



# INCEPTION REPORT

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# 1. Introduction

This document presents the inception report for the evaluation of a gap analysis of research on small-scale agriculture in the global south, with a focus on sustainable agriculture intensification (SAI). It outlines the evaluation team's intended approach to the gap research evaluation. Under the guidance of the Commission for Sustainable Agriculture Intensification (CoSAI) team, this document was prepared by Havos, an AI services and consulting firm. It contains information regarding the purpose and scope, objective, approach, and work package.

Havos Inc on behalf of the International [Commission on Sustainable Agriculture Intensification](#) (CoSAI) will develop a gap analysis of research on small-scale agriculture in the Global South, drawing on methods used in [Ceres2030](#), with an emphasis on gaps in evidence related to sustainable agriculture intensification (SAI).

The study will provide an important piece of evidence feeding into CoSAI: helping fill in gaps in priorities for future innovation spending. It will also feed into the [Transforming Innovation global campaign](#) to increase funding to R&D and innovation in this area, which will inter alia aim to influence the 26<sup>th</sup> United Nations Climate Change Conference of the Parties ([COP26](#)).

The purpose of this document is to confirm that all agreed-upon tasks are included in a work plan which will form the basis of a 3-month project delivery.

## 1.1 Background

Global food systems are off track to deliver nutritious, affordable, and healthy food to a growing global population whilst reducing carbon emissions in line with limiting global heating to 1.5C, increasing resilience to a changing climate, and reversing the food system's contribution to biodiversity crisis.<sup>1</sup> Research and innovation, including innovation in policy, institutions, and finance, will play a large part in developing the transformative changes in agricultural systems needed to address these complex challenges. There is evidence that although agricultural research and innovation provide high returns<sup>2</sup>, there is consistent underinvestment in this area. In particular, recent work by the [Ceres2030 Initiative](#) (based at Cornell University, 2018-20) has highlighted that there is massive under-investment in research for small-scale farms in the Global South (Nature Editorial, 2020<sup>3</sup>).

The [Commission on Sustainable Agriculture Intensification](#) (CoSAI) was set up to promote more and better investment in innovation for Sustainable Agriculture Intensification (SAI) for the Global South, [in support of the Sustainable Development Goals \(SDGs\)](#). For CoSAI, innovation includes not only science and technology but also innovation in policies, finance, and social institutions. CoSAI has a timeline running up to December 2021.

<sup>1</sup> (CCAFS, 2020; EAT-Lancet Commission et al., 2019; GCA et al., 2018; GLOPAN et al., 2020; HLPE, 2020; IPCC, 2019; Pharo et al., 2019; Searchinger et al., 2019)

<sup>2</sup> (Alston et al., 2020; Hurley et al., 2016)

<sup>3</sup> <https://www.nature.com/articles/d41586-020-02849-6>

CoSAI has six Commissioner Working Groups addressing [Big Questions](#) around innovation for SAI. Working Group 2 focuses on priorities for innovation. Some of the work already commissioned under this working group includes two studies on global funding for innovation in SAI ([Investment Baseline](#) and [Investment Gap](#) studies) and a study on [instruments and approaches](#) for innovation in SAI.

CoSAI is building up an evidence base to support the case for increased and better-targeted investment in agricultural innovation for the Global South. This includes studies on the investment baseline and projected investment gap, approaches and instruments, learning from case studies on pathways to innovation, and a Taskforce on Principles and Metrics.

What is currently missing from CoSAI's evidence base is good-quality evidence on specific gaps and priorities for research and innovation topics. CoSAI's investment baseline study has highlighted the poor quality of information available on funding for different topics. To fill this missing evidence, this study will look at past publications and use these to assess the gaps in evidence.

## 2. Purpose and Scope

### 2.1 Purpose

The purpose of the study is to highlight major gaps and possible areas for investment in research and innovation for small-scale farms in the Global South. This will aid the prioritization and coordination of international funding and research efforts. It will provide an important piece of evidence feeding into CoSAI's advocacy for more and better-targeted funding for innovation in SAI for the Global South, including the discourse on innovation around the UN Food Systems Summit and the United Nations Climate Change Conference of the Parties (COP26). Finally, the analysis will also provide the first step towards the establishment of an Evidence and Gap Map, that could be a legacy product from CoSAI.

### 2.2 Scope

The scope of the study is small-scale farming and post-production food systems in the Global South.

The analysis will use artificial intelligence software that was originally developed by researchers at Cornell University for [Ceres2030](#), and subsequently updated for other work commissioned by IFAD, USAID, and the Bill and Melinda Gates Foundation. The CoSAI study represents the largest dataset used by the team to date—more than one million agri-food research publications using a citation and abstract dataset provided by CABI Research Organization. It will also include some of the grey literature sources used in Ceres2030 and related projects, representing a comprehensive dataset.

### The preliminary list of factors to be explored is:

- Focus of research (local/national/global):
  - *The research will be mapped at the country level, although when more specific detail is provided, such as city or province, that will also be included.*
- Regions and countries
  - *General geographical regions as defined by the World Bank Country Classification 2021.*
- Research leadership
  - *The organizational affiliations of the study's primary author.*
- Funding source
  - *The funding source of the research*
- Intervention type
  - *The primary interventions from the study, and each classified into three tiers of technology, socioeconomic and ecosystem services.*
- User groups
  - *The primary population of the research study. While we anticipate the majority of the research in the dataset will focus on small-scale producers, often referred to as small-scale farmers, populations such as value-chain actors, service providers, private sector actors, may also be present and will be mapped accordingly.*
- Sectors and subsectors
  - *The primary and sub-sectors of the research, such as farming, fisheries, livestock, and forestry, and sub-sectors contained within.*
- Disciplines
  - *The general research disciplines, such as crop and soil sciences, agricultural economics, and extension and advisory services.*
- Scale of research (field/farm/landscape/food system)
  - *The research phase of the study, such as field study, research & development, landscape analysis, meta-analysis and more.*
- Outcome categories
  - *The primary research outcomes from a study.*
- Equity - wealth, ethnic group, gender
  - *The research includes analysis on social differences, especially female, resource-poor, educational attainment and literacy, ethnic group and more*

The final list of factors and the specific categories for each will depend on the completeness of the data. An initial review of the dataset is underway now and finding where metadata is incomplete. For instance, only up to 90% of the data can be used to understand research leadership, because affiliation information is not available for all citations. These limitations will be noted in the final report

## 2.3 Evaluation Question

The evaluation question for this study is to identify what research has been conducted in agriculture and present it in a way that is more useful to development and international financing partners. Rather than retrieving only search results based on a keyword search, we present *a priori* classification of large text-based datasets. This enables users to focus on the analysis of existing content. We will focus on the categorization of existing research according to the factors listed above. To understand what these gaps are, Havos will be using machine learning (AI) to map the research and see where the gaps are. Havos will provide an analysis to CoSAI that describes our findings.

## 2.4 Approach

### Machine learning

Advancements in artificial intelligence (AI) and machine learning (ML) have significant potential for development funders and agencies to improve evidence-based decision-making. This is due in large part to the development of new language models from organizations such as Google, which give computer scientists the ability to train models that predict sequences of words based on either their preceding or surrounding context. In a machine-learning environment, computers use various algorithms to simulate human learning and perform tasks, and the performance of these tasks is subsequently improved based on acquiring new knowledge from human experts. Since ML generates "data-driven predictions," knowledge about the sources of the data is essential for the results of ML to be useful.<sup>4</sup>

There is a growing body of work and experiences, involving the use of ML methods in the context of international development that new efforts and practitioners can learn from.

Machine-learning models are most successful when they have clearly stated communication and classification tasks and a plethora of available data. **Figure 1** shows a simplified look at the machine learning process. ML can be used for (a) data exploration, (b) data description, (c) prediction of future patterns, and (d) an aid in decision-making, meaning the system will use



the data to make suggestions about what action to take.<sup>5</sup>

<sup>4</sup> Paul, Amy, Jolley, Craig, Anthony, Aubra (2018) *Reflecting the past, Shaping the Future: Making AI Work for International Development*. Washington, D.C.: Center for Digital Development, United States Agency for International Development. [[Reflecting the Past, Shaping the Future: Making AI Work for International Development \(usaid.gov\)](https://www.usaid.gov/reflecting-the-past-shaping-the-future-making-ai-work-for-international-development)]

<sup>5</sup> Watt, Jeremy, Borhani, Reza, Katsaggelos, Angelos (2016) *Machine Learning Refined*. Cambridge: Cambridge University Press.

**Figure 1** The Machine Learning process (Source: Ceres2030)

### Previous use cases of the model

The model has been previously trained to work with agricultural, economic, and environmental datasets part of other global projects seeking to address the gaps in the evidence base. These include [Ceres2030: Sustainable Solutions to End Hunger, Agriculture in the Digital Age](#), in addition to internal pilot projects with USAID and IFAD. Many of the same algorithmic processes will be used in this program using the CABI and Ceres2030 datasets.

For additional technical details about the model, please see the paper published in *Nature Machine Intelligence*.<sup>6</sup>

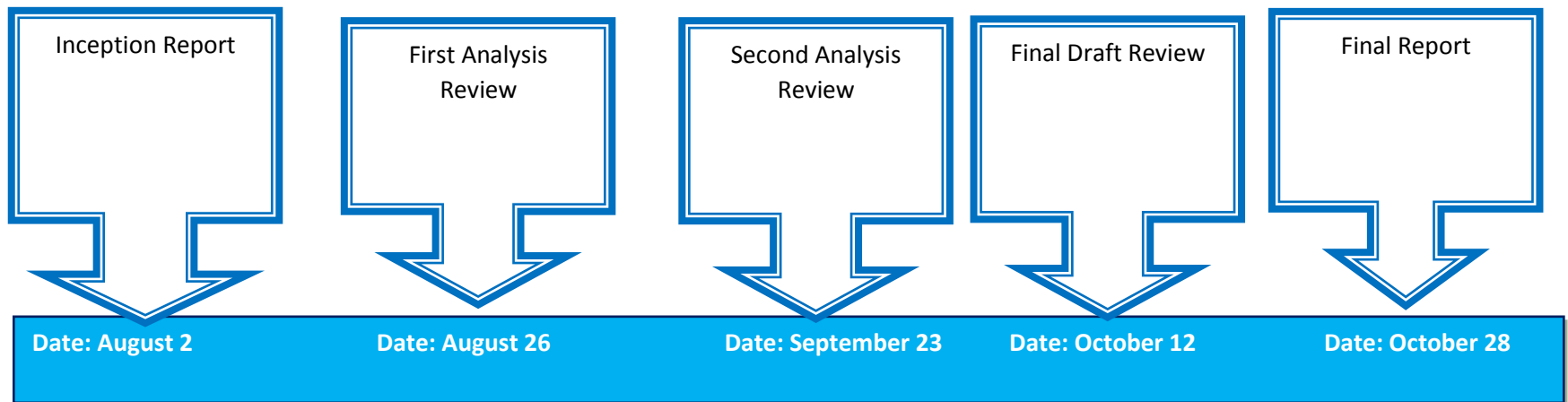
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<sup>6</sup> Porciello, J., Ivanina, M., Islam, M. *et al.* Accelerating evidence-informed decision-making for the Sustainable Development Goals using machine learning. *Nat Mach Intell* **2**, 559–565 (2020). <https://doi.org/10.1038/s42256-020-00235-5>

### 3. Work Package

#### 3.1 Deliverable Timeline

The following chart layouts the timeline for the project and deliverables to be completed in each phase of the work along with the date of completion. Between 3 to 5 days before the deliverable date, a draft of the deliverable will be sent to CoSAI to receive feedback. Once feedback is received edits will be made for the final draft of the deliverable.





### 3.2 Work Package Activities, Outcome, and Deliverables

The following table sets out the detailed start-end dates of the meetings, key tasks, and deliverables.

	Activity	Outcome	Deliverable
1.	Kickoff Meeting	Detailed Work Plan and Agreement to Timelines	Inception Report
2.	Analysis Review Meeting	Review the first analysis and provide input for the second analysis	First Analysis
3.	Analysis Review Meeting	Review the second analysis and provide input for final analysis	Second Analysis
4.	Draft Review Meeting	Review the final analysis and provide input for the final report	Final Draft
5.	Final Meeting	Review final report	Final Report

### 3.3 Outputs

The deliverables will be presented in two primary outputs. We will create an **internal platform** that is accessible upon request, as shown in **Figure 2**. This will enable users to review the analysis, ask questions and interact with the data. Pending any further funding, this is to remain a very simple interface and password-protected portal. An instruction manual will accompany the portal.

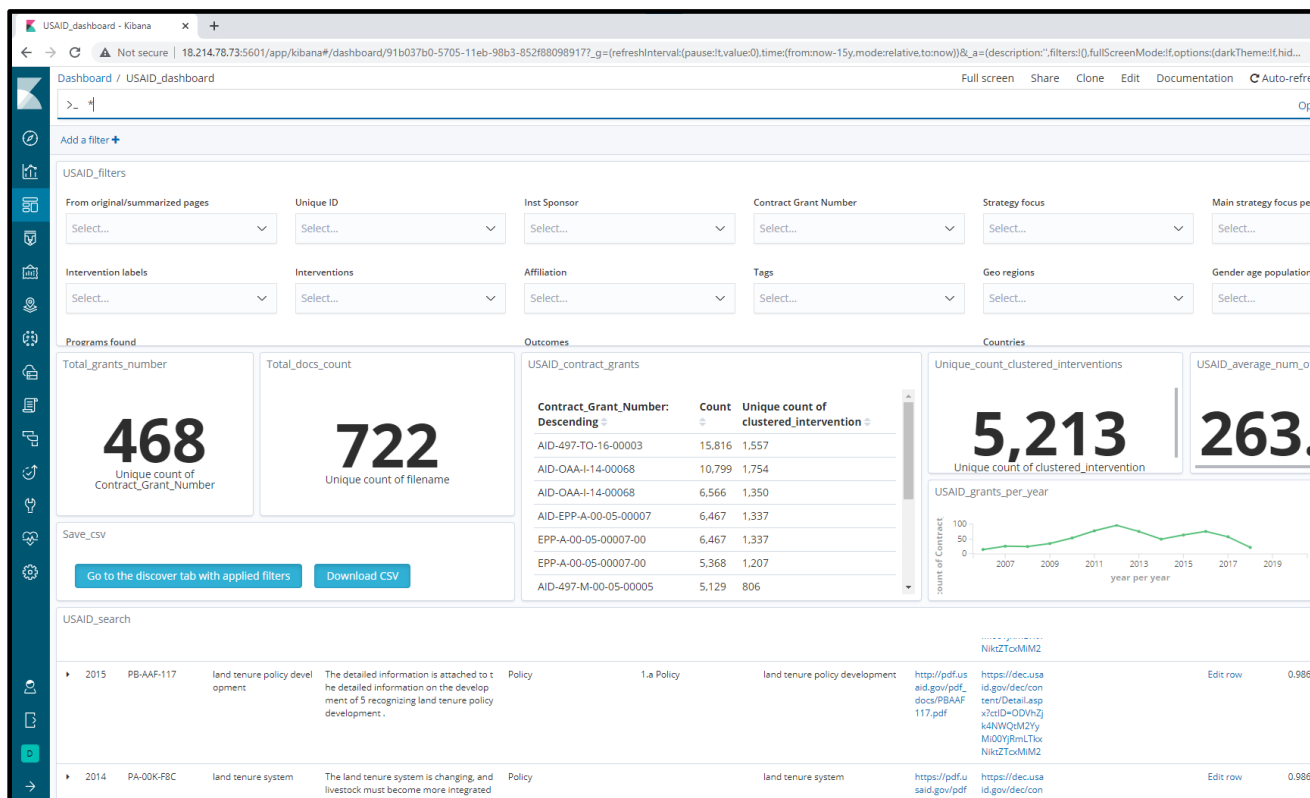


Figure 2 An example of the online dashboard

The second output will be a high-impact and professional report describing the key findings of this work. This report will be jointly informed by the analysis, but also the needs of CoSAI to ensure that it is relevant to support its mission.