

Enabling Digital Technologies

Precision agriculture

Investment potential

- Precision agriculture using sensors, weather stations, Variable Rate technology (VRT), Artificial intelligence, cloud processing to reduce variability and increase efficiency and predictability in primary production.

Management

- Private Agtech and fintech (mostly start-ups). Both service provision and data-against-service business models can be used.
- Digital building blocks needed: farmers' registries, digital literacy, rural connectivity, regulatory measures, incentive framework.

Beneficiaries

- **Farmers**: through higher agriculture outputs, higher farmgate prices, lower production costs.
- **Digital service providers (Agtechs/ fintechs/SMEs)**: improved business ecosystem allowing for more effective and sustainable delivery of digital services.
- **Agribusiness**: More reliable and higher quality agriculture raw material supply.
- **Environment**: more favourable input/output ratios, better NR management, less pollution, less climate impact.
- **Rural populations**: more jobs, better gender and youth balanced, more attractive agriculture opportunities and rural livelihood which reduces urban migration.

Benefits

- **Financial and economic**: higher yields, higher farm gate prices, lower production costs, improved business models by digital service, more reliable and traceable raw material for down-part VC actors, better value for money for consumers, improved competitiveness of food products domestic and international, improved food commercial balance, improved food safety with positive health impact.
- **Environmental and climate**: better NR management, reduced climate impact and pollution.
- **Equity and social**: more attractive farming system for youth.

Enabling Digital Technologies

Digital marketplaces

Investment potential

- Digital marketplaces connecting supply and demand of agriculture products. Possible integration with precision agriculture, farm management and traceability packages. Systems are supported by web or APP-based platforms. They include digital, logistic and financial/payment components.

Management

- Private operators. Marketplace can be managed on a commercial basis.
- Farmer organization (or other VC actors) can set up the platform and use service providers for establishment and operation activities (digital and logistic).
- Digital building blocks needed: farmers' registries, digital literacy, rural connectivity, incentive framework.

Beneficiaries

- **Farmers**: (and their organizations): higher farmgate prices, lower food losses.
- **Specialised service providers**: improved business ecosystem allowing for more effective and sustainable delivery of digital services.
- **Agribusiness**: traceable and higher quality and safer agriculture raw material supply, lower food losses.
- **Environment**: lower food losses (associated with tighter logistics) and related lower climate impact.
- **Consumers**: safer and higher quality food (assuming stringent food quality and safety requirements are implemented).

Benefits

- **Financial and economic**: more efficient distribution of value added between sellers and buyers and less presence of intermediaries, higher value products deriving from stringent food quality and safety requirements in these marketplaces, improved competitiveness of food products domestic and international, reduced FLW, improved food commercial balance, improved and food safety with positive health impact, better value for money for consumers.
- **Environmental and climate**: lower food losses and associated lower climate impact.
- **Equity and social**: improved access to marketplaces.

Enabling Digital Technologies

Data repositories for food system transformation

Investment potential

Pooled, centralised, open access and publicly-managed data repositories would greatly enhance food system transformation capacity. These could include:

- **Digital dashboards** for monitoring and planning of food system transformation.
- **Data stacks** including big data sourced from digital farmer registries, various geodata and satellite imagery, social media, telecom.

Management

- Relevant ministries involved in food system transformation (agriculture, health, ICT, energy, trade, infrastructure) possibly in a coordinated manner.
- Agriculture and food research institutions.
- Private actors involved in agrifood sector (agtechs/fintechs, farmer organizations, processors, agribusiness, banks and insurances) can set up and manage their own databases. This solution is not optimal (pooled, centralised and open access one would be far preferable) but it is quite frequent among private sector actors.
- Data governance aspects: data will need to be governed as a precious asset by addressing key questions: (i) who owns the data, (ii) what are the ethical criteria to manage data, (iii) who controls the use of data, (iv) how to harmonize the use data, (v) are farmer and other VC actors willing to share data and under which conditions, (vi) how is access to data regulated, (vii) what is the data security policy, (viii) what specific role for legislation and policy in bridging the above gaps.

Beneficiaries

- **Public sector**: relevant ministries involved in food system transformation through better monitoring and planning capacity.
- **Private sector**: improved access to data which is an essential element (data is the new oil) for developing digital solutions (advisory, marketplace, financial services, traceability).

Benefits

- **Financial and economic**: improved business model and viability of digital services for food system, reduced cost of collecting data for developing digital solution (very significant cost for start-ups).
- **Environmental and climate**: refer to those generated by more sustainable food system as presented in previous slide.
- **Equity and social**: Open and semi-open data frameworks can greatly facilitate digital agriculture transformation with associated benefits as mentioned in the previous slide.

Enabling Digital Technologies

Digital agriculture advisory

Investment potential

- Digital agriculture advisory systems using SMS, video, chat box, virtual reality. Possible integration with precision agriculture and farm management packages. Systems are supported by web or APP-based platforms. Possible feed-back loop from users to improve the system.

Management

- Private Agtech and fintech (mostly start-ups). Both service provision and data-against-service business models can be used. In many cases, digital advisory is provided for free as part of other bundled services that are charged.
- Digital building blocks needed: farmers' registries, digital literacy, rural connectivity, regulatory measures, incentive framework.

Beneficiaries

- **Farmers**: through higher agriculture outputs, higher farmgate prices, lower production costs.
- **Digital service providers**: (Agtechs /fintechs/SMEs): improved business ecosystem allowing for more effective and sustainable delivery of digital services.
- **Agribusiness**: More reliable and higher quality agriculture raw material supply.
- **Environment**: more favourable input/output ratios, better NR management, less pollution, less climate impact (assuming advisory is climate smart).
- **Rural populations**: more jobs, better gender and youth balanced, more attractive agriculture opportunities and rural livelihood which reduces urban migration.

Benefits

- **Financial and economic**: higher yields, higher farm gate prices, lower production costs, improved business models by digital service, improved competitiveness of food products domestic and international, improved food commercial balance, improved food safety with positive health impact; better value for money for consumers.
- **Environmental and climate**: better NR management, reduced climate impact and pollution.
- **Equity and social**: improved access to knowledge and information and improved revenues as a result of financial and economic gains.

Enabling Digital Technologies

Digital traceability systems

Investment potential

- Digital traceability systems using sensors along the supply chain, blockchain or other digital ledgers for storing data, bar codes or QR codes for reading results. Possible integration with precision agriculture and farm management packages. Systems are supported by web or APP-based platforms.

Management

- Private Agtech and fintech (mostly start-ups). Both service provision and data-against-service business models can be used. Traceability is generally a digital service that can be charged.
- Digital building blocks needed: farmers' registries, digital literacy, rural connectivity, regulatory measures, incentive framework.

Beneficiaries

- **Farmers**: higher agriculture outputs, higher farmgate prices, lower production costs.
- **Digital service providers**: (Agtechs /fintechs/SMEs): improved business ecosystem allowing for more effective and sustainable delivery of digital services.
- **Agribusiness**: traceable and higher quality and safer agriculture raw material supply, lower cost of addressing food supply disruption due to traceability.
- **Environment**: lower food losses and waste and related lower climate impact.
- **Consumers**: safer and higher quality food.

Benefits

- **Financial and economic**: food traceability, food quality enhancement, food safety leading to higher farm gate prices, improved competitiveness of food products domestic and international, reduced FLW, improved food commercial balance; improved and food safety with positive health impact, better value for money for consumers.
- **Environmental and climate**: lower food losses and waste and lower climate impact.
- **Equity and social**: improved food safety and quality.

Enabling Digital Technologies

Digital financial services

Investment potential

Digital credit profile of clients using various data (farmer registries, geodata and GIS, social network data, other big data).

- Mobile payments.
- Parametric crop insurance.

Management

- Fintechs.
- Financial institutions.
- Insurance companies.

Digital building blocks needed: farmers' registries, digital literacy, rural connectivity, incentive framework.

Beneficiaries

- **Farmers and other VC actors**: improved to credit at better conditions.
- **Specialised service providers**: delivering digital financial services.
- **Financial institutions**: able to increase outreach in rural areas at limited risk and transaction cost.

Benefits

- **Financial and economic**: farmers and other VC actors accessing financial and insurance products at lower cost, financial institutions increasing their banking and insurance business, specialised providers increasing digital finance.
- **Equity and social**: improved access to finance.

Thank you

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