CoSAI
Commission on Sustainable Agriculture Intensification

CGIAR
RESEARCH PROGRAM ON
Water, Land and Ecosystems

CoSAI: Innovation Investment Study

Inception Report

About the report

This report was commissioned by the Commission for Sustainable Agriculture Intensification (CoSAI). CoSAI brings together agricultural and food systems experts and decision-makers from the Global South and is collaborating with scientists, innovators and partner organizations from across the globe. CoSAI was initiated and is supported by the CGIAR Research Program on Water, Land and Ecosystems (WLE). WLE is funded by the CGIAR Trust Fund and other donors. CoSAI Commissioners are independent.

The Oversight Committee for the study comprises CoSAI Commissioners Vara Prasad (Chair), David Simon, Jennifer Baarn, Rodomiro Ortiz, Ruben Echeverria, Sara Mbago-Bhunu, Shenggen Fan (design/inception phase), and Head of Secretariat, Julia Compton (study manager). We also acknowledge technical inputs from a CGIAR Expert Group.

The inception report has been prepared by Dalberg Asia.

October 2020

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1. CONTEXT

The need to measure investment trends in innovation for Sustainable Agriculture Intensification (SAI)

Feeding 10 billion people by 2050 will need a significant increase in agricultural output, putting a huge burden on available resources. Feeding 10 billion people in 2050 will require 56% more food than what we will be able to achieve in business as usual growth rates[1]. This will not only be driven by a growing population, but also by an expected growth in per capita food consumption of 8-12% as incomes increase. At past rates, we will need to increase global agricultural land by 593 million hectares to produce enough crop to feed this population which is the land equivalent of approximately twice of India.

Growth with current methods will be socially, economically, and environmentally unsustainable. Agriculture activities have a large impact on emissions globally, as per some studies accounting for up to ~45% of CH_4 emissions[2] and ~60% of N_2O emissions[3]. Growth of agricultural output using current methods will create a 11-gigaton GHG mitigation gap[4] between expected agricultural emissions in 2050 and the target level needed to hold global warming below 2°C. Further, some studies have stated that global water use for agriculture accounts for ~70% of total water usage. Given growing populations and food demands, water usage in agriculture will increase considerably to meet the irrigation needs of the future. While these pose obvious challenges, the overall environmental impacts of intensification of agriculture production on biodiversity and natural resources is highly uncertain. Furthermore, over and above these environmental impact, there will be severe social and economic effects of agricultural intensification for example soil erosion could lead to a loss of ~ USD 400 bn per year globally[5] and utilization of non-organic fertilizers, pesticides, is expected to create risks for human health.

The dual burdens of increasing food demand and rising food climate footprint make scaling up sustainable agriculture intensification crucial and urgent. Given the challenges in the business as usual growth path, stakeholders within the agricultural system including governments, private companies, funders, researchers, and development agencies will need to collaborate to innovate new means of agricultural production and distribution that are environmentally, economically, and socially sustainable. This will require research as well as business model innovations that are focused on increasing efficiency while keeping in mind the agroecological principles that maintain the flow of natural resources, livelihoods of farmers, and nutrition levels of consumers.

CoSAI, an initiative set up by CGIAR aims to influence public and private support towards innovation that can rapidly scale up Sustainable Agriculture Intensification (SAI) in the Global South. CoSAI comprises of a set of 21 commissioners from the Global South who are experts on agriculture and food. The Commission has identified seven main questions that it seeks to answer in related to innovation in SAI and the Global South –

1. *What do future scenarios of agriculture and food systems mean for innovation needs?*
2. *What are the current and recommended investment priorities?*
3. *What are the knowledge and policy constraints?*
4. *How can innovation support environmental objectives?*

[1] World Resources Institute "How to Sustainably Feed 10 Billion People by 2050" 2018
[2] Kevin A. Smith, "The impact of agriculture and other land uses on emissions of methane and nitrous and nitric oxides", 2005
[3] Kevin A. Smith, "Changing views of nitrous oxide emissions from agricultural soil: key controlling processes and assessment at different spatial scales", 2017
[4] World Resources Institute "How to Sustainably Feed 10 Billion People by 2050" 2018
[5] Eswaran, et al. "Land Degradation: An overview", 2001

5. *How can innovation support human objectives?*
6. *What can we learn from successful experiences?*
7. *What are some principles and metrics to guide future innovations?*

To promote SAI, it is critical to understand current investments in innovation in SAI, and how these compare to investments in agriculture innovations overall; however, data is scattered, and a macro-understanding is missing. Initial hypotheses within experts in agriculture, investments, and innovation hold that the overwhelming focus of intensification of existing practices is without consideration of any aspects of sustainability. Recent research on Bill and Melinda Gates Foundation's (BMGF) investments between 2015-2018 showed that ~85% of investments were limited to supporting only the intensification of current agricultural practices and/or increasing its efficiency. Only 3% of the Foundation's projects have any agroecological components. Similarly, 70% of projects by Kenyan research institutes were focused on intensification of current agricultural practices[6]. However, beyond the few isolated studies, there does not exist a structured assessment at a global level. Building a robust baseline will be the first step to influencing stakeholders that have the potential to increase investments in innovation in SAI.

To this end, CoSAI is working with Dalberg Advisors to conduct a baseline estimation of investments in agricultural innovation in the Global South as well as flows into SAI. Our collective ambition is to use this baseline assessment to start a dialogue on the need for increasing and improving investments in SAI. To achieve this goal, we will be publishing an output that includes the following –

1. Estimation of total investments in innovation in agricultural and SAI for the Global South from 2010 - 2019.
2. Segmentation of investments by selected parameters such as instrument type, investor type, region, investment returns, agro-ecological zones, and thematic focus.

Development of eight case studies on countries/institutions to better understand the landscape of investments in agriculture and replicate best practices.

This inception report covers four key aspects of the study.

The Agriculture Innovation Investment Tracking Framework (Chapter 2): The framework provides the main categories and sub-categories that we aim to target and include within the overall investment estimation exercise. In this chapter, we also provide a high-level methodology to be followed to populate and validate the value of investments for the final data matrix.

Case study selection (Chapter 3): This chapter gives an overview of the process followed to shortlist case studies and a proposed shortlist of ~ 15. The shortlist of case studies includes 6 countries, 5 funding agencies, and 6 themes/topics that will be evaluated further in Phase 2 when we have more data and research collected on investment flows.

Outline of the final deliverables (Chapter 4): This is an initial view on what the table of contents will look like for the final report as well as case studies. This may change based on our findings in Phase 2 and discussions with CoSAI.

Project workplan (Chapter 5): Macro workplan for Phase 2 & 3.

[6] Biovision, "Money Flows: What is holding back investments in agroecological research for Africa", 2020

2. THE AGRICULTURAL INNOVATION INVESTMENT TRACKING FRAMEWORK

This section covers the process adopted to develop the investment framework as well as the final framework that will get used to identify and tag investments in agriculture innovations for the Global South. It is structured into four sub-sections.

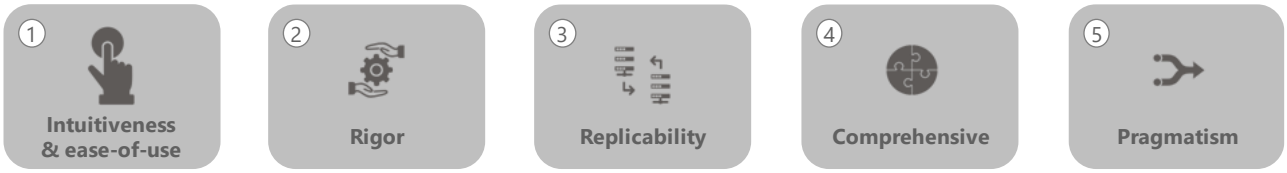
a) **Framework development process:** Key principles of design, iterative development.
b) **Leveraging perspectives from existing frameworks:** Analysis of existing frameworks to define and classify sustainable agriculture.
c) **The agriculture activity map**: Develop a macro-frame through which agriculture investments can get identified.
d) **Filtering, tagging, & SAI classification of investments**: for innovation spending, tagging into categories, and classifying investments as SAI.

Framework development process

Guiding principles

Five key principles were followed to design the framework in order to maximize its value.

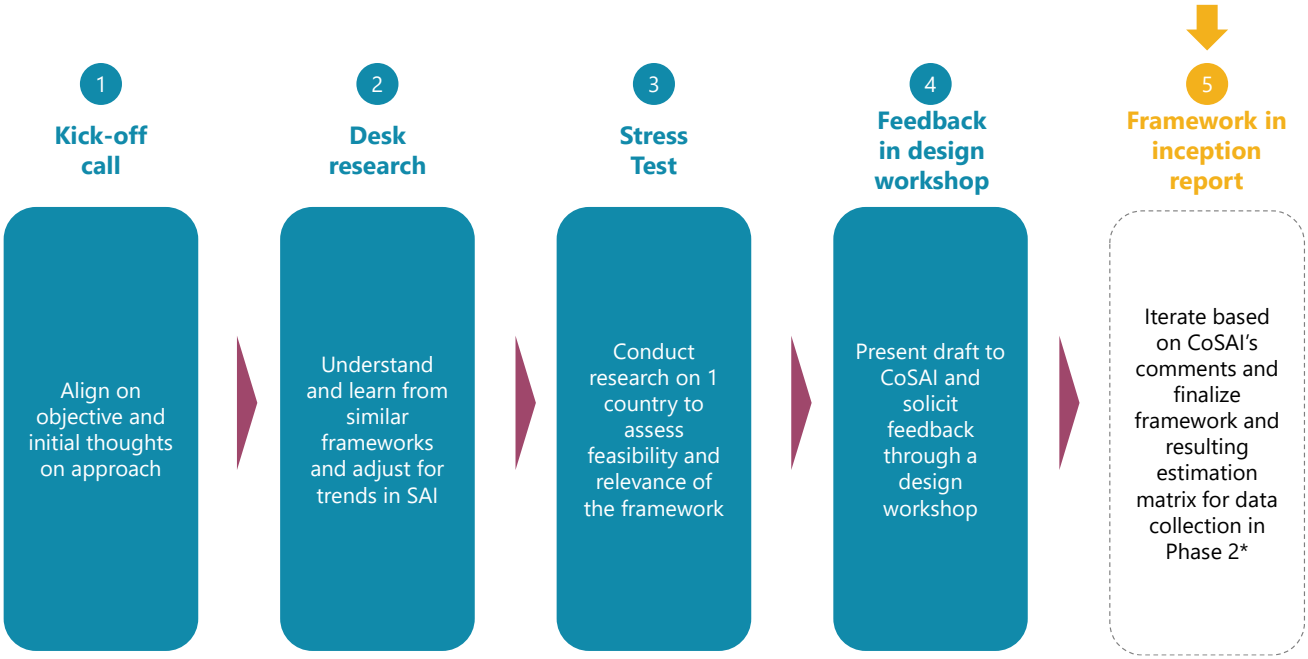
Figure 1 -Framework design principles



1. **Intuitiveness and ease-of-use:** We created a framework that is easy to use and understand for the average reader. We used terminologies and data cuts that will make it easier for various stakeholders including funders, researchers, governments, international organizations, and corporations to assimilate the output
2. **Rigor:** We understood that the additionality of this study will lie in the research rigor and resulting credibility of the output. We will conduct extensive research and analysis to make sure the final output is backed by a data matrix built through rigorous research and modelling.
3. **Replicability:** We believe the success of this framework and resulting estimation will also lie in the ability to replicate this study in future years. We will follow a methodology and structure the output such as that the document holds as an easy guide to conduct this study again.
4. **Comprehensiveness:** Our framework will aim to be comprehensive around the realm and scope of innovation in agriculture. The framework will include all investments in this space that is related to new formal and informal ways of operating without restricting to data which is easy to find.
5. **Pragmatism:** We will finally make sure that the framework used makes it easy to assign innovations and investments into each sub-category.

Iterative development - *to* develop the framework, we adopted an iterative 5-step process involving frequent check-ins with CoSAI

Figure 2- Overview of process to create framework



Please note that the framework developed in the following sections serves as a starting point for us to commence data collection and modelling to map investment flows. However, the framework including the level of tagging and innovation types tracked will be adapted based on our findings and data availability in Phase 2

Leveraging perspectives from existing frameworks

Crucially, we reviewed ~ 15 existing frameworks on agriculture innovation and sustainability to identify common themes, key differences, in order to develop a framework that was fit for purpose on this study.

Table 1 - List of reports and frameworks studied in Phase 1 to develop the framework

	Report/Framework	Description
1	USAID - Sustainable Intensification Assessment Framework (Musumba, et al. "Guide for the Sustainable Intensification Assessment Framework", 2017)	Defines 5 domains of sustainable intensification including economic, social, environmental, the human condition, and productivity considered at various levels of spatial scale from field to farm to household to landscape. The framework provides indicators and metrics that can be measured under each domain and a way to visualize the trade-offs and synergies to understand sustainability of innovations in agricultural intensification.
2	FAO "10 elements of agroecology" (FAO, "Tool for agroecology performance evaluation", 2019)	Details 10 aspects that need to be considered when transitioning to agroecological systems. The 10 elements include - Diversity; synergies; efficiency; resilience; recycling; co-creation and sharing of knowledge (describing common characteristics of agroecological systems, foundational practices and innovation approaches) Human and social values; culture and food traditions (context features) Responsible governance; circular and solidarity economy (enabling environment).
3	FAO/HLPE 13 agroecological principles (High Level Panel of Experts, "Agroecological and other innovative approaches: for sustainable agriculture and food systems that enhance food security and nutrition", 2019)	Builds on past work to reformulate 13 agroecological principles that are broadly built around three main themes of agroecological systems i.e. resource efficiency, strengthening resilience and securing social equity/responsibility.
3	Altieri's 5 principles of agroecology (Miguel A. Altieri, "Agroecology: principles and strategies for designing sustainable farming systems", 1995)	Details 5 key principles for the design of agroecological systems and various strategies to restore agricultural diversity in time and space include crop rotations, cover crops, intercropping, crop/livestock mixtures, polycultures, and so on.
4	FAO – The food system wheel framework (FAO and HLPE, "Nutrition & food systems", 2017)	The food system wheel framework is centered around FAO's main goals, which include poverty reduction, food security and nutrition. The framework captures different elements of the food supply chain and food environment that are necessary to drive food and nutrition outcomes. The framework is embedded in the broader performance of the system, referring to the three dimensions of sustainability: economic, social, and environmental.
5	Gliessman's 5 levels of agroecological transition (S. R. Gliessman , "Transforming food systems with agroecology", 2016)	Provides 5 levels for transitioning from the current industrial agricultural system towards a system based on agroecological principles and processes.
6	Cassman, et al. "A global perspective on sustainable intensification research", 2020	Reviews current trajectories towards sustainable intensification, published research on the topic, identify missing links, and propose a prioritization framework to fill gaps.
7	Social Ecological Systems framework for UK's Agricultural System	Devised to guide data collection and analysis, this framework states that the complex outcomes of SESs (e.g., sustainability and equity) are the function of both the ecological and the human components, and the

	Report/Framework	Description
	(Mahon et al, "Towards a broad-based and holistic framework of Sustainable Intensification indicators, 2018)	interactions between these components. Although this framework was devised primarily for the investigation of common-pool resources, e.g., forests and fisheries, it has been applied to agricultural systems as well.
8	Sustainable Agriculture Network (SAN), "Sustainable Agriculture Framework", 2018	Provides key outcomes and indicators mapped to each sustainability goal and impact areas. Impact areas include sustainable management of agricultural and livestock options, conservation and management of biodiversity, conservation and management of natural resources, integrated pest management, protection of worker's rights, occupational health & safety, wellbeing of workers and their family, wellbeing of rural communities, sustainable livestock production, and climate change mitigation and adaptation.
9	EAT Lancet Commission, "Healthy Diets from Sustainable Food Systems", 2019	Understands the trade-offs and optimization of diets that can meet scientific targets for human health as well as environmental sustainability. Further, the report details out 5 strategies to transform the food industry including production and consumption patterns.
10	Commission on Sustainable Agriculture and Climate Change, "Achieving food Security in the face of climate change", 2012	Assesses the current food system in the context of climate change and provides 7 recommendations as essential actions for food security and climate stabilization. Additionally, provides sources of climate and agriculture finance.
11	Agricultural Innovation Systems Conceptual Framework (Ponniah Anandajayasekeram, "The role of agricultural R&D within the agricultural innovation systems framework", 2011)	Details out the various actors, their roles and their interactions within the Agriculture Innovation System.
12	The World in 2050, "Innovations for Sustainability", 2020	Discusses the future of sustainability outcomes in the wake of the COVID-19 crisis including the role of innovation and a section on innovation investment and financing.
13	UNCTAD, "Investing in Innovation for development", 2013	Details a list of instruments used for financing innovation for development.
14	DeLonge, et al. "Investing in the transition to sustainable agriculture" 2015	Analyses investments in sustainable agriculture by identifying projects funded by United States Department of Agriculture (USDA) Research, Extension & Economics (REE) Mission Area and then assessing text under each project mapped against Gliessman's 5 levels of transition towards to agroecological systems. The study used a software called QDAMinerLite to import and analyze all projects from the USDA database.
15	WWF - 6 pillars of responsible investment (WWF, "Sustainable Finance Report", 2019)	Details 6 pillars and sub-indicators to assess whether an investor is focused on responsible/sustainable investments - Purpose, Policies, Processes, People, Products, and Portfolio.
16	Earth Security - Principles for Responsible Investment in Agriculture and Food Systems (Earth Security Group, "A framework for sustainability innovation in agri-business", 2018	Provides 10 principles for corporations to consider when strategizing and investing in sustainable agriculture and food systems.
17	TEEB Agrifood evaluation framework (TEEBWeb, "The Evaluation Framework", 2018	The framework brings together various value-chains along with the stock and flow components of agricultural systems to evaluate impact across four domains – Environmental, Economic, Health, and Social

We parsed out main learnings from secondary research on existing literature and expert interviews.

1. The literature on SAI and sustainable agriculture **emphasizes environmental sustainability**, but also gives importance to social, economic, health, nutrition, and other non-environmental aspects of sustainability.
2. There is some **ambiguity and considerable controversy around the definition as well as the scope of SAI,** specifically whether agricultural innovations such as gene editing GMO tech which attract a large amount of investment can be classified as sustainable given their unknown long-term effect on soil health and biodiversity.
3. The frameworks also emphasize the importance of macro, systems-level support to **drive innovations**[7]. For example, investments in incubation centers and accelerators that promote start-ups, in the setting up of research facilities focused on agriculture, and in knowledge and collaboration platforms that stimulate innovation or the transfer of technology across geographies.
4. Activities that drive the **adoption of agriculture innovations are equally important and should be included in the investment tagging framework.** In many cases, especially in the Global South, the technical innovation exists (say mobile phone extension services) but needs a focused push through business model and farmer engagement models to drive uptake. Such investments should be counted in and included in the analysis.

Based on this analysis, we anchored on elements from three key frameworks in the sustainable agriculture space while developing the investment tagging framework for this study. These are included in the table below.

Table 2 - List of most credible and cited frameworks on sustainable agriculture assessment

	Framework	Pros	Cons
1	***USAID's framework to assess sustainable intensification***	- *Provides a way to understand sustainability of interventions across domains, spatial scales* - *Doesn't specifically assess sustainability as a trade-off between various domain*	- *Doesn't provide a binary way to understand whether an investment is intended towards SAI or not*
2	***FAO's 10 agroecological elements***	- *Comprehensive assessment of sustainability of agriculture interventions within the realm of "agroecological systems"*	- *Anchors on agroecological systems as the main pathway towards sustainable systems*
3	***Gliessman's 5 levels of transitioning to agroecological systems***	- *Covers aspects of improvements in current processes (increase efficiency of input usage) as well as adoption of agroecological principles and developing a new global food system*	- *Anchors agroecological systems as the main pathway towards sustainable systems*

[7] As detailed in the Agricultural Innovation Systems conceptual framework; The Economic Times "How incubators are disrupting the Indian agri-tech startup landscape", 2019; OECD "Agricultural Innovation Systems: A framework for analyzing the role of the government", 2013

1. ***USAID's framework to assess sustainable intensification*** *provides 5 domains of sustainability which need to be considered while assessing sustainability of an intervention*

Figure 3 - USAID's 5 domains of sustainable intensification

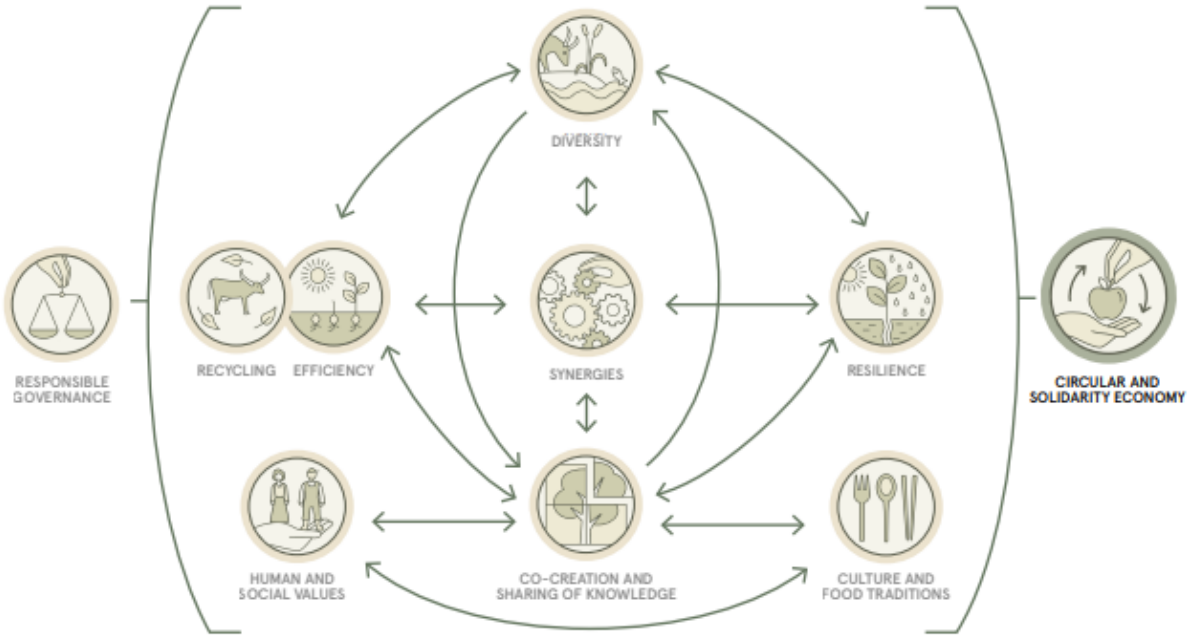
Domain	Coverage of assessment indicators
Productivity	Productivity both in cropping and livestock systems by keeping land as the key unit of input
Economic	Profitability of agricultural activities and returns of factors of production apart from land
Social	Social interactions of the farming communities or society, including equitable relationships across social groups/gender, level of collective action, and the ability to resolve conflicts related to agriculture and natural resource management.
Environmental	Natural resource base supporting agriculture (e.g., soil, water, air), the environmental services directly affected by agricultural practices (e.g., habitat, soil water holding capacity, biodiversity) and the level of pollution coming from agriculture (pesticides, eutrophication, GHGs).
The Human Condition	The individual or household, including nutrition status, food security, and capacity to learn and adapt.

Across spatial scales*

**Indicators include coverage at plot level, farm level, household level, and the landscape or administrative unit."*

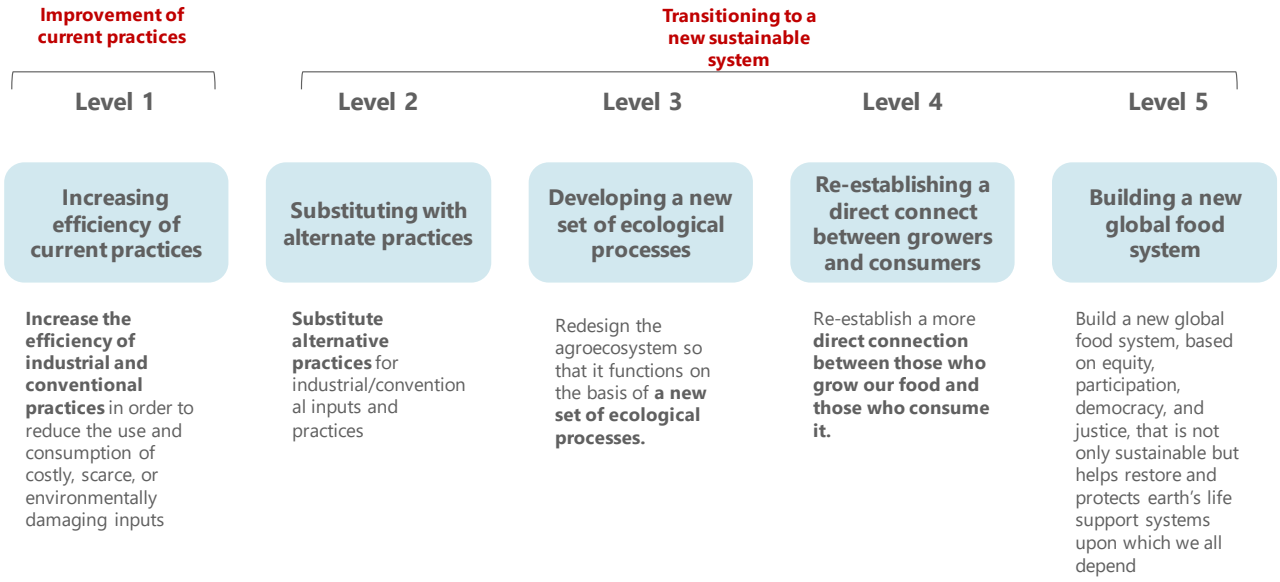
2. ***FAO's 10 agroecological elements*** *lists areas of the agroeconomic system that are essential for building and transitioning towards agroecological systems*

Figure 4 - FAO's 10 agroecological elements



***3. Gliessman's 5 levels of transitioning to agroecological systems** provides an understanding of the steps required to transition towards a an agroecological system from increasing efficiency of current practices to building a new global sustainable food system*

Figure 5 - Gliessman's 5 levels of transitioning to agroecological systems

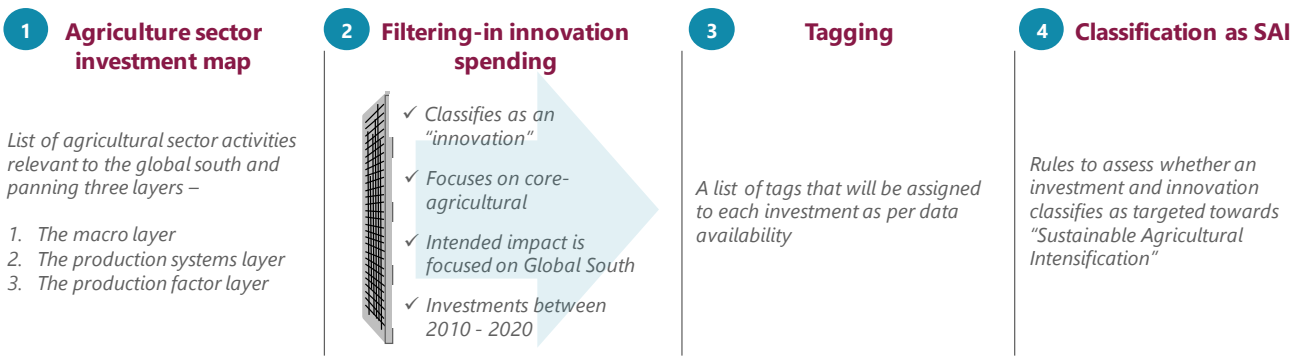


The investment framework

We will follow a four step process to analyze investments in agriculture and tag appropriate investments within the framework: 1) First, we will look at the agriculture sectors activity in (& for) the Global South through a systems lens that includes three layers, 2) We will identify investments made in agriculture innovation (as opposed to agriculture overall) through a strict filtering process, and 3) We will use a combination of tags against investments to classify them, and 4) We will use a well-defined heuristic logic to classify investments into SAI.

The diagram below and details follow.

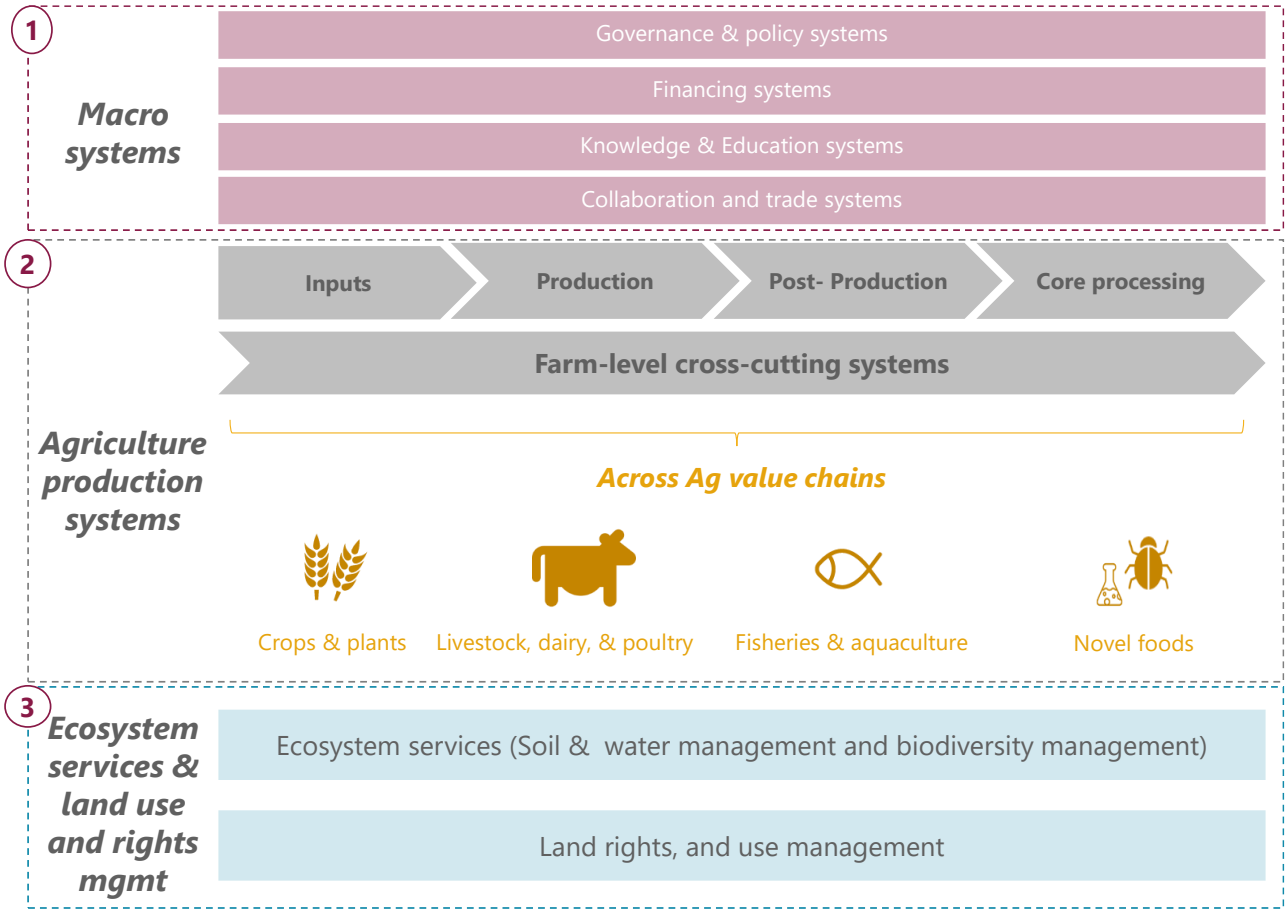
Figure 6 – Analyzing investments through the framework



1. Agriculture sector investment map

We have developed an agriculture sector investment map to capture investments at three levels 1) Investments in the macro systems that support innovation in agricultural production e.g. policies, incubation centers, research centers, collaboration platforms; 2) Investments that directly drive core production and processes of agricultural products; and 3) Investments that protect or restore production factors that are necessary for the long-term sustainability of agricultural production.

Figure 7- The agroecosystem & innovation canvas



Different elements of the investment map are described below.

1) **<u>Layer 1: The macro agriculture system</u>**

This layer refers to actors, their activities, and innovations in the fields of agriculture policy, regulation, agriculture financing, education, and, research and development. Activities and innovations in this layer play an outsized role in the innovation activity in agriculture production (Layer 2). For example, investments in setting up research institutes or incubation centers that promote innovation in agriculture lead to the development of new production processes.

Innovations in this layer can be further categorized into the following four buckets:

Table 3 - Categories and sub-categories under the macro agriculture system

Category	Innovation sub-tags
Agriculture governance systems & policy support	• Rural infrastructure policies • Human capital development • Agricultural pricing policies • Minimum support price programs • Stabilization and risk in agriculture • Food & nutrition policy • Natural resource rights • Certification systems • International environmental policy
Agriculture financing systems	• Agriculture income support programs • Management fees and set up costs for agriculture innovation funds • Innovative instruments such as climate credits and trading • Subsidies for agriculture innovations and their adoption
Research, knowledge & education systems	• Research centers and institutes (private & public) • Agriculture education institutes and programs • Extension programs • Knowledge platforms • Incubation and acceleration centers for agriculture innovation • E-learning
Collaboration & trade systems	• Sustainable agri-trade policy • International collaboration programs • Institutes for trade/tech transfer • Free trade zones • International trade fairs

2) Layer 2: Agriculture production processes

This layer refers to activities within the actual agriculture production process across the lifecycle (inputs, production, post-production, processing, and cross-cutting). Agriculture value chains have been classified into plants & crops, livestock-poultry-dairy, fisheries & aquaculture, and finally novel foods. For the purpose of this study we will also consider core processing systems for agricultural products within the agricultural value-chain (e.g. pasteurization of milk, rice processing) but exclude any retail focused innovations for (e.g. Tetra Pak aimed at increasing retail shelf life, new milk flavorings).

Table 4 –I illustrative innovations within agricultural production systems (Indicative list; will be expanded and finalized during Phase 2)

	Inputs	Production	Post-production	Core-processing	Cross-cutting
Plants & Crops	Plant breeding & biofortification	Hydroponics	Decentralized farm-level storage systems	Commodity specific processing operations (where core)	Farmer engagement platforms (including marketplaces and information platforms)
	Fertilizers/manure	Aeroponics	Packaging technology	Food fortification	Rural extension networks
	Pesticides	Integrated cropping	Uberized transport services	Protein extraction systems	AI/analytics based advisory algorithms (incl. weather)
	Genetically modified tech	Farm mechanization	Temperature sensitive storage	Upcycling of food waste/byproducts	Value-chain financing and risk management
	Agri input e-commerce platforms	Equipment automation	Decentralized solar storage		Agriculture traceability systems
	Bio fertilizers (inputs)	Irrigation systems	Food waste management		Farmer financing services
	Microbial applications	Precision agriculture			
	Seed banks	Borewell re-charging			
	Heirloom seeds	Drone tech/robotics			
	Biocides	Agroforestry			
		High nature value farming			

	Inputs	Production	Post-production	Core-processing	Cross-cutting
Livestock, Dairy, and Poultry	Animal feeding	Animal health	Packaging technology	Dairy processing (incl pasteurization)	
	Animal genetics	Integrated livestock systems	Cold storage	Meat & poultry processing	
	Animal reproduction	Precision livestock farming	Waste management	Food fortification	
		Integrated dairy farms	Farmer cooperative business models	Preservation techniques (meat curing)	
Fisheries and Aquaculture	Breeding & genetics	Fish disease management	Storage technologies	Seafood processing	
	Fish feed	Aquaponic fisheries	Waste management	Food fortification	
	New species	Vertical fish farms (offshore)	Packaging technologies	Fish preservative techniques	
	Fish disease management	Smart ponds (IoT etc.)	Supply chain technologies		
		Closed loop aquaculture	Agri marketplaces		
Novel foods	Plant meat		Storage technologies	Novel food processing	
	Lab grown meat		Waste management		
	Insect-protein based feed		Packaging technologies		
	Seaweed		Supply chain technologies		
	Wild foods				
	New local sources				

Note: The above innovation types are not comprehensive and will be added to during Phase 2.

3) Layer 3: Ecosystem services and land rights and use management

This layer refers to activities that preserve and maintain the underlying production factors for agriculture: soil, water, land, biodiversity, and forests. The ability to restore and protect these resources is directly related the sustainability of agricultural operations and hence this layer gets included in our framework.

Table 5 – Illustrative list of categories and sub-categories under " Ecosystem services and land rights and use management"

Category	Innovation sub-tags
Support and regulation of ecosystem services[1]	Soil & water management • Soil regeneration and remediation • Crop rotation • Soil and nutrient monitoring systems • Carbon sequestration systems • Watershed management • Soil erosion prevention systems Biodiversity management • Habitat enhancement • Animal and fish monitoring systems • Forest management
Land rights, and use management	• Land use and rights management systems

2. Filtering-in innovation spending

Since the scope of this study is to estimate innovation spending for agriculture in the Global South overall and assess SAI innovation spending from within that, it is essential that non-innovation agriculture spending as well as non-core agricultural spending gets excluded from our analysis.

We will only include investments that meet the following four filtering criteria

- The investment should be clearly towards an innovation
- The investment should be on core-agriculture (not frills such as flavored milk)
- The investment should either be in full or in part be targeting the Global South
- The investment should have been made between 2010-2020

Each of these filters is described below.

1) **Unambiguous classification as a present-day innovation**
    a. Classification an innovation of one or more of the following sub-types:
        i. Basic science and research spending
        ii. New product or service development
        iii. Process innovation
        iv. Marketing or behavioural innovations
        v. Business model innovations
        vi. Systems innovation
        vii. Policy innovation
        viii. Knowledge or educational innovations
        ix. Financial innovation

    b. Classification as a present-day innovation (2010-2019)

i. Is still considered an innovation and isn't an "old / mature" category: We want to include investments that still qualified as an innovation between 2010-2020

c. Making assessments on innovations relevant for the Global South: While in a large fraction of cases, we expect the classification of innovations to be straightforward, in the event of ambiguities around classifying an innovation into one of the innovation types or ambiguity around timelines, we will consult with experts &/or the CoSAI team. *Innovation categories will be classified as innovative or not by consulting experts within the industry. For example, while hydroponics, urban farming, drone technology and so on may have been introduced in agriculture decades ago, these will still be considered innovative in the Global South and hence all expenditures into these categories will be classified as an investment in innovation.

2) **Focuses on agricultural production systems**
The investment should directly impact or relate to the agricultural production system i.e. the production process required to create agricultural produce that can be consumed. This includes innovations in input systems, production, post-production, and core processing systems. In the context of this study, core processing involves any basic process required to make a raw output into a food product for e.g. pasteurization of milk. However, we will exclude any downstream processes such as flavoring, food product manufacturing, and retail. Furthermore, investments in behavioral change programs by the government or other macro level institutions to create a product category will be included (for e.g. government mass media campaigns to clean meat) but marketing spends of private agriculture to promote a specific (clean meat) brand will be excluded.

3) **Intended impact is focused on the Global South**
Building on the requirements of the ToR, we will focus on investments that are specifically targeted towards creating impact in a country or region within the Global South. These investments will thereby exclude any generic research conducted on value-chains or impact not specific to the Global South such as research by a large agro-chemical company for the discovery and development of innovative pest management products. However, we will include any innovation or research conducted in the Global North countries but intended for application in the Global South for e.g. a BMGF grant for research on cassava in Zurich will be considered within the scope of our study.

4) **Investments between 2010 – 2019**
Our study aims to assess total investments made towards innovation in agriculture between 2010 - 2020. While we understand that expenditure data may not always be available, we will use data on budgets and commitments where available highlight the same within the final data matrix. Hence, since some estimates will be based on budgets and some based on expenditures, the final aggregated investments values will be within a range that will consider conservative and aggressive estimates of budgets/commitments that are expensed. Illustratively, if a USD 100 Mn fund for innovation in agriculture has been created in 2020, we will include only the value of funds that have been disbursed by making assumptions around disbursement rates.

3. Tagging

In addition to the primary classifications into specific innovation types and value-chain segments and impact intention, we will tag each investment to the following secondary tags as per data availability.

Figure 8 - List of proposed secondary tags for each investment

Priority tags

1	**Funding source (country)**	*Country of primary source of funds*
2	**Funding source (org)**	Private Company | Private Funds | Government | Foundation/Philanthropies | Bi-laterals | Multi-laterals
3	**Funding recipient (country/ region)**	*Country or region receiving funding*
4	**Funding recipient (org)**	Private Company | University/Research Institute | NGO/NPO | Bi-lateral/Multi-lateral | Dev Agency | End-consumer
5	**Funding instrument**	Grants | Debt | Equity | TA | Hedging | Tax incentives | Guarantees/Insurance | Blended instruments
6	**Innovation stage**	Research & development | Pilot/launch | Growth/Adoption
7	**Innovation area**	Science & Tech | Product Development | Marketing extension/Behavioural change | Institutional/Infra | Policies | Business model
8	**Intended country of impact**	*Intended country of impact (if not global/regional)*
9	**Intended region of impact**	*Intended region of impact (if not global)*
10	**Stated impact intention**[1]	Economic | Productivity | Environmental | Social | Human condition
11	**Spatial scale**	Field/Animal herd | Farm/Household | Landscape
12	**Value-chain**	Crops & plants | Livestock, Dairy, and Poultry | Fisheries & aquaculture | Novel foods | Cross-cutting
13	**Holding size**	Smallholder farmers | Large-holder farmers | Both

Note: Investments in each of the rows above should add up to the same value i.e. the total investments in agriculture. In case any investments are unable to fall into the above categories due to lack of information on the investment or a new category itself it will be tagged as "N/A" or under a new sub-category i.e. "others"

1. **Funding source (country):** The source country from where the funding initially originates – for example, the funding source for BMGF in most cases would be the USA and for DFID would be the UK.

2. **Funding source (organization type)**: The organization that makes investment decisions related to agriculture and innovation including governments, bi-laterals and multi-laterals, private companies, private funds, or philanthropic/private donors.

3. **Funding recipient (country/region)**: The country to which the investment flows directly - can include countries not in the Global South. For example – Switzerland will be tagged as the funding recipient country for research on Cassava conducted in Zurich

4. **Funding recipient (org type)**: The recipient of the investment made by the primary funder that has invested in innovation in agriculture.

5. **Funding instrument:** The financial instrument used to fund the innovation.

6. **Innovation stage**: Assess whether the investment was in the research & development, pilot/launch, or growth/adoption stage. For examples, an investment in evaluating the effectiveness of a new water management system will be classified within the pilot stage

7. **Innovation area**: The functional focus area of the investment. For e.g. an investment in driving adoption of a new tractor would be classified as an investment in marketing whereas an investment in R&D for the tractor would be classified as science & technology. Similarly, investments in a new business model such as tractor as a service will be tagged as "business model" under this category.

8. **Intended country of impact[8]:** The intended country of impact for the innovation (if not regional or global).

9. **Intended region of impact**: The intended region of impact for the innovation (if not global).

10. **Stated impact intention:** Understands whether an investment is intended to impact any of the sustainability domains – economic, environmental, social, productivity, and the human condition (further detailed in the below section).

11. **Spatial scale:** Identifies the amount of investments intended to create impact at the field/plot level (e.g. yield, crop quality); farm level (e.g. improving livelihoods of farmers and overall output); or at a landscape level (e.g. innovations to change or impact a larger landscape such as whole watersheds, whole peri-urban area-level innovations).

12. **Value-chain:** The value-chain of focus for the investment (if any). This tag will be further broken down into Cereals, Pulses, Oilseeds, Tubers, Fruits, Vegetables, Other Crops, Dairy, Poultry, Livestock, Fisheries & Aquaculture, and Cross-cutting wherever feasible

[8] Standard UN country names and region classifications will be used for tags requiring country/region tagging.

4. Classification as SAI

From the various categories assigned to investments, we will use "impact intention" to determine whether an investment is focused on SAI. Learning from existing frameworks[9] on sustainability intensification assessment, we will classify impact intentions into five broad categories – 1) Economic, 2) Productive, 3) Environmental, 4) Social, and 5) The Human Condition. These categories along with associated sub-categories provide a practical and balanced framework to think about sustainability outcomes which doesn't over index on any single approach (say, agroecological methods and frameworks such as Gliessman's 5 principles). Further, while assessing whether an investment is focused on SAI or not, we will only look at the **intention of the investment** and not the eventual impact.

Figure 9 – Five sustainability domains (as per USAID framework)[10]

Sustainability Domain	Key Question	Impact Pathways
Economic sustainability	*Is it intended to improve profits?*	• Increase profitability of the private sector • Increase profitability for government (net revenues) • Increase profitability for producers • Reduce wastage • Reduce costs for end-consumers
Productivity	*Is it intended increase output per unit land?*	• Increase crop or animal yield • Increasing cropping intensity • Reduce production variability
Environmental	*Is it intended to improve the quality and quantity of natural resources and biodiversity, ?*	• Conserve natural resources or biodiversity • Reduce environmental impact per unit input/output • Move towards a lighter mix
Social	*Is it intended to improve social cohesiveness or reduce discrimination?*	• Reduce social conflict • Increase gender equity • Increase equity amongst marginalized groups
Human condition	*Is it intended to improve the state of the human condition?*	• Improve nutrition • Increase food safety • Improve food security • Increase farmer's or consumer's capacity to learn and experiment

[9] USAID Sustainability Intensification Assessment Framework; Musumba et al. (2017)
[10] "Move towards a lighter mix" refers to any intervention that aims to change the final consumption basket of consumers in such as manner to reduce the overall environmental impact of food consumed

Wherever possible, we will try and further classify investments intention under sub-buckets of each domain.

Figure 10 - Sub-categories under each sustainability domain

Productivity	Environmental	Social	Human
Improving crop or animal yield	Improved soil quality	Increase social equity	Improved nutrition
Increasing cropping intensity	Improved biodiversity	Increase gender equity	Health
Reducing production variability	Improved water availability	Reduced conflict	Food safety
Other economic	Improved water quality	Promote collective action	Food security
Increasing output per unit input	Climate Change mitigation		Improved knowledge/skills
Reducing variability of profits	Ocean Acidification reduction		
Reducing cost of inputs	Reduced fuel consumption		
Improved price realization	Biogeochemical flows (including nitrogen, phosphorous, carbon, and sulphur cycles)		
Waste reduction	Increasing forest cover		
	Improved air quality		

The following figure illustrates alternate heuristics to classify an investment as SAI. Please note that <u>the final classification approach will be decided over the course of Phase 2 in consultation with CoSAI.</u> Note, the second investment provided below mentions the use of "aeroponics" technologies. In the case that we classify certain innovation types to be SAI (for e.g. vertical farming technologies, multi-functional fish landscapes etc.), we may include this as an investment in SAI.

Figure 11 - Examples of investments classified as SAI depending on heuristics used

Investment example / SAI rule	*Philanthropic grant to Ministry of Agriculture in Ethiopia **to address food security for smallholder farmers** and the urban population through developing fully functional, **motorized small-scale machinery for teff production***	*Indian private company invests in research on **high-quality proprietary varieties of seeds** and utilizing technology advancements like cocopeat and aeroponics technologies for seed multiplication to help **improve potato production efficiencies***
Scenario 1 *None is negative*	?	?
Scenario 2 *Environmental should be positive*	Non-SAI	Non-SAI
Scenario 3 *Social or Human or Environmental is positive*	SAI	Non-SAI
Scenario 4 *Any one domain should be positive*	SAI	SAI
Scenario 5 *Environment AND (Social or Human) should be positive*	Non-SAI	Non-SAI
Scenario 6 *All domains should be positive*	Non-SAI	Non-SAI

Note: We will tag investments based on the above 5 sustainable domains and sub-tags under each wherever available. However, the exact algorithm to decide which investments classifies as SAI or not will be decided in phase 2 and 3 based on conversations amongst experts and stakeholders. We will also consider OECD/Rio type markers[11] for each sustainability tag to indicate whether the sustainability domain was a "significant" or "principal" objective of the investment.

In addition to the heuristics described above, we will also try to classify the investments, where possible, as per the five levels of transition to agroecological systems. Given the wide use of Gliessman's framework on levels of transition to agroecological systems (Refer Figure 5 above) in past research papers[12] that have studies investments in agricultural research in sustainable systems, we will aim to classify each investment wherever feasible as per the table below. These investments will also be tagged based on the intention of the investment and not the actual impact assessment.

[11] OECD "OECD DAC Rio Markers for Climate"
[12] Gliessman's 5 levels of agroecological transition has been used in papers such as DeLonge et al. (2016) and Biovision "Money Flows: What is holding back investments in agroecological research in Africa" (2020)

Table 6 - Categories and descriptions of investments that will be classified as per Gliessman's levels of agroecological transition[13]

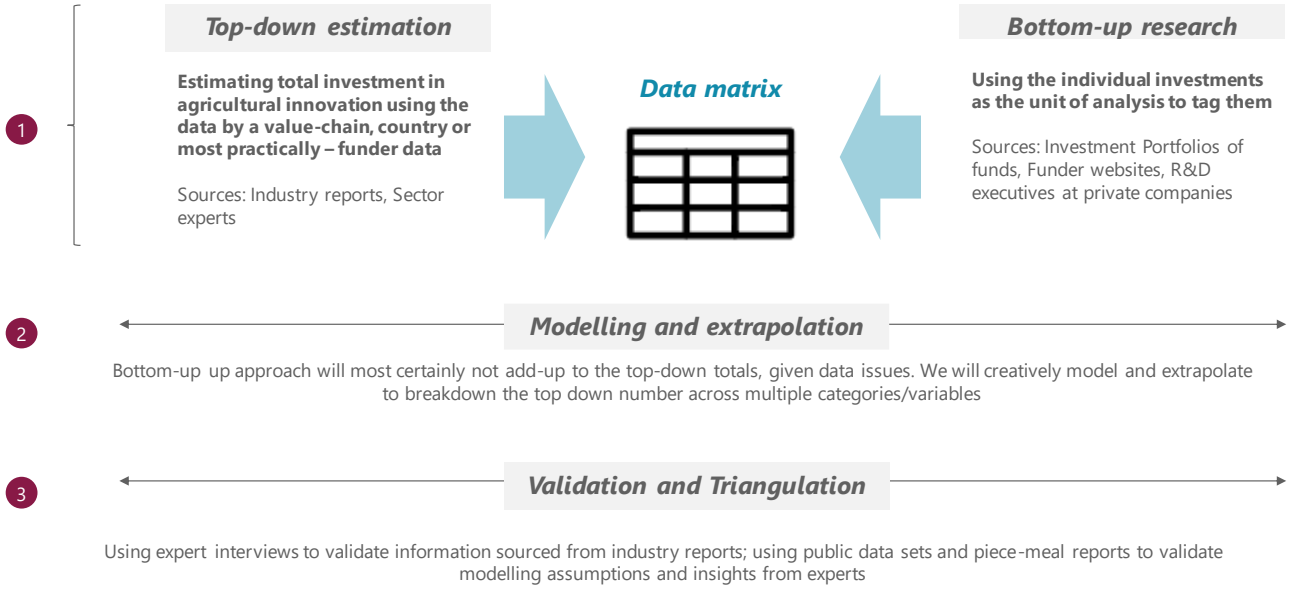
Gliessman's level of transition	Description of types of investments
Level 1	Reducing water use, reducing pesticide use, reducing fertilizer use, reducing energy consumption, reducing waste (considering post-harvest production) Improving yields per unit input (crops, meat, dairy, and fish) *
Level 2	Cover cropping to improve soil condition, adding alternate amendments, growing crops to build soil nutrients (green manure), biological pest management, cover cropping for pest management, implementing other pest management practices, planting perennials, reducing tillage, low-input or organic farming
Level 3	Selecting locally adapted crops, incorporating non-crop plants, implementing crop rotations (2 crop or more complex systems), spatially diversifying farms, agroforestry, integrating crops and livestock, improving grazing systems (rotational, regenerative), protecting biodiversity, protecting pollinators, mitigating climate change (soil carbon sequestration or achieving net greenhouse gas reductions)
Level 4	Re-establishing the connection between producers and consumers through community, business, and policy support and incentive
Level 5	Building upon the agroecological farm-scale practices (L3) integrated with new sustainable food relationships (L4) to build an equitable, just, participatory, fully sustainable global food system. While these ideas fall outside the scope of current public funding and therefore this analysis, systems-based research at Levels 3 and 4 provide the foundation for this needed change.
Unrelated to any of the levels mentioned above	Investments supporting general agriculture and/or environmental education, general care and support programs, health and/or medical support for farm workers or rural populations, increased profits for business outside of sustainable agriculture, managing environmental problems unrelated to agriculture, and investments that did not fit in any other category
Investments targeting ecological or social symptoms of current agricultural systems	Environmental damage, health risks due to toxins and contamination, health problems due to poor nutrition and limited food access, social and gender equity

[13] Descriptions have been adapted from DeLonge et al. (2016) and will be further adjusted in Phase 2 of this project as more research is conducted

Research and analysis methodology: Using the framework

Our research method would include a well-balanced (efficient) mix of top-down and bottom-up investment identification, appropriate tagging, modeling to fill gaps, and validation and triangulation for sensitive data points.

Figure 12 - High-level methodology to allocate investments into the innovation investment framework



1. Using top-down and bottom-up research to populate the data sheet of investments

Top-down research: We will understand investments in agricultural innovation through available secondary research and experts within the industry**.** While there hasn't been a comprehensive study on investments in innovation in agriculture, there are sectoral or thematic reports and datasets that can be used to fill in the high-level values of investments in agricultural innovation. For e.g. OECDstat can provide data on investments by private donors and philanthropies focused on agricultural innovation as well as environmental objectives. Similarly, reports by organizations such as AgFunder and FAO can provide high-level data and breakdown by private funds & public funders respectively.

Bottom-up research: Complementing the top-down approach, we will analyze portfolios of specific investors and funders and tag investments based on the framework. A mix of secondary research and a very small number of interviews with funders will be used for this activity. Through this bottom-up analysis, we hope to get detailed views on agriculture innovation and SAI more specifically. The table below illustrates how we might tag specific investments using different tags of the framework.

Table 7 - Illustrative tagging of investments through bottom-up research

26	Sample Investment 1	Sample Investment 2	Sample Investment 3
Investment / Tag	BMGF grant to IITA with the purpose to build an international agronomy research alliance towards improving the productivity and profitability of crops, increasing climate resilience, and rehabilitating soil health for sustainable intensification in the Global South	BMGF Grant to a Zurich-based research agency to identify the cassava CMD2 gene and its function in resistance to Gemini viruses.	Bayer's R&D expense on crop science[14]
Funding Source (country)	USA	USA	Germany
Funding Source	Philanthropic Organization	Philanthropic Organization	Private Company
Funding Target	Public Research Institute	Private Research Institute	Private Research Institute
Funding Instrument	Grant	Grant	Debt/Equity
Innovation Type	Country systems	Inputs	Farm Inputs
Innovation Sub-Type	Research Capacity Allocation	--	--
Innovation Area	Infrastructure	Science & Technology	Science & Technology
Innovation Stage	Pre-development	Development	--
Value-Chain	Crops	Crops	Crops
Value-Chain Sub-Type	--	Tubers	--
Region of focus	Global South	Africa	Global
Country of focus	--	--	Global
Impact Intention*	SAI	SAI	Non-SAI
Spatial scale	Landscape	Field/Animal herd	Field/Animal herd
Adoption curve stage	Ecosystem support	Product introduction	Product introduction

In some cases where investments will be cross-cutting across multiple sub-tags, we will make assumptions around the funding split. For example, an innovation in an Agri marketplace platform for the livestock and aquaculture industry will be split between the two value-chains based on an assumption around the value of the aquaculture and livestock market in the considered geography. Wherever, this is difficult to estimate and if the investment is sufficiently small, we will use roughly equal ratios and flag this as an assumption in the model.

2. Modelling and extrapolation to fill gaps in the data matrix

We do anticipate a scenario where the top-down and bottom-up research will still leave some data gaps in some parts of the analysis. We will fill gaps in the final data matrix through pragmatic modelling, validating sensitive assumptions with experts. Our exercise on tagging will result in a large data matrix that maps each investment to an innovation type, innovation area, funding source, funding target and so on. However, stress test of the draft framework, showed that data gaps can exist due to a lack of either the overall data or else missing detail that prevents allocation. To solve for these data gaps, we will use models and assumptions that will be informed by inputs from internal Dalberg experts and select external conversations. These assumptions will be highlighted in the final data matrix.

[14] Though publicly listed private corporations in most cases report only their overall R&D expenses with limited information on the types of innovations this spent on, we will speak to executives part of a few private companies to break-down their expenses further wherever possible

3. Validation and triangulation

Finally, for sensitive / important assumptions or parts of the model, the output will be validated and triangulated with an alternate source of data depending on the credibility of the source. In cases where data credibility is high – for example, the AgFunder database or BMGF grants database, we will conduct no or limited triangulation or validation. However, for cases where data points or assumptions are sourced through piece-meal reports, we will validate the input through either another expert interview or through available data on the topic.

3. CASE STUDY PROPOSALS

The objective of the case studies is to draw lessons pertaining to the constraints and opportunities for driving investments towards SAI in the Global South. This section covers the process followed in creating a shortlist of potential case study candidates and provides an overview of each shortlisted candidate.

Case study selection process

The objective of the selection process is to select eight diverse candidates – three countries, two international funding agencies, two ag innovation themes, and a research institute - as case studies on SAI. We understand from the ToR and discussions with CoSAI that the objective of building the case studies is to understand the funding flows in detail, as well as motivations, drivers and barriers for the investment into SAI. Through the case studies, we hope to capture the various typologies of investments in SAI, through a wide range of actors – three countries, two funding agencies and a research institute. Additionally, we will select two themes or topics of investment that can provide cross-actor insights – what are the total investment flows by different actors; what have been the focus areas; and what roles have been played by the different actors in supporting the ag innovation theme and how have these been complementary.

Figure 13 - Proposed number and type of case studies

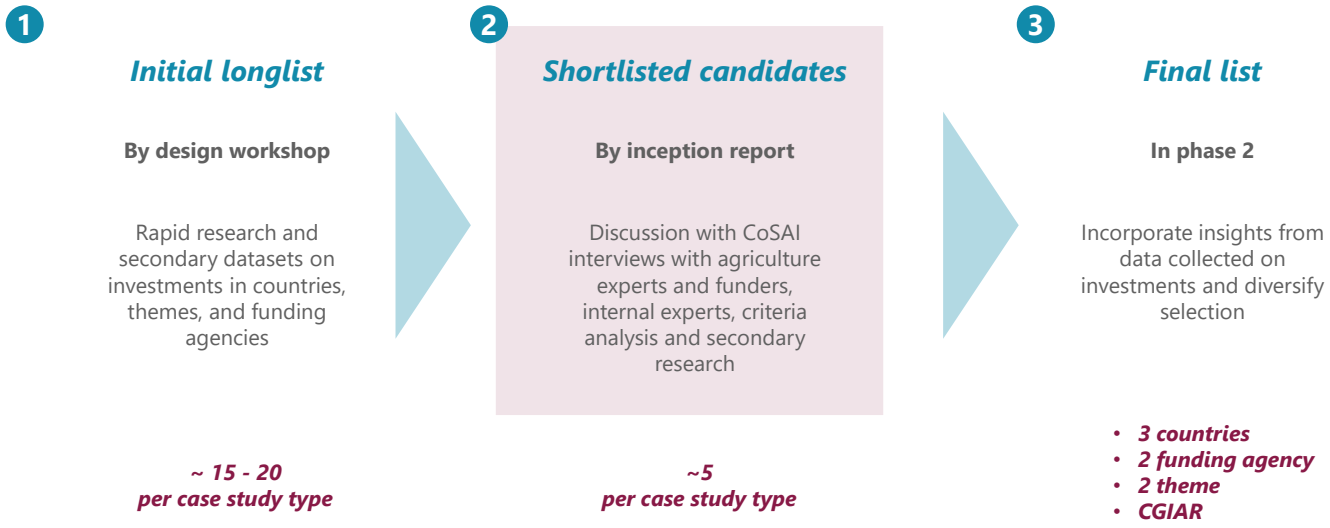
Case study type	Requirement as per ToR	Proposed selection
Country	*At least 2*	**3**
Research Organization	*CGIAR*	**1** (CGIAR)
International Funding Agency	*At least 1*	**2**
Theme/Topic	*No preference*	**2**

CGIAR, as a research institute, was selected as one (of the eight) case study candidates. CGIAR is the largest global agricultural innovation network and its associated fund is the largest public vehicle for financing agricultural research advances. CGIAR's vision is pertinent to SAI: to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership. The CGIAR Fund specifically supports research across a consortium of 15 international research institutes[15] driving innovation within the sector. Among other items, the case study on CGIAR will provide a robust view of funds that have been directed towards agricultural research for the Global South. This will be instructive for various other research institutes, funders, and governments.

We are employing a three-step process, involving frequent check-ins with CoSAI, to select the remaining seven case study candidates. We started by identifying a long list of actors and themes as step 1 based on secondary research and inputs from CoSAI. Feedback on the long list was sought during a working session with CoSAI. In addition to the feedback, the long list was prioritized based on additionality, influence, novelty, and access to data/experts (step 2). The final step (#3) will involve finalizing the seven candidates based on feedback on the inception report and in consultation with CoSAI in Phase 2, i.e. after the inception phase.

[15] The World Bank "CGIAR Fund Securing Investments For A Food Secure Future"

Figure 14 - Overview of process for shortlisting case studies



The rest of the section shares the process for steps 1 and 2 and provides an overview of the shortlisted case-study topics.

Initial longlist

We followed a top-down approach to build the longlist of case study topics under each of the three categories – countries, funding agencies, and ag innovation themes.

- **We identified potential candidates for the country case studies by assessing aggregate investments in agricultural research at a country level.** We tracked ODA flows[16] and government spending towards agriculture[17]. This includes investments directed by international bilateral/ multilateral organizations. Private expenditure and philanthropy typically add to a smaller chunk of the investment space[18]. This dual approach allowed us to track countries which are the leading investors in agriculture research and innovation but also those who are the leading recipients of investments in the area.
- **We identified potential funding agencies by assessing their total funding commitments to Agriculture, Forestry and Fisheries[19]; and investment in research as a percentage of total commitments in agriculture, forestry, and fisheries[20].** We used commitments made by bilateral/ multilateral organizations as well as philanthropies in the agriculture, forestry and fisheries sector to narrow down to few major funders. We then used investments in agricultural research as a percentage of the total commitments made in the agriculture, forestry and fisheries as a proxy for the investment flows in innovation to further narrow down the list.
- **We created a list of prominent agriculture innovation themes by analyzing VC/ PE investments[21], as well using inputs from topic experts.** This helped us gauge the emphasis placed by various actors on different innovation topics and thus, helped create a longlist under the ag innovation themes. The list was further tested by experts in different domains of innovation.

[16] OECDstat "ODA Gross Disbursements for Agricultural Research", USD mn (2018)
[17] FAOStat "Government expenditure in Agriculture, Forestry and Fisheries" (2018)
[18] Data analyzed from Fuglie et al. (2016), OECDstat, AgFunder, and ASTI shows that government/public expenditure and ODA flows for agricultural research will constitute ~ 65-75% of total research and innovation funding
[19] FAOStat 'Total Commitments in Agriculture, Forestry, and Fisheries" (2018)
[20] OECDStat "Total commitments to agricultural research" (2018)
[21] VC investments values sourced from investment portfolios of VCs like AgFunder, Anterra Capital, Greensoil Investments, Lewis & Clark Ventures, Crunchbase

We validated the longlist with the CoSAI Oversight Group in a design workshop. The top down longlist was driven primarily by secondary research and literature review. To ensure we are not excluding some critical countries, the list was stress tested with the CoSAI oversight group during the design workshop. Additions were made based on the suggestions of the CoSAI oversight group and internal experts to create a **final longlist of 16 countries, 17 funding agencies, and 21 themes/topics.**

Figure 15 - Long-list of case studies

Countries		Funding agencies		Themes/topics	
1	Bangladesh	1	Australian Centre for International Agricultural Research (ACIAR)	1	Agriculture marketplaces and new farm-to-fork models
2	Brazil	2	African Development Bank (AfDB)	2	Ecosystem services payment mechanisms
3	Cameroon	3	AgFunder	3	Farm automation and analytics
4	China	4	Asian Development Bank (ADB)	4	Forest conservation financing
5	Columbia	5	BBVA Microfinance Foundation	5	Government programs to promote sustainable agriculture
6	Ethiopia	6	Bill & Melinda Gates Foundation	6	Investments in land rights in agriculture
7	Ghana	7	Climate Investment Funds (CIF)	7	Micro-irrigation
8	India	8	European Bank for Reconstruction and Development (EBRD)	8	New and novel foods
9	Indonesia	9	Global Environment Facility (GEF)	9	New financing instruments or funds that promote SAI
10	Kenya	10	Green Climate Fund (GCF)	10	New learning networks or R&D platforms set up to promote SAI
11	Malaysia	11	IDB Invest	11	New national or global bodies set up to direct funding for SAI
12	Mexico	12	International Bank for Reconstruction and Development (IBRD)	12	New proteins
13	Nigeria	13	International Development Association (IDA)	13	Offshore fish farms
14	Philippines	14	International Fund for Agricultural Development (IFAD)	14	Permaculture
15	Thailand	15	OPEC Fund for International Development (OFID)	15	Soil health management
16	Vietnam	16	Swiss Agency for Development and Corporation (SDC)	16	Storage and waste reduction
		17	USAID	17	Sustainable animal feed
				18	Sustainable fertilizer and pesticide financing
				19	Sustainable seeds
				20	Urban farming
				21	Watershed management financing

Shortlisted candidates

We used four parameters – additionality, scale of investments, novelty and access to data/experts – to narrow down the longlist to a shortlist of 5-6 in each category. Key questions answered and proxies under each parameter are listed below:

1. **Additionality**

   *To what extent will the case study **add to existing knowledge and insight** within the sector?*

   Proxies used: Number of available case studies covering investments in agriculture innovation or sustainable agriculture, and general reports on agricultural innovation and sustainable agriculture

2. **Scale**

   *How large is the **size of investments** in ag innovation?*

   Proxies used: Government expenditure and ODA flows towards agriculture research for countries; Commitments towards agriculture, forestry, and fisheries and percentage of commitments towards agriculture research for funding agencies; expert inputs and VC funding for themes/topics, Among different parameters, there is an implicit tilt towards scale in choosing countries.

3. **Novelty**

   *To what extent is the case study **interesting for stakeholders** within the agricultural research, innovation, and investments ecosystem?*

   Proxies used: For countries we looked at the rankings by the Global Innovation Index (2017)[22] in their 2017 report which was dedicated to the theme of innovation in agriculture and food systems. For countries, we also look at available literature on types of innovations (new vs traditional) that were gaining prominence in the country; For funding agencies we looked at types of innovations (new and disruptive vs traditional and widely adopted); For themes and topics we considered expert inputs and a subjective assessment of existence and potential growth in the Global South

4. **Access to data/experts**

   *What level of **access to data and insights through secondary sources** including databases, experts, and reports?*

   Proxies used: Dalberg's network and experience within the country/topic or with the funding agency, coverage in databases such as OECDstat, FAOStat and government websites, availability of reports on the case study

These four parameters were validated with the CoSAI oversight group during the design workshop. **Based on the above-mentioned parameters, we conducted an analysis of the longlist to shortlist 6 countries, 5 funding agencies, and 6 themes.**

Please note that analysis below is a high-level effort employing a mix of qualitative and quantitative data. It is NOT intended to be a rigorous and extensive look into each country/agency/topic. The shortlisted case study proposals will be investigated in significant detail in Phase 2 before case study finalization.

[22] The Global Innovation Index "Innovation Feeding The World" (2017) ranks countries based by scoring them on innovation in various pillars such as institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, and creative outputs

Countries

Selecting six potential countries (refer Annex for detailed analysis and scoring)[23]:

We recommend finalizing the two country case studies from the following shortlist of six[24].

- **Brazil**. Brazil's transformation from a food importer to become the world's largest producer of food, fuel, feed and fibers, is explained partly by heavy public investment in sustainable means of increasing production. The country has been investing in the development of sustainable rural practices, such as integrated production and direct drilling systems, organic farming, crop-livestock-forest plantation integration, soil conservation and the recovery of degraded areas. A good representative of countries with large land holdings, Brazil's rapid agricultural growth using sustainable methods can inspire several countries in the Global South.

- **China.** China is the only country in the Global South to feature a sub-25 ranking for innovation - the next best rank for a country in the Global South is 37. China is one of the largest investors in agriculture as well as sustainable practices. The government's standard rules and regulations has provided a top-down push in the transition to sustainable practices. This is coupled by bottom-up efforts for safe, healthy, and sustainable food. This could have contributed to a revolution in ecological food and ethical eating in China's cities. China's size, its innovation ecosystem, and the approach of investing in a combination of the top-down and bottom up initiatives makes it a case study to consider.

- **Ethiopia.** Ethiopia is one of the largest recipients of ODA flows for agricultural research. The country has invested in capacity building including promoting research, development and education in various public institutions and setting up various independent research centers. The government has specifically emphasized agriculture and has been promoting private sector investments in agriculture as part of its 5-year strategy plan. In addition, it has further set up an Agricultural Transformation Policy (ATA) and Integrated Agro-Industrial Parks (IAIP). More importantly, as a case study - Ethiopia when compared to Kenya could be a better representative of the average African economy. Like its neighbors, Ethiopia is highly reliant on the agricultural sector for employment and has favorable conditions for agricultural growth. Additionally, unlike Kenya, Ethiopia doesn't have historical institutional advantages of established agricultural and dairy boards governing the sector. Its successes in promoting agricultural innovation can be relevant to other economies in the region. Given Ethiopia's representativeness of sub-Saharan Africa and its push towards agricultural research and an enabling environment for innovation, other countries are likely to find some key lessons.

[23] Kenya has been marked low on additionality due to a recent report - Biovision 'Money Flows', 2020 which covers an analysis of investments by Kenyan research institutes into agriculture
[24] We have included 6 since selection of Ethiopia vs Kenya as representative countries of the sub-Saharan Africa and African region will depend on the availability of data (favouring Kenya) and the additionality and representativeness of the case study (favouring Ethiopia)

- **India.** A leading AgTech hub in the Global South, India represents public as well as private innovation in an ecosystem marked by small land holding. India recorded second highest number of deals in agriculture after the U.S.A in 2019, seeing a ~85% funding growth. Small land holding combined with climatic diversity makes India an ideal sandbox for most of the Global South, especially African countries. Private enterprises are building on the back of public policies, research and movements centering around sustainability. For instance, the National Mission of Sustainable Agriculture (NMSA) is leading projects on soil health management, among other topics. Thus, a thriving AgTech private space, enabling ecosystem and diversity of the country – can present learnings for different countries in the Global South.

- **Kenya.** Considered as the hub of AgTech innovation in Sub-Saharan Africa (SSA), more than 25% of AgTech investments in SSA go to Kenya. The digital infrastructure – evidenced by the penetration of mobile money – is already powering new business models in agriculture. Sustainability features strongly in the government's agriculture strategy (13-18). A conducive ecosystem combined with its political and economic influence in the region makes Kenya the gateway for ODA as well. Kenya's investments in the digital ecosystem, clout in the region as well as Dalberg's own reach in the country makes Kenya a compelling choice for a case study.

- **Mexico.** Apart from being a top 10 exporter of agricultural output globally, Mexico has developed into a research hub for agriculture with well-known universities and research institutes that take a leadership position within agricultural innovation that critically important to the world, and especially to countries in Sub-Saharan Africa where hundreds of millions of people face severe hunger and poverty. Successful partnerships between the government, research organizations, and foundations have enabled international collaborations for agricultural research. Mexico has also seen the growth of venture capital and PE that is starting to establish itself within the AgTech industry in the country. A major agricultural research hub serving other parts of the Global South, successful collaborations on agricultural innovation, and encouraging growth in AgTech making it an interesting country to study.

Figure 16 - Analysis of long-list of case study proposals based on four broad criteria

Country	Scale	Novelty	Additionality	Access to data/experts	Brief rationale for ratings
Bangladesh					Bangladesh scores low in the Global Innovation Index (GII) 2017 but has had a recent growth in AgTech startups. Government spend on agricultural research is limited. Further, it gets limited support from ODA funds. However, access to data and experts to understand this country is high and could be a potential case study at a later stage in time given the recent growth of AgTech companies and technology transfer underway between India and Bangladesh. Dalberg has a good network within Bangladesh, making access to data easy.
Brazil					Brazil is set to become the world's largest food producer with a high rank in the GII 2017 amongst Latin American countries and an influential agricultural economy in the overall Global South. Investments in the country have focused on innovative topics within agriculture such as supply chain optimization and innovative livestock farming. Access to secondary data resources related to Brazil is substantial to conduct a robust analysis of investments towards the agriculture sector.
Cameroon					The government had launched improvements in agricultural competitiveness with support from the World Bank – inspiring presence in our long list. The country though has attracted limited ODA funding in the agricultural research space. Investments in agriculture are largely focused on basic pest management techniques which are common across the countries in the Global South. Its smaller size also makes it less representative of Global South.
China					China has the highest ranking in the GII 2017 signifying its strong position as an innovator overall and including within the agricultural sector. The country has heavily invested in the organic farming sector for many years. With the highest investments through governmental expenditure in the agriculture sector, China also receives significant official development funds towards agricultural research. making it a highly influential country within the agricultural sector of the Global South. However, access to data and information could be comparatively limited in China.
Columbia					With a low ranking in the GII, Columbia's focus has revolved around traditional topics (such as agricultural infrastructure, fertilizer registration, etc.) with recent interest in organic farming. Further, the country receives limited investments in agricultural research through ODA and governmental funds.
Ethiopia					Ethiopia receives large amount of ODA funds from multilateral and bilateral donors. The funding is focused on agriculture and agriculture research, making it an important country for agricultural development, especially within Sub-Saharan Africa. Though governmental expenditure on Ag research is low, there has been increased focus to develop this in the recent past with policies, institutions, and an ecosystem being set up to support research and innovation. Ethiopia has a low ranking in GII 2017 Index but can be considered as a good representative as well as a learning case study for the sub-Saharan Africa region. Further, Dalberg has a good network within Ethiopia, making access to data easier.
Ghana					Ghana has focus from the Feed the future program (funded by USAID), as well as interest from Ag experts. The country though has limited ODA funds as well as government investments in agricultural research. Further, access to data and information on investments and the agricultural sector in Ghana will be limited for detailed case study on investment flows.
India					India is one of the leading countries within the Global South when it comes to research as well as innovation within agriculture. The country has specifically been able to build a robust ecosystem for Ag tech companies and is a torchbearer of the AgTech start up sector. Dalberg has significant presence in India, thus making access to data easier.

Country	Scale	Novelty	Additionality	Access to data/experts	Brief rationale for ratings
Indonesia					Indonesia ranks low in GII 2017 (at 87) with most innovations directed towards traditional sustainable farming practices. The country also spends relatively less on agricultural research due to geopolitical constraints affecting budget allocation to agriculture.
Kenya*					Kenya ranks high on the GII 2017 and is also considered the AgTech innovation hub within sub-Saharan Africa. Given Kenya's political, research, and economic influence within the region and within the agricultural sector, it can serve as a good case study for understanding ag innovation in Africa. Furthermore, access to data and information is easier in Kenya considering the Dalberg's presence and past work.
Malaysia					Malaysia has limited ODA funds in agricultural research as well as low governmental expenditure making it a less influential country to study. Malaysia has had limited coverage in current literature cover their sustainable agriculture practices and specifically investments in this topic. Sharing the region with India, does impact its inclusion in the final six – in terms of diversity.
Mexico					Mexico's agricultural sector is driven by high investments from the government and specifically investments in novel innovative practices like climate resilient agriculture. The country ranks high in GII 2017. At the heart of Mexico's innovative efforts is Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), where there have been considerable investments to develop higher-yielding, more resilient seeds for maize and wheat, and to introduce better agricultural practices that help farmers be more productive.
Nigeria					Nigeria has limited inflow of ODA funds and governmental expenditure towards agriculture research. The country ranks low (119) on the GII Index (2017) indicating a very early stage of innovation ecosystem. However, Nigeria is an influential economy and a good representative of West Africa – warranting consideration. It also has 26 agriculture research institutions and hence, a strong consideration for a case study that aims to understand public funding in an African country that is a good representative of other countries in the region and has significant investments in agricultural research.
Philippines					With a low rank on the GII index (2017), Philippines is mostly investing in the infrastructural projects that support the agricultural sector but is relatively smaller in size compared with other Asian countries in investments in agricultural innovation and research. Further, access to data and experts is limited because of restrictive government policies in Philippines.
Thailand					Thailand has invested in the agricultural sector through a combination of ODA funding as well as governmental expenditure on agricultural research. Though the investments are significant, smaller geographical size makes the country less representative and provides limited learning for the Global South. The investments are focused on organic farming methods and other traditional innovations.
Vietnam					Vietnam has received considerable ODA funds targeted towards agriculture research. The Vietnamese government has also invested substantially towards agriculture innovation and research. However, available case studies that already analyze agricultural innovations in Vietnam reduce the additionality of studying this country again within our report. Sharing the region with India, does impact its inclusion in the final six – in terms of diversity.

***Note:** Kenya has been selected over countries such as Vietnam and Malaysia despite similar scores since access to data and the ability to conduct a robust analysis will be stronger for Kenya.

Funding agencies

Selecting five potential funding agencies (refer Annex for detailed analysis)[25]:

We recommend finalizing the funding agency case study from the following shortlist of five.

ADB
A major funder with more than USD 1.3 billion in funding (2018) in agriculture, forestry, and fishery, ADB has committed more than USD 2 billion per year towards sustainable food security. Having shifted its focus from standalone agriculture to a comprehensive multi-sector food security engagement, ADB has relied on targeted operations to tackle three challenges: stagnating productivity; lack of access to finance, infrastructure and markets; and threat of climate change and price volatility. Additionally, ADB's focus on supporting agricultural research and demonstrating returns stands out – the internal rate of return on investments in agricultural research has been 20-40%. ADB's size, multi-sector outlook towards SAI and expertise with funding research, makes it an interesting candidate for the case study.

AfDB
With more than USD ~400 million invested in the agricultural sector in 2019, AfDB is one of the leading funders in Africa. AfDB's Feed Africa Strategy 2016-2025 seeks to transform agriculture in Africa through (among others) – increased productivity and inclusivity, sustainability and effective nutrition. AfDB has been investing in novel agricultural financing tools such as 'Green Bonds' and 'Social Bonds' that promote sustainable agricultural practices. AfDB's focus and specialization in African ecosystems, ambitious future strategy and experience in novel financing tools makes it a case study to consider.

BMGF
BMGF is one of the largest private investors in the agricultural space, having committed over USD 2 billion till date, and USD ~390 million in 2018. Known for its high-risk platform plays, BMGF focuses on three channels for delivering impact: global public goods, country systems and farmer level impact. The work on global public goods has cascaded to inclusive agricultural transformation – these include vaccines, digitizing extension, public databases, etc. BMGF looks at country led agricultural work through holistic lenses of gender, country systems, nutrition, productivity and household expendable income increment. An influential private player known for its work in building ecosystems, as well as with governments, BMGF has lessons for many.

[25] BMGF has been marked low on additionality due to a recent report by Biovision 'Money Flows', 2020 which covers an analysis of investments by investments by BMGF towards agricultural research

IFAD

The only UN specialized financial institution focused exclusively on rural development, IFAD has successfully used agriculture as a means of poverty reduction – contributing USD 21 billion in funding till date. IFAD stands out with its nutrition and gender-sensitive lenses coupled with investments in climate resilient agriculture – mainstreaming nutrition, gender and climate change work in agriculture. An experienced agency in brokering partnerships, IFAD has to date mobilized USD 28 billion in co-financing and funding from domestic sources. IFAD's specialized focus on agriculture with additional lenses, as well as its success with collaborations can inspire many other funders.

USAID

With more than USD 1.2 billion in funding in 2018, USAID is one of the largest bilateral investors contributing to make agriculture sustainable. USAID's investments include setting up AgTech hubs and innovation platforms, programs for adoption of new agricultural practices and research projects including in novel foods. USAID is leading the Feed the Future initiative along with other stakeholders to strengthen agricultural growth along with nutrition and resilience. A torchbearer of ODA, other countries tend to follow USAID's areas of investment. USAID's convening power in the space along with its focus on leading frontiers of innovation makes it a key candidate for a case study on funders.

Table 8 - Analysis of long-list of case study proposals based on four broad criteria

Funding agency	Scale	Novelty	Additionality	Access to data / experts	Brief rationale for ratings
Australian Centre for International Agricultural Research (ACIAR)					ACIAR has limited funds allocated towards agricultural research or innovation when compared to other multilateral funding agencies. Further, investments by ACIAR have mostly focused themes such as Agroforestry which are not considered disruptive and novel. Access to data and experts is also limited within Dalberg's network and other secondary sources.
African Development Bank (AfDB)					AfDB has been investing in novel agricultural financing tools such as 'Green Bonds' and 'Social Bonds' that promote sustainable agricultural practices. The agency also has limited coverage in the public domain that outline its investments in innovation in sustainable agriculture. Lastly, Dalberg's strong African presence and past work with AfDB can potentially help with access to information and experts within AfDB.
AgFunder					AgFunder is one of the leading VCs investing in disruptive AgTech startups. The funding portfolio and ticket size is considerably lesser compared with international funding agencies such as IFAD, IBRD, etc. Finally, private VC funds such as AgFunder have published reports on their investments and portfolio companies making the analysis not as additional to the sector.
Asian Development Bank (ADB)					ADB has committed signification funding towards agricultural with their focus being largely towards Asia and parts of Africa. ADB has invested heavily in transforming arid/ semi-arid land to arable land making them a relevant agency within the scope of sustainable agriculture. Dalberg has a wide network within ADB making it easy to study and conduct robust analysis.
BBVA Microfinance Foundation					BBVA Microfinance foundation focus on microfinancing tools for agricultural ecosystem limits the foundation's influence as well as scope within sustainable agriculture. Further, secondary sources provide limited information on investments by this agency.
Bill & Melinda Gates Foundation					BMGF is the largest private investor in the innovation in sustainable agriculture sector making it highly influential within agricultural development sector and agricultural innovation space. Though it ranks low in terms of additionality (specifically due to a recent study by Biovision on BMGF's investments in ag research), its investments in innovations in agricultural digitization sets it apart from the rest of the funding agencies. Further, Dalberg has worked extensively with BMGF making it easy to access experts within the organization.
Climate Investment Funds (CIF)					CIF has committed ~USD 56 million in the agricultural research in 2018 which is considerably lesser than other funding agencies. Access to data and experts to understand the fund's portfolio's is limited but not a challenge for this study.
European Bank for Reconstruction and Development (EBRD)					EBRD has invested large amounts in agricultural research and innovation with investments of ~ USD 1.5 mn (2018). However, investments have mostly focused on aiding agribusinesses and hence have lacked innovation or novelty.
Global Environment Facility (GEF)					GEF has a committed ~USD 72 mn in Agriculture, Forestry and Fisheries (2018) which is considerably lesser than the other funding agencies considered. GEF's investments on agriculture have focused on dissemination of climate mitigation strategies making it relatively less interesting to study.
Green Climate Fund (GCF)					GCF's focus is making the world ready for the impact of climate change. Its focus on innovation in sustainable agriculture is limited to creating inclusive sustainable financing techniques. It also has limited funding focused on novel innovations.
IDB Invest					IDB invest has limited funding commitments towards sustainability within the agriculture sector. Further, access to information and data on IDB Invest's portfolio of investments can be challenging.

Funding agency	Scale	Novelty	Additionality	Access to data / experts	Brief rationale for ratings
International Bank for Reconstruction and Development (IBRD)					IBRD had the highest funding commitments towards agriculture, forest, and fishery sector in 2018 amongst all international funding agencies making it an important funder to study. However, it lacks in novelty as most of the innovations are directed towards improving food security through boosting the shift from unsustainable practices to sustainable agriculture.
International Development Association (IDA)					IDA has committed a large amount funding to the agricultural sector. However, investments are focused on the development of rural enterprises making it a relatively uninteresting funding agency within the realm of innovative agricultural practices. Access to experts and information will also be challenging in this pace.
International Fund for Agricultural Development (IFAD)					IFAD has invested heavily in climate resilient agriculture making it an interesting agency to study for this project. IFAD's total portfolio within agriculture is also substantial. Lastly, Dalberg has access to databases and experts through CoSAI and Dalberg's past projects that can inform a robust analysis of the agency.
OPEC Fund for International Development (OFID)					OFID committed ~ USD 176 mn to agriculture in 2018 making it relatively smaller that the other agencies considered. OFID also largely focuses on the financing of specific crop sectors in their country of focus and got limited interest as a case study when showcased to the CoSAI oversight group. However, access to data and information on OFID is strong due to good coverage on secondary sources.
Swiss Agency for Development and Corporation (SDC)					SDC has invested heavily in agricultural innovation that is targeted towards the Global South. However, there is limited access to experts and databases making a robust analysis of past investments a challenge. Moreover, the agency's investment focus has been greatly on improving agricultural storage techniques which has limited innovation.
USAID					USAID is one of the largest bilateral agencies investing in agriculture as well as innovation in agriculture. USAID's investments include setting up of AgTech hubs, setting up innovation platforms, running programs for adoption of new agricultural practices, as well as funding of research projects, and investments in novel foods. Further, Dalberg has an extensive network within USAID making information and experts easy to access.

Themes/Topics within SAI

Selecting six potential themes (refer Annex for detailed analysis):

We recommend finalizing the theme/topic case study from the following shortlist of five.

Farm automation

Farm automation has moved from traditional agricultural tools and machinery to more new age robotics, IOT, and precision agriculture techniques also known as smart agriculture. The smart agriculture market is estimated to be worth ~ USD 14 billion in 2020 and is projected to reach ~USD 22 billion by 2025. With growing demand for products, increasing per capita income of farmers in developing countries, increasing herd and farm size, livestock farming and agricultural sectors in developing countries are expected to witness increased demand for monitoring technologies, such as milking robots, feeding robots, precision agriculture technologies, precision forestry applications and other automation technologies in the coming years. Currently, VC investments in farm automation based ag tech start-ups are experiencing strong growth due to the lack of available agricultural workers during the pandemic in India. The potential growth and efficiency impact of these technologies as well as interest from private funders make this an interesting topic to study.

Food loss and food waste reduction

This topic includes reduction in the decrease in quantity or quality of food along the food supply chain including management of agro-waste by turning it into ecological and economic assets such as energy, animal feed, etc. The scale of the overall food wastage challenge is large. A survey of households in Tanzania in 2018 found that post-harvest losses account for ~12 percent of households' annual maize harvests. Studies of the tomato supply chains of Rwanda found that ~30 percent of produce is lost at critical loss points included sorting, grading, storage and transportation. In the milk supply chain, ~40 percent is lost at the farm, storage and transportation points. The SDG Target 12.3 calls for halving per capita global food waste at retail and consumer levels and reducing food loss along production and supply chains, including post-harvest loss, by 2030. Given the potential impact of investing in this topic, donors such as BMGF, Rockefeller Foundation, USAID, UK Aid, The World Bank, FAO, and others have invested considerable amounts in the early stage development of technologies to reduce losses, such as hermetic bags for cereal storage, improved crates for transporting tomatoes and better fish processing technology. Finally, investing in this topic also has clear benefits to private stakeholders within the agricultural supply chain since it can directly affect profitability of businesses. Companies such as Cargill Inc., Archer-Daniel Midland Company, etc. have invested in monitoring and educating stakeholders about food and waste management, improving food storage, and the production process to minimize waste generated at every level. The scale of the challenge along with already established interest by key public and private sector investors make this an interesting topic to study for this project

Soil Health Management

Improving soil fertility is fundamental to enhancing the productivity of smallholder agriculture across the world. Soil also sits at the intersection of three UN conventions on climate change, biodiversity, and desertification. Hence, multilaterals, bilaterals, and foundations have invested heavily in soil health management sectors such as land degradation, sequester carbon, soil monitoring systems, and others. These organizations have focused on increasing access to soil nutrients and appropriate fertilizers for farmers, increase knowledge on integrated soil fertility management, and influence national policy environments for investments in this space. This topic has also seen interest by governments in the Global South such as India that have planned to on soil renewal and soil health restoration as part of their 5-year strategic plan. Given the overall investment and impact of this topic on sustainable agriculture, this would be an interesting topic to study.

Sustainable seeds and sustainable seed management

Sustainable seeds – seeds that can be environmentally, economically, and socially sustainable while delivering genetic gains – are a key area of SAI. Given the importance of seed quality and their impact on agricultural production systems and food systems, understanding investments in various types of seeds including genetically modified seeds, heirloom varieties, early generation breeders, and seed systems is critical. Organizations such as Rockefeller Foundation, USAID, BMGF, AGRA, and various others have invested in programmatic and research efforts to improve farmer access to quality seeds and sustainable seed management practices. Some sustainable seed varieties not only encourage biodiversity but can also be resilient to environmental shocks and climate change. Sustainable seeds specifically play an important role in sub-Saharan Africa (SSA) which has a strong need for increased use of quality seeds of improved and well-adapted crop varieties. Further, these seeds can crowd in a lot of private investment in some crops once proven to be profitable. Given the wide impact sustainable seeds can have on production factors including soil health and biodiversity and its ability to attract private sector funding make it an attractive topic to study.

Novel Foods

Novel food is defined as food that does not have a significant history of consumption or is produced by a method that has not previously been used for food. The industry is gaining traction with many early age novel food focused Agri-tech startups being backed by VCs and significant research being conducted on the use of artificial meat, alternate proteins, and ethnic sources of food. In H1 2020, innovative food or novel food contributed to 18% of all AgTech investments globally, raising more in the first half of this year than all of 2019. While most of this growth is driven by the global north, the category also has strong relevance for Global South countries. Latin America specifically has seen high growth in alternate protein with countries such as Brazil seeing exponential growth in the plant based protein market. Research and breakthroughs in other novel food categories such as ethnic food for e.g. hormigas culonas (in Columbia), tanajura (in Brazil) and escamoles (in Mexico) can have a large impact in the Global South. Innovation in the sale and consumption of insects as food also holds high relevance given that demand already exists in some developing countries in Central Africa and South Asia. The investment growth within this topic and growing relevance within the realm of sustainable agriculture and food make this an interesting case to study for the Global South.

Sustainable animal feed

The size of the animal feed market in 2017 was estimated to be ~ USD 340 billion. A majority of this market is located in the Global South since countries such as China, Brazil, India, Ethiopia, Argentina and others together constitute a majority of the world's livestock population. The topic strong relevance within sustainable agriculture given that animal feed constitutes 70% of the cost of livestock production and has a huge impact on the sustainability of land, water resources, biodiversity, and forests. About half of global agricultural land is used for feeding animals, and more than a fifth of wild-caught fish is fed to animals. While most agtech investments in this topic have been driven by the global north, a fair amount of public and private philanthropic funding has been targeted towards this topic. The size of this market in the Global South and potential impact on sustainability outcomes makes it important to track investments in this topic and influence further research and funding.

Table 9 - Analysis of long-list of case study proposals based on four broad criteria

Theme/topic	Scale	Novelty	Additionality	Access to data/experts	Brief rationale for ratings
Agriculture marketplaces and new farm-to-fork models					Agricultural marketplaces mainly focus on streamlining the supply chains through various innovative approaches. Investments in these models are gaining traction in the recent years with significant potential of growth subsequently. However, assessments of investments on this topic have already been conducted since most funding comes through VCs and PE funds and are focused on the food processing or retail side.
Ecosystem services payment mechanisms					Payment for ecosystem services is a novel concept that is gaining popularity within policy and academic circles. However, investments in this space have been limited make it too early to study sustainability and flow of funds in this topic.
Farm automation and analytics					Farm automation has the potential to transform the agricultural sector is growing at a high rate. The global farm machinery market was USD 200 bn in 2019, and sub-sectors under this including precision farming are gaining a lot of traction within countries in the Global South where companies have are using robotics, Global Positioning System (GPS) and navigation systems to enhance the effectiveness of their equipment and gain a competitive advantage. Given this topics importance in the overall agricultural space - understanding the level of sustainable investments in this category will be an important assessment for the sector.
Food waste and food loss reduction					Innovations in food waste reduction complement sustainable agriculture intensification. Some studies have already been carried out on investments towards waste reduction as waste management and upscaling are gaining traction. The scale of this topic is large as it has strong potential to intensify agriculture with limited impact on types of inputs used attracting the attention and investments from large private donors, public agencies, and private companies.
Forest conservation financing					Forest conservation financing is essential to promote afforestation programs necessary to create a sustainable ecosystem. However, the sector has received less investments due to government policy barriers and lacks financial experts in the domain.
Government programs to promote sustainable agriculture					Government is a key entity in driving promotion of various policies across the innovation spectrum specially including those targeted towards agriculture. However, government programs within the Global South lack innovation and have also been extensively covered in various investment assessment case studies.
Investments in land rights in agriculture					Investments in land rights in agriculture is essential to safeguard the rights of mainly the small holder farmers facing legal issues. Currently, the lens of small holders' farmers is gaining traction but investments in this space is still limited. Access to experts that understand investments in this topic will also be challenging.
Micro-irrigation					During the last three decades micro irrigation systems have gained a lot of popularity around the globe because of their irrigation efficiency. While this topic plays a strong role in driving sustainability of agriculture production systems across the world, the topic has been studying several times including assessments of investments in this space.
New and novel foods					New and novel foods such a s artificial meat, insects, ethnic sources, and so on are widely considered the future for agricultural systems and especially a source for alternate protein as growth of livestock and meat industries get more unsustainable. While most of the innovation till date has been concentrated in the Global North, this topic is ripe with innovations and new research and the estimated meat substitutions market is expected to reach USD 3.5 bn by 2026. Given that a majority of livestock production occurs in the Global South and hence this category has a strong impact on the Global South. Moreover, ethnic food sources have been gaining popularity in research even within the Global South.
New financing instruments or funds that promote SAI					Innovative financing instruments can play a big role in attracting funding towards a sector, however, there has been limited innovation in this regards that specifically target sustainable agriculture. Most innovation in financial instruments are relevant to the development sector overall, and there is a sufficient data and studies done on innovative financing making this topic less additional for stakeholders.

Theme/topic	Scale	Novelty	Additionality	Access to data/experts	Brief rationale for ratings
New learning networks or R&D platforms set up to promote SAI					Setting up learning, and research platforms for stakeholders to collaborate towards agricultural innovation is seen as a promising vehicle to foster a paradigm shift in agricultural research for development (AR4D). Many AR4D programs, including the CGIAR Research Programs on Integrated Systems for the Humid Tropics, Climate Change, Agriculture and Food Security (CCAFS), Agricultural Aquatic Systems (AAS), Livestock and Fish, and Maize, as well as the Forum for Agricultural Research in Africa (FARA) Sub-Saharan Africa Challenge Program (SSA CP) have adopted multi-stakeholder approaches and set up innovation platforms to achieve development impacts
New national or global bodies set up to direct funding for SAI					Global bodies have always been instrumental for disbursement of funding for sustainable agriculture. However, this has been already been greatly studied by many internal and external studies focused around global/ national policies.
New proteins					New proteins are can be a disruptive innovation within the livestock industry and food industry as a whole however, it has mainly been present in the Global North. Investments are mostly backed by VCs having high risk appetite and the overall investments in this sector is low.
Offshore fish farms					While countries such as China are attempting to shift from inland freshwater aquaculture to offshore mariculture, offshore fish farming and Recirculating aquaculture system still form only ~1% of all fish farming. While there have been some considerations and studies conducted on this topic in Latin America, India, and China, this is yet to take off at a large scale.
Permaculture					Permaculture can help develop a sustainable agriculture ecosystem. However, this theme is very old with it first being introduced in 1929 and consequently has many detailed case studies present on investments in permaculture leading to lack of additionality.
Soil health management					Soil health management is a popular and well-studied topic within the sustainable agriculture space. This topic has attracted investments from public sector actors, start-ups as well as leading agricultural businesses such as Syngenta and Monsanto that have invested heavily in innovations that target soil health. While there have been studies on investment in soil health management, getting a sustainability and Global South lens to this topic would be helpful for the sector.
Sustainable animal feed					Sustainable animal feed is essential to assure input sustainability of livestock farming practices. While changing the feed for livestock can have a huge impact on sustainability of the industry, investments in this sub-sector have been limited but can have a high impact on the sector.
Sustainable fertilizer and pesticide financing					Innovations in sustainable inputs like fertilizers and pesticides are important in achieving sustainable agricultural intensification. However, this sector has been lagging in terms of investments. This topic is also difficult to study due to lack of access to experts and information on this topic overall.
Sustainable seeds					Well-targeted investments in sustainable seed multiplication systems have the potential to make a vital contribution to meeting current and future food production challenges in developing countries. The organic seed market in 2015 was ~USD 1.6 bn and was expected to grow at a CAGR of 12.5% up till 2024.
Urban farming					The global urban farming market was estimated at USD 210 bn in 2017. Countries such as China and India specifically will drive a lot of investments in this space given their narrow land accessibility for feeding a growing population. Though there are studies conducted on urban farming globally, taking a sustainability and Global South lens to this subject will add value to the sector.
Watershed management financing					Watershed management financing has seen investments as it is one of the major levers affecting sustainable farming practices. Many studies have analyzed the theme in detail leading to a lack of additionality.

The Innovation Investment Study Oversight Group met on 25th September 2020 to consider the options for case studies and decided on the following final list of case studies (in addition to CGIAR).

Type	Selection
Countries	1. Brazil 2. India 3. Kenya
Funding agencies	4. IFAD 5. USAID
Themes/Topics	6. New financing instruments or funds that promote SAI including new national and global bodies set up to direct funding for SAI[26] 7. Sustainable seeds & sustainable seeds management

[26] This topic will include themes and patterns in financial instruments being used, with detailed sub-categories where possible.

4. OUTLINE OF THE FINAL DELIVERABLES

Investment report

The final report will be roughly 100+ pages in length and will include an executive summary (6-7 pages) , the analysis of the investments (60-65 pages), methodology (5 pages), and case studies (48 pages overall – 8 x 5 pages) that summarizes the main findings from the project.

	CHAPTER
1	**Acknowledgements**
2	**Executive summary**
3	**Context & goals of the study**
4	**SAI: An introduction**
5	**The state of investments in ag innovation***
	Investments in ag innovation
	Investments in SAI
	Trends by year and geography
	Trends by other data cuts
6	**Gaps & opportunities**
7	**Detailed methodology**
8	**Case studies**
	Country X
	Country Y
	Funding agency A
	CGIAR
	Theme/Topic 1

Things to note:

1. The current report structure is flexible and can be changed basis findings in Phase 2 and discussions between Dalberg, CoSAI, and external stakeholders
2. We will provide benchmarks to give a sense of the value of investments within agriculture and SAI in relation to other sectors or similar investments.
3. The executive summary will include a short overview of the methodology and approach followed to estimate and track investment.
4. In addition to the report, we will provide a detailed excel based output that is easy to use to understand investments in agricultural innovation and SAI based on all data cuts that were available through our research.

Case study reports

Each of the case studies will be 4-5 pages in length and will focus on on investments, their flows, and the sectors and sub-sectors that they have targeted but not assess the impact of these investments.

A high-level outline of the case studies is given below.

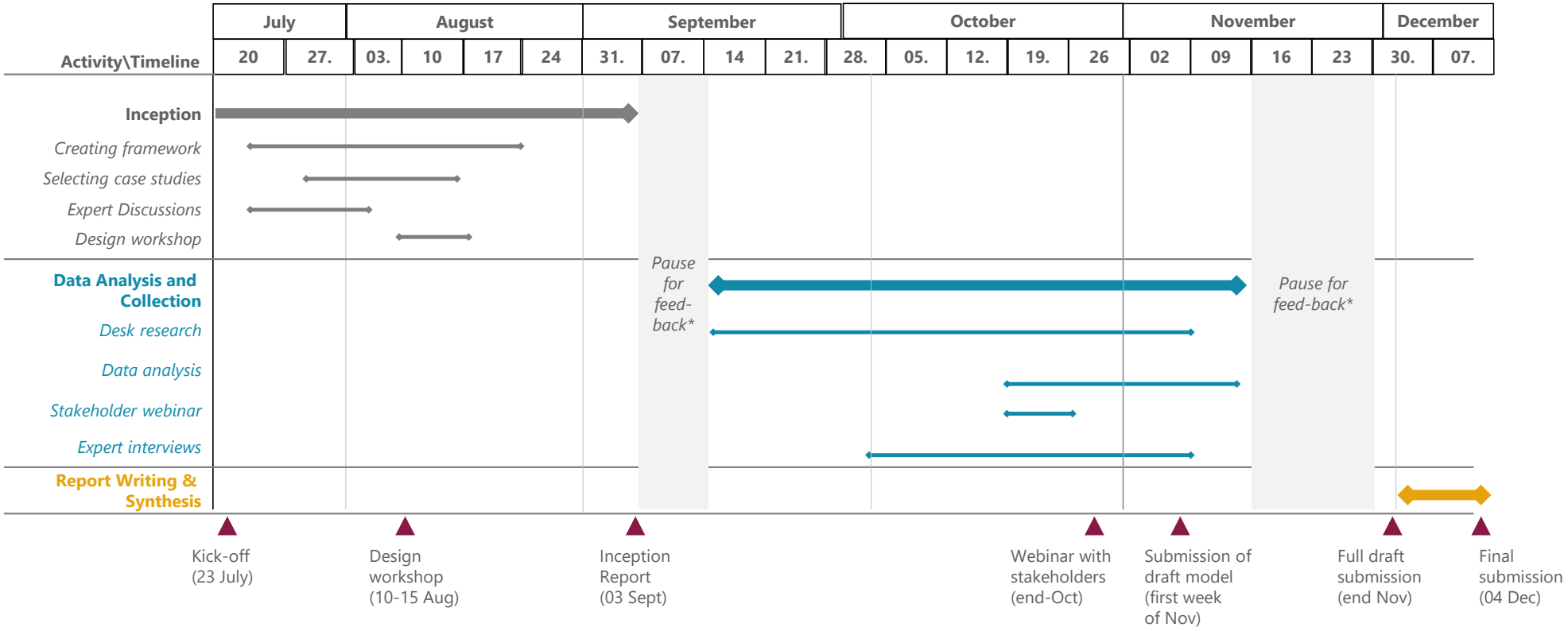
	SECTIONS
1	**Context**
	Background on entity
	Overview of agricultural focus of entity
2	**Funding sources and target flows**
	Overview of sources of funding
	Overview of funding targets
	Trends in funding flows
	Financing needs and opportunities
3	**Sectors of focus**
	Investments by sector and sub-sectors
	Investments in SAI
4	**Learnings and Best Practices**
	Best practices in driving investments in SAI
	Key learnings from investment portfolios
5	**Planning for COVID-affected future growth***
	COVID Mitigation Strategies
	The way forward

**Adding an analysis and narrative around the impact of COVID-19 on case studies will be decided on a case by case basis*

5. PROJECT PLAN

Workplan

We aim to spend ~ 8 weeks on data collection and submit the final report, model, and case studies by 4th December*.



* Subject to revisions based on data availability and finalization of the inception report

Key check-in points

Over the course of the project, we will have the following check-ins with the CoSAI -

1. Inception report feedback (first week of September) - *completed*
2. Webinar with stakeholders (End-October)
3. Draft model presentation (first week of November)
4. Full draft presentation (End November)
5. Final presentation and submission (first week of December)

ANNEXURE

Scoring criteria for shortlisting case studies

Note: In addition to the scoring below, we have considered qualitative inputs from secondary research, internal and external expert reviews and recommendations from the CoSAI team to adjust the score for each case study.

Countries [27]

Additionality

- Available case studies on investments in innovation in sustainable agriculture
- Available case studies on agriculture innovation (More than two)
- One or two case studies detailing sustainable agricultural practices or ag innovation
- No case studies detailing sustainable agricultural practices or ag innovation

Scale

- Low governmental expenditures in ag research + Low ODA flows in ag research
- Low governmental expenditures in ag research + Medium ODA Flows in ag research
  Low governmental expenditures in ag research + High ODA Flows in ag research
- Med. governmental expenditures in ag research + High ODA Flows in ag research
  Med. / High governmental expenditures in ag research + Med. / Low ODA Flows in ag research
- High governmental flows in ag research + High ODA Flows in ag research
  High governmental flows in ag research + Medium ODA Flows in ag research

Low: Bottom 1/3rd
Medium: Middle 1/3rd
High: Top 1/3rd

Novelty

- Low ranking in GII 2017 + largely innovations in traditional topics
- Medium ranking in GII 2017 + largely innovations in traditional topics or
  Low ranking in GII 2017 + largely innovations in novel topics
- High ranking in GII 2017 + strong focus on traditional topics of innovations
  Medium ranking in GII 2017 + largely innovations in novel topics
- High ranking in GII 2017 + strong focus on novel topics of innovations

Low: Bottom 1/3rd
Medium: Middle 1/3rd
High: Top 1/3rd
GII: Global Innovation Index

Traditional: Existing technologies dominant in the Global North
Novel: New age technologies gaining traction all over the world

Access to data/ experts

- Limited Network of internal/ external experts + Almost no coverage on databases
- Some available internal/ external experts + Almost no coverage on databases
- Strong network of internal/ external experts + Limited coverage on databases
- Strong network of internal/ external experts + Strong coverage on databases

Limited Network: No Dalberg presence
Some/ Limited: Dalberg past studies conducted; fragmented data sources and websites present
Strong: Presence of Dalberg office and external experts availability; data abundance in websites, OECD, etc.

[27] Government expenditures (Total public expenditure) taken from FAOStat; ODA Flows on total investments on Agriculture, Forestry, Fisheries sourced from OECDStat; GII: Global Innovation Index 2017

Funding agencies[28]

Additionality

- Detailed case studies available in investments in innovation in sust. agriculture with portfolios
- Greater than one case studies available in sustainable agriculture
- One or two case studies available detailing sustainable agricultural practices or ag innovation
- No case studies available detailing sustainable agricultural practices

Scale

- Lower commitments to agri., forestry & fisheries
- Low commitments to agri., forestry & fisheries
- Medium commitments to agri., forestry & fisheries
- High commitments to agri., forestry & fisheries

Lower: Bottom 1/4th
Low: Mid 1/4th
Medium: Below top 1/4th
High: Top 1/4th

Novelty

- Investments focus mainly in widely adopted technologies across the world
- Investments focus mainly in the widely existing technologies of Global North
- Investments focus mainly in new technologies referencing Global South
- Investments focus mainly in disruptive technologies across the globe

Access to data/ experts

- Limited Network of internal/ external experts + Almost no coverage on databases
- Some available internal/ external experts + Almost no coverage on databases
- Strong network of internal/ external experts + Limited coverage on databases
- Strong network of internal/ external experts + Strong coverage on databases

Limited Network: No Dalberg presence
Some/ Limited: Dalberg past studies conducted; fragmented data sources and websites present
Strong: Presence of Dalberg office and external experts availability; data abundance in websites, OECD, etc.

[28] Commitments to Agriculture, Forestry & Fisheries (2018, US $ Millions) sourced from FAOStat; % agricultural research sourced from FAOStat; Novelty of investments assessed based on position on the innovation Adoption curve (conceptually taken from Crossing the Chasm, G. Moore) and analyzed on a subjective basis for each funding agency

Themes/Topics[29]

Additionality

- Detailed case studies available in investments in innovation in agriculture
- Few case studies available in agriculture innovation (More than two)
- One or two case studies available detailing sustainable agricultural practices
- No case studies available detailing sustainable agricultural practices

Scale

- Nearly no VC investments in the theme of focus
- Low VC investments in the theme of focus
- Medium VC investments in the theme of focus
- High VC investments in the theme of focus

Low: Bottom 1/3rd
Medium: Middle 1/3rd
High: Top 1/3rd

Note: Expert Interviews also considered

Novelty

- Significant presence and almost no potential of growth in the Global South
- Fragmented presence and some potential of growth in Global South
- Low presence and strong potential of growth in the Global South
- Disruptive technology with almost no presence but strong potential in G. South

Access to data/ experts

- Limited Network of internal/ external experts + Almost no coverage on databases
- Some available internal/ external experts + Almost no coverage on databases
- Strong network of internal/ external experts + Limited coverage on databases
- Strong network of internal/ external experts + Strong coverage on databases

Limited Network: No Dalberg presence
Some/ Limited: Dalberg past studies conducted; fragmented data sources and websites present
Strong: Presence of Dalberg office and external experts availability; data abundance in websites, OECD, etc.

[29] VC investments values sourced from investment portfolios of VCs like AgFunder, Anterra Capital, Greensoil Investments, Lewis & Clark Ventures, Crunchbase