



# **Sustainable Farming Program**

## **Full design document**

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## List of acronyms

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ACIAR	Australian Center for Agricultural Research
Africa RISING	Africa Research in Sustainable Intensification for the Next Generation.
AfricaRice	Africa Rice Center
AGRA	Alliance for Green Revolution in Africa
AI	Artificial Intelligence
AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
Alliance	Alliance of Bioversity International and CIAT
AoW	Area of Work (refers to the Program's key areas of work)
ARIs	Advanced Research Institutes
ASSAP	Agronomy Science and Scaling Accelerator Platforms
BMGF	Bill and Melinda Gates Foundation
CA	Comparative advantages
CAADP	Comprehensive African Agricultural Development Programme
CapSha	Capacity sharing for development
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
CIRAD	French Agricultural Research & International Cooperation Organization
CoAs	Clusters of activities
DST	Decision support tools
EiA	Excellence in Agronomy Initiative
EIAR	Ethiopian Institute of Agricultural research
ESG	Environmental and Social Governance
EU	European Union
FAIR	Findable, Accessible, Interoperable, and Reusable (referring to data)
FAO	Food and Agricultural Organization of the United Nations
FFO	Farmer facing organizations
FLW	Food, Land and Water
FTE	Full time equivalent
GAIA	Guiding Acid Soils Management Investments in Africa
GHG	Greenhouse gas emissions
GIZ	German Development Cooperation
GREAT	Gender-Responsive Researchers Equipped for Agricultural Transformation
HCD	Human-centered design
HH	Hidden hunger
HLO	High level outputs
HPR	host-plant resistance
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development

IFDC	International Fertilizer Development Center
IFI	International Financial Institutions
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
ILSSI	Innovation Lab for Small Scale Irrigation
IMM	Integrated mycotoxin management
IOs	Intermediary Outcomes
IPDWM	Integrated pest, disease and weed management
IPG	International Public Goods
IRRI	International Rice Research Institute
ISFM	Integrated soil fertility management
ISRIC	International Soil Reference and Information Centre
IWMI	International Water Management Institute
KPIs	Key performance indicators
LLMs	Large Language Models
LTE	Long term experiments
MEL	Monitoring, evaluation and learning
MELIA	Monitoring, evaluation, learning and impact assessment
MFS	Sustainable Intensification through Mixed Farming Systems Initiative
MP	Multi-dimensional poverty
NAP	National Adaptation Plans
NARES	National Agricultural Research and Extension Systems
NDC	National Determined Contributions
NGOs	Non-Governmental Organizations
NPPO	National Plant Protection Organizations
PDW	Pests, diseases and weeds
PH	Plant Health Initiative
QFFD	Qatar Fund for Development
R&D	Research & Development
ROI	Return on investment
RPPO	Regional Plant Protection Organizations
RQ	Research questions
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
RUTF	Ready-to-use therapeutic foods
SAM	Scale-appropriate mechanization
SME	Small and medium enterprises
SOP	Standard operating procedures
SSNM	Site-specific nutrient management
TAAT	Technologies for African Agricultural Transformation
WFP	World Food Program
WorldVeg	The World Vegetable Center
WP	Work Package

# 1. Executive Summary

The Sustainable Farming Program simultaneously addresses several pressing challenges to evolving agri-food systems. It aims at efficient production of more nutritious foods while protecting the environment, also translating this growth into decent and equitable employment opportunities. The Program will address the combined threats posed by changing climate, inefficient production systems, soil degradation, pests, diseases, weeds, environmental degradation and desertification. It will co-develop and validate a stream of integrated agronomic, plant health, and farming system solutions. These solutions will catalyze adaptation and scaling through a coherent approach that integrates effective data management, prioritization tools, capacity sharing, and partnerships built around contextualized demands.

The Program addresses farmer and community needs through co-creation principles and systems integration. It prioritizes bundled agronomic, plant health, and farming system solutions and socioeconomic innovations in a collaborative, integrated manner, backstopped by CGIAR and partners' expertise. By co-developing solutions with partners and leveraging public, civil society and private-sector capacities and investment, it promotes agricultural transformation towards more productive, resilient, and sustainable farming systems.

Supported by aligned pooled investments and bilateral funds, the Program will deliver integrated farming solutions impacting over five million farmers (target estimated using average annual pooled investments over the last three years). These will advance socially equitable and sustainable agricultural gains across at least two million hectares of land, better allowing public and private-sector partners to effectively invest in farming communities and rural development.

Capacity building (primarily for NARES<sup>1</sup>) will establish broader

expertise in sustainable farming systems science and data systems infrastructure along FAIR<sup>2</sup> principles to increase accessibility of knowledge generated. This work builds upon the substantial progress made by three CGIAR Initiatives, namely Excellence in Agronomy, Plant Health, and Mixed Farming Systems. It will further create efficiencies among these Initiatives and unlock resources to invest in new science challenges.

Program goals will be achieved by developing and disseminating a series of Global Public Goods, promoting local adaptation and realizing delivery at scale with stakeholders in over 30 countries in the Global South supported by pooled and bilateral investments. The Program will operate through eight interrelated Areas of Work (AoWs): (i) Climate adaptation and mitigation, (ii) Precision crop-nutrient management, (iii) Resilient soils, (iv) Plant Health and mycotoxin-safe crops, (v) Integrated water management, (vi) Scale-appropriate mechanization, (vii) System integration through co-creation, and (viii) Program efficiency and delivery. Integrated, inclusive actions will synergize 12 CGIAR Centers' work and interface with other planned Science Programs and Accelerators. The Program will harness a diverse pool of agronomists; soil scientists; plant health specialists; systems integrators and modelers; data and policy specialists; socio-economists; and co-creation and gender-aware experts. The Program builds on deep experience of working with public and private partners across Africa, Asia and tropical America for more than four decades. It offers unique physical resources, including globally distributed experimental farms, long-term experiments and advanced laboratories within its well-distributed CGIAR Centers.

<sup>1</sup> National Agricultural Research and Extension Systems

<sup>2</sup> Findable, Accessible, Interoperable, and Reusable

## 2. High-level vision in response to challenges and megatrends

### 2.1. Challenges and mega-trends

The Sustainable Farming Program will address demographic, environmental, economic, and social challenges and mega-trends by providing a stream of carefully composed and integrated agronomic, plant health, and farming system solutions over the next six years. Population growth in the Global South strongly impacts current agri-food systems. By 2050, we must increase the production of more nutritious food by 60% to meet expanding population demands, and to translate this economic growth into decent employment opportunities. At the same time, agricultural productivity is threatened by changing climate, land and environmental degradation, and devastating pests, diseases and weeds (PDW). Since 1960 climate change has reduced agricultural productivity growth by 20–40% in Africa and Asia (Ortiz-Bobea et al., 2021). The agricultural environmental footprint is responsible for about one-third of annual greenhouse gas (GHG) emissions directly from farms and through land-use change (Crippa et al., 2021). Over 3.2 billion people are negatively impacted by land degradation caused by soil erosion, deforestation, desertification and other factors. (IPBES, 2018). Extreme poverty remains high, particularly in sub-Saharan Africa. Social inequities persist and the agricultural labor force is aging. To achieve greater equality and social inclusion, we must create avenues for engaging diverse groups, particularly youth in agriculture and increase the productivity of women and marginalized communities (Abdisa et al., 2024).

### 2.2. High-level vision

The Sustainable Farming Program seeks to **achieve high productivity, resilience, and sustainability at scale through widely disseminating science-based socio-technical innovation bundles that offer integrated agronomic, plant health, and system-level advantages to farmers, helping to redesign their farming systems.** It will achieve this goal by co-developing and delivering global and regional public goods with key stakeholders, particularly National Agricultural Research and Extension Systems (NARES). Collaborative research-for-development with a full spectrum of partners will deliver proven and contextualized innovations bundling agronomy, plant health, and farming system options. Partnership and scaling approaches will address context-specific needs of small- and medium-scale farmers, particularly women and youth, and the characteristics of the national and regional innovation systems. This work builds upon the substantial progress made by CGIAR's Initiatives on Excellence in Agronomy (EiA), Plant Health (PH), and Sustainable Intensification through Mixed Farming Systems (MFS) between 2022 and 2024.

Through our work, farmers (particularly women, youth, and marginalized communities) will realize more productive, profitable, resilient, and sustainable farming systems through delivering agronomic gains at scale. These are defined as profitable yield

increases, yield stability, adaptation to climate change, enhanced nutrient and water-use efficiencies, increased labor productivity, improved soil health, and reduced losses caused by PDW and mycotoxins. They also embrace sustainability key performance indicators (KPIs), including: profitability for farmers; environmental benefits at farm and landscape levels; GHG emissions mitigation and climate resilience; and improved social equity. Agronomic gain is achieved through single or combined agronomic and farm system practices under specific environments and social contexts. We will advance these goals through the integrated management of crops, trees, livestock and fish when appropriate. All solutions will consider economic, environmental, and social dimensions. The Program significantly contributes towards realizing CGIAR's vision for optimizing food, land, and water systems<sup>3</sup> through targeting all five CGIAR Impact Areas<sup>4</sup>.

### 2.3. What is new in this Program?

New Program research areas are described in greater detail in Section 6. Firstly, through whole-farm and human-centered perspectives, the Program aims to innovatively integrate agronomy, plant health, and farming system solutions, along with technologies and practices developed by other programs. This holistic approach will enhance resource use efficiency for the 12 participating CGIAR Centers and their research and scaling partners. Secondly the Program will innovatively apply a coherent, program-wide approach to deliver solutions at scale. This includes working through demand partnerships and using harmonized data generated in the Program's eight areas of work (AoWs) to better prioritize context-specific options. Other new areas include deploying big data and artificial intelligence (AI) applications to evaluate interventions for (i) Enhancing adaptive capacity and reducing GHG emissions at different scales; (ii) Tailoring agro-advisories towards soil health, precision crop-nutrient management ('precision nutrient' management hereafter) and efficient water use; (iii) Developing and applying modeling and decision support tools (DST) for better integration of crops, trees, shrubs, livestock, fish, and orphan crops into farming systems that can increase diversity and resilience; (iv) Developing technological and innovative solutions to enhance soil resilience at scale; (v) Using AI-supported PDW risk analysis and management; (vi) Improving understanding of plant-microbe interactions on plant health; (vii) Using cost-effective genotyping platforms, remote sensing and multispectral imaging to monitor and manage crop growth, and assess soil and water status; (viii) Exploring alternative water resources and circular approaches for agricultural use in water-scarce contexts such as desert farming; (ix) Exploring public-private business models and options for scale-appropriate machinery, including their potential use in precision agriculture; and (x) Combining biophysical systems modeling and behavioral sciences to better understand priorities and support stakeholders' decisions and capabilities for bundling and scaling farm innovations. These new areas will be continuously updated during engagement with research and scaling partners, resulting in a co-creation process that leads to more meaningful agricultural solutions.

<sup>3</sup> "...sustainable and resilient food, land, and water systems that deliver diverse, healthy, safe, sufficient, and affordable diets, and ensure improved livelihoods and greater social equality, within planetary and regional environmental boundaries".

<sup>4</sup> (i) increasing income, improving livelihoods, and creating jobs; (ii) increasing climate resilience and yield stability while reducing the environmental footprint; (iii) increasing environmental health and protecting biodiversity by reducing agricultural land expansion and pollution; (iv) reducing hunger and improving nutrition, health, and food security by intensifying and diversifying farming systems; and (v) reducing gender and social inequality gaps through responsive solutions.

### 3. Prioritization

New crop, soil, water, PDW, and mycotoxin management approaches and machinery technologies are greatly needed by target-country stakeholders, but must be integrated in a whole-farm management approach according to contexts. Small-scale producers cannot currently solve many problems they face, given their limited available resources (e.g. information, knowledge, technologies), some of which may not contribute to sustainability or build climate resilience. The Sustainable Farming Program aims at co-developing innovations that assist farming communities to cope with new and changing conditions, and to meet the demands of rapidly evolving food systems, where crop and livestock productivity is increased, raising their incomes, and improving their diets and health. To achieve this, farmers need “technology bundles” (Woomer et al., 2023) that can deliver reliable and more affordable production inputs, improved soil fertility, PDW and water management strategies; more efficient harvest and post-harvest management, and scale-appropriate mechanization to reduce drudgery. Widespread digital applications are changing approaches to agricultural extension and product marketing. These technologies often represent Public Goods that offer recognizable benefits, as well as opportunities for the private sector to develop new and more potent commercial production inputs based upon them. Technological options need to be contextualized to respond to the priorities set by country stakeholders.

The co-designed innovation bundles should contain both technologies and scalable socio-technical innovations, which could include technical elements along with the information, knowledge, financial, social and cultural components according to contexts and farming systems (Barret et al., 2020). A detailed review of agronomic, digital, genetic, institutional, and mechanical innovations led to the conclusion that existing and emerging technologies are equally constrained by sociopolitical factors. Potent technologies must navigate a complex array of political, economic and sociocultural obstacles, which vary with time and space, before they may be adopted at scale. This situation is best addressed by coupling technical advances with social, economic and policy changes through the formulation of “socio-technical innovation bundles” that need to respond to country demands. Creation of these bundles necessarily requires dynamic multi-party cooperation across the developmental, financial, public and private sectors in order to accelerate their acceptance, diffusion and scaling, and the design of the Sustainable Farming Program takes this complexity into account.

A growing approach to technology bundling involves the critical role of Innovation Platforms and their linkage to agricultural research, extension providers, agro-dealers and markets (Mandlenkosi et al., 2024). These Platforms, which will be strengthened at country level, seek bundled technologies that work together to overcome production constraints and that significantly increase farming system production levels. These Platforms can support scaling of suitable technical innovations according to contexts and demands. They also provide members with the opportunity to process their harvests to commercial standards and to market their surpluses through collective action. Devising the means to assemble and disseminate the technology packages that allow cost-recoveries will be key to their sustainability, and will generate opportunities for creative service provision.

These perspectives were reinforced by the results of CGIAR Listening Sessions conducted in late 2023 and early 2024 in 25 countries. These sessions revealed that agricultural sustainability is a high priority among more than 50% of country stakeholders. These concerns included the need for integrated farm solutions; enhanced soil and water management advice; crop and production-system diversification; a wider range of PDW management options), and improved post-harvest options that increase food safety and reduce losses. Other consultations and prioritization exercises were conducted by CGIAR EiA and PH Initiatives between 2022 and 2023. These actions indicated that adaptation to climate change and sustainable intensification of cropping systems are high priorities across 18 countries, mostly in Africa and Asia. Furthermore, strengthening capabilities for surveillance and monitoring of priority pests and diseases was assigned a high priority by national partners in 26 countries in Africa, Asia and Latin America. The MFS Initiative also identified the need to better target, compose and deliver integrated farm system innovations in a more site-specific manner.

Following a partial prioritization, a preliminary list of 34 priority countries was developed through exercises conducted by the EiA, PH and MFS Initiatives (Figure 3.1) combined with bilateral project interventions. These countries include (from West to East) Mexico, Guatemala, Peru, Colombia (in Tropical America); Senegal, Morocco, Mali, Côte d’Ivoire, Ghana, Benin, Niger, Nigeria and Egypt (in Northern and West Africa); DR Congo, Zambia, Zimbabwe, Mozambique, Malawi, Tanzania, Rwanda, Burundi, Uganda, Kenya, Ethiopia, and Madagascar (in Central, Southern and East Africa); Uzbekistan, Pakistan, India, Bangladesh, Nepal, Laos, Cambodia, Vietnam, and the Philippines (in Asia). This prioritization recognizes the presence of activities funded by CGIAR as pool-, bilateral- and window-3 (W3) \-funded projects that are implemented by 12 CGIAR Centers and their partners. A second map (Figure 3.2) depicts results from a country analysis using 22 indicators relevant to the Sustainable Farming Program related to food security, population, poverty, gender, youth, soil erosion and pesticide use. This Figure shows potential target countries based on needs. The targeted countries shown in Figures 3.1 and 3.2, however, are subject to change, when CGIAR-level priority setting is completed with a focus on farming systems, more specific indicators relevant to the Program AoWs are included, and alignment with other evolving CGIAR Programs will be refined over the Inception Phase.



## 4. Comparative Advantage

The Sustainable Farming Program's greatest source of comparative advantage is that it addresses smallholders' needs for bundled technologies and innovations at farm and farming-system level in a collaborative, integrated manner, backstopped by CGIAR and partners' operating principles and expertise. Solutions and innovation bundles are viewed in a novel, more holistic context that appeals to the broader agricultural development community, whose strengthened agendas then serve to deliver management solutions to millions of farm households in prioritized farming systems. The Sustainable Farming Program identified 36 high-level outputs (HLOs) essential for achieving objectives in eight Areas of Work (AoWs). These AoWs consider (i) climate adaptation and mitigation on farms; (ii) precision nutrient management; (iii) resilient soil systems; (iv) plant health and mycotoxin-safe crops; (v) integrated water management; (vi) scale-appropriate mechanization; (vii) system integration through co-creation, and (viii) Program efficiency and delivery. Each of these AoWs are further described in Section 6. The HLOs are classified into five broad categories: (i) innovation (17 outputs); (ii) capacity sharing (8 outputs); (iii) policy and investment information (8 outputs); (iv) project support activities related to monitoring and evaluation (1 output), data and analytics (1 output), and (v) partnership management (1 output). A table with the full description of outputs and comparative advantage analysis is included in Annex 4.1.

CGIAR and its participating Centers hold a strong capacity and experience in organizing and coordinating an international program around the future sustainability of agricultural systems. This requires quality contributions across the agricultural research and development sector, implying that comparative advantage is also held by others. Experience within international efforts suggest that irreplaceable key advantages are held by CGIAR established partners from NARES; Advanced Research Institutes (ARIs); the private sector; non-government organizations (NGOs); government policymakers and regulators; universities; inter-governmental organizations; finance institutions, and farmer organizations. NARES have a comparative advantage in relation to local farm management research capabilities and extension agent networks and collaborative links with farmers and local communities. ARIs are often more advanced in the areas of PDW crop, soil and farm modeling, data science, and next-generation technologies. The private sector holds expertise and financial resources in relation to agro-input and output market functioning; private extension; equipment engineering; market research; regulatory and industrial aspects, and business development. Through the environmental, social and governance (ESG) regulations, the private sector plays a pivotal role in ensuring sustainable food systems from production to consumption. NGOs offer established mechanisms for community engagement and experience in scaling interventions and hold logistical advantages through their networking. Government organizations are necessary partners in relation to policy innovation and the regulatory approval and cross-border movement of new farm management technologies. Universities open their higher education curricula to new areas of knowledge and manage the MSc and PhD programs that often backstop CGIAR and partner research projects. International Financial Institutions (IFIs) drive sustainable farming technology scaling through the loans and grants offered to countries, and national and local banks offer loans that allow for farm improvement. These institutions also hold expertise in formulating and improving agribusiness models. Farmers' organizations and their grassroots subsidiaries provide support for widespread technology adoption, hold local knowledge of

farming conditions and opportunities, and provide insight into local adaptation of farm innovations.

Based on a partial analysis, and given the recognized essential contributions from its partners, the sources of comparative advantage of CGIAR Sustainable Farming Program in delivering HLOs may be summarized across four categories related to its human, physical and social capital, and strong incentives for the formulation and recognized release of next-generation IPGs.

1. In terms of human capital, the Program boasts a diverse pool of agronomists, soil scientists, plant health specialists, desert farming specialists, crop modelers, data scientists, policy scientists, co-creation and gender experts, with experience and presence in at least 45 low and middle-income countries across tropical America, Africa and Asia. This expertise allows the Program to lead in developing IPGs that can be translated into global, regional and context-specific innovative agricultural solutions, including research products delivered within the private sector. Additionally, the Program offers indispensable experience in designing and implementing comprehensive training and capacity-building programs to NARES, NGOs and other development partners. The Program has capabilities to generate and synthesize local, regional and global scientific evidence, and provide policy-ready information, to influence agricultural policy and strategy designs that enable more sustainable farming systems.
2. The Program has extensive physical resources within its CGIAR Centers, including research stations, field sites, laboratories, germplasm health units, manufacturing facilities, and long-term experiments located across priority countries. For the most part, this physical infrastructure currently operates in close association with NARES and other government organizations through field office networks. These assets support research and multi-stakeholder development activities, and enable designing, implementing, scaling and assessing agricultural innovations.
3. The Program also has a global network and established relationships with a wide range of stakeholders in 45 countries. This network positions the Program as a neutral facilitator and broker of South-South and South-North collaboration. This role helps in coordinating multi-stakeholder efforts, identifying and assessing farm technology bundles, and ensuring outputs and outcomes are effectively delivered.
4. The Program team is driven by the mission and commitment to develop a series of IPGs and work with partners to translate scientific research into whole-farm solutions and innovations for achieving transformation of food, land and water (FLW) systems aligned to the CGIAR 2030 Research and Innovation Strategy.

In summary, the analysis indicates that this Program would excel in several research and delivery areas, and its planned partnership will offer complementary strengths. Thus, CGIAR Sustainable Farming Program will play a key brokering and catalytic role bringing together diverse stakeholders together to co-develop, promote and validate a series of scientific, farm-level solutions, while partners support local adaptation, technology deployment, policy integration, and community engagement towards scaling. By co-developing solutions with NARES and ARIs, leveraging developmental and private sector investment, and maximizing broad-based network capabilities, the Program will systematically achieve synergies and impact at various levels towards sustainable farming system solutions. A full comparative analysis will be carried out during the first year of the Program.

## 5. Program-level theory of change

The Sustainable Farming Program responds to pressing demographic, climatic, environmental and social trends and challenges. There will be significantly more people to feed in the future, extreme weather will likely continue, and agricultural resources will degrade in absence of corrective action. Economic and social inequalities within and between countries must be narrowed through multifaceted approaches including governance, institutional, policy, and technological innovations. By promoting more productive and profitable agriculture while reducing natural resource use, this program can contribute to rural prosperity. These challenges include the need to (i) increase crop and total farm productivity, providing more nutritious food and higher incomes for farmers; (ii) increase farm resource use efficiencies, avoiding environmental degradation, pollution and biodiversity loss, whilst improving productivity; (iii) tackle climate hazards by developing context-specific climate-resilient farming practices and systems; and (iv) develop equitable solutions that boost livelihoods for all farmers and agribusinesses, particularly among women and youth.

In response to these challenges, the Sustainable Farming Program aims to contribute to the five CGIAR Impact Areas through the co-developing and scaling of whole-farm solutions that deliver agronomic gain at scale (Figure 5.1). The expected gains are: (i) increased productivity and production of nutritious food, (ii) improved soil health, (iii) enhanced efficiencies of water, nutrient, and labor use, (iv) reduced crop losses to expanding and emerging PDWs, and (v) more stable yields through adaptation to climate change. Sustainability considerations must be met, which include profitability for farmers; environmental benefits at farm and landscape levels; GHG emissions' mitigation and climate resilience, and improved social equity.

The Program commits to co-developing and delivering the above in the geographies covered through its sphere of influence (see Section 3), and will work with other Programs, Accelerators and partners to create the circumstances in which these lead to impacts within the five Impact Areas, acknowledging that this will depend on many factors beyond the control of this Program and CGIAR. To contribute to the above impacts, **2030 Outcomes** have been defined using the average investment of pooled funds over the last three years (average annual investment of about USD 35 million projected across 2025-2030). Once the figure of total investment including bilateral projects is estimated, the figures could be significantly increased. The Program expected outcomes are: (i) at least five million farmers adopting and/or benefiting from bundles of innovations for integrated farm management, with positive impacts on socially equitable and sustainable agronomic gains across two million hectares; and (ii) at least fifty public or private development partners are facilitating the scaling of solutions to farming communities and integrating innovations in their investments, independent of Program support. In support of the above, efficiency and continuity aspects will be addressed by: (iii) at least twenty-five national science partners ultimately becoming able to drive new research, initiatives, including advancing their capabilities in farm systems science, building on skills learnt through Program support; and (iv) all CGIAR Centers and their partners optimizing the sharing of data, tools, system methods, and research products, resulting in more effective design of pooled and bilaterally funded projects into the future.

Three pathways combine to deliver the Program outcomes. The innovation pathway draws upon validating a framework that includes (i) contextualized prioritization; (ii) needs assessments; (iii) integrating farm-level solutions through co-design and data-led learning; (iv) integration of multiple innovations to address whole-farm challenges, and (v) bundling with enabling innovations or services. Areas of Work (AoWs – see Section 6), will generate solutions to address locally appropriate combinations of issues, including climate adaptation; precision nutrient management; soil health restoration; reducing crop losses due to PDWs; integrated water management; scale-appropriate mechanization, and farm system integration. Iterative design and monitoring will be enabled by state-of-the-art data and analytical processes, and co-creation and participatory approaches. We will create a compendium of sustainability-validated, gender- and youth-positive farm innovation bundles linked to prioritization tools and big datasets to unlock the scaling potential of solutions to new locations. The High-Level Outputs facilitate the delivery of the Intermediate Outcomes: (i) whole-farm innovation bundles are co-developed and promoted by partner organizations; (ii) CGIAR Centers and NARES share and use data and analytics tools; (iii) partner organizations adopt new tools and methods, and (iv) partner organizations scale validated innovation bundles. Existing delivery and scaling platforms, such as the Agronomy Science and Scaling Accelerator Platforms (ASSAPs), by EIA, will be strengthened and expanded to accommodate the complete solution space of the Program.

The **capacity sharing pathway** operates through translating scientific outputs to provide training and materials for farmers and extension workers related to the contextualized solutions; through providing training and materials to partner organizations for using data and process tools, and through novel capacity sharing models to enhance NARES actors' research and scaling capacities.

The **policy change pathway** builds on outputs consisting of evidence and briefs for policymakers to enable the uptake of integrated farm solutions; the establishment of multi-stakeholder platforms for designing, delivering and scaling demand-responsive bundles of innovations; and engagement with international dialogue fora. These, in partnership with the *Policy Innovations* and *Scaling for Impact Programs*, will facilitate the delivery of policy-related Intermediate Outcomes of increased engagement and widespread investment in delivering farm innovation bundles.

To facilitate validating and delivering integrated agronomic, soil, water, plant health, and farming system solutions, discussions have been initiated with **strategic partners** who are also starting up new programs, aiming at identifying areas of common interest for co-investment. With GIZ/BMZ, discussions are focusing on (i) the relationship between agricultural practices and soil health; (ii) methodologies for monitoring changes in soil and plant health; (iii) strategies to incentivize investments in soil and plant health; and (iv) policy frameworks to facilitate reinvestment in soil health. With AGRA, discussions are focusing on: (i) data/digital tools; (ii) evidence-based policy advice; (iii) deploying knowledge products/solutions for scaling; and (iv) building country capacities in agricultural technologies and practices for addressing immediate and future climate challenges. With the Sustainable Agriculture Initiative, discussions are focusing on (i) a global indicator framework for regenerative agriculture; (ii) Standard operating procedures (SOPs) and assessment solutions for implementing the indicator framework; (iii) approaches to regenerative agriculture and practices appropriate for smallholder farming systems; and (iv) mobilization of private sector investment and engagement in

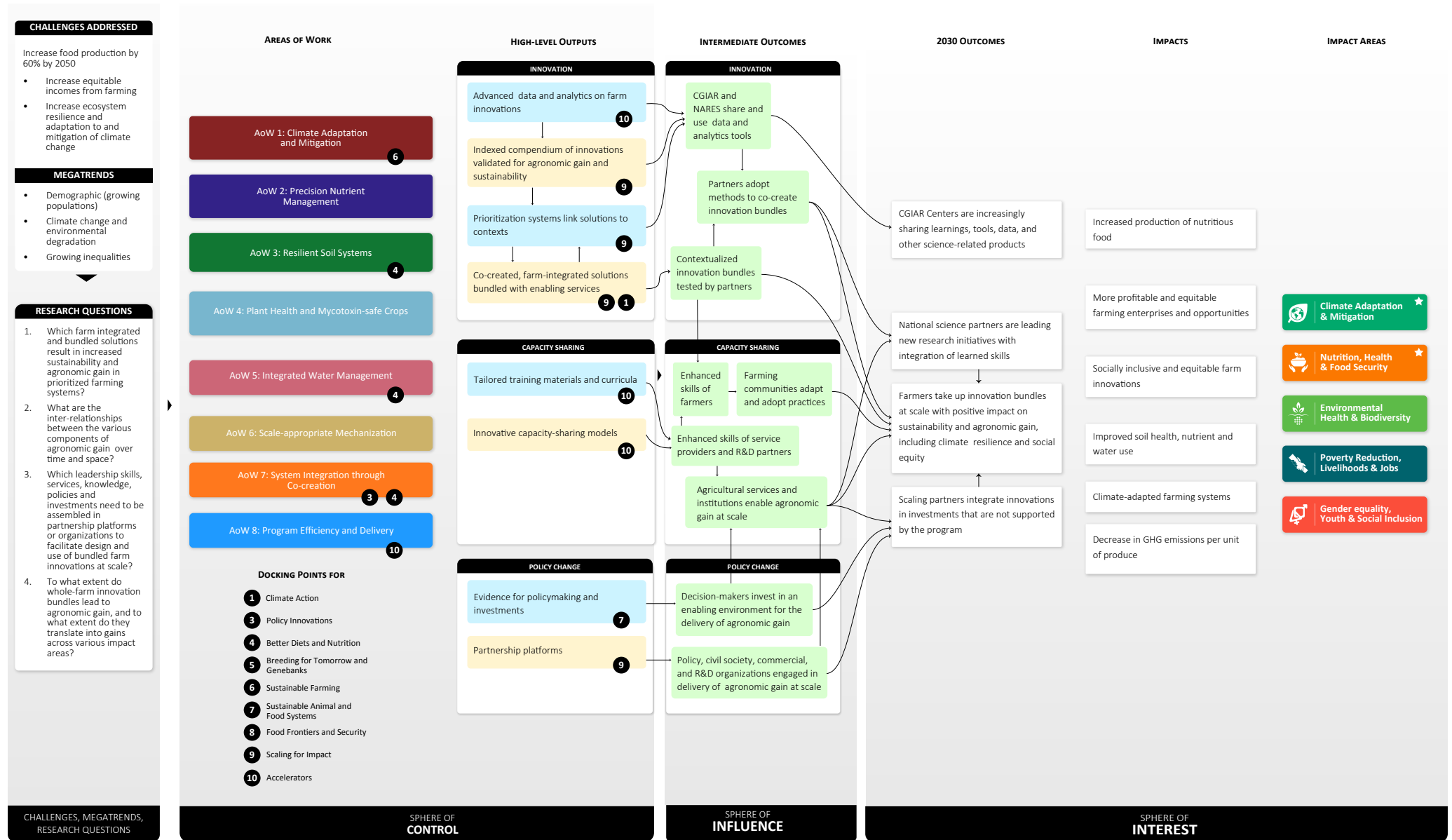
smallholder supply chains. With the Sustainable Intensification Innovation Lab, discussions are focusing on: (i) climate adaptation and mitigation; (ii) resource use efficiency; (iii) soil fertility and soil health management; (iv) circular bioeconomy; and (v) digital and decision tools. With the United Arab Emirates (UAE) government and the Gates Foundation (BMGF) discussion are focusing on (i) Red palm weevil management, and (ii) integrated desert farming systems (IDFS). All the above discussions will generate formal joint work plans for implementation in 2025.

The AoWs underpin all HLOs (see Section 6). AoWs focus either on component research addressing prioritized thematic constraints within prioritized farming systems and geographies; or on integrative research that assembles and appraises component innovations within farming system contexts and higher system levels. They will also focus on support actions to facilitate program efficiency and delivery towards more integrated interventions within the Program and across CGIAR Programs. The component AoWs are: (AoW 2) precision nutrient management, (AoW 3) resilient soils, (AoW 4) plant health and mycotoxin-safe crops, (AoW 5) integrated water management, and (AoW 6) scale-appropriate mechanization. The integrative AoWs are: (AoW 1) climate adaptation and mitigation, and (AoW 7) system integration. AoW 8 (Program efficiency and delivery) focuses on building synergies across AoWs. The AoWs also provide docking points for the CGIAR Science Programs: Better Diets and Nutrition; Breeding for Tomorrow and Genebanks; Climate Action; Food Frontiers and

Security; Multifunctional Landscapes; Policy Innovations; Scaling for Impact; Sustainable Animal and Aquatic Foods; and Sustainable Farming. They will also link with the three accelerators: Capacity Sharing; Digital Transformation; and Gender Equality and Inclusion. AoW 8 consists of five expertise areas that will support the work of the other AoWs: prioritization, data and analytics, capacity sharing, partnership platforms and integrated policy relevant evidence, as well as containing management and monitoring, evaluation, learning and impact assessment (MELIA) functions. The overarching **programmatic research questions** (RQs) are:

1. Which farm integrated and bundled innovations will result in increased sustainability, resilience and agronomic gains in prioritized farming systems?
2. What are the inter-relationships between the various components of sustainable farming (profitable yields, yield stability, resources use efficiency, soil and plant health) over time and space?
3. Which leadership skills, services, knowledge, policies and investments need to be assembled in partnership platforms to facilitate design, implementation and scaling of bundled farm innovations according to contexts?
4. To what extent do whole-farm innovation bundles lead to agronomic gains, and to what extent do they translate into gains across various Impact Areas?

**Figure 5.1.** The overall theory of change that drives the Sustainable Farming Program



## 6. Areas of Work

### 6.1. AoW 1: Climate adaptation and mitigation on farms

A third of the global crop production is threatened by changing climate. Evidence indicates that climate change has already reduced productivity growth by 20-40% in Africa and Asia since 1960 (Ortiz-Bobea et al., 2021). With increasing climate variability and severity of climate-change impacts, agricultural producers must be prepared for multiple threats. While some solutions exist to help producers cope with climate risks (Rosenstock et al., 2024), existing strategies are generally predicted to be insufficiently effective under future climate scenarios (Lissner et al., 2024). Meanwhile, agricultural activities account for approximately one-third of annual GHG emissions (Crippa et al., 2021). Hence the urgent need for new and more potent farm integrated solutions that simultaneously reduce negative impacts of climate change on farming (adaptation), reduce agriculture's contribution to GHG emissions (mitigation) and enhance community's capacity to recover quickly from negative impacts (resilience) in the future.

This AoW will deliver climate-resilient farming system innovations, in some cases with mitigation co-benefits, to at least five million farmers using the Program's solutions by 2030. These innovations will enhance resilience under floods, droughts, cold stress, rising temperatures, variable rainfall patterns, and lead to a 15% reduction in GHG emissions compared to current levels (per participating farm). Intermediary outcomes support this by strengthening the enabling environment in collaboration with farmer-facing organizations (FFOs) (Outcome 1.1); government bodies (Outcome 1.2); and public and private-sector investors for developing climate-responsive agriculture (Outcome 1.3). We foresee collaboration with Climate, Policy, Landscape and Scaling Programs as well as other AoWs within the Sustainable Farming Program, and emerging partnerships such as the Integrated Desert Farming Program addressing adaptation and mitigation needs in dryland areas. Facilitating these changes requires addressing the following key research questions (RQ), see Figure 6.1.1:

1. How can innovative tools and information be best developed to enhance climate adaptiveness of sustainable farming systems?
2. When, where, and under what climate conditions can sustainable farming innovations be most effective in assisting small-scale producers to adapt, while also reducing GHG emissions now and in a warmer future world?
3. How can we overcome the key determinants restricting resilient low-emission<sup>6</sup> farming at scale?

Over the past two years, the EIA Initiative conducted listening sessions and prioritizing exercises to better co-develop, design, test, and scale such solutions in the future. The Program network offers a key comparative advantage (CA), as it includes 170 partners currently co-developing, testing and scaling 67 climate-related agronomic innovations. The presence of multi-disciplinary teams, research facilities and partner networks across different geographies allows for a systematic, agile approach to co-developing and evaluating a stream of climate-adaptation and -mitigation interventions using a combination of climate homologs, long-term trials, state-of-the-art data science, and analytics with partner-inclusive participatory approaches to target climate resilience for smallholder farmers.

Based on quantified effects of climate-related hazards on agronomic gains (Output 1.1), we will co-develop inclusive and hazard-specific

agronomic, soil and plant health, and farming system innovations with robust evidence on adaptation and mitigation potential (Output 1.2). Digital platforms and targeted outreach products will better inform the design, implementation, and investment of resilient, low-emission farming systems, in collaboration with CGIAR Climate and Policy Programs. By providing training materials and technical support for assessing, innovating, and implementing potent solutions toward climate security, FFOs' capacity will be enhanced (Output 1.3). These partners will facilitate feedback loops among producers and researchers, allowing for continuous improvement and customization of solutions tailored to local conditions and decision needs. Translating the evidence articulated in policy and investment-ready information (Output 1.4) will inform strengthening the enabling environment to enhance resilient low-emission farming at scale. To achieve these HLOs, we foresee the following three clusters of activities (CoA).

#### 6.1.1. Data and information to climate-proof sustainable farming.

This CoA ensures that the design, implementation, and scaling of farming practices address the risks posed by climate change. This CoA also contributes to AoW 8. CoA activities include (i) incorporating climate risk analysis and DST into targeting adaptation and mitigation interventions; (ii) integrating local climate information (in collaboration with the Climate Action Program) with agronomy, and soil and plant health advisory services<sup>7</sup>; and (iii) using analytics to co-create frontier solutions in predicted future climates. New lines of work include developing a prioritization and targeting tool for attuning proven adaptation measures to other geographies.

#### 6.1.2. Establishing the effectiveness of sustainable farming toward climate adaptation and mitigation now and in the future.

This CoA enhances and evaluates the effectiveness of single or combined farming practices (across AoWs 1 to 7) aiming to combat single or multiple climate hazards, and mitigate GHG emissions and potential risks for maladaptation. Activities include (i) developing approaches for assessing yield and livelihood resilience; using data science and modeling to enhance the adaptive capacity during co-design and co-piloting; (iii) evaluating agronomic practices aimed at enhancing adaptive capacity<sup>8</sup>, and at reducing GHG emissions<sup>9</sup>. New lines of work include (i) quantifying carbon capture through resilient soils practices under different crop-livestock systems (with AoW 3); (ii) evaluating potential maladaptation risk for the future, and (iii) evaluating and categorizing farming systems' adaptive and mitigative limits across agro-ecologies and time.

#### 6.1.3. Accelerating resilient low-emission farming solutions at scale.

This CoA accelerates resilient low-emission farming solutions from CoA 1.1 and 1.2 at scale in collaboration with AoW 8 (particularly CoA 8.4 in collaboration with the Scaling Program) by addressing the key constraints to adoption at scale. CoA activities include (i) using behavioral science to assess a) gendered climate risk perceptions to farming practices, b) access to climate information and c) adoption of adaptive/mitigative innovations; (ii) synthesizing evidence for policy and investment partners (linked to CoA 8.5); (iii) developing training materials along the co-creation process of climate interventions; and (iv) providing technical assistance to FFOs and others in low-emission farming (linked to CoA 8.3). New lines of work include (i) assessing project-level returns on investment from climate-resilient, low-emission farming; (ii) developing tools to evaluate benefits, synergies and trade-offs of interventions (together with the Climate Action and Multifunctional Landscapes Programs); (iii) identifying social and institutional innovations that enhance the adaptive/mitigation capacity of sustainable farming practices, and (iv) developing climate-resilient scaling pathways based on farmer and partner risk profiles with the Scaling Program.

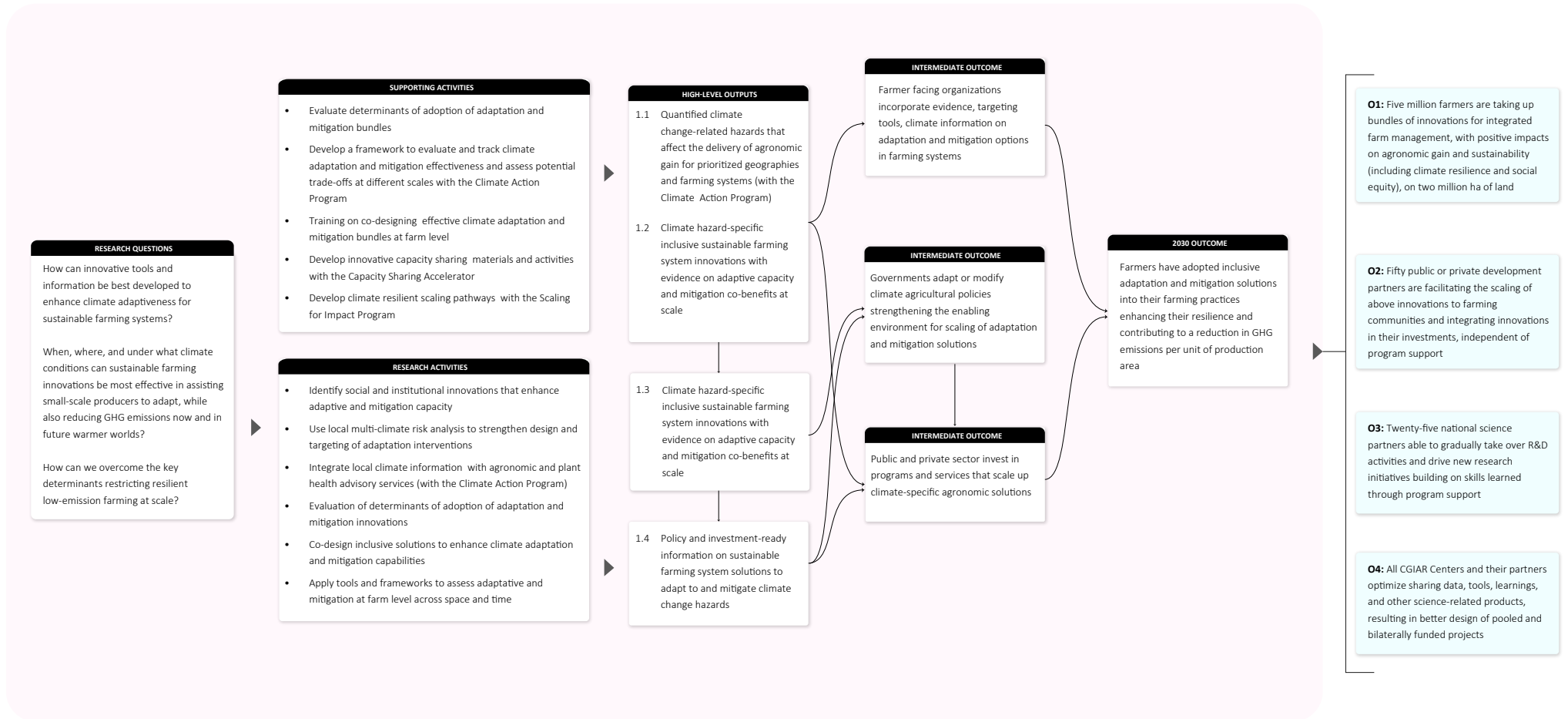
<sup>6</sup> Wherever we refer to 'low-emissions', this is shorthand for low emissions of greenhouse gases.

<sup>7</sup> including diversifying crops, forages, fish feed and trees; moving planting windows, and using weather-based fertilizer recommendations

<sup>8</sup> e.g., solar-based irrigation, use of nature-based solution principles

<sup>9</sup> e.g., dry direct seeded rice, conservation agriculture

**Figure 6.1.1.** Contributions by Area of Work 1 (Climate Adaptation and Mitigation) to the Sustainable Farming Program



## 6.2. AoW 2: Precision nutrient management

Farmers often lack access to relevant recommendations for optimal management of available plant nutrients. Furthermore, the amount of available external and recycled nutrients is often insufficient to raise crop yields to levels required for adequately supplying demand and improving livelihoods. There is scant validated, site-specific, easily accessible information on crop-nutrient management that is dynamically tied to weather forecasts and bundled with other crop-management practices. This lack of information exacerbates productivity shortfalls. These difficulties hinder decisions about (i) selecting appropriate crop varieties; (ii) fertilizer requirements and appropriate use; (iii) co-application of organic inputs; (iv) implementing good agronomic practices, and (v) managing other crop-limiting factors such as soil acidity, as assembled through the Integrated Soil Fertility Management (ISFM) approach (Vanlauwe et al., 2010 and 2015). In some areas, other problems include overuse or unbalanced fertilizer use, so managing crop nutrition needs to be more precise, and widely available crop-nutrition solutions must be developed.

Through collaborations to jointly address concerns over crop nutrient access and use through 2030, the Program will release a framework containing a series of DSTs for guiding tailored nutrient recommendations for at least 15 priority crops, as identified by EIA (Figure 6.2.1). These tools will be used by extension specialists and over three million farmers in at least 15 countries, achieving at least 25% increase in their crop productivity and profitability, due to improved input and recycle use efficiency. Agronomic data and information generated over years of research will be transformed into user-friendly tools through an advanced analytics and human-centered design (HCD) process. This work builds on the AgWise modeling framework being developed and used through the EIA Initiative, which in turn leverages earlier approaches for site-specific crop nutrient management (Chivenge et al., 2021) to establish nutrient recommendations, but with greater attention to HCD contextualization (Muller et al., 2024). AgWise is heavily dependent on high-quality, standardized data and computing infrastructure available through AoW 8 and the Digital Transformation Accelerator. This next-generation framework will be advanced to dynamically use short and long-term weather forecasts, soil nutrient balances, management solutions for acidity and salinity, and cropping system considerations such as rotation, perennial crops, residue management and use of organic fertilizers. The framework will consider integrated nutrient management to address yield gaps over space for optimized nutrient uses. It will be steadily expanded and adapted to more countries and crops within CGIAR focus regions.

Partnering with domain partners (e.g., FAO, IFDC, ISRIC) and technology actors (e.g., Google, Microsoft) coupled with an open data and open science approach will be especially critical to harness AI and other advanced technologies that promise faster, more accurate solutions based on large amounts of quality data. Thus, private sector engagement is integral to meeting stakeholder expectations and complementing the institutional capacities of NARES. An explicit youth and gender lens through HCD will assure that partners and solutions respond to the needs and constraints of these often-marginalized stakeholders, paying special attention to actions that bridge the digital divide. We will respond to three key research questions through co-creation with research and scaling partners that work with many thousands of farmers, and in partnerships with the private sector, ARIs and local universities.

1. What is the appropriate spatial scale and resolution of soil information for developing tailored nutrient recommendations associated with optimal return on investment (ROI), beyond which extra investment costs are no longer associated with meaningful economic gain?

2. How, and which tailored soil and crop management solutions can be developed and improved in response to farmer needs and preferences within complex cropping systems in priority geographies?
3. How can solutions that support decisions for agronomic gain be efficiently and sustainably co-created and integrated into the advisory services of scaling partners?

To respond to these research questions, the following four Clusters of activities (CoA) are planned:

### 6.2.1. Improved modeling framework using integrated soil fertility management (ISFM) and site-specific nutrient management (SSNM) principles.

This CoA aims to improve nutrient recommendations, building on ISFM and SSNM principles (Vanlauwe et al., 2015) through integration of additional functionalities into AgWise. It will include development and integration of (i) spatially explicit acid and saline soils management recommendations modules including refining fertilizer recommendations based on lime and crop nutrient interactions; (ii) functionalities that allow accounting of previous crop and organic resource availability in generation of recommendations, following SSNM approaches; and (iii) weather forecast data to optimize input application, sowing and other management decisions while minimizing weather-related risk and maximizing profit with AoW 1. It will explore integrating both area-based and farm-level indices related to financial risks and crop insurance support. It will also evaluate appropriate spatial scales of soils input data for developing the recommendations, and assess potential trade-off among KPIs related to productivity, environment, and climate-change mitigation (e.g. profit vs. soil nutrient mining or GHG emissions). It will include development and improvement of process-based models and their validations in new geographies, which have had little attention over the last decade.

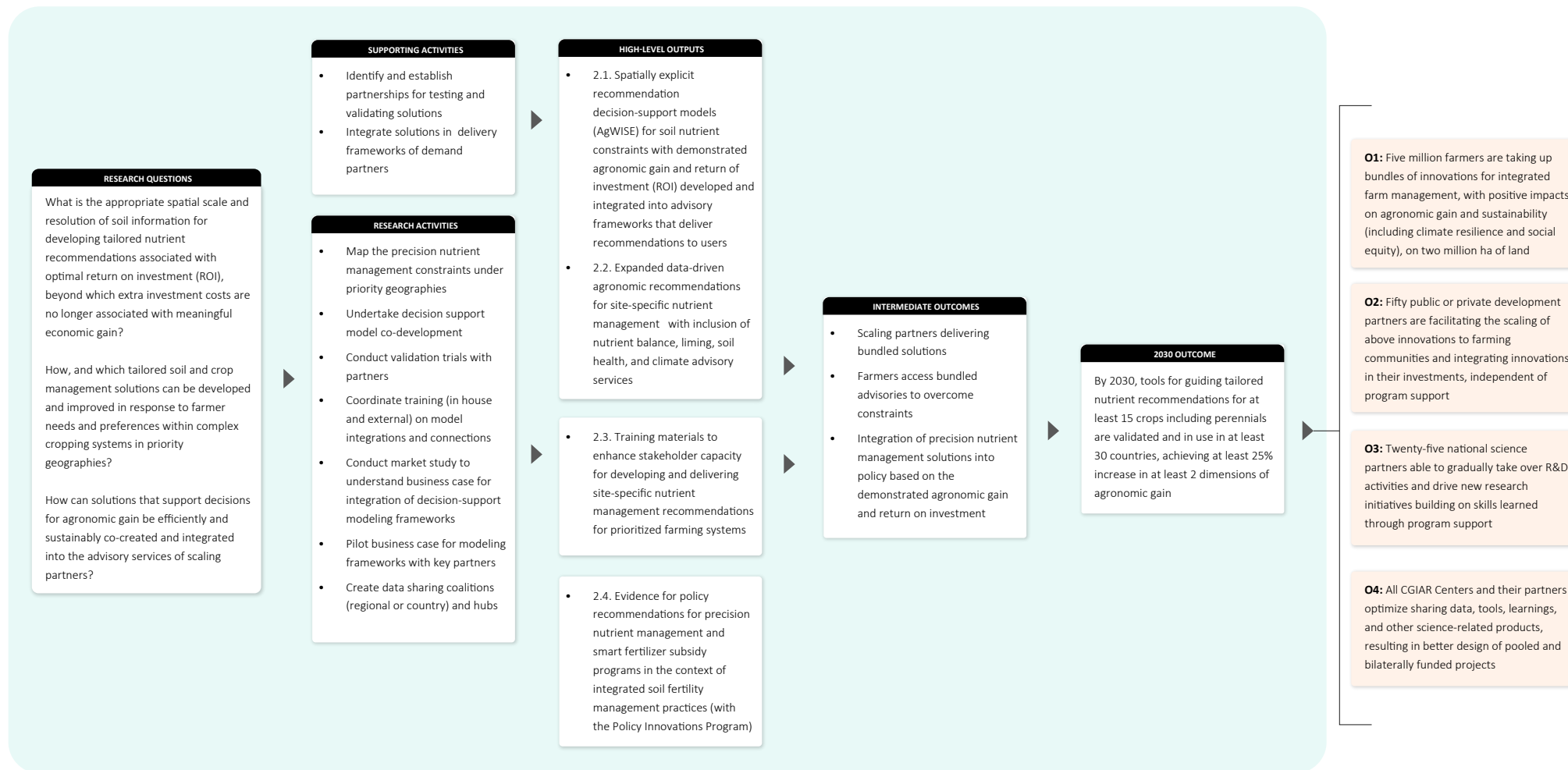
### 6.2.2. Guiding nutrient management for perennial systems.

This CoA addresses nutrient management as a key determinant of on-farm perennial crop yields, such as for bananas, cocoa, coffee, date palm, and forages. It will synthesize current knowledge on perennial systems into decision support systems to guide practitioners on best practices. Based on an adaptation of ISFM for perennial systems, activities include developing and delivering tools that support good agricultural practices for nutrient management, density and shade solutions, and addressing soil-borne pest and disease constraints. It will also, working with AoW 7, develop solutions to diversify the perennial systems by identifying crop mixtures with reduced competition and enhanced complementarity. The CoA will also include providing training to extension agents on the use of the tools.

### 6.2.3. Integrating proven solutions into agro-advisories.

Solutions and evidence generated through the modeling framework will need to be integrated into agro-advisory delivery frameworks of scaling partners and used to support policies for smarter fertilizer subsidies and soil health investments (in collaboration with AoW 3). A system where multiple actors can access or link to agronomic solutions, and associated algorithms and data (where national sensitivities allow) will be developed and tested as a potential business opportunity for the private sector. It will also be used to develop collaborations with a wider set of domain and technology actors. In collaboration with the Policy Innovations and Scaling for Impact Programs, evidence will be provided to design policies that support smart fertilizer subsidies through use of precision crop nutrient advisories guided by ISFM and SSNM principles. This CoA assures more widespread adoption and implementation of advisory content.

**Figure 6.2.1.** Contributions by Area of Work 2 (Precision Nutrient Management) to the Sustainable Farming Program



#### 6.2.4. Application of Artificial Intelligence (AI) as a pathway to improve development of agro-advisories.

This CoA addresses AI as a rapidly emerging topic (Tzachor et al., 2023). Large Language Models (LLMs) will explore massive volumes of literature and identify and translate the key information into messages understandable to farmers and extension advisors. Integration of chatbots into knowledge and data systems enables human-AI conversations in real time. However, LLMs must be trained to distil accurate, location-relevant information and generate agro-advisories, and this will require collaboration among AI experts, scientists, scaling partners and experienced field staff. Other emerging areas address use of high-resolution remote sensing to guide and adjust in-season crop nutrient management decisions and integration of both process-based and AI models to provide precision solutions beyond data-defined temporal and spatial scales. We envision this CoA to be implemented in collaboration with AoW 6 (e.g. unmanned vehicles) and the Digital Transformation Accelerator.

From this AoW, the expected intermediary outcomes (Figure 6.2.1) are (i) scaling partners delivering bundled solutions, (ii) farmers accessing bundled advisories delivered through scaling partners to overcome constraints and (iii) Integration of precision crop nutrient management solutions into policy based on demonstrated agronomic gains and ROI.

### 6.3. AoW 3: Resilient soils

A healthy soil possesses physical, biological and chemical properties critical for multiple ecosystem services including, organic carbon storage and climate-change mitigation; preventing desertification, nutrient cycling and retention; and water retention and provision; while also providing habitat for diverse and beneficial soil organisms. However, anthropogenic soil degradation poses a key threat to global food security and environmental health, primarily due to deforestation, agricultural intensification and overgrazing, as well as climate change, dust storms and droughts. Globally, drought and land degradation are turning about 23 hectares of land into desert every minute, leading to a loss in the potential to produce 20 million tons of grain annually (UNCCD, 2017). This degradation is exacerbated by land clearance, nutrient mining, organic matter depletion, and soil erosion and compaction. Soil erosion is the most widespread form of soil degradation, severely limiting the ability of soil to provide critical ecosystem services, including those that sustain agricultural production (Vågen and Winowiecki, 2019). Building soil resilience at farm and landscape levels is needed to reverse the trends that compromise soil health in its many ecological and agronomic functions (Tenywa et al., 1999).

This AoW will co-develop technologies and other innovative solutions aimed at enhancing soil health in relation to soil fertility, hydrological functions, soil-borne pest and disease control, biomass productivity and carbon sequestration essential for building more resilient farming systems and prevent land degradation caused by erosion, deforestation or desertification. The AoW will work with farmers, farmer organizations and other stakeholders to reverse land degradation and enhance ecosystem services, informed by context-specific information on soil health indicators as part of a monitoring framework.

This AoW addresses the following research questions:

1. What are the impacts of various agricultural management practices and interventions on soil health, as assessed within a soil health monitoring framework, and how does soil health affect resource use efficiency, carbon sequestration, soil moisture dynamics, and beneficial biodiversity?

2. Which indicators and frameworks can best enable evidence-based decision-making at farm and national levels to catalyze and target investments in soil health?
3. What are the best ways to manage, share and visualize soil health data in a recipient-oriented and efficient manner?
4. What are the potential contributions of introduced micro-organisms in delivering agronomic gain?

The Resilient Soils AoW plans to deliver several outcomes. By 2030, science-based tools and methods to assess, monitor and interpret soil health status will be deployed across a network of long-term monitoring sites managed by at least 10 public or private-sector partners to support decision-making investments in sustainable farming (Outcome 1). Over 500,000 farmers will implement targeted practices that restore and enhance soil health, also meeting net carbon emission and water conservation targets (Outcome 2). These farmers will support practices that conserve and promote above- and below-ground biodiversity that enhance farm productivity and sustainability, in collaboration with the Multifunctional Landscapes Program (Outcome 3). At least five stakeholders in cooperating countries will include achievable soil health targets in national policies, and strategies in collaboration with the Policy Program (Outcome 4). It operates through the following four CoAs:

#### 6.3.1. Better understanding and promoting resilient soil ecosystems.

Current knowledge gaps around soil degradation limit the adoption of sustainable farming practices and need to generate and apply newfound evidence to farm-level decision-making. This CoA will maintain and/or establish a network of long-term monitoring sites including existing long-term experiments managed by CGIAR Centers as the basis for identifying a suite of soil health indicators tailored to the contexts and needs of smallholder farming systems. Ultimately, the CoA will use this information to implement a robust monitoring framework of these indicators to set benchmarks and track soil health changes across time and scales.

#### 6.3.2. Promoting the implementation of validated soil health practices.

This CoA focuses on optimizing farm resource use by implementing validated soil health practices to positively impact net carbon emissions, plant health, and water conservation across landscapes. The validated solutions will be bundled and tailored to demands of target partners including farmers, private and public scaling partners, and business enterprises. In collaboration with the Multifunctional Landscapes Program, it will identify a suite of positive soil health guidelines and practices, emphasizing the integration of leguminous crops, trees, organic inputs, perennials, livestock, and fish. Activities will also focus on establishing relationships between agronomic, plant health, and farming system practices, and changes in soil health indicators, as affected by inherent soil properties, in support of soil health monitoring systems.

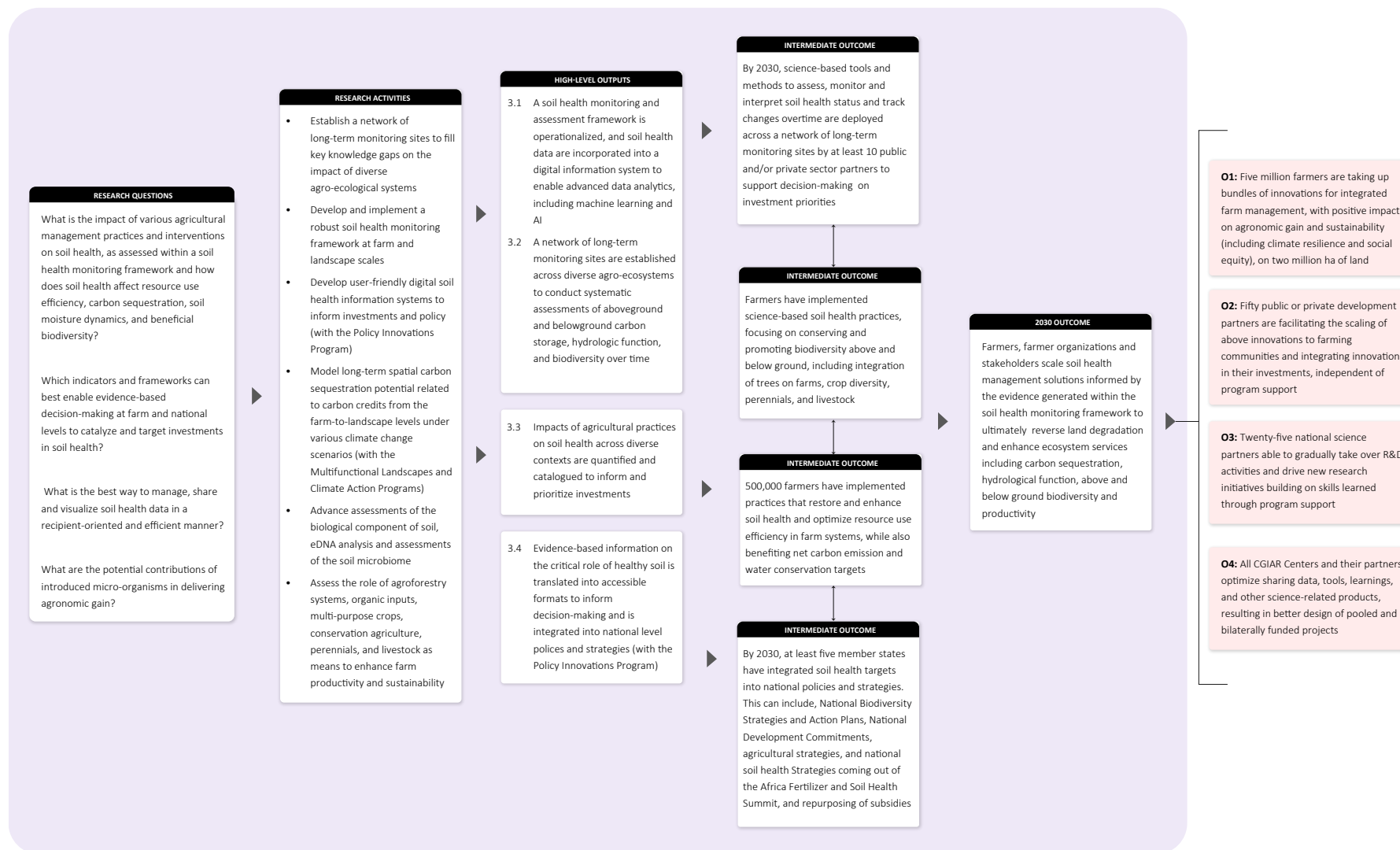
#### 6.3.3. Provide strategies and incentives for sustainable investment in soil health.

Sustainable soil health management is essential for profitable farming, yet current investment remains insufficient for transformative change. This CoA will focus on developing strategies for targeted and profitable investments in soil health to boost productivity, reduce degradation, and address food security. It will provide policy advisory with an emphasis on increasing investment, offering inclusive incentives, and fostering collaboration between smallholders and agribusiness to achieve long-term soil health benefits. A particular role will be through providing scientific evidence to the Fertilizer and Soil Health Action Plan of the African Union.

6.3.4. Generate evidence on the role of microorganisms towards supporting the delivery of agronomic gain. Many discussions nowadays focus on the role of introduced micro-organisms on crop growth, nutrient availability, and access to soil moisture. While a large number of such bio-fertilizers are already available in the Global South, many questions on their efficiency and contributions to crop production, resource use efficiency, and soil health remain unanswered. It is critical to (i) develop procedures to

generate unequivocal evidence on their potential contributions to the delivery of agronomic gains, preferably supported by an understanding of their mode of action, (ii) work with regulatory agencies in the target countries to get such procedures adopted, (iii) to work with the private sector on adapted delivery systems for bio-fertilizers with proven functionality.

Figure 6.3.1. Contributions by Area of Work 3 (Resilient Soils) to the Sustainable Farming Program



AoW 3 will deliver the following HLOs (see Figure 6.3.1): (i) A soil health monitoring and assessment framework is operationalized and soil health data are incorporated into a digital information system to enable advanced data analytics including machine learning and AI; (ii) a network of long-term monitoring sites are established across diverse agro-ecosystems to conduct systematic assessments of aboveground and belowground carbon storage, hydrological function and biodiversity over time; (iii) impacts of agricultural practices on soil health across diverse contexts are quantified and catalogued to inform and prioritize investments; (iv) evidence-based information on the critical roles of healthy soil is translated into accessible formats to inform decision-making, and integrated within national-level policies and strategies. This AoW will engage with research organizations and civil society to co-develop evidence-based and applicable tools for monitoring soil health at scale, including soil health assessment frameworks with validated benchmarks and digital information and advisory systems. Establishing long-term monitoring sites will require support from Centers and partners to identify the locations and practices that need to be considered to fill current knowledge gaps. This will include modeling the carbon-sequestration potential of various agricultural management practices at farm- and landscape levels. Moreover, the knowledge around the soil microbiome to understand functional diversity of micro-organisms and their role in nutrient, carbon and hydrologic cycles will be advanced. The AoW will further engage with decision-makers and investors, providing advisory and strategies for policy reforms and investment incentives aimed at restoring and promoting soil health.

#### 6.4. AoW 4: Plant health and mycotoxin-safe crops

Effective plant health management plays a crucial role in sustaining and enhancing agrifood systems' productivity, profitability, and resilience. It also contributes to realizing genetic improvements from enhanced crop varieties. Yet, many farming communities continue to grapple with various PDW outbreaks. Each year, crop PDW infestations result in losses ranging from 10% to 40% of major food crops, amounting to a staggering USD 220 billion globally (IPPC Secretariat, 2021). These losses severely affect food and feed security, safety, and nutrition (Rizzo et al., 2021). Regions facing food deficits and rapid population growth experience the highest losses due to uncontrolled plant health threats. PDWs impact all aspects of food security, including production, quality, access, and utilization. Additionally, mycotoxin contamination of food and feed too often exceeds safe limits, posing a substantial health burden and reducing market opportunities (Eskola et al., 2020). This AoW aims to strengthen plant health systems in target countries through enhanced diagnostics and surveillance for problem identification and scaling of innovations to counter PDW and mycotoxins (Figure 6.4.1). It will use frontier technologies and continue investing in discoveries essential to effective monitoring, risk prediction, and integrated management, with a focus upon ecofriendly solutions.

The outcome is that by 2030, over one million additional farmers use integrated PDW management that reduces crop losses caused by biotic threats, improves environmental and human health due to reduced pesticide and mycotoxin exposure, and increases the availability of safe and nutritious food and feed to consumers and livestock, respectively. Major research questions follow.

1. How to improve global diagnostics and surveillance in the global south involving NARES, enabling better PDW management?
2. Which sustainable approaches can improve cost-effective PDW management and risk prediction under current and future climate scenarios to improve preparedness and response?
3. How to reduce crop losses, and protect food and nutrition security from major biotic threats by developing and scaling sustainable, gender-responsive and socially inclusive integrated PDW management (IPDWM)?
4. What approaches allow converging technological, institutional, and policy actions towards integrated mycotoxin management (IMM) to better recognize and reduce mycotoxin contamination at scale?

This AoW offers sources of CA because of recent and ongoing achievements by the PH Initiative, and its strong network of 180 partners. The network operates across major food staples, forages, and horticulture crops across many countries. Furthermore, CGIAR Centers have a track record of co-creating fit-for-purpose solutions in collaboration with national and regional partners to ensure successful, ecofriendly management of PDW and mycotoxins, influencing policymakers and capacity building that successfully countered several recent plant pandemics including maize lethal necrosis, fall armyworm and others (Kreuze et al., 2023), in addition to having a 22-year program working on aflatoxin biocontrol across Africa and expanding to other regions. The geographic penetration of CGIAR research offers strong sources of CA for preventing and managing the transboundary nature of plant health, including cases of virus, bacteria or insects such as the red palm weevil or potato psyllid that can be transmitted through vegetative planting material. The research activities will be organized into CoAs as follows:

##### 6.4.1. Continued focus on developing state-of-the-art and cost-effective tools to enhance surveillance and early warning systems.

These tools include methods for PDW diagnostics and surveillance, data management, modeling, risk prediction and forecasting, and phenotyping. These activities will be supported by frontier technologies in data science and AI to support modeling and predictive tools in collaboration with Climate Action Program. Emerging areas of work will include researching the roles of citizen science in collaboration with Digital Transformation Accelerator.

##### 6.4.2. Developing gender-responsive IPDWM and IMM options with partners and stakeholders in target countries.

This will include identifying priority PDWs with partners; assessing state-of-the-art management strategies; and developing, testing and scaling IPDWM and IMM using co-creation and participatory, gender-responsive approaches. Using a case-study approach, we will develop IPDWM packages for specific farming systems where PDWs represent major constraints. These include links with soil health, water management and mechanization AoWs. We will also co-develop solutions exploiting host-plant resistance (HPR) and deploy seed-based solutions in collaboration with the Breeding Program. We also intend to support public-private partnerships in collaboration with the Scaling for Impact Accelerator. Regarding IMM, priority will be placed upon developing a comprehensive traceability system to enhance food safety decision-making. We will provide new and better solutions for mycotoxin management in collaboration with the Better Diets and Nutrition Program.

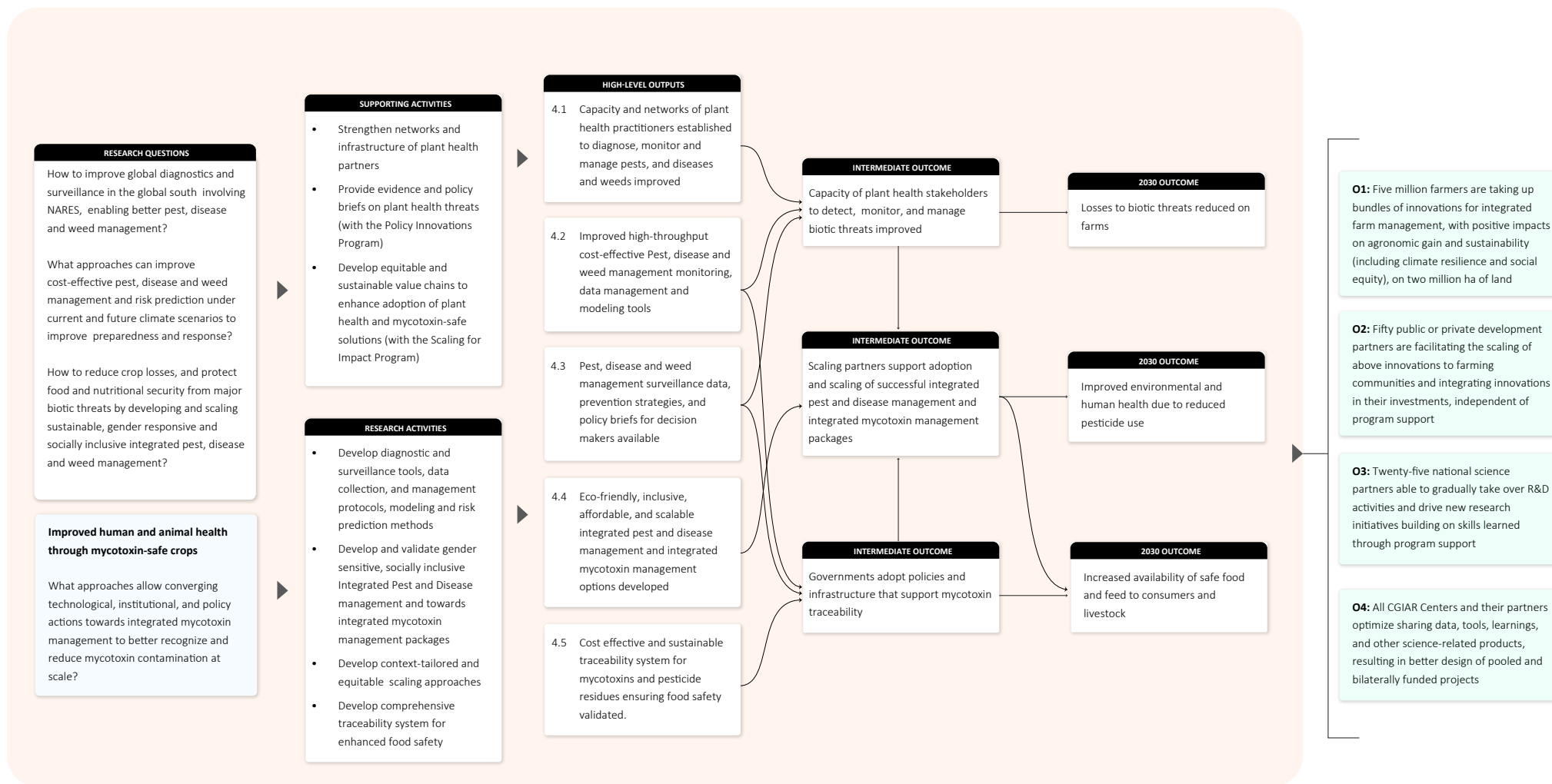
### 6.4.3. Designing inclusive, equitable, and context-specific IPDWM and IMM scaling approaches for achieving greater impacts.

This CoA evaluates plant health options in ways that inform and influence policymaking decisions and dialogue. Supporting these efforts, key activities include strengthening networks and infrastructure; influencing policymakers to foster a favorable environment for converging technological, institutional, and policy actions that will lead to plant health improvements; and developing suitable value chains to enhance the acceptance and adoption of new technologies and strategically bundled practices. The continuation of scaling of plant health innovations and those in the process of reaching the scaling stage will be done in collaboration with the Scaling for Impact Program, which will support organizing a coordinated response to, for example, emerging PDWs that are of concern to specific agro-ecosystems, such as potato zebra chip disease in the Andes, the fall army worm in Africa and Asia or the red palm weevil in dryland areas. We also intend to strengthen and expand public-private partnerships in collaboration with the Scaling for Impact Program for both IPDWM and IMM.

These CoAs and combined efforts will result in several key HLOs (Figure 6.4.1) that address (i) enhanced capacity and strengthened networks of plant health practitioners; (ii) improved and more cost-effective tools for monitoring, data management, and modeling; and (iii) provision of surveillance data, prevention strategies, and (iv) policy briefs for decision-makers for relevant policy changes, and (v) mycotoxin prevention and traceability systems. The initiative will deliver eco-friendly, inclusive, affordable, and scalable technology packages to partners, contributing to more resilient and sustainable agricultural production systems as well as cost effective traceability systems for ensuring food safety.

Meaningful collaboration with regional and national plant protection organizations is particularly important to this AoW. Key partners also include NARES, NGOs, farmers' organizations, aggregators and private-sector actors, with some of them already having investments to manufacture and distribute plant health innovations at scale. ARIs and universities are important research partners. Note that the PH Initiative provided an average of USD 800,000 annually to 40+ partners during 2022-2024 to foster meaningful collaboration which future activities could build on.

**Figure 6.4.1.** Contributions by Area of Work 4 (Plant Health and Mycotoxin-Safe Crops) to the Sustainable Farming Program



## 6.5. AoW 5: Integrated water management

Improved water management is key to increasing crop productivity, necessitating its inclusion as a separate Program AoW. Agriculture accounts for 70% of global freshwater withdrawals (UN-water, 2024), while 3.2 billion people live in areas where agriculture production exhibits high levels of water stress due to climate change (FAO, 2020). This highlights the urgency of effective water management strategies to mitigate water-related risks to and from food systems. Irrigation requirements are increasing due to more erratic rainfall leading to severe water insecurity and desertification, yet there is potential to move 200 million hectares of rainfed cropland into sustainable irrigation (Rosa et al., 2020). In water-scarce areas, practices that improve water storage and sustainable access are required to address water-related risk to food systems. In areas where agriculture overuses and contaminates freshwater, use must be reduced, water productivity and quality enhanced. Poor water management hampers sustainable agricultural gains, leading to salinization, land degradation, water pollution, and increased GHG emissions. In water-scarce areas, alternative water resources and recycling waste water should be explored for safe agricultural production, which is the intention of emerging partnerships such as the Integrated Desert Farming Initiative. The need to focus on water scarcity and improved water management practices was mentioned in two thirds of the CGIAR listening sessions conducted in 25 countries during late 2023 and early 2024.

The overall ambition is to contribute to water-resilient farming systems for at least three million producers by 2030. The adoption of water innovations and integrated management practices will mitigate water-related risks and address the unsustainable use of water resources (Figure 6.5.1). Achieving this target requires the Program to work with (i) diverse partners including FFOs such as NGOs, private-sector entities and local extension to accelerate adoption of proven technologies and management practices; (ii) NARES and government bodies to refine, adopt and enforce recommended water management practices and policies; and (iii) public and private sector investors to facilitate the scaling of water-resilient farming. The integration of farm-level water-management practices with watershed level interventions will provide the basis for collaboration with the Multifunctional Landscapes Program. To achieve these Outcomes, we address the following three research questions.

1. Where, when, and to what extent do water-related risks threaten or arise from agronomic gains?
2. What inclusive water innovations and management practices address water-related risks to and from agronomic gains, at the field and farm level? Under what conditions are these solutions effective?
3. How can we overcome key determinants preventing water-resilient farming at scale?

The Program's sources of CA include (i) decades of expertise in co-delivering water solutions across diverse cropping systems and geographies; (ii) strong public and private-sector networks to scale cutting-edge water innovations and practices; (iii) advanced data analytics and models to assess water-related risks and impacts; and (iv) available facilities offering methodological expertise in measuring water availability, use and soil-plant interaction. We aim to co-create tools to enhance site-specific prioritization of proven water interventions address water-related risks to and from agronomic gains (Output 5.1), ensure that socially inclusive water management solutions are integrated into sustainable farming (Output 5.2). Through evidence-based research with national

partners, capacity-sharing activities (Output 5.3), and targeted outreach, we will inform policies and investment to support scaling of validated water solutions at field and farm levels (Output 5.4), in collaboration with the Multifunctional Landscapes and Policy Innovations Programs. Three interactive CoA are designed to achieve water-resilient farming systems at scale.

### 6.5.1. Addressing water-related risks to and from agronomic gains.

This CoA aims to enhance the prioritization and evaluation of site-specific suitable field/farm-level water innovations and integrated water-management practices to address the water-related risks to and from agronomic gains under current and future climatic conditions. We aim to do this by (i) Developing tools to quantify the spatial and temporal variability of water-related risks to (e.g., economic and physical water scarcity) and from (e.g., over-irrigation, agro-chemical pollution) agronomic gains; (ii) Enhancing the site-specific quantification of water availability, water use (e.g. high resolution remote sensing based consumptive use), and its limitations (together with the Multifunctional Landscapes program); (iii) Using crop water modeling and state of the art data science to evaluate the risk-mitigation potential of water solutions for current and future climates; and (iv) developing frameworks that assess KPIs of water solutions within whole-farm situations (AoWs 6.1. to 6.7). New lines of work include establishing state-of-the-art sensing techniques and analytics for early soil and water stress response; evaluating current on-farm water management practices, and assessing water-quality risks that impact agronomic gains.

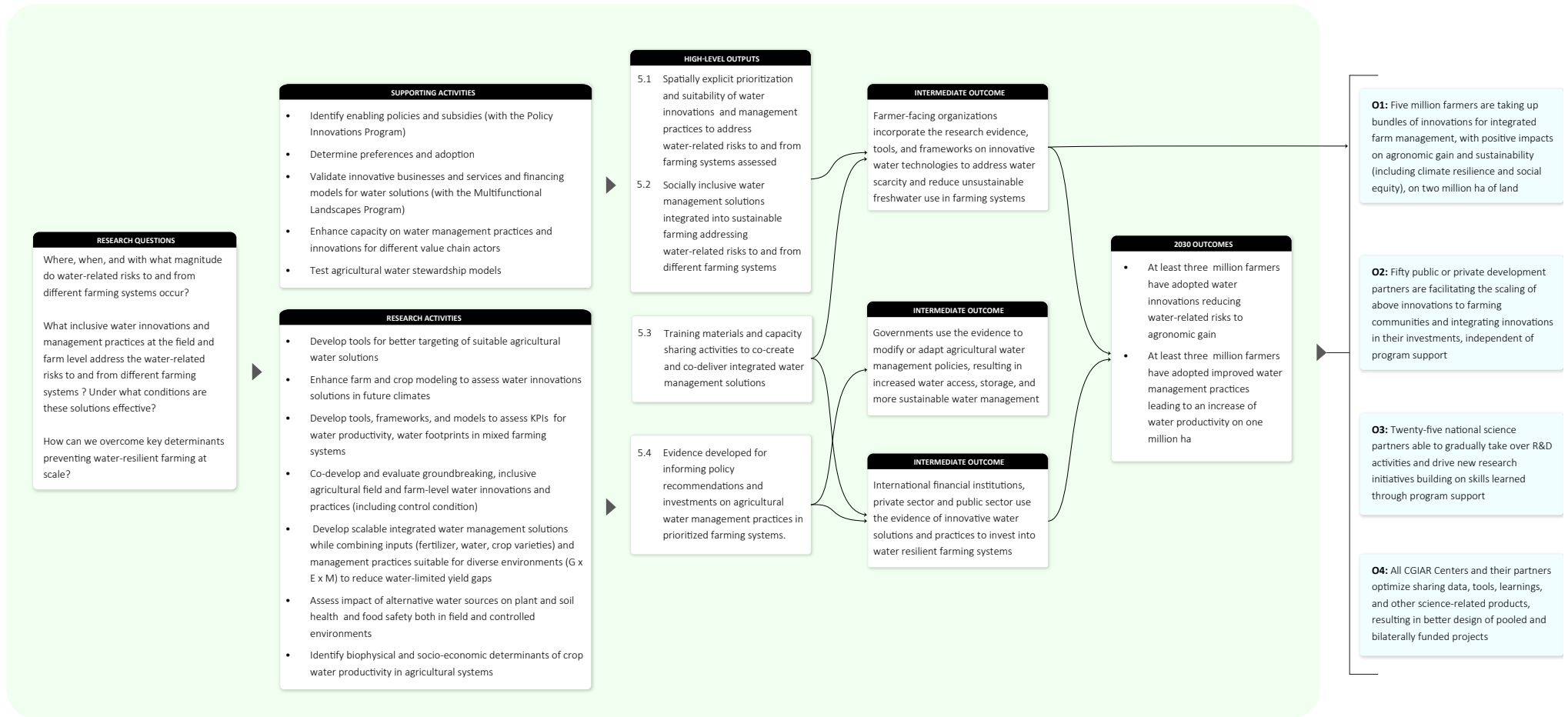
### 6.5.2. Socially inclusive, effective and scalable integrated water-management solutions for diverse production ecosystems.

This CoA aims to co-create socially inclusive water solutions aimed at addressing the identified site-specific, water-related risks in rainfed and irrigated systems including desert areas. Specific activities include (i) developing innovations that a) enhance water storage (e.g. water harvesting and fishponds); b) enhance access and productive use in rainfed systems (e.g. agronomic practices, low-water requiring crops and varieties, soil and water conservation in collaboration with AoW 6.3); or c) optimize water use in irrigation systems (e.g. crop diversification, application methods, cost effective soil moisture sensor based advisories, multiple- use services); ii) integrating water-management solutions with agri-inputs and management practices suitable for diverse environments (including desert farming); and (iii) accommodating gendered and socio-cultural preferences and norms throughout the co-creation process. New lines of work include exploring potential alternative water sources and circular principles, and assessing their impact on productivity, plant and soil health and food safety.

### 6.5.3. Water-resilient farming systems at scale.

Working closely with CoAs 6.8.3 (Capacity Sharing Accelerator), 6.8.4 (docking to the Scaling for Impact Program) and 6.8.5, this CoA will explore options to remove constraints to farmer adoption, public and private-sector investment, and program design for water-resilient farming systems at scale. Main activities include (i) Identifying determinants of improved water productivity; (ii) Developing inclusive business and service mechanisms and incentives to achieve water-resilient farming systems at scale; (iii) Tailoring agricultural water management advice to different value-chain actors; (iv) Providing policy recommendations (with CoA 6.8.5) on agricultural water management; and (v) Offering technical assistance to public and private-sector investment programs. New lines of work, in collaboration with CoA 6.8.5, include evaluating innovative agricultural water stewardship models, and repurposing subsidies to reduce unsustainable freshwater use.

**Figure 6.5.1.** Contributions by Area of Work 5 (Integrated Water Management) to the Sustainable Farming Program



## 6.6. AoW 6: Scale-appropriate mechanization

Smallholder farmers face difficulties in crop production partly because of poor access to technologies that relieve drudgery and labor bottlenecks. Sub-Saharan Africa has the world's lowest level of agricultural mechanization, where 65% of farm power is provided by humans (Sims & Kienzle, 2016, 2017). However, agriculture absorbs labor as agricultural workers in areas with high population densities, so the role of scale-appropriate mechanization (SAM) to needs to be placed in context and tailored to local conditions. During peak labor demand periods, labor shortage may delay agricultural operations (e.g. land preparation, crop establishment, pest and weed management, harvesting etc.) leading to significant losses. Rising temperatures reduce the capacity of manual labor due to heat stress. Urban migration, and an aging agricultural labor force are causing labor scarcity. Making effective machinery services available helps to address labor shortages; reduces drudgery; improves resource use efficiency; reduces climate risks, and opens transformative opportunities for youth through rural employment. This includes work in services, spares and repairs provision, and aligned small industries. However, machinery and equipment must be commercially available, affordable, easy to operate and repairable under local conditions. Lastly, mechanization reduces labor requirements, allowing more time for other income-generating activities or leisure, and could be an entry point for sustainable intensification and precision agricultural management.

The AoW's outcome ambition is that by 2030, over one million additional smallholders will benefit from increased access to machinery services, improving labor productivity by at least 25%. These machines include, for example, an assortment of cultivators, planters, weeders, power sprayers, irrigation pumps and water-delivery systems, harvesters, choppers, shellers, threshers, and (straw/hay) bailers etc. This target will be realized by creating an enabling environment that allows farmers to better understand, access and utilize these machines, and promotes mechanization services and entrepreneurship. This environment includes policy support to manufacturers and distributors of these machines. These actions raise the following research questions:

1. What are all the human-centered design SAM options and workable methods to co-develop gender-responsive, socially inclusive SAM with stakeholders for improved labor productivity and reduced carbon footprint?
2. What will be the implications and tradeoffs of introducing SAM on intra-household decision-making, labor dynamics, productivity at farm and community level?
3. What factors influence the adoption of SAM and what type of context-specific scaling approaches (including policy interventions) will lead to wider adoption of SAM by different stakeholders including women and youth?

The Program has sources of CA to lead this effort for several reasons. CGIAR Centers have interdisciplinary expertise including mechanization experts, agronomists, and social scientists, enabling holistic approaches to establish partnerships with private sector, universities and other organizations. CGIAR research facilities and infrastructure support multi-locational testing of mechanization options and behavioral studies to evaluate adoption enablers. It has strong working relationships with partners including national governments and the private sector to facilitate mechanization efforts. At the same time, balanced partnerships are required because CGIAR Centers do not have sources of CA in the commercialized manufacture and market distribution of prioritized machinery.

The AoW and its HLOs are presented Figure 6.6.1. We aim to achieve these by (i) Following human-centered design approaches based upon knowledge of various SAM options identified for target beneficiaries; (ii) Promoting SAM that most improves labor productivity and reduces carbon footprints, and (iii) Development and distributing tools that facilitate the design, testing and scaling of vetted equipment through mechanization stakeholder platforms. Four CoA are planned to address these issues.

### 6.6.1. Developing SAM options.

Several mechanization options are known and available, and also new options emerging, therefore, standard operating procedures (SOPs) for those options are needed for potential users to better understand the equipment. Continued efforts to improve and adapt these innovations across target sites will assess synergies and trade-offs among a suite of standardized KPIs, including labor, energy use efficiency, and carbon footprint.

### 6.6.2. Assessing SAM responsiveness to gender and youth needs.

Special attention will promote gender equity and women's and youth empowerment through greater access to mechanized operations, and understanding of how this impacts labor dynamics. The equipment will be assessed in term of client constraints, needs, and preferences, labor dynamics, and through targeted inclusion of women in capacity development activities.

### 6.6.3. Assessing drivers of SAM adoption.

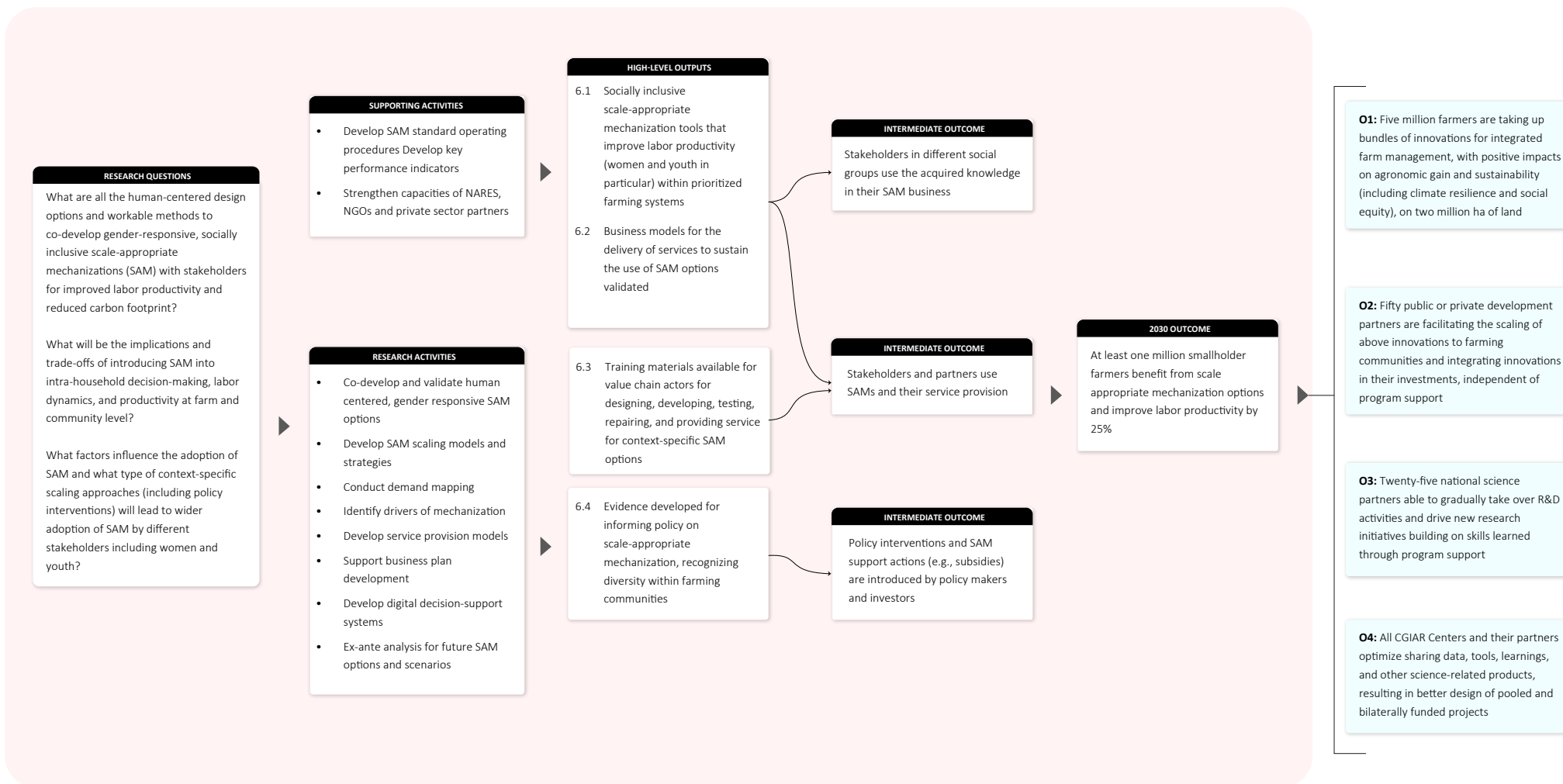
Prevailing biophysical and socio-economic factors influence the adoption of mechanization options that need to be addressed through site-specific scaling models and strategies. Approaches include demand mapping of machines based on need and appeal and promoting conducive policies regarding financial incentives and market regulations. In regions where farmers are most unable to afford recommended machines, various service provision options will be assessed.

### 6.6.4. Developing SAM business models.

This Cluster supports the capacity of entrepreneurs, local manufacturers, engineers and students to design, develop and repair machinery generating employment opportunities, particularly for youth. This situation will be addressed by building the capacity of these actors through knowledge exchange programs. Other supporting activities include developing scaling-out mechanisms, multistakeholder platforms that strengthen linkages among value-chain actors, financial services, business model development, and market incentives.

Emerging areas of work include assessing unmanned vehicles that are gaining attention for various farm operations and precision agriculture including seeding and the application of fertilizers and crop protection materials. Mechanized assessment of crop growth, yield, plant health, and soil and water status requires attention for precision agriculture (linking with AoWs 1 to 5). For example, developing SOPs for drone applications ensures safe and widespread future use in agriculture. While this AoW does not cover post-harvest mechanization at this moment, there are significant opportunities in this area. Mechanizing post-harvest operations, such as threshing, milling, and storage, could improve efficiency, reduce losses, and enhance overall value chains. Thus, this area will also require attention, and area for collaboration with the Better Diets and Nutrition Program.

**Figure 6.6.1.** Contributions by Area of Work 6 (Scale-appropriate Mechanization) to the Sustainable Farming Program



## 6.7. AoW 7: System integration through co-creation

This AoW fulfils a vital role in the Program, addressing the problem of bridging between farm component research (crops, livestock, trees, fish, etc.) and farmers' whole-farm perspectives, integrating this with other levels of systems analysis. Highly scalable socio-technical innovation bundles will be designed, tested, monitored, and prioritized for specific contexts through co-designing with partner organizations, co-creating with farmers, using system modeling approaches, and sustainability assessments. These bundles will comprise multiple on-farm technologies or practices and enabling services or support measures that may come from policy and institutional levels (Barret et al., 2020). The development, validation, and scaling of methods for designing and appraising these bundles is also a key objective of the AoW, and will draw upon HCD, behavioral sciences, systems science, and data and DST developed across the Sustainable Farming Program in collaboration with the Scaling for Impact Program.

The planned 2030 outcome for this AoW is that five million small and medium-scale farmers adopt and benefit from bundles of farm system innovations (same outcome as the Program), from which particularly women, youth, or other disadvantaged groups will benefit (Figure 6.7.1). There are four intermediate outcomes. Two are related to stakeholder organizations scaling the Program's products: scaling innovation bundles (IO7.2) and scaling methodologies for bundle design and appraisal (IO7.1). These are contingent upon the HLOs of validated, co-designed bundles (HLO7.1) and the bundle design and targeting methodologies, which draw on co-creation methods, system sciences, sustainability assessment, and HCD, and enable local people to define feasible and context-specific transition pathways to sustainability. Intermediate Outcome 7.3 supports the innovation pathway (IO7.1 and IO7.2), via short- and long-term capacity development. Training materials will be prepared to enable the use at scale of prioritized bundles, and to enable using co-creation and system science approaches and bundle design methodologies by stakeholders and partner organizations (HLO7.3). Long-term capacity sharing involves developing curricula and other diverse mechanisms towards the intermediate outcome that enhances the ability of current and future agricultural professionals to engage with better integrated systems and behavioral sciences. Intermediate outcome 7.4 aims for governments, the private sector, and international organizations to invest in scaling innovation bundles and in mainstreaming co-creation and system science methods in their institutional approaches. Evidence to support this (HLO7.4) will come from evaluating the farm bundles at scale, and evaluating and applying bundle-design methodologies. Collaborative work is envisioned with the Breeding for Tomorrow and Genebanks, Multifunctional Landscapes, Sustainable Animal and Aquatic Foods, Policy Innovations, Better Diets and Nutrition, and Scaling for Impact Programs, as well as with the three Accelerators.

Three research questions underpin this agenda.

1. What are the most promising integrated farm-level innovation bundles for improving sustainability, equity, and agronomic gains at scale within the selected Program geographies?
2. How can co-creation and systems science methods contribute to prioritizing and designing highly desirable, sustainable, and equitable farm system innovation bundles?
3. How can co-creation and systems science methods accelerate scaling farm innovation bundles, and what evidence is needed to design enabling policies and influence investments in mainstreaming these methods in organizational strategies and educational efforts?

The Program team has extensive experience in developing, validating and adapting participatory research methods (Ortiz et al., 2019;

Ortiz et al., 2020), from the seminal paper "farmer back to farmer" (Rhoades and Booth, 1982) through participatory breeding, crop management, and value-chain creation. Systems science is applied at multiple levels within CGIAR from plant, through farm (Hammond et al. 2017; 2020), landscape (Hammond et al. 2021), and macro-economic levels (Giller et al 2021). Often these efforts have been applied to component technologies, but not to design or evaluate integrated and bundled solutions, which is now required to rapidly address sustainable development challenges to meet 2030 SDG targets. The research questions will be addressed via transdisciplinary action research using focus sites and innovation platforms through which researchers will co-develop, test, and iterate solution bundles and integrative methodologies. This will include the following CoA:

### 6.7.1. Co-designing, testing and integrating multi-component farm innovation bundles with enabling services to increase adoption.

These activities will involve collaborative research with partners, other AoWs and Programs, which develop farm-level innovations that include crops, livestock, trees, fish, etc. that will need to be integrated according to contexts, and supporting an enabling environment (case of Breeding for Tomorrow and Genebanks, Multifunctional Landscapes, Policy Innovations, Scaling for Impact, Sustainable Animal and Aquatic Foods, Better Diets and Nutrition, and the Accelerators). Co-investment and co-location of activities is planned to design, test, and appraise integrated context-specific solutions, and maximize efficiencies and learning opportunities.

### 6.7.2. Developing, applying, and testing co-creation methods for the design and integration of farm innovation bundles.

This CoA builds upon previous experiences of participatory, co-creation research and HCD to include the farmer perspectives and participation in monitoring, particularly from women and youth and connect with system sciences (see 6.7.3).

### 6.7.3. Developing, applying, and testing system science methods for the design and targeting of innovation bundles.

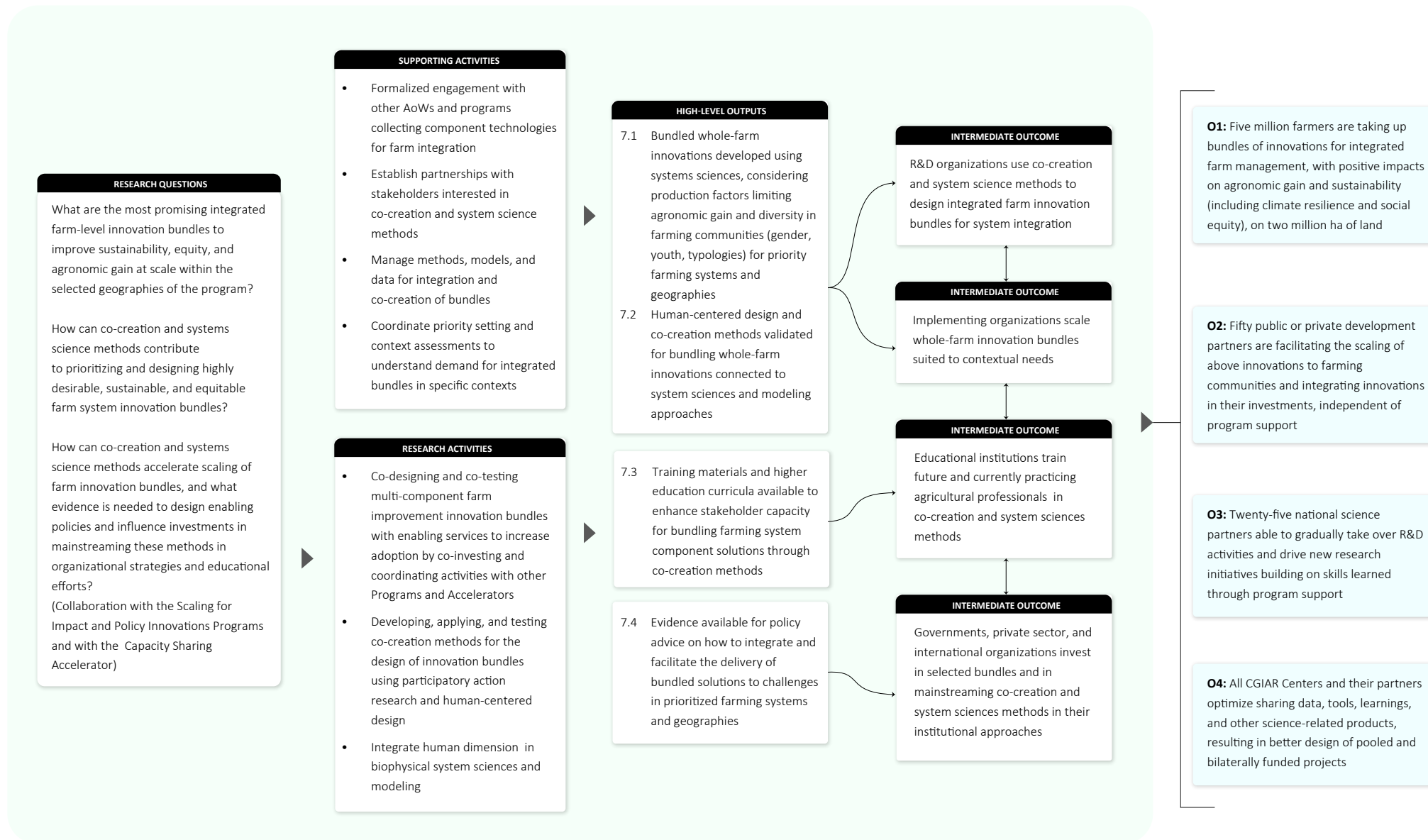
This CoA combines the human perspective gathered through co-creation methods, with biophysical and socio-economic systems-oriented modeling, aiming for enhanced decision-making at multiple levels. It also includes developing a multi-variate sustainability appraisal to be applied to all farm-level solutions, and considers the need to adapt over time. This work will be in collaboration with the Policy Innovations, Multifunctional Landscapes, and Scaling for Impact Programs to explore the factors that influence adoption of innovation bundles in wider political, institutional, and cultural contexts.

### 6.7.4. Capacity sharing towards institutional change for using co-creation and systems science methods and stimulating policy investments.

This is achieved in collaboration with the Policy Innovations and Multifunctional Landscapes Programs and the Capacity Sharing Accelerator to define and address capacity gaps for the short- and long-term across different stakeholder groups. This will build in the progress made by the MFS Initiative, French Organizations, and the SYSTEMS Group of the SUSTAIN-LIFE European University (<https://www.sustainlife-university.eu/>), and the results of a workshop organized in May 2024 about how to strengthen system sciences in CGIAR. This collaboration will expand involving additional relevant partners to continue enhancing CGIAR and partners' system science skills.

These clusters of activities will build upon the methods, sites, platforms, and processes established in the EIA, PH and MFS Initiatives (as well as bilateral projects), including an inventory of systems science tools and a virtual institute for systems science.

**Figure 6.7.1.** Contributions by Area of Work 7 (System Integration through co-creation) to the Sustainable Farming Program



## 6.8. AoW 8: Program efficiency and delivery

AoW 8 supports common functions across all component-based areas of work (AoWs 2-6), and the integrative AoWs (1, 7), creating a coherent, programmatic delivery model. AoW 8 will increase efficiencies in cross-cutting data science and analytics, prioritization, MELIA, scaling and delivery partnerships, capacity sharing, and evidence-based policy support. Achieving efficiencies in these aspects common to all technical AoWs is a key benefit of building a sole Sustainable Farming Program instead of three independently implemented Initiatives on agronomy, plant health and farming systems, and disconnected bilateral projects (as in the past). This AoW assembles those cross-cutting skills, services, and partnerships that support developing, validating, and delivering solutions implemented by the other AoWs; and it also represents a mechanism for coordinated engagement with other Science Programs and Accelerators.

The AoW 2030 Outcome will flow from three Intermediary Outcomes (IO), focusing on changes in the way Program integration occurs between all AoWs, and how evidence-based decisions are made, and in the way CGIAR staff and partners contribute to shared data and analytical processes, and in the way partnership platforms focus AoW activities on the complex challenges that need to be resolved on the path towards sustainable farming systems (Figure 6.8.1). Through IO 8.1, interventions and locations will be prioritized based upon expected ROI and where needs are greatest. A real-time MELIA system will support the assessment of progress towards the delivery of agronomic gains at scale, and the impact assessment of the integrated solutions. Through IO 8.2, integrated data management and new analytical tools will generate substantial value, ensuring that data and analytical processes are standardized and FAIR, and analysis of 'big' data provides insights across AoWs. Through IO 8.3, partnership platforms will engage with other AoWs and Programs to input on designing and bundling farm level innovations, and that through this process they will be ready to invest in or scale proven bundles. Bundling partners will ensure that key services allow efficient scaling over time and space. Research questions (RQ) underlying the delivery of these Outcomes follow:

1. How can better integrated science and delivery services create more agile, effective and efficient Program operations?
2. What mechanisms and incentives are needed for CGIAR and partner staff to engage with those services?
3. How can partnership platforms be most efficiently organized around key operational units, integrating some of the above services?

The Program is well placed to address these research questions because of its staff expertise, facilities and partnership mechanisms, including cooperation with other Programs and Accelerators, and building on previous work under the Initiatives. In relation to RQ 8.1, qualitative approaches will be used to quantify the investments made in the suggested cross-cutting services to document the interactions such service units have with other Program teams and activities. In relation to RQ 8.2, survey procedures will be applied that document what drives people to spend the extra effort required to share data, analytics, and solutions towards more integrated solutions. In relation to RQ 8.3, existing partnership platforms with proven successes in delivering and scaling integrated innovations (across AoWs and with other Programs) will be evaluated, and their internal organization analyzed. Critical business units, in relation to technical support services, business development support, or resource mobilization will be identified and assembled in guidelines for effective partnership platforms. The AoW's five Clusters, which aim at integrating and building synergies across the AoWs, are:

**6.8.1. Implementing a prioritization and agronomic gains MELIA system.**  
The CoA will develop a prioritization logic, highlighting farming systems and areas where agronomic gains and/or sustainable farming options are needed. This will be supported by a digitally enabled Program-wide MELIA strategy, focusing on assessment of agronomic gains at scale, potentially by other CGIAR Programs and external research and scaling partners.

### 6.8.2. Developing data and analytical infrastructure.

This CoA will develop infrastructure for standardizing and 'FAIRifying' data and assembling advanced analytics across AoWs 1 to 7. This will include identifying incentives for sharing data and analytical tools, that will allow generating benefits from using Artificial Intelligence and other advanced analytical tools. This CoA will cooperate with the Digital Transformation Accelerator, and build upon the substantial progress made in the Initiatives.

### 6.8.3. Operationalizing novel capacity sharing models.

This CoA will identify and operationalize effective and integrated capacity-sharing models for all AoWs and stakeholders engaged in the Program. This will include assembling state-of-the-art and bespoke training materials, with a particular focus on national system scientists and 'last-mile delivery' staff. This CoA will cooperate with the Capacity Sharing Accelerator.

### 6.8.4. Facilitating multi-stakeholder platforms for the delivery and scaling of solutions.

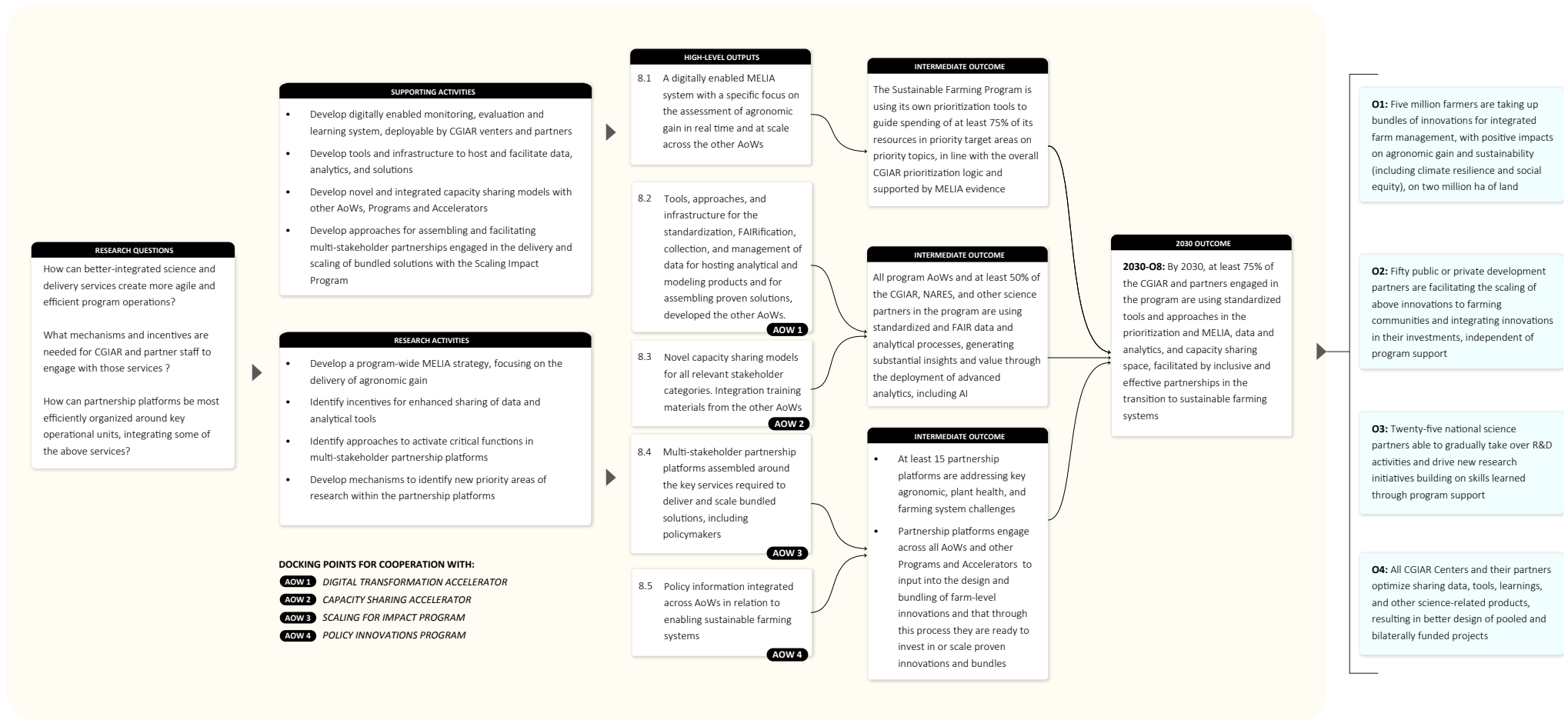
This CoA will identify and facilitate stakeholder platforms for assembling the necessary expertise and services to enable the demand-led design, delivery and scaling of bundled Program solutions. It will be supported by critical business units, including the ASSAPs established through EIA facilitation, and plant health innovation hubs and innovation platforms set by the PH and MFS Initiatives. This CoA will cooperate with the Scaling for Impact Program to assess stakeholder demand, strategic locations for intervention, and alignment with partners' agendas.

### 6.8.5. Assembling evidence-based information for policy formulation.

This CoA will summarize and make available evidence regarding the suitability of bundled solutions and the enabling conditions for their uptake at scale in support of policy formulation. This will include (i) Repurposing fertilizer subsidy programs and incentives for farmers to invest in soil health and water management practices; (ii) Influencing NDCs/National Adaptation Plans (NAPs) with relation to climate adaptation and mitigation, and (iii) Repurposing subsidies to disincentivize over-irrigation and stimulate agricultural water stewardship. This CoA will integrate AoW-relevant evidence and cooperate with the *Policy Innovations Program*

Three of the four HLOs (HLO 8.1, 8.2, and 8.3) are related to tools, methods, and approaches to generate efficiencies across all Program AoWs, while a fourth HLO 8.4 refers to the establishment of partnership platforms and HLO 8.5 focusses on policy support enabling the delivery of integrated and bundled solutions. Most of these Outputs build upon efforts initiated by the Initiatives from which the current Program have partly been built, and some novel tools will be integrated into them in relation to AI or HCD approaches – two scientific topics that require specific attention in this Program. The partnership platform will be constructed primarily on the ASSAPs, established by the EIA Initiative, but will also accommodate broader soil and plant health, water management, mechanization and farming system solutions, in addition to the agronomic solutions. This AoW will foster tangible cooperation with the Digital Transformation Accelerator, the Capacity Sharing Accelerator, the Scaling for Impact Program, and the Policy Innovations Program to facilitate the delivery of HLO 8.2, HLO 8.3, HLO 8.4, and HLO 8.5, respectively. The list of high-level outputs, outcomes and partner roles are presented in Annex 6.8.1.

**Figure 6.8.1.** Contributions by Area of Work 8 (Program Efficiency and Delivery) to the Sustainable Farming Program



## 7. Country integration

### 7.1. Example of Program country integration in Ethiopia

#### **The Sustainable Farming Program co-design with key stakeholders and the Scaling for Impact Program to respond to local demand:**

There are three main avenues for stakeholder input into the Program design. First, it responds to the needs articulated by Ethiopian stakeholders through CGIAR listening sessions, and through Initiative consultations including: (i) a consultation of 288 science and delivery partners from over 18 countries (including Ethiopia) by the EIA Initiative, (ii) a diagnosis of capacity gaps in surveillance and monitoring of priority pests and diseases among national partners in 26 countries (including Ethiopia) by the PH Initiative, and (iii) six country-level stakeholder consultations conducted by the MFS Initiative. Second, during Program design, stakeholders were consulted through an online event (183 attendees globally), with key stakeholders invited to review and provide input to the proposal, including 17 experts on Ethiopia representing NARES and NGOs. Third, during the Inception Phase and during program operation, a national advisory group will be assembled to guide development of the country workplan, steer the program implementation, and respond to evolving national demands and opportunities, in close collaboration with the *Scaling for Impact* Program. Furthermore, the EIA Initiative has significantly advanced Ethiopia's engagement in decision-support efforts. By uniting various CGIAR Centers, other International Centers (IFDC, ISRIC), and national bodies such as the Ethiopian Institute of Agricultural research (EIAR), various Ethiopian regional research Centers), EIA has facilitated the development of a harmonized Decision Support Framework for site-specific fertilizer recommendations across key crops (maize, sorghum, teff, and wheat). This collaborative approach, supported by major donors, such as BMGF, GIZ, and USAID, has streamlined data aggregation and curation, made use of advances in data analytics and modeling possible, and fostered a more efficient use of agronomic expertise and resources.

#### **Sustainable Farming Program work embedded in national and/or regional policies, strategies, programs, priorities, and processes:**

Ethiopia's agricultural policies have prioritized grain production, watershed management and reducing soil degradation, and food and nutrition security as key areas in response to key trends: increasing population, changing diets, land degradation, and climate change. Sustainable farming practices are identified priorities in strategic documents such as [The Vision 2030: Transforming Ethiopia's Food Systems](#), in existing policies such as Ethiopia's Agricultural Transformation Agency Strategy, as well as the regional priorities of Africa Union's [Soil Initiative for Africa](#) and Agenda 2063 continental Initiative [CAADP]). These are well aligned with the Program's focus on whole-farm productivity of mixed systems, diversification, resource use efficiency, soil health, appropriate mechanization, and the development of agricultural jobs and equitable income creation. The national environmental targets of Ethiopia's Ten-Year [Perspective Plan](#) of reducing annual soil pollution, raising the rate of annual increase of soil carbon content, and enhancing the reduction of GHG emissions are central to the Sustainable Farming Program. While the Program is integrating AI into decision frameworks, Ethiopia has at the same time taken significant steps to define AI policies and establish institutions to drive AI development (African Union, 2024). CGIAR's Ethiopian team is highly integrated into national systems, with all CGIAR Centers

represented on a single campus, and long-term engagement through delivery of major projects including Africa RISING, AICCRA, the Community-based Breeding Program, GAIA, ILSI, and TAAT, as well as previous Initiatives based on joint planning with the National Soil Information Service, EIA, Regional research institutions and Regional Bureaus of Agriculture. The Program will complement the Ethiopian Soil Information System where digital soil maps are linked to soil management practice. Through its membership of the Rural Economic Development and Food Security Sector Working group, a platform bringing together the Government of Ethiopia, with its Agriculture Sector Development Partners, CGIAR will continue to embed this Program into national programs and policies including the 10-year Perspective Plan.

#### **Country lessons from the 2022-2024 Portfolio (including regional/ country partnership and engagement structures) integrated into the Sustainable Farming Program:**

Key gaps identified during the EIA Initiative include the need for consideration of soil acidity, previous farm management, organic resources, seasonal weather and HCD in farm intervention design. These are all included within the Sustainable Farming Program. HCD integration across the Program underscores solution design informed by grassroots feedback. The Program's approaches provide opportunities for implementing bundled farming solutions across farming systems and landscapes. In the past, both EIA and MFS Initiatives conducted collaborative efforts in Ethiopia. Tools developed by CGIAR Initiatives are readily applied across the country, and the 2022-24 Portfolio offers further opportunity for South-South learning and transfer of information.

Developing conflict-sensitive operational modalities such as having coordinators on project sites and regular security monitoring are important for supporting field operations and developing functional partnerships for successful implementation amid security concerns and recurrent travel restrictions. Key learnings will be integrated in the Program planning in Ethiopia. These include having multiple sites; aligning field activities with periods of relative peace; relocating field activities to safe areas, and using remote data collection methods. Such methods include using android-based data collection tools and capacitating grassroots partners such as field exchange agents in data collection.

#### **Program work alongside specific local and other partners:**

The Program will build on existing trusted partnerships. A multi-stakeholder platform approach will be operationalized to set national, regional, and local priorities, identifying priority value chains and use-cases. This logic builds on the EIA and MFS Initiatives, and the Africa RISING program. Platform stakeholder members will come from various sectors, including governmental, commercial, research, NGOs, finance, and civil society. In collaboration with the *Scaling for Impact* Program, platforms will co-develop and scale technology bundles attractive to farmers, and evidence will be translated into DSTs available across Ethiopia through EIAR, the Ministry of Agriculture, NGOs, Community Organizations, and extension networks. We will extend the ongoing partnerships within Initiatives and bilateral projects (AICCRA, the Capacity Sharing Accelerator, GAIA, and QFFD). Such partnerships include the Coalition of the Willing that continues to build data assets supporting development and tailoring of sustainable farming interventions.

#### **Different components of the Program working together:**

All Program AoWs are relevant in Ethiopia. AoW 8 (efficiency and delivery) will be responsible for identifying needs and platforms through establishing a national advisory group, leading to

multi-stakeholder operations within prioritized geographies and themes, where other relevant AoWs will participate. Focus geographies are selected for research and development of component and integrated farm solutions. Within the Ethiopian highlands, soil and plant health, watershed management, precision crop-nutrient management, and mechanization form the basis of farming system improvement. AoW 7 (system integration) will combine technologies into bundles with enabling services through partnership networks. Capacity sharing activities will operate over both the short- and long-term term, building technical capacity and intellectual capital.

**Program link with other Programs and Accelerators for more effective scaling and impact in Ethiopia:** The Sustainable Farming Program will interact extensively with many other CGIAR Programs and Accelerators. The Programs on *Breeding for Tomorrow and Genebanks*, *Sustainable Animal and Aquatic Foods*, *Multifunctional Landscapes*, and *Climate Action* will feed proven options into the Sustainable Farming delivery pipeline. The *Better Diets and Nutrition*, and *Climate Action* Programs will inform on underutilized crops and foods and climate hazards. Living labs for on-farm innovation testing and bundling will be co-designed, co-located, and co-invested in with the Programs on *Sustainable Animal and Aquatic Foods*, and *Multifunctional Landscapes*. Cross-scale interactions between farming practices, landscape management practices, and landscape outcomes will be strengthened through the *Multifunctional Landscapes* Program. Building the evidence base for investment in enabling environments will be co-implemented with the *Policy Innovations* and *Scaling for Impact* Programs.

Compilation of evidence and translation into accessible information tools will be supported by the *Digital Transformation Accelerator*, as well as the design of large-scale prioritization tools drawing on multiple big data sources. Appraisal of innovation bundles for sustainability, climate resilience, equity implications, and scalability, will be done in collaboration with the *Climate Action* and *Scaling for Impact* Programs and the *Gender Equality and Inclusion Accelerator*. Mainstreaming, scaling, and south-south learning will be done in collaboration with the *Scaling for Impact* Program. The *Gender Equality and Inclusion Accelerator* and the *Better Diets and Nutrition* Program will also collaborate on the impact assessment of agronomic gains to strengthen equity and nutrition impacts. The *Capacity Sharing Accelerator* will assist in tracking the achievement, outcomes, and impacts or capacity gains, and assist in the design of innovative engagement models for capacity development, such as university curricula, virtual, or accredited courses for trainee or established agricultural professionals.

## 7.2. Overview of selected work in top countries

In Section 3, and based on a partial priority analysis, a preliminary list of countries and maps was presented to describe the indicative geographic scope of the Sustainable Farming Program. Annex 7.2.1 provides additional information of a sub-set of countries including the farming systems and/or districts where the Program will intervene, the AoW that will participate, the intended collaboration with other CGIAR Programs and Accelerators and a preliminary list of key partners in each country.

A tiered approach is planned for country engagement, with major R&D investments in a smaller number of countries addressing specific challenges with wider relevance. From these, validated interventions and operational models can be scaled to a larger number of countries. A small number of countries with high

impact-potential, but an under-developed CGIAR presence will also be selected, and additional working locations will be driven by the acquisition of W3 and bilateral funding. The exact list of countries to be prioritized will be refined during the Inception Phase when the priority setting process is completed at CGIAR level.

## 8. Boundaries and linkages with other components of the Portfolio

### 8.1. Boundaries with other components of the Portfolio

The Sustainable Farming Program focuses its activities at the field- and farm-levels toward delivering farm-level bundled solutions to a wide range of recognized agricultural constraints. This effort includes management of crops, soil, water, PDWs, mechanization, livestock, and climate response, and the integration of these options. These same elements necessarily feature in the actions of other CGIAR Programs and Accelerators. For example, other CGIAR Programs such as *Multifunctional Landscapes* focus efforts on a higher level of agricultural systems, while the *Policy Innovation* and *Scaling for Impact* Programs focus their work at the institutional and developmental levels, but all stand to benefit from contributions from field and whole-farm solutions developed by the Sustainable Farming Program.

### 8.2. Linkages across the Portfolio

Because different CGIAR Programs and Accelerators will be looking at diverse components of agri-food systems, close collaboration with them is expected. The Sustainable Farming Program will cooperate with other Programs by following three different modes of engagement: (i) co-investing in terms of staff time and operational funds in areas of common interest, delivered through complementary skills and expertise; (ii) through providing joint solutions in the agronomy, soil and plant health, and farming systems arenas with other Programs; and (iii) by adopting common approaches, particularly in relation to the assessment of KPIs. This inter-Program collaboration is briefly described below, recognizing that more specific plans will be defined during the upcoming CGIAR Program Inception Phase.

#### 8.2.1. Linkages with the Breeding for Tomorrow and Genebanks Program.

Collaboration involves providing information on cropping system and phytosanitary conditions that better inform Program breeding objectives. This leads to advanced breeding material to optimize input and management (G x E x M) recommendations for advanced and released cultivars, and basing crop management recommendations around this improved performance. Collaborative activities with the Plant Health AoW will support screening of new breeding materials for tolerance to biotic constraints. Data collected will be used to better predict improvements, at the system level following adoption of these improved varieties and guide for developing breeding product profile. The Sustainable Farming Program, especially the Plant Health AoW, will engage Germplasm Health Units (GHUs) of the Genebanks Program for (i) co-development, validation, and scale diagnostics for germplasm health monitoring; (ii) engage GHUs as hubs to anchor and facilitate subregional and crop-specific diagnostic networks; (iii) strengthen phytosanitary capacity to prevent the transboundary spread of pests and diseases; and (iv) long-term maintenance of reference isolates for diagnostics and phenotyping.

### 8.2.2. Linkages with the Sustainable Animal and Aquatic Foods Program.

Collaboration will be on designing and evaluating innovation bundles, drawing on technologies and practices developed within *Sustainable Animal and Aquatic Foods* Program and bundled for different whole-farm contexts. The generated evidence will also inform the Sustainable Farming Program compendium, prioritization, and decision support tools, which the *Sustainable Animal and Aquatic Foods* Program can later capitalize on. This Program works on value chains, food consumption, and localized theory of change that may better inform the Program's scaling, impact, and innovation platform processes. This will be achieved through co-investment in activities within common sites, systems modeling work, and potentially staff with complementary roles in both programs.

### 8.2.3. Linkages with the Multifunctional Landscapes Program.

The scope of both Programs is different, where the Sustainable Farming Program seeks entry points at the field, farm and community level, and Multifunctional Landscapes operates at the landscape level. However, delivery in key CGIAR Impact Areas will require co-investments in solutions at landscape, community, farm, and field level. Three specific topics of common interest for collaboration, co-location and co-investment are: (i) assessing the productivity and ecosystem service status of landscapes with varying degrees of natural ecosystems, to generate data in support of land-sharing vs land-sparing approaches towards sustainable farming landscapes; (ii) integrating watershed-related investment to capture more rainfall with farm- and field-level investments to increase the use efficiency of more available water; and (iii) assembling evidence-based policy documentation in support of targeting investments in sustainable intensification and/or agro-ecological approaches for specific contexts. Secondly, both programs will cooperate in the space of soil (micro)biology and soil health, with Sustainable Farming Program focusing on the relationship between specific farm- and field-level agronomic, soil and plant health, and farming system practices, including the use of effective bio-inputs and changes in soil health, and the *Multifunctional Landscapes Program* focusing on the generation of extra biomass within landscapes as means of investing in soil health and (micro)biology. Lastly, both Programs will develop a joint set of critical KPIs in relation to productivity and other community and ecosystem dimensions.

### 8.2.4. Linkages with the Climate Action Program.

Sustainable farming systems will use climate hazard and climate-induced stress information from the *Climate Action* Program to prioritize farm-level climate-adaptation and -mitigation solutions. The Sustainable Farming Program will deliver a range of climate-adaptation and -mitigation solutions for various production systems, which will be evaluated for their adaptation and mitigation effectiveness in collaboration with *Climate Action* Program. By leveraging climate data, evaluating adaptation and mitigation solutions, and collaborating across Programs, this integrated approach will enable the Sustainable Farming Program to develop and implement effective, context-specific strategies that enhance farming systems' resilience while reducing GHG emissions where possible in the face of climate change.

### 8.2.5. Linkages with the Policy Innovations Program.

Together, these Programs will co-invest in areas of common interest: for example, with the soil-related AoW of the Program to upgrade fertilizer policies and subsidies to facilitate farmers to not only increase crop yield but also to rehabilitate soil health, and second to identify incentive schemes for farmers, extension agents, and other stakeholders to invest in soil health over time, including but not limited to soil carbon sequestration

as a public service. All AoWs within the Sustainable Farming Program have an HLO specifically referring to generating evidence in support of policy formulation related to agronomic, soil and plant health, and farming system needs, that will be integrated by the Efficiency and Delivery AoW for consideration by the Policy Innovations Program and its clients.

### 8.2.6. Linkages with the Scaling for Impact Program.

The Sustainable Farming Program will partner with the *Scaling for Impact* Program to assess stakeholder demands, co-design agronomic, plant health, and farming system innovations, and co-develop scaling pathways via stakeholder platforms. They will co-evaluate and co-adapt these bundles for improved scaling impact. Promising bundles will be amplified through evidence-based pathways, including integration into international financial institutions' (IFI) investments, country policies, development programs, and commercial enterprises. Both programs will collaboratively set principles to validate, refine, and scale innovations through multi-stakeholder networks and hubs.

### 8.2.7. Linkages with the Better Diets and Nutrition Program.

Common interests between Programs include reduced pesticide use and consequent residues, mycotoxin control, diversification and greater reliance upon lesser known, highly nutritious and biofortified crops. The *Better Diets and Nutrition* Program ensures that these advantages reach consumers, considering marketing and distribution structures beyond the farm gate. Joint activities connecting farmers and consumers in pursuit of healthier diets will examine the role of market incentives, consumer demand, and food safety on the production of more nutritious foods. Other important considerations include promoting post-harvest practices that reduce food loss, studying the effects of agronomic gains on food quality, and assessing the impact of increased farm incomes on household diet and health.

### 8.2.8. Linkages with the Capacity Sharing Accelerator.

Among other responsibilities, this Accelerator supports countries and partners build capacities to assess, innovate and implement bundled and integrated sustainable farming solutions. Together these Programs will identify and support joint training needs at the country-level as related to Sustainable Farming, and then track resulting outcomes. The Program and Accelerator will co-design tools that advance the understanding of factors that support sustainable agriculture. In addition, the Accelerator will identify novel capacity-sharing models for different stakeholder categories useful to the Sustainable Farming Program. Key collaborative efforts will inform system sciences within CGIAR and partners, building on the progress made by the MFS Initiative in collaboration with European universities.

### 8.2.9. Linkages with the Digital Transformation Accelerator.

Sustainable Farming will prioritize developing digital tools and models, including FAIR databases, AI use, and citizen science, to support farm-level decision-making and prioritized investments. This will include tools for AoWs 1–7, and will build upon digital systems developed under the EIA, PH, and MFS Initiatives. For the next several years, close collaboration with the *Digital Transformation* Accelerator will connect the Sustainable Farming Program to the rapidly evolving global digital arena in ways compatible with the larger CGIAR infrastructure.

### 8.2.10. Linkages with the Gender Equality and Inclusion Accelerator.

From starting the design of the Sustainable Farming Program, gender specialists have been included to make sure that the Program AoWs include developing gender- and youth-responsive

solutions related to climate-adaptation options; soil, water, and PDW management; mechanization options and integrated farm bundles of innovations. The collaboration with the *Gender Equality and Inclusion Accelerator* will continue to enhance capabilities of the Program and partners towards developing and scaling equitable and inclusive solutions.

## 9. Monitoring, Evaluation, Learning, and Impact Assessment (MELIA)

### 9.1. Monitoring, Evaluation, and Learning (MEL)

Monitoring, evaluation, and learning (MEL) activities will be housed within AoW 8 and report to program leadership. The MEL and Impact Assessment teams will be combined, standardizing study design and data collection across other AoWs. A Program MELIA expert will be appointed with other experts embedded in each AoW and key countries. A MELIA plan will be developed with key performance indicators (KPIs) for each AoW and across the program assessing sustainable agronomic gains, to maximize opportunities for adaptive management and learning. Bilateral/W3 projects will participate in and contribute to these standardized MELIA team activities through common KPIs and reporting against the program ToC. Program delivery will be evaluated against the ToC, with annual reporting of outputs and outcomes. An annual internal evaluation of management implementation and working culture will be conducted using surveys and interviews and reported to the Program Steering Committee. Monitoring data will also track the performance of innovations against the KPIs defined for agronomic gain and sustainability. These KPIs will include measuring economic profitability and feasibility, equity implications and accessibility for less-advantaged groups. Monitoring tools will interface with those developed by other Programs and during the Initiatives to collect data on bundled innovations in relation to the numbers and roles of partner and scaling organizations, policy engagements, investment potential, and equitability considerations. This monitoring will primarily be performed by partners following standardized collection procedures and tools.

### 9.2. Impact Assessment (IA)

The Sustainable Farming Program plans a programmatic approach to Impact Assessment, going beyond evaluation of individual technologies or farming practices. This necessitates a mixed methods approach, making use of monitoring data on the use of innovations by the Program and its partners, as well as targeted impact evaluations, benchmarking studies, projections, and validations. Impact assessment studies will be questioning whether or not the Program is delivering integrated on-farm solutions that generate agronomic gains, and whether these result in anticipated impacts across the Impact Areas, as well as how readily these benefits are assimilated into others' agendas, enabling diffusion. In this way, the Program establishes and assesses its delivery pipeline approach toward sustainable agriculture.

Impact assessment studies will focus on three impact pathways: on-farm component and bundles of innovations, institutional capacities and behavior change, and policy change. On-farm innovations will be assessed for agronomic gains, for sustainability, and for Impact Area contribution. At different stages of the R&D pipeline, different studies will be appropriate, including (i)

proof-of-concept efficacy and learning studies for component and integrated innovations; (ii) behavioral studies to design enabling components of bundles; (iii) adoption and efficacy studies during the scaling phase, and (iv) ex-post impact evaluations towards the end of the program for big-win innovation bundles. Policy influence will be evaluated for potential impact and reach, and most-promising cases subject to rigorous evaluation. These studies will be adapted and conducted within each AoW, and some will be conducted at Program level. Focus geographies will be selected for rigorous establishment of impacts, with implications drawn for expansion and replication. Studies evaluating the causal mechanisms between increased sustainability will often be conducted in partnership with other Programs and Accelerators.

## 10. Capacity sharing

The Sustainable Farming Program will work closely with the Capacity Sharing Accelerator to promote understanding and adoption of innovations that support more sustainable agricultural systems. Capacity development clients include governments, NARES, NGOs, and the private sector. While implementation will support the priority countries of the Program, outputs will be made available as global or regional public goods. The objectives of the capacity-sharing activities of the Program are to (i) support countries and partners to develop capacities to assess, co-create, innovate and implement bundled and integrated sustainable farming solutions, considering climate and production constraints, and gender and social inclusivity; and (ii) support the integration of new science perspectives, including human-centered design processes, systems science and data-driven evidence approaches as new ways of working that are mutually beneficial to partners. The main topics across the Program include (i) building capacities for agricultural soil and water management; (ii) co-designing inclusive and effective climate-adaptation and -mitigation bundles at farm level; (iii) improved detection, monitoring and management of biotic threats through gender-sensitive, socially-inclusive technology packages; (iv) designing, developing, testing, repairing, and servicing scale-appropriate machinery; (v) managing soil health and other farming practice data that support more sustainable agriculture; and (vi) facilitated investment in proven farm technology bundles by manufacturers, distributors and small-scale farmers.

Capacity sharing in the Program builds on past and ongoing efforts and interactions initiated by the EIA, PH and MFs Initiatives. The MFS Initiative has been working on a "virtual institute" to host training courses to which national universities can align and professional development courses can be based. EIA developed an e-learning hub that hosts various training materials for self-paced learning, and its scientists have also benefited from training on social sciences by the GREAT (Gender-Responsive Researchers Equipped for Agricultural Transformation platform. PH developed innovation hubs and capacity-building plans based on regional needs determined through consultations. Also, a partnership with the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) was developed, where monthly seminars on topics around data analytics and soil health are offered.

Within the Sustainable Farming Program, the entry point of capacity sharing efforts will be stakeholder demand and needs assessments within target geographies, supported by the *Capacity Sharing Accelerator* and *Scaling for Impact* Program. This will be realized through developing innovative capacity sharing and training materials and activities. Building on lessons from past efforts, the Program will engage multiple partners through networks and functional stakeholder platforms for accelerated reach and adoption

of solutions, co-development of higher education curricula, and delivery mechanisms and training materials on co-creation and system sciences, among other topics. Co-creation and system sciences is a new area requiring specific efforts so that educational institutions can train future and currently practicing agricultural professionals in appropriate methods.

The capacity development objectives will vary from (i) instilling “short-term” skills or techniques that can be learned relatively quickly through short-term courses to students, topical seminars (such as adaptation of prototypes and maintenance/repairs of mechanization solution) using platforms and virtual classrooms; and (ii) longer-term engagements where “deep” capacities in critical thinking, advanced analytics and modeling are developed through secondments, internships, and training programs. The longer-term sharing of capacities entails embedding staff within Program activities to work with CGIAR and other partners through the solution development and testing process, followed by piloting and scaling. For university degree-oriented training on priority topics, the Program will designate opportunities for MSc and PhD training, targeted to students from local RUFORUM universities. This will also be supported through knowledge exchange with advanced universities, with co-supervision by Program scientists. CGIAR scientists will also work with RUFORUM universities and Technical and Vocational Education and Training Institutes to co-design upgraded training curricula.

These Capacity Sharing interventions require systematic demand assessment to identify the activities that will remain within the Sustainable Farming Program, the Centers and the Capacity Sharing Accelerator, leveraging on existing infrastructure and the need for innovative solutions. Collaborating with leading experts on resilient and sustainable farming practices, the Program will also build data assets by supporting collation and harmonization of national agronomy and soils datasets, from both new and legacy data. This will drive development of agronomy solutions and policy guidance and strengthen human knowledge base, skills and capacities for designing integrated agronomy, plant health and farming system solutions. Thus, CGIAR and its range of partners will work collaboratively to enable sharing and integrating capacities that enable partners to better participate and contribute effectively to foresight analysis and development of solutions in response to local and more site-specific challenges. In this way, the Program’s capacity-sharing strategy will improve skills and generate data, methods and tools for locally developing better-tailored, sustainable farming solutions.

## 11. Gender and social inclusion

Agricultural institutions too often lack capacities to prioritize the design and scaling of inclusive technologies. When assessing the performance of crop and livestock innovations, gender equity and equality, and social inclusion components are often ignored due to the limited awareness and skills for conducting interdisciplinary research among researchers, as well as lack of disaggregated data, tools and protocols. The Sustainable Farming Program will address gender and social inequalities in agri-food systems by employing an inclusive and gender-responsive approach throughout its AoWs.

The process of designing, deploying, and scaling agronomic, soil and plant health, and farming system solutions too often fails to incorporate the diverse perspectives and needs of women, youth, and socially excluded groups. The wide and pervasive gender gap

in agricultural productivity is a major limiting factor to agricultural development (Maeda et al., 2014). Gendered (non-land) agricultural input, technology, and extension-service gaps create noticeable productivity differences between women and men (Peterman et al. 2014), ranging from 8% (Slavchevska, 2015) to 28% (Oseni et al., 2015). Some studies show that the adoption of improved varieties intended to increase productivity or enhance other agronomic outcomes is gendered, with men more likely to adopt than women (e.g., Gaya et al., 2017). These constraints combine to negatively impact women’s abilities to adapt to climate change (Huyer, 2016). Furthermore, there is a complete lack of understanding of age (generational) gaps in productivity (Lindsjö et al., 2021), but more broadly, the extent of youth involvement and benefits derived from sustainable agricultural intensification. In the case of youth, acceptability of innovations must consider the importance of mechanization, value addition and digital agriculture, as youth seek to disassociate from the drudgery associated with small-scale farming, are attracted to higher value and more profitable enterprises, and regard smart phones as their main access to advisory services and market intelligence.

Building on the achievements of EIA, PH and MFS Initiatives, the Sustainable Farming Program will be fully responsible for assembling interdisciplinary teams to co-design and implement gender-responsive and socially inclusive approaches that identify bottlenecks for scaling innovations to achieve equitable impacts. The Sustainable Farming Program will collaborate with the *Gender Equality and Inclusion Accelerator* to further generate evidence for facilitating institutional and policy change to promote gender equality and social inclusion in farming systems. The Program will engage in capacity development for conducting interdisciplinary research to identify diverse needs, constraints and impacts of sustainable farming solutions.

Towards these ends, the Program will address the following overarching research questions across its AoWs in relation to gender equality and social inclusion.

1. What are gender-and social responsive innovations and innovation bundles that ensure inclusive approaches and achievements across the Sustainable Farming Program’s key areas of work? This question relates to equitable and inclusive innovation development.
2. What are contextually relevant approaches for the scaling of inclusive and gender-responsive Sustainable Farming innovations? This question relates to equitable and inclusive scaling of innovations.
3. What are the resulting social equity and gender-related effects within and outside the household when such integrated agronomic, plant health and farming system solutions are used/adopted by women, men, and youth farmers? This question relates to equitable and inclusive outcomes, impact and policy pathways.
4. Which capacity development and training models most effectively increase social and biophysical science research capacities to ensure that workflows develop gender- and youth-responsive integrated agronomic, soil and plant health and farming system solutions? This question relates to the selection of capacity development approaches.

In terms of Program output-, outcome-, and impact-related gender equity and social inclusion, the Sustainable Farming Program will generate evidence on the efficacy of co-creation methods to bundle innovations responding to farmer demands, placing emphasis upon the expressed needs and preferences of women and youth.

Program activities will strengthen partner capacities and contribute to an enhanced use of co-creation and system sciences methods to develop, bundle and contextualize integrated solutions responding to the needs of women and youth. Through the Sustainable Farming Program's activities, by 2030 women, youth, and vulnerable groups will benefit from integrated agronomic, soil and plant health, and farming system innovation bundles. For the gender equity and social inclusion component to be successful, the Sustainable Farming Program needs dedicated human and financial resources that are programmed into each key AoW. Additionally, resources dedicated to coordinating gender equity and social inclusion activities and for enhancing synergies across the AoW will also be required.

## 12. Climate change

The main challenge facing the Sustainable Farming Program is to ensure that more potent climate-resilient farming practices emerge and gain traction across the tropics. Climate change severely affects crop and livestock production, and these impacts are expected to increase into the future, as the result of more frequent and intense extreme weather events, floods and prolonged droughts (FAO, 2018). Altered pest and disease pressures further exacerbate risks to farms, and increased exposure to higher temperatures reduces the capabilities and threatens farm workers' health (Cicero et al., 2021). Climate change mainly threatens targeted production systems with rising temperatures and declining precipitation also threatening other natural resources, leading to desertification. Climate change also reduces the benefits from otherwise proven agricultural interventions; particularly soil conservation efforts, water-saving technologies and irrigation schemes (Lissner et al., 2024). This highlights the need for rapid adaptation of proven climate-resilient innovations by farmers and within agricultural development agendas, accompanied by anticipated mitigation co-benefits. For this reason, the Program will recommend and deliver a stream of proven climate-resilient farming practices and technology bundles through AoW 1, in conjunction with the *Climate Action* Program.

Toward this end, the Program will develop, validate and deploy the technologies and tools that ensure integrated, climate-responsive agronomic, plant health and integrated farming innovations. This service ensures the Program develops and bundles climate-responsive innovations related to (i) soil organic carbon protection and gains (ii) GHG containment; (iii) more responsible fertilizer management, water conservation and harvesting, and (iv) rapid response to new pest and disease outbreaks. These efforts include the use of latest data science and modeling techniques to inform the prioritization and evaluation of candidate interventions across multiple climate hazards, again performed in conjunction with the *Climate Action* Program. While AoW 1 specifically integrates climate adaptation and mitigation within fields and on farms, all other Program AoWs are tasked to incorporate climate resilience within their specialized interests, particularly through their processes of co-creation with partners and stakeholders. The tools developed in AoW 1 will help to evaluate and enhance the solutions being co-created in the other AoWs.

In this way, the Program will identify, mobilize and distribute state-of-the-art climate-resilience frameworks, and screen and evaluate the effectiveness of climate adaptation via various products, practices, and technology bundles, both in terms of immediate benefits to climate-impacted farming communities, and also in terms of mitigative contributions over time. This

latter element relies heavily upon the efforts of the *Climate Action* Program. This process of impact evaluation will be used to compare the potency of solutions with the *Scaling for Impact* Program to develop investment-ready information and inform regional agendas. The evaluation of options will also consider other key agronomic performance indicators, such as profitability, inclusiveness, resource use efficiency, and soil health; ensuring that enhancing the solutions' adaptation and mitigation capacity does not counteract other agronomic gains.

Planned work on determinants of adopting sustainable farming solutions for climate change adaptation and mitigation will provide new insights useful for policymakers, farmer-facing organizations, and investors. These insights will focus on how access to and use of climate information, climate risk perception, and adaptive and mitigation capacity preferences influence the adoption of larger adaptation and mitigation strategies. Evidence synthesis will compile and deliver policy- and investment-ready information on farming system solutions under different scenarios of climate change, in conjunction with efforts by the *Scaling for Impact* and *Policy Innovation Programs*. This thrust will lead to an investment pipeline of single or integrated farming solutions, illustrating their effectiveness, mitigation co-benefits, potential limitations, and likelihood of adoption for widespread inclusion across the agricultural and environmental communities.

In support of these efforts, the Program will also implement capacity-sharing activities to enhance climate awareness and promote climate-resilient farming among all our public, private, and research partners. Again, this is performed in collaboration with the *Climate Action* and *Scaling for Impact* Programs and the *Capacity Sharing Accelerator*. Capacity sharing also builds upon the past experiences and expertise to accelerate partnerships and platforms within the EiA, PH and MFS Initiatives. Capacity sharing topics will include climate information services for small-scale farmers to support locally led adaptation of farming systems, evaluating and designing effective adaptive capacity of sustainable farming practices, and measuring the mitigation co-benefits of farming practices at scale. These efforts will contribute to better translation of research products into climate policies and actions as related to CGIAR's global targets by 2030.

## 13. Risk management

Risks will be finalized and mitigation actions will be developed as part of the risk management plan during the Inception Phase.

The Sustainable Farming Program is evolving from three Initiatives implemented between 2022 and 2024 and so does the risk management strategy.

**Table 13.1.** Preliminary risks identified at proposal stage

Risk title	Risk statement including potential event, sources, and consequences on objectives
Risk 1: Uncontrolled change causing disruption	Uncontrolled changes emerging from transitioning from Initiatives to Programs can disrupt Center and partner teams' key research activities, resulting in losing progress in the Program AoWs, momentum and funding.
Risk 2: Failure to attract, and/or retain talent	Uncertainty and limited clarity of roles, responsibilities and opportunities for Center and partner staff in the Program structure can result in limited attraction and retention of key talent, weakening the Program research and scaling teams.
Risk 3: Limited inter-Program integration	Speed of change, uncertainty of financial resources and limited system approaches would result in insufficient inter-Program integration/collaboration, reducing synergies key for Sustainable Farming system integrated approaches, outputs and outcomes.
Risk 4: Limited stakeholder involvement and potential conflicts	Limited stakeholder involvement in Program planning and implementation due to speed of change, number of partners, and funding uncertainty can lead to misalignment of goals, conflicts, delays and/or non-delivery of Program outputs and outcomes.
Risk 5: Funding uncertainty limits proper planning	Funding uncertainty limits proper planning of research and scaling activities by Center and partners' teams, delaying and/or interrupting the delivery of Program outputs and outcomes.

## 14. Funding sources

The Sustainable Farming Program will be funded through a combination of pooled and bilateral funding. Each type of funding will be governed and managed in accordance with applicable rules. Program management will ensure accountability, transparency, complementarity, and synergy across all sources and types of funding.

An indicative list of bilateral projects aligned to the Sustainable Farming Program is included in the Appendix. This table includes active projects managed by the Centers participating in the Program, namely AfricaRice, the Alliance of Bioversity International and CIAT, CIMMYT, CIP, ICARDA, ICRISAT, ILRI, IITA, IRRI, IWMI, and WorldVeg. The list includes a total of 143 projects, with durations between 0.5 to 9 years, from 2025 onward. The total investment of these projects during their implementation period from 2025 onward is US\$139 million, with an average value per project of about US\$1million. Bilaterally/W3-funded projects mapped to the Sustainable Farming Program will bring an annual funding amount of US\$66 million on average to support research activities, respond to Sustainable Farming's research questions, deliver the Program's outputs and outcomes, and respond to the demands of countries indicated in Section 3. Funders of these bilateral and W3 projects include international funding agencies, private sector actors, and LMIC governments.

Regarding the pooled funding, Table 14.1 presents the high-level breakdown per AoW considering a baseline scenario based on pooled funding received by the Excellence in Agronomy, Mixed Farming Systems, and Plant Health Initiatives in 2024, which amounts to US\$36.04M.

Overall, the Program will seek complementarity between pooled and bilateral funding to deliver the planned research results that are described in this proposal. Annual work plans will be adjusted based on the evolution of the available funding.

Since 2022, the Excellence in Agronomy, Mixed Farming Systems, and Plant Health Initiatives have received on average US\$36 million annual pooled funding. An indicative distribution of this amount between the Sustainable Farming Program's AoWs is presented in Table 14.1, resulting from the mapping of the Initiatives' Work Packages (WP) to the Program's AoWs. The principles used for budget mapping include: (i) WP budgets should be mapped to one or more relevant AoWs where key research topics initiated under the Excellence in Agronomy, Mixed Farming Systems, and Plant Health Initiatives can continue (this allocation is based on the 80:20 principle: 80% of work will continue from the previous Portfolio while 20% will cover new topics); (ii) Initial budget allocations are likely to evolve once the full prioritization and comparative analyses are completed at CGIAR and Program level. See Figure A.1, which outlines the main connections between the 2022-24 Initiatives and the Sustainable Farming Program AoWs.

An explanation of the priorities for investing pooled funding is presented in the Pooled Funding Annex.

**Table 14.1.** High-level breakdown of pooled funding per AoW (in kUSD)

Sustainable Farming Program	Baseline scenario	
	Total	%
<b>Areas of Work</b>		
1. Climate Adaptation and Mitigation	4,700	13.0
2. Precision Nutrient Management	3,100	8.6
3. Resilient Soils	1,900	5.3
4. Plant Health and Mycotoxin Safe Crops	6,600	18.3
5. Integrated Water Management	1,800	5.0
6. Scale-appropriate Mechanization	1,300	3.6
7. System Integration	6,200	17.2
8. Program Efficiency and Delivery	10,440	29.0
<b>TOTAL</b>	<b>36,040</b>	<b>100.0</b>

**Note:** AoW 8 includes common operational functions that will accelerate the implementation and delivery of all AoWs, and therefore requires a relatively large proportion of the pooled funding budget (see Annex for details).

## Annex - Pooled funding

This section describes principles and guidelines for using the pooled funding allocated to the Sustainable Farming Program AoWs, as indicated in Table 14.1. This Program builds on three CGIAR Initiatives (Excellence in Agronomy, Mixed Farming Systems, and Plant Health), all working at field, farm, and community level on complementary farming system dimensions. Initiative activities identified as priorities for continuity have been mapped to the Sustainable Farming Program's AoWs, while other Initiative activities have been dropped. Figure A.1 shows the main alignment of the constituent Initiatives to the Program AoWs (noting that part of the Mixed Farming Systems and Plant Health activities were mapped to other CGIAR Programs).

The efforts led by the three aforementioned Initiatives are now part of a single Program, which aims to integrate and bundle agronomic, plant health, and farming system solutions for scalable action in response to key challenges. The Sustainable Farming Program aims to co-develop and scale with partners (particularly NARES) a series of socio-technical innovation bundles tailored to specific contexts. These bundles emerge from synergistic interactions, integrating the most relevant technologies, tools, and services to respond to country and regional demands with pooled and bilateral/W3 funding.

A portion of pooled funding will be used to deliver synergies and efficiencies across the Program through AoW 8 (Program Efficiency and Delivery), which supports common, key functions required across AoWs. These functions consist of (i) prioritization and decision-making, (ii) data management and analytics (docking point with the Digital Transformation Accelerator), (iii) capacity sharing (docking point with the Capacity Sharing Accelerator), (iv) policy advisory services (docking point with the Policy Innovations Program), and (v) facilitation of delivery and scaling partnerships (docking point with the Scaling for Impact Program). These functions require long-term investments in expertise, assets, and operations and are not only essential for the Program itself but also for associated W3/bilateral projects. Several of these functions were part of the 2022-24 Initiatives; merging them into a single Program will create efficiencies and free up resources to invest in other activities.

Two integrative areas of research will receive pooled investment: AoW 1 and AoW 7. Within AoW 1 (Climate Adaptation and Mitigation), pooled funds will support the design, implementation, and scaling of farm-level practices that address climate risks. Funds will also be directed toward evaluating the adaptive and mitigative potential of climate-smart practices through data science, modelling, and the development of frontier GHG-reduction technologies. In addition, pooled funds will support assessing ROI, develop climate scaling pathways, and strengthen institutional capacities. The pooled funds will advance foundational research initiated by the Initiatives to deliver committed outputs.

AoW 7 (System Integration) is a pivotal research area that will use pooled funds to advance system integrative research. By developing methodological approaches that blend biophysical and human-centered design principles, AoW 7 emphasizes gender- and youth-responsive research and capacity sharing, particularly with higher-education organizations. This integrative approach aims to create stakeholder-oriented decision support tools, integrating solutions

coming from other AoWs. The goal is to strengthen and foster system-oriented, sustainable farming approaches and practices through enhanced stakeholder decision-making.

Another important principle is that pooled funding will be primarily invested in supporting globally relevant AoWs and functions, and in facilitating regionally defined teams that will focus on priority challenges and topics in the regions co-defined by AoWs 1, 7, and 8 (see Sections 6.1, 6.7 and 6.8), research and scaling partners, and through demand signaling through the Scaling for Impact Program.

Pooled funds will also be used to strengthen key research of AoWs working on specific farm components (AoW 2 to 6, see Sections 6.2 to 6.6). In this case, pooled funding will act as the "glue" to define priority research activities to be complemented by W3/bilateral projects. This will allow prioritizing the investments in expertise, skills, and assets required to implement a global program effectively and efficiently at scale and in cooperation with other CGIAR Programs and Accelerators and partners.

AoW 2 (Precision Nutrient Management, see Section 6.2) is evolving from work of the Excellence in Agronomy Initiative and continues activities implemented by multi-Center teams and external partnerships. With high relevance to the Nairobi Declaration on Africa Fertilizer and Soil Health, continued investments through CGIAR pooled funding have a high likelihood of catalyzing further W3/bilateral and national investments. Continued investment will ensure: (i) sustained momentum in improving precision nutrient management tools, e.g. through support of AgWise – this will be done by integrating key aspects including farmer inputs and soil acidity management, and by expanding into new countries; (ii) integration of knowledge from other AoWs, such as climate adaptation; (iii) maintenance of partnerships created for co-designing and developing precision nutrient management solutions as part of the Initiatives; (iv) strengthened partnership and collaborations to grow funding for precision nutrient management at regional and national levels; and (v) identification and mobilization of new opportunities for utilizing AI, e.g. to enhance modeling integration into decision support tools to provide more tailored recommendations.

In AoW 3 (Resilient Soils), pooled funding will contribute to developing a soil health KPI framework that will enable soil health monitoring to inform decision making at farm, regional, and national levels. This framework will be continuously updated with other metrics such as biological indicators and carbon sequestration potential. The KPI framework will be a key contribution to guiding investments and efforts to improve the health and resilience of Africa's soil through the African Union 10-year Fertilizer and Soil Health Plan, and to share lessons with other regions. Pooled funding will be used to establish a network of long-term monitoring sites across diverse agroecological typologies to fill knowledge gaps linking agronomic practices to potential changes in soil health over time. This data will be leveraged to co-design and scale soil health management solutions. These activities will also be a critical entry point for stakeholder participation, including cross-sectoral engagement at the policy level.

The pooled funding investment in AoW 4 (Plant Health and Mycotoxin Safe Crops) will focus on addressing significant and emerging plant health threats that have documented impacts at the national, regional, or global level. This will involve supporting coordinated phytosanitary approaches and disease management

networks. Specifically, investment will include monitoring changes in pathogen virulence, with a significant emphasis on utilizing AI and citizen science tools for surveillance and to inform decision-making. The investment will also involve developing modeling, risk prediction, and decision support tools for establishing context-appropriate Integrated Pest, Disease, and Weed Management (IPDWM) strategies. Further, investments will continue in gender-responsive research, generating evidence for policy design and advocacy, and scaling inclusive IPDWM for priority constraints. It will also promote private and public sector involvement in regions affected by mycotoxin contamination to expand previously developed Integrated Mycotoxin Management (IMM) packages. Additionally, funds will be allocated for facilitating rapid responses to PDW emergencies.

Within AoW 5 (Integrated Water Management), pooled funds will be strategically used to attract larger investments in R&D to develop and deliver solutions at scale. Pooled funding will enable development of data-driven tools and techniques needed to prioritize and evaluate water management solutions and their contributions to agronomic gains. In co-developing scalable and socially inclusive integrated water management solutions, pooled funding will go toward developing context-specific, socially and

culturally acceptable solutions, using the G x E x M approach, circular economy principles, and alternative water resource use. For water-resilient farming systems at scale, we will use the pooled funding to co-finance collaboration with the Scaling for Impact Program and Capacity Sharing Accelerator, which will focus on providing technical assistance to public and private sector partners to attract larger investments using Sustainable Farming’s knowledge products.

Within AoW 6 (Scale-appropriate Mechanization [SAM]), pooled funds will be used to co-develop socially inclusive options that improve labor productivity, reduce drudgery, and enhance resource efficiency, building on Initiatives’ efforts. Resources will also support validating sustainable business models for SAM service provision, fostering entrepreneurship among local machinery manufacturers and service providers. A portion of the funds will be allocated to developing and disseminating training materials for value chain actors involved in designing, developing, repairing, and providing mechanization services. Additionally, funding will support research to generate evidence on factors influencing SAM adoption and intra-household labor dynamics for informing policies on mechanization. New activities in this AoW include assessing unmanned vehicles for various farm operations and precision agriculture, including seeding and the application of fertilizers and crop protection materials.

Figure A.1. Alignment of Initiatives to the Sustainable Farming AoWs

	AOW 8: Program effectiveness and delivery	Prioritization and MELIA	Data, tools, solutions	Capacity sharing	Partnerships for delivery/scaling	Policy advisory evidence
Current Initiative: EIA	AOW 1: Climate adaptation and mitigation					
	AOW 2: Precision nutrient management					
	AOW 3: Resilient soil systems					
	AOW 5: Integrated water management					
	AOW 6: Scale-appropriate mechanization					
Current Initiative: PHI	AOW 4: Plant health and mycotoxin-safe crops					
Current Initiative: MFS	AOW 7: System integration through co-creation					

**Note:** This is a simplified view. Some activities of the Plant Health and Mixed Farming Systems Initiatives have been mapped to other AoWs than AoWs 4 and 7; similarly, some of the work under Excellence in Agronomy will continue under AoW 7.

**Discontinuation of previously pooled-funded activities.** For the Excellence in Agronomy Initiative, this includes: (i) activities that have delivered final products that are ready to be transferred to other partners as ‘turnkey solutions’ (e.g., those hosted on the MyEiA Platform); (ii) use cases that have delivered final decision support or other agronomic tools; and (iii) strategic R&D projects that have delivered final outputs or that have not been effective.

Activities under the Plant Health Initiative that will be de-emphasized include those where sufficient progress has been made, such as the (i) completed diagnosis of key knowledge and capacity gaps; (ii) baseline reporting on available databases and tools; (iii) report on integration and management of data; (iv) identification of biosecurity risks to seed delivery pathways; and (v) strategies for mycotoxin sampling and testing. Sufficient progress has also been made on (i) identifying target sites for IPDWM options; (ii) improved aflatoxin bioprotectants and associated regulations; and (iii) decision support tools for deploying more equitable IPDM innovations.

The Mixed Farming Systems Initiative’s activities that will be discontinued include those that have been successfully completed, mainly related to stakeholder engagement, baseline and descriptive studies about the main types of mixed farming systems and their status, and studies on challenges and opportunities for sustainable intensification. The available results from these activities will

support Program activities in AoW 7 (Systems Integration) as well as in other AoWs, allowing a better understanding of opportunities, challenges, and trade-offs associated with bundled innovations to improve targeting and scaling. Other Mixed Farming Systems activities to be de-emphasized include those related to purely agronomic management technologies such as crop/variety testing, developing crop management options, and mechanization. This work will be carefully embedded within other AoWs and sites.

Freed-up pooled funding will be invested in (i) AoWs that have received relatively less investment during the 2022-24 Portfolio, including climate adaptation and mitigation on farms, long-term experiments, whole-farm system integration, and scale-appropriate mechanization; (ii) broadening delivery and scaling of partnerships beyond single partner Use Cases to accelerate scaling through the ASSAPs integrating the Plant Health and Mixed Farming Systems’ platforms; (iii) global and regional functions required for an agile and effective farming system and agronomy Program; (iv) strategic R&D to retain a viable solution pipeline in response to challenges that matter for prioritized farming systems; (v) emerging areas that could receive seed money to develop sound proposals for multi-Center and large bilateral projects; and (vi) collaborative, co-financed activities with other Programs and Accelerators to be co-implemented in common locations, aiming at a more integrated CGIAR response to country demands.

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# Sustainable Farming Program

## Appendix

November 15, 2024

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## Section 4 Comparative Advantage: Appendix 1 Item 4.1: Table of comparative analysis including the 8 areas of work (AoW) and high-level outputs of the Sustainable Farming Program.

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
<b>High-level output</b>	<b>Needed sources of Comparative Advantage required to deliver the high-level output</b>	<b>CGIAR's sources of Comparative Advantage in delivering the high-level output</b>	<b>Potential partner types (e.g., NARES, SMEs, private sector...)</b>	<b>Partners' sources of Comparative Advantage in delivering the high-level output</b>	<b>Analysis of the trade-offs between CGIAR and (potential) partners' sources of CA in delivering the high-level output, and indication of where the CA lies (e.g., with CGIAR or with the potential partner)</b>
<b>AoW 1: Climate change</b>					
1.1. Quantified climate change-related hazards that affect the delivery of agronomic gain for prioritized geographies and farming systems [with the Climate Action Program].	<p><b>Human capital:</b> Agronomist, climate change expert, crop modeler, extension agent, social scientist, gender specialist , data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), cutting-edge technologies and data analytics (e.g. remote sensing, machine learning, artificial intelligence , soil moisture sensors IoT GHGs).</p> <p><b>Social capital:</b> Collaboration with NARES, linkage with local communities and farmers</p> <p><b>Incentive:</b> International public good that can be applied elsewhere</p>	<p><b>Human capital:</b> Agronomist, climate change expert, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES and private sector.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	ARIs, NGO NARES, Private sector.	<p><b>Human capital:</b> Crop modeler (ARIs), extension agent (NARES).</p> <p><b>Physical capital:</b> Cutting-edge technologies (private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers through public (e.g. NARES, NGOs such as the Rainforest alliance) and private sector (agricultural value chain actors).</p>	CGIAR has strong experience and expertise on R&D for quantifying climate-change related hazards. Although CGIAR has some expertise in crop modeling, ARIs and networks like AgMIP possess a comparative advantage in this area (note that CGIAR Centers are also heavily involved in some of activities in AgMIP). The private sector excels in physical capital, particularly with cutting-edge technologies, while NARES's strong linkage with local communities and farmers is essential. Furthermore, a growing number of startups and agri-business SME's are incorporating the dissemination of climate change related hazard information into their businesses. By collaborating with these entities, CGIAR can enhance its capabilities in delivering innovative outputs.
1.2. Climate hazard-specific inclusive sustainable farming system innovations with evidence on adaptive capacity and mitigation co-benefits at scale.	<p><b>Human capital:</b> Agronomist, climate change expert, crop modeler, extension agent, social scientist, gender specialist, data scientist, private sector engagement specialist, finance expert, business model developer, economists.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. sensor for water, GHG).</p> <p><b>Social capital:</b> Collaboration with NARES and private sector, linkage with local communities and farmers.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, NAPs and NDC's, climate finance and other investments into climate adaptation and mitigation space.</p>	<p><b>Human capital:</b> Agronomist, climate change expert, data scientist, economists.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES, private sector, MFI's and IFI's.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	ARIs, NARES, Private sector, MFI's, IFI's.	<p><b>Human capital:</b> Crop modeler (ARIs), extension agent (NARES), finance expert (MFI's/IFI's), business model developer (private sector).</p> <p><b>Physical capital:</b> Cutting-edge technologies (private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers (NARES).</p> <p><b>Incentives:</b> Climate and other types of finance (NARES).</p>	CGIAR has strong resources (data repository, publications, research station), experience and expertise on developing agronomy-based technical packages for climate adaptation and mitigation. Although CGIAR has some expertise in crop modeling, ARIs and networks like AgMIP possess a comparative advantage in this area. The private sector excels in physical capital, particularly with cutting-edge technologies, while NARES's strong linkage with local communities and farmers is essential. Furthermore, a growing number of startups and agri-business SME's are incorporating climate adaptation or mitigation measures into their agricultural advisory services. MFI's and IFI's are investing in climate adaptation and mitigation solutions at scale. By collaborating with these entities, CGIAR can enhance its capabilities in delivering innovative outputs.
1.3. Training materials to enhance stakeholder capacity for identifying and implementing sustainable farming system solutions for climate adaptation and mitigation.	<p><b>Human capital:</b> Agronomist, climate change expert, crop modeler, data scientist, partner engagement specialist, social scientist, gender expert, extension agent.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, private sector and universities, local network.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, climate change expert, crop modeler, data scientist, partner engagement specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, private sector and universities.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NGO, NARES, government, private sector.	<p><b>Human capital:</b> agricultural service (private sector), extension staff (NARES, government, NGO).</p> <p><b>Physical capital:</b> digital solutions (private sector).</p> <p><b>Social capital:</b> local network (NARES, government, NGO, private sector).</p> <p><b>Incentive:</b> Social impact (NARES, government, NGO, social impact).</p>	CGIAR has comparative advantage in R&D, knowledge management, and training delivery, whereas partners have strengths in delivery and impact through extension networks, businesses/service arrangements and community engagement. Partnership development is crucial for maximizing the overall impact and efficiency of delivering training materials.

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
1.4. Policy and investment-ready information on sustainable farming system solutions to adapt to and mitigate climate change-related hazards.	<p><b>Human capital:</b> Policy advisor, policy scientist, economists, data scientist, climate change expert, agronomist, partner engagement specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> Collaboration with the governments, IFI's, MFI's, NARES, and universities, local network and multi-stakeholder platforms.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Political scientist, economists, data scientist, climate change expert, agronomist, partner engagement specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, IFI's, MFI's, and universities.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NARES, IFI's, MFI's, government.	<p><b>Human capital:</b> Policy advisor (government), economists, financial experts (IFI's, MFI's), local communication (NARES).</p> <p><b>Social capital:</b> Local network and multi-stakeholder platforms (NARES, government, IFI's, MFI's).</p> <p><b>Incentive:</b> Social impact (NARES, government) and investment (IFI's/MFI's).</p>	CGIAR has comparative advantage in human/physical capital to generate scientific evidence-based outreach products and tap into or facilitate multi-stakeholder platforms/dialogues whereas partners have strong local networks. Partnerships enable the effective delivery of policy/investment-ready information on agronomic, plant health, and farming system solutions.
<b>AoW 2: Precision Nutrient Management</b>					
2.1. Spatially-explicit recommendation decision support models (i.e., AgWise) for soil nutrient constraints with demonstrated agronomic gain and return of investment (ROI) developed and integrated into advisory frameworks that deliver recommendations to users.	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. AI, remote sensing).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES</p> <p><b>Incentive:</b> International public good that can be applied elsewhere</p>	ARIs, NARES, private sector.	<p><b>Human capital:</b> Data scientist (ARIs, private sector).</p> <p><b>Physical capital:</b> Cutting-age technologies and laboratories (ARIs, private sector)</p>	<p>ARIs and private sector can have comparative advantage (CA) in human capital in terms of data scientist with great expertise on cutting-edge technologies (e.g. AI, remote sensing), whereas CGIAR has CA in other sources.</p> <p>By collaborating with ARIs and private sector, CGIAR can enhance its capabilities in delivering innovative decision models that can be transformed into private advisory services.</p>
2.2. Expanded data-driven agronomic recommendations for site specific nutrient management with inclusion of nutrient balance, liming, soil health, and climate-related advisory services.	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	ARIs, NARES, private sector.	<p><b>Human capital:</b> Data scientist (ARIs, private sector).</p>	ARIs and private sector can have comparative advantage (CA) in human capital in terms of data scientist, whereas CGIAR has CA in other sources. By collaborating with ARIs and private sector, CGIAR can enhance its capabilities in delivering innovative decision models that can be transformed into private advisory services.
2.3. Training materials to enhance stakeholder capacity for developing and delivering site-specific nutrient management recommendations for prioritized farming systems.	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist, partner engagement specialist, social scientist, extension staff, agricultural service provision.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions for bundling service.</p> <p><b>Social capital:</b> collaboration with the governments, NARES, and universities, local network.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist, partner engagement specialist, social scientist.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information</p> <p><b>Social capital:</b> Long-term collaboration with the governments, NARES, and universities.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NGO, NARES, government, private sector.	<p><b>Human capital:</b> Agricultural service (private sector), extension staff (NARES, government, NGO).</p> <p><b>Physical capital:</b> Digital solutions (private sector).</p> <p><b>Social capital:</b> Local network (NARES, government, NGO, private sector).</p> <p><b>Incentive:</b> Social impact (NARES, government, NGO, social impact).</p>	As partners have different CA, functional stakeholder platform is needed for developing solutions and accelerating their adoption. CGIAR's CA is development and testing of precision nutrient management solutions and generating scientific evidence on its performance.

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
2.4. Evidence for policy recommendations for precision nutrient management and smart fertilizer subsidy programs [with the Policies and Institutions Program].	<p><b>Human capital:</b> Policy advisor, olicy scientist, economists, data scientist, agronomist, partner engagement specialist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, universities, local network and multi-stakeholder platforms.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Policy scientist, economists, data scientist, agronomist, partner engagement specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, and universities.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NARES, government.	<p><b>Human capital:</b> Policy advisor (government), local communication (NARES.)</p> <p><b>Social capital:</b> Local network and multi-stakeholder platforms (NARES, government).</p> <p><b>Incentive:</b> Social impact (NARES, government).</p>	CGIAR has comparative advantage in human/physical capital to generate scientific evidence-based outreach products and tap into or facilitate multi-stakeholder platforms/dialogues whereas partners have strong local networks. Partnerships enable the effective delivery of policy/investment-ready information on agronomic, plant health, and farming system solutions.
<b>AoW 3: Resilient Soils</b>					
3.1 A soil health monitoring and assessment framework is operationalized and Soil health data are incorporated into a digital information system to enable advanced data analytics including machine learning and AI.	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. AI, remote sensing).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	ARIs, NARES, private sector.	<p><b>Human capital:</b> Data scientist (ARIs, private sector).</p> <p><b>Physical capital:</b> Cutting-age technologies (ARIs, private sector).</p>	<p>ARIs and private sector can have comparative advantage (CA) in human capital in terms of data scientist with great expertise on cutting-edge technologies (e.g. AI, remote sensing), whereas CGIAR has CA in other sources.</p> <p>By collaborating with ARIs and private sector, CGIAR can enhance its capabilities in delivering innovative decision models that can be transformed into private advisory services.</p>
3.2 A network of long-term monitoring sites are established across diverse agro-ecosystems to conduct systematic assessments of aboveground and belowground carbon storage, hydrologic function and biodiversity overtime.	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE).</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	ARIs, NARES, private sector.	<b>Human capital:</b> Data scientist (ARIs, private sector).	ARIs and private sector can have comparative advantage (CA) in human capital in terms of data scientist, whereas CGIAR has CA in other sources. By collaborating with ARIs and private sector, CGIAR can enhance its capabilities in delivering innovative decision models that can be transformed into private advisory services.
3.3 Impacts of agricultural practices across diverse contexts are quantified and catalogued to inform and prioritize investments.	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist, partner engagement specialist, social scientist, extension staff, agricultural service provision.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions for bundling service.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, and universities, local network.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, soil scientist, crop modeler, data scientist, partner engagement specialist, social scientist.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information.</p> <p><b>Social capital:</b> Long-term collaboration with the governments, NARES, and universities.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NGO, NARES, government, private sector.	<p><b>Human capital:</b> Agricultural service (private sector), extension staff (NARES, government, NGO).</p> <p><b>Physical capital:</b> Digital solutions (private sector).</p> <p><b>Social capital:</b> Local network (NARES, government, NGO, private sector).</p> <p><b>Incentive:</b> Social impact (NARES, government, NGO, social impact).</p>	As partners have different CA, functional stakeholder platform is needed for developing solutions and accelerating their adoption. CGIAR's CA is development and testing of precision nutrient management solutions and generating scientific evidence on its performance.

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
3.4 Evidence-based information on the critical role of healthy soil is translated into accessible formats to inform decision making, including integrated in the national level policies and strategies.	<p><b>Human capital:</b> Policy advisor, policy scientist, economists, data scientist, agronomist, partner engagement specialist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, universities, local network and multi-stakeholder platforms.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Policy scientist, economists, data scientist, agronomist, partner engagement specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, and universities.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NARES, government.	<p><b>Human capital:</b> Policy advisor (government), local communication (NARES).</p> <p><b>Social capital:</b> Local network and multi-stakeholder platforms (NARES, government).</p> <p><b>Incentive:</b> Social impact (NARES, government).</p>	CGIAR has comparative advantage in human/physical capital to generate scientific evidence-based outreach products and tap into or facilitate multi-stakeholder platforms/dialogues whereas partners have strong local networks. Partnerships enable the effective delivery of policy/investment-ready information on agronomic, plant health, and farming system solutions.
<b>AoW 4: Plant Health and Mycotoxin safe crops</b>					
4.1. Capacity and networks of plant health practitioners to diagnose, monitor and manage pests, and diseases and weeds improved.	<p><b>Human capital:</b> Plant pathologist, virologist, mycologist, bacteriologist, nematologist, entomologist, weed specialist, soil scientist, molecular biologist, bioinformatician, disease modeler, data scientist.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. AI, remote sensing), point of care diagnostics), digital tools and infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, NPPOs and RPPOs.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	<p><b>Human capital:</b> Plant pathologist, virologist, mycologist, bacteriologist, nematologist, entomologist, weed specialist, soil scientist, molecular biologist, bioinformatician, disease modeler, data scientist.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. AI, remote sensing), point of care diagnostics), digital tools and infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, NPPOs and RPPOs.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	ARIs, NARES, NPPOs, private sector.	<p><b>Human capital:</b> Plant health scientists.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. AI, remote-sensing), point of care diagnostics), digital tools and infrastructure.</p> <p><b>Social Capital:</b> National and regional networks.</p> <p><b>Incentive:</b> Experience in co-creating multi-stakeholder regional and global networks and strengthening capacities of diagnostic and monitoring pests and diseases.</p>	CGIAR has comparative advantage in physical capital in disease diagnostic and monitoring infrastructure, and human capital to generate scientific knowledge and develop innovation at global level. ARIs, NARES, and NPPOs have strong networks at national and regional levels and deliver/communicate knowledge and innovations through the multi-stakeholder platform.
4.2. Improved high throughput cost effective pests and diseases monitoring, data management and modeling tools.	<p><b>Human capital:</b> Diagnostician, plant pathologist, virologist, mycologist, bacteriologist, nematologist, entomologist, weed specialist, molecular biologist, bioinformatician, disease modeler, data scientist.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, cutting-edge technologies (e.g. AI, remote sensing, point of care diagnostics).</p> <p><b>Social capital:</b> Collaboration with ARIs &amp; NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	<p><b>Human capital:</b> Diagnostician, plant pathologist, virologist, mycologist, bacteriologist, nematologist, entomologist, weed specialist, molecular biologist, bioinformatician, disease modeler, data scientist.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, cutting-edge technologies (e.g. AI, remote sensing, point of care diagnostics).</p> <p><b>Social capital:</b> Collaboration with ARIs &amp; NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	ARIs, NARES, private sector.	<p><b>Human capital:</b> Scientists, data scientists.</p> <p><b>Social capital:</b> Local, national and regional networks.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, cutting-edge technologies (e.g. AI, remote sensing, point of care diagnostics).</p> <p>AI technologies (the private sector).</p> <p><b>Incentive:</b> Experience in data management and using modeling tools and information obtained through the modeling tools.</p>	CGIAR has strong experience and expertise in data management, developing modeling tools, and analyzing data at global level. ARIs and NARES will collect data at national level and provide the data to and receive information from CGIAR.
CGIAR, ARIs and NARES will work together in all the process of data management and modeling. The private sector will provide cutting edge technologies in data collection and analysis such as AI remote sensing.					

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
4.3. Surveillance data, prevention strategies, and policy briefs for decision makers available.	<p><b>Human capital:</b> Policy advisor, policy specialist, disease modeler, data scientist, economist, gender specialist to transform scientific knowledge into practices for policy change for greater impacts.</p> <p><b>Physical capital:</b> Pest and disease databases, predictive models, management strategies and infrastructure.</p> <p><b>Social capital:</b> Collaboration with ARIs &amp; NARES, NPPO, RPPO.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally</p>	<p><b>Human capital:</b> Policy advisor, policy scientist, disease modeler, data scientist, economist, gender specialist.</p> <p><b>Physical capital:</b> Pest and disease databases, predictive models, management strategies.</p> <p><b>Social capital:</b> Collaboration with ARIs &amp; NARES, NPPO, RPPO.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	NARES, NPPO, RPPO, governments.	<p><b>Human capital:</b> Policy advisors</p> <p><b>Social capital:</b> Local and national research networks, government networks.</p> <p><b>Incentives:</b> Experience in transforming scientific evidence into enabling policies.</p>	Policy experts, NARES, NPPO, PPPO and government organizations bring their experience in engaging with policies and policy making, and design enabling policies using scientific evidence provided by CGIAR and relevant partners.
4.4. Eco-friendly, inclusive, affordable and scalable options for Integrated management of pest, disease, weed and mycotoxin management strategies developed.	<p><b>Human capital:</b> Plant pathologist, virologist, mycologist, bacteriologist, nematologist, entomologist, weed specialist, soil scientist, molecular biologist, bioinformatician, disease modeler, data scientist, mycotoxin specialist.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, cutting-edge technologies (e.g. AI-based decision support tools).</p> <p><b>Social capital:</b> Collaboration with NARES, ARIs and private sector.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	<p><b>Human capital:</b> Plant pathologist, virologist, mycologist, bacteriologist, nematologist, entomologist, weed specialist, soil scientist, molecular biologist, bioinformatician, disease modeler, data scientist, mycotoxin specialist.</p> <p><b>Physical capital:</b> Field sites, pest and pathogen and natural enemy collections &amp; cultures, specialized research equipment, long-term experiment (LTE), cutting-edge technologies (e.g. AI-based decision support tools).</p> <p><b>Social capital:</b> Collaboration with NARES, ARIs and private sector.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere. Reduced losses to pest, diseases and weeds globally.</p>	ARIs, NARES, private sector, NGOs.	<p><b>Human capital:</b> Scientists, field practitioners, extension.</p> <p><b>Physical capital:</b> Field experiment sites, farmers' fields, DST (the private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers.</p> <p><b>Incentives:</b> Experience in co-design bundles of innovation, participatory and gender-responsive approaches to scaling.</p> <p>Scientific knowledge and practical tools for crop protection.</p>	CGIAR has comparative advantage in human/physical capital to generate scientific evidence of integrated pest and disease management. ARIs and NARES will co-develop practical tools and co-design bundle of innovation in farmer fields by responding to context-specific and diverse needs. NGOs will support engaging with farming communities especially women and youth. The private sector will facilitate scaling of innovations in collaboration with NARES.

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
4.5. Cost effective and sustainable mycotoxin traceability system for ensuring food safety validated.	<p><b>Human capital:</b> Plant pathologists, biocontrol specialists, process engineers, business developers, social scientists, communication specialists, data scientist.</p> <p><b>Physical capital:</b> Field sites, biocontrol beneficial fungi collections &amp; cultures, specialized research and formulation equipment, biocontrol manufacturing facilities.</p> <p><b>Social capital:</b> Collaboration with NARES, NPPOs, RPPOs, ARIs, WFP, FAO, RUTF manufacturers, private sector manufacturers and distributors.</p> <p><b>Incentive:</b> International public good that can be applied in areas affected by mycotoxin contamination in the Americas, Europe, Asia, Oceania. Reduced losses to mycotoxins globally and increased trade and market access when complying with standards.</p>	<p><b>Human capital:</b> Plant pathologists, biocontrol specialists, process engineers, business developers, social scientists, communication specialists, data scientist.</p> <p><b>Physical capital:</b> Field sites, biocontrol beneficial fungi collections &amp; cultures, specialized research and formulation equipment, biocontrol manufacturing facilities.</p> <p><b>Social capital:</b> Collaboration with NARES, NPPOs, RPPOs, ARIs, WFP, FAO, RUTF manufacturers, private sector manufacturers and distributors.</p> <p><b>Incentive:</b> International public good that can be applied in areas affected by mycotoxin contamination in the Americas, Europe, Asia, Oceania. Reduced losses to mycotoxins globally and increased trade and market access when complying with standards.</p>	ARIs, NARES, NPPOs, Universities in Global South and Global North, private sector manufacturers and distributors of plant health solutions (e.g., aflatoxin biocontrol).	<p><b>Human capital:</b> Scientists (ARIs, NARES, NPPOs, Universities), manufacturing and market specialists, traders (private sector), policy makers governments).</p> <p><b>Physical capital:</b> Field sites, specialized equipment, biocontrol manufacturing facilities.</p> <p><b>Social capital:</b> Networks with farmers (NARES), market linkages (the private sector), national and regional networks (NPPOs), investors (the private sector).</p> <p><b>Incentives:</b> Experience in co-creating multi-stakeholder regional and global networks.</p> <p>Strengthening capacities of food systems participants to prevent mycotoxin contamination across target value chains.</p> <p>Developing, testing, registering, and transferring plant health solutions to private sector partners.</p> <p>Facilitating linkages between smallholder farmers and quality conscious buyers.</p> <p>Converging capabilities of multiple stakeholders to sustainably improve plant health (e.g., Food Convergence Innovation approach).</p>	<p>CGIAR has comparative advantage in developing, testing, registering, technology transferring, mass manufacturing and distribution of plant health solutions (e.g., aflatoxin biocontrol) and human capital to generate scientific knowledge, develop innovation, and transfer technologies for large scale use at global level.</p> <p>ARIs, NARES, WFP, FAO, RUTF manufacturers have strong networks at national and regional levels and deliver knowledge and innovations through the multi-stakeholder platform.</p> <p>Private sector partners navigate the food systems components (agricultural, social, regulatory, industrial, political) judiciously to effective scaling up of plant health solutions.</p>

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
<b>AoW 5. Integrated Water management</b>					
5.1. Spatially explicit prioritization and suitability of water innovations and management practices to address water-related risks to and from agronomic gains.	<p><b>Human capital:</b> Agronomist, water specialist, crop modeler, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), cutting-age technologies (e.g. AI, remote-sensing).</p> <p><b>Social capital:</b> Collaboration with NARES, farmers association.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, water specialist, crop modeler, data scientist</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), cutting-age technologies (e.g. AI, remote-sensing).</p> <p><b>Social capital:</b> Collaboration with NARES, farmers association</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NARES, private sectors, farmers group.	<p><b>Human capital:</b> Agronomist, water management specialist, Data scientist (ARIs, private sector).</p> <p><b>Physical capital:</b> Cutting-age technologies (ARIs, private sector); field sites.</p> <p><b>Social capital:</b> Linkage with local communities and farmers (NARES).</p>	<p>CGIAR has comparative advantage in R&amp;D, knowledge innovation and human capital to generate science-based innovation and deliver/communicate those innovations through multi-stakeholder platform, strong multi-stakeholder local networks.</p> <p>CGIAR has strong resources (data repository, publications, research station, long-term trials), experience and expertise on advanced data analytics and models to assess water related risks and impacts on agricultural production systems. CGIAR has good partners network to translate the science-based innovation to local context involving multiple stakeholders at local level. Such partnership enables the effective delivery of water innovation support for policy/investment for adoption at scale.</p>
5.2. Socially inclusive water management solutions integrated into sustainable farming addressing water-related risks to and from agronomic gains.	<p><b>Human capital:</b> Agronomist, water specialist, soil scientist, crop physiologist, Data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), laboratories.</p> <p><b>Social capital:</b> Collaboration with NARES, farmers association.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact</p>	<p><b>Human capital:</b> Agronomist, water specialist, soil scientist, crop physiologist, data scientist.</p> <p><b>Physical capital:</b> Field site, research equipment, long-term experiment (LTE), laboratories.</p> <p><b>Social capital:</b> Collaboration with NARES, farmers association.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NARES, private sectors, farmers group.	<p><b>Human capital:</b> Agronomist, water management specialist, Data scientist (ARIs, private sector).</p> <p><b>Physical capital:</b> Cutting-age technologies (ARIs, private sector); field sites.</p> <p><b>Social capital:</b> Linkage with local communities and farmers (NARES), private sectors.</p>	<p>CGIAR and its research partners have well equipped research stations (including long-term experiments) and human capital to generate high level innovative research for different production environments. CGIAR has a global mandate for breeding new varieties for different crops. CGIAR has good network of partners and human capital for participatory evaluation of crop varieties and innovations to validate in different biophysical and socio-economic environment which provide opportunity to develop integrated management solution for different crops and production environment.</p>
5.3. Training materials and capacity sharing activities to co-create and deliver integrated water management solutions.	<p><b>Human capital:</b> Agronomist, water management specialist, data scientist, partner engagement specialist, social scientist, gender expert, extension agent.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, and universities, local network, private sector.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, water management specialist, data scientist, partner engagement specialist, social scientist, gender expert, extension agent.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> collaboration with the governments, NARES, and universities, local network, private sector.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	NARES, private sectors, farmers.	<p><b>Human capital:</b> Agronomist, water management specialist, Data scientist (ARIs, private sector).</p> <p><b>Physical capital:</b> Cutting-age technologies (ARIs, private sector); field sites.</p> <p><b>Social capital:</b> Linkage with local communities and farmers (NARES), private sectors.</p>	<p>CGIAR has comparative advantage in R&amp;D, knowledge innovation and human capital to generate science-based innovation and deliver/communicate those innovations through multi-stakeholder platform, strong multi-stakeholder local networks. CGIAR has capacity to translate the science-based innovation to local context involving multiple stakeholders at local level, capacity strengthening of relevant stakeholder.</p>
5.4. Evidence for informing policy recommendations and investments on agricultural water management practices in prioritized farming systems.	<p><b>Human capital:</b> Agronomist, water expert, crop modeler, data scientist, partner engagement specialist, social scientist, gender expert, extension agent</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions.</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, and universities, local network, private sector</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, water expert, crop modeler, data scientist, partner engagement specialist, social scientist, gender expert, extension agent.</p> <p><b>Physical capital:</b> Knowledge management tools, data and information, digital solutions</p> <p><b>Social capital:</b> Collaboration with the governments, NARES, and universities, local network, private sector.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>		<p><b>Human capital:</b> Agronomist, water management specialist, Data scientist (ARIs, private sector).</p> <p><b>Physical capital:</b> Cutting-age technologies (ARIs, private sector); field sites.</p> <p><b>Social capital:</b> Linkage with local communities and farmers (NARES), private sectors.</p>	<p>CGIAR has comparative advantage in R&amp;D, knowledge innovation and human capital to generate science-based innovation and deliver/communicate those innovations through multi-stakeholder platform, strong multi-stakeholder local networks. Such partnership enables the effective delivery of water innovation support for policy/investment for adoption at scale.</p>

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
<b>AoW 6: Mechanization</b>					
6.1. Social-inclusive SAMs that improve resource use efficiencies including labor productivity developed.	<p><b>Human capital:</b> Agronomist (testing), mechanization specialist (local adaptation), social scientist (facilitation), gender expert, extension agent, engineer, market/finance research, business development, marketing, sales, registration.</p> <p><b>Physical capital:</b> Engineering workshop, field site, manufacturer.</p> <p><b>Social capital:</b> Collaboration with NARES, linkage with local communities and farmers, link with private sector but seen to be neutral</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Engineering workshop, field site.</p> <p><b>Social capital:</b> Collaboration with NARES, link with private sector but seen to be neutral.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere</p>	Private sector, government, NARES, NGO.	<p><b>Human capital:</b> Extension agent (NARES) Engineer, market research, business development, marketing, sales (private sector) Registration (government).</p> <p><b>Physical capital:</b> Manufacturer (private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers (NARES, government).</p> <p><b>Incentive:</b> Social impact (government).</p>	<p>CGIAR and partners have different comparative advantage. By leveraging CGIAR's strengths in context-specific R&amp;D (testing, local adaptation, facilitating among partners, and gender &amp; social inclusion) and broad collaborations alongside partners' strengths in manufacturing capabilities, leveraging direct community connections, market integration, partnership development is essential for maximizing the overall impact and efficiency of delivering this high-level output.</p> <p>CGIAR could focus on co-developing and adapting SAMs and business models to local contexts. Furthermore, CGIAR has strong experience and expertise on developing agronomy-based technical packages for mechanization.</p>
6.2. Business models for the delivery of services to sustain the use of SAM options validated.	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert, extension agent, engineer, market research, business development, marketing, sales, registration.</p> <p><b>Physical capital:</b> Engineering workshop, field site, manufacturer.</p> <p><b>Social capital:</b> Collaboration with NARES, linkage with local communities and farmers.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Engineering workshop, field site.</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	Private sector, government, NARES, NGO.	<p><b>Human capital:</b> Extension agent (NARES) Engineer, market research, business development, marketing, sales (private sector) Registration, policy making (government).</p> <p><b>Physical capital:</b> Manufacturer (private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers.</p> <p><b>Incentive:</b> Social impact (government).</p>	<p>CGIAR leads in generating scientific evidence, considering social inclusion, and developing evidence-based business models, whereas partners collaborate with CGIAR to test these models in local contexts to ensure they are supportive of key scaling partners (e.g. gender responsive scaling tools).</p> <p>CGIAR as a neutral facilitator can convene networks interested in scaling, while also being able to collect evidence of the scaling processes for critical decision-making. Once evidence is available, private sector have incentives to scale SAM.</p>
6.3. Training materials available for value chain actors for designing, developing, testing, repairing, and providing service provision of context specific SAM options.	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert, extension agent, engineer, market research, business development, marketing, sales, registration.</p> <p><b>Physical capital:</b> Engineering workshop, field site, manufacturer.</p> <p><b>Social capital:</b> Collaboration with NARES, linkage with local communities and farmers.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Engineering workshop, field site.</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	Private sector, government, NARES, NGO.	<p><b>Human capital:</b> Extension agent (NARES) Engineer, market research, business development, marketing, sales (private sector) Registration (government).</p> <p><b>Physical capital:</b> Manufacturer (private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers</p> <p><b>Incentive:</b> Social impact (government).</p>	<p>CGIAR has comparative advantage in R&amp;D, local adaptation, and training delivery. To leverage potential partners' strengths in community engagement and infrastructure, partnership should be developed to maximize the overall impact and efficiency of delivering training materials.</p>
6.4. Evidence developed for informing policy on scale-appropriate mechanization, recognizing diversity within farming communities.	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert, extension agent, engineer, market research, business development, marketing, sales, registration.</p> <p><b>Physical capital:</b> Engineering workshop, field site, manufacturer.</p> <p><b>Social capital:</b> Collaboration with NARES, linkage with local communities and farmers.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere, social impact.</p>	<p><b>Human capital:</b> Agronomist, mechanization specialist, social scientist, gender expert.</p> <p><b>Physical capital:</b> Engineering workshop, field site.</p> <p><b>Social capital:</b> Collaboration with NARES.</p> <p><b>Incentive:</b> International public good that can be applied elsewhere.</p>	Private sector, government, NARES, NGO.	<p><b>Human capital:</b> Extension agent (NARES) Engineer, market research, business development, marketing, sales (private sector) Registration, policy making (government).</p> <p><b>Physical capital:</b> Manufacturer (private sector).</p> <p><b>Social capital:</b> Linkage with local communities and farmers.</p> <p><b>Incentive:</b> social impact (government).</p>	<p>CGIAR leads in generating scientific evidence, considering social inclusion, and developing evidence-based scaling approaches, whereas partners collaborate with CGIAR to test these approaches in local contexts to ensure they are supportive of key scaling partners (e.g. gender responsive scaling tools).</p> <p>CGIAR as a neutral facilitator can convene networks interested in scaling, while also being able to collect evidence of the scaling processes for critical decision-making. Once evidence is available, the government and private sector have incentives to scale SAM.</p>

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
<b>AoW 7: System integration through co-creation</b>					
7.1. Bundled whole-farm innovations using system sciences, considering production factors limiting agronomic gain and diversity in farming communities (gender, youth, typologies) for priority farming systems and geographies.	<p><b>Human capital:</b> Agriculture system sciences specialists and modelers from the biophysical (e.g. soil, water, plant health), and socioeconomic (e.g. economists, gender, scaling) perspectives.</p> <p><b>Physical capital:</b> System science modeling and data management infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p><b>Human capital:</b> Core group of agriculture system sciences specialists and modelers from the biophysical (e.g. soil, water, plant health), and a few socioeconomic (e.g. economists, gender, scaling) perspectives.</p> <p><b>Physical capital:</b> system science modeling and data management infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p>ARIs that are strong in agriculture socioeconomic modeling connected to system sciences and co-creation methods, and have modeling and data science infrastructure, including AI approaches.</p> <p>NARES that bring the local and regional context for innovation bundling and co-creation methods.</p>	<p><b>Human capital:</b> ARIS: methodological experience in farm system modeling connecting biophysical and socioeconomic approaches, particularly gender and youth perspectives.</p> <p>NARES: information and experience on local contexts and farmer demands.</p> <p>NGOs and grass root organizations facilitate working with farming communities.</p>	<p>CGIAR has a core team with experience in AoW 7 and plays a brokering role in connecting ARIs with advanced system modeling experience with NARES and grass-root organizations, which otherwise would not be able to work together in diverse contexts to develop whole-farm innovation bundles, system methodological tools and co-creation, HCD approaches.</p>
7.2. Human-centered design and co-creation methods for bundling whole-farm innovations connected to system sciences and modeling approaches.	<p><b>Human capital:</b> Participatory research, human-centered and co-creation methods specialists and system specialists and modelers from the biophysical (e.g. soil, water, plant health), and socioeconomic (e.g. economists, gender, scaling) perspectives.</p> <p><b>Physical capital:</b> system science modeling and data management infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p><b>Human capital:</b> Core number of participatory research, human-centered and co-creation methods specialists and system specialists and modelers from the biophysical (e.g. soil, water, plant health), and socioeconomic (e.g. economists, gender, scaling) perspectives.</p> <p><b>Physical capital:</b> system science modeling and data management infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p>ARIs, NARES, NGOs, government extension organizations and grass-root organizations</p>	<p><b>Human capital:</b> ARIS: methodological experience in farm system modeling connecting biophysical and socioeconomic approaches, particularly gender and youth perspectives.</p> <p>NARES: information and experience on local contexts and farmer demands.</p> <p>NGOs and grass root organizations facilitate working with farming communities.</p>	<p>CGIAR has a core team with experience in AoW 7 and plays a brokering role in connecting ARIs with advanced system modeling experience with NARES and grass-root organizations, which otherwise would not be able to work together in diverse contexts to develop whole-farm innovation bundles, system methodological tools and co-creation, HCD approaches.</p>
7.3. Training materials and higher education curricula to enhance stakeholder capacity for bundling farming system component solutions through co-creation methods.	<p><b>Human capital:</b> Training specialists that work together with participatory research, human-centered and co-creation methods specialists, and system specialists and modelers from the biophysical (e.g. soil, water, plant health), and socioeconomic (e.g. economists, gender, scaling) perspectives to develop training materials and curricula.</p> <p><b>Physical capital:</b> Knowledge management hubs and virtual capacity sharing tools.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p><b>Human capital:</b> Training specialists that work together with participatory research, human-centered and co-creation methods specialists, and system specialists and modelers from the biophysical (e.g. soil, water, plant health), and socioeconomic (e.g. economists, gender, scaling) perspectives to develop training materials and curricula.</p> <p><b>Physical capital:</b> Knowledge management hubs and virtual capacity sharing tools.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p>Universities in the South and North.</p>	<p><b>Human capital:</b> Experienced staff in translating scientific evidence into training materials and curricula for higher education</p>	<p>Universities in both the Global South and North have the advantage of developing curricula for higher education and training materials. CGIAR will provide the evidence resulting from AoW 7 to be translated into curricula, supporting materials and infrastructure for documentation and experience sharing, facilitating South-South and South-North exchanges.</p>

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
7.4. Evidence for policy advice on how to integrate and facilitate the delivery of bundled solutions to challenges in prioritized farming systems and geographies.	<p><b>Human capital:</b> Policy specialists that support transformation of evidence about system sciences for bundling innovations and co-creation, human centered methods into supporting policies and investment strategies.</p> <p><b>Physical capital:</b> System science modeling and data management infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	<p><b>Human capital:</b> Policy specialists that support transformation of evidence about system sciences for bundling innovations and co-creation, human centered methods into supporting policies and investment strategies.</p> <p><b>Physical capital:</b> System science modeling and data management infrastructure.</p> <p><b>Social capital:</b> Collaboration with NARES, ARIS from the South and North, universities, and grass root organizations.</p>	Policy Program, NARES and ARIS.	<p><b>Human capital:</b> Experience in transforming scientific evidence into enabling policies.</p>	Policy Program and NARES and government organizations bring their experience in designing enabling policies using scientific evidence. CGIAR team from AoW 7 will provide documented evidence to be used for policy design.
<b>AoW 8: Program efficiency and delivery</b>					
8.1. A digitally enabled MELIA system with specific focus on the assessment of agronomic gain in real time and at scale across the other AoWs	<p><b>Human capital:</b> MELIA experts, data scientists, agronomists.</p> <p><b>Physical capital:</b> Server space and digital data collection tools.</p> <p><b>Social capital:</b> Multi-stakeholder partnerships.</p> <p><b>Incentives:</b> Internal reporting incentives; prioritization of the next generation of R&amp;D questions.</p>	CGIAR has all of the sources presented in the column to the left to lead and deliver on this high-level Output.	Public and private scaling partners need to engage in the assembly of information to populate the MELIA system.	<p><b>Human capital:</b> MELIA experts within partner organizations.</p> <p><b>Physical capital:</b> Data collection tools.</p> <p><b>Social capital:</b> Farmer and extension networks.</p> <p><b>Incentives:</b> Quantitative feedback from engagements with farming communities.</p>	CGIAR has been (i) conceptualizing ‘agronomic gain’ and (ii) developing and validating a digitally enabled MELIA system in direct cooperation with scaling partners in the context of the EIA Initiative and earlier projects. This approach is being implemented in a number of new investments such as the AID-I investments of USAID.
8.2. Tools, approaches, and infrastructure for the standardization, FAIRification, collection, and management of data, for hosting analytical and modeling products, and for assembling proven solutions, developed by the other AoWs. <i>[with the Digital and Data Accelerator]</i>	<p><b>Human capital:</b> Data experts; coding experts.</p> <p><b>Physical capital:</b> Service space.</p> <p><b>Social capital:</b> Effective partnerships with science partners.</p> <p><b>Incentives:</b> contractual requirements; high quality scientific papers.</p>	CGIAR has all of the sources presented in the column to the left to lead and deliver on this high-level Output.	International and national science partners.	<p><b>Human capital:</b> All scientists.</p> <p><b>Physical capital:</b> Data collection tools.</p> <p><b>Social capital:</b> Science networks.</p> <p><b>Incentives:</b> Contractual requirements; high quality scientific papers.</p>	The comparative advantage lies with CGIAR in view of its lead scientific roles in many of the projects implemented in the Global South. Besides the necessary assets, as a ‘neutral broker’ CGIAR also has the mandate to lead the science community in this respect.
8.3. Novel capacity sharing models for all relevant stakeholder categories. Integration training materials from the other AoWs. <i>[with the Capacity Sharing Accelerator]</i>	<p><b>Human capital:</b> Technical experts; capacity sharing experts.</p> <p><b>Physical capital:</b> Digital training infrastructure; training infrastructure.</p> <p><b>Social capital:</b> Partnership networks; trust in content development.</p> <p><b>Incentives:</b> Capacity sharing is a key condition for the uptake at scale of science solutions.</p>	CGIAR has all of the sources presented in the column to the left to lead and deliver on this high-level Output.	<p>All stakeholders engaged in the Program; capacity sharing networks (e.g., RUFORUM).</p> <p>Specialist organizations on training extension staff (e.g., the African Plant Nutrition Institute – APNI).</p>	<p><b>Human capital:</b> Training specialists; specialists in translating science knowledge into formats accessible by last-mile delivery staff.</p> <p><b>Physical capital:</b> Decentralized training facilities.</p> <p><b>Social capital:</b> Recognition at international and national level.</p> <p><b>Incentives:</b> Increased uptake of science solutions and innovations.</p>	The comparative advantage lies with CGIAR for assembling best available information and with regional and sub-regional organizations, facilitating networks of universities and extension networks.

HLO	CA needed	CGIAR CA	Partner types	Partner CA	Trade-Offs CGIAR/Partner CA
8.4. Multi-stakeholder partnership platforms assembled around the key services required to deliver and scale bundled solutions, including policymakers. <i>[with the Scaling Program]</i>	<p><b>Human capital:</b> Delivery and scaling experts; scaling readiness experts; science of scaling experts.</p> <p><b>Physical capital:</b> Compendium of validated solutions (e.g., TAAT).</p> <p><b>Social capital:</b> Multi-stakeholder partnerships and facilitation models.</p> <p><b>Incentives:</b> Uptake at scale of solutions addressing key challenges faced by smallholder farming communities.</p>	<p><b>Human capital:</b> Delivery and scaling experts.</p> <p><b>Physical capital:</b> Compendium of validated solutions (e.g., TAAT).</p> <p><b>Social capital:</b> Honest broker status; partnership networks.</p> <p><b>Incentives:</b> Uptake at scale of Program solutions.</p>	All stakeholders engaged in the Program.	<p><b>Human capital:</b> Delivery and scaling experts; extension networks.</p> <p><b>Physical capital:</b> NA</p> <p><b>Social capital:</b> Effective engagement models; multi-service partnerships.</p> <p><b>Incentives:</b> Uptake at scale of solutions that matter to farmers.</p>	The comparative advantage lies with the delivery and scaling community, both public and private, technically supported by CGIAR. Stakeholder platforms are best managed by these stakeholders, including the agreement on governance and required business units, in the interest of sustainability beyond the Program's lifespan.
8.5. Policy-related information across the other AoWs in relation to enabling sustainable farming systems. <i>[with the Landscapes and Policy Programs]</i>	<p><b>Human capital:</b> Policy makers and shapers; policy scientists; agronomists.</p> <p><b>Physical capital:</b> NA</p> <p><b>Social capital:</b> Stakeholder engagement processes; policy formulation processes.</p> <p><b>Incentives:</b> Improved enablers for the uptake of Program solutions.</p>	<p><b>Human capital:</b> Policy scientists and agronomists.</p> <p><b>Physical capital:</b> NA</p> <p><b>Social capital:</b> Partnership networks.</p> <p><b>Incentives:</b> Increased uptake of agronomic, plant health, and farming system solutions.</p>	All stakeholders engaged in the Program.	<p><b>Human capital:</b> Policy shapers and policy makers.</p> <p><b>Physical capital:</b> NA</p> <p><b>Social capital:</b> Policy makers have the regional, national or sub-national mandate to formulate policies for a specific target area and domain.</p> <p><b>Incentives:</b> Enabling policy is a key term of reference of policy makers and shapers.</p>	The comparative advantage lies with CGIAR through its Policies and Institutions Program. The direct engagement with policy shapers – those people that formulate policies – and policy makers is best facilitated through policy scientists, hosted by above Program.

## Section 5 Program-level theory of change: Appendix 2 Item 5.1 TOC table

ToC Element	Statement	Contributing AoWs	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator & target (2030 outcomes only)
Output 1	Advanced data and analytics on farm innovations	Led by 8, all contribute.	CGIAR Digital Accelerator provide expert support and digital services	Not required	Not required
Output 2	Indexed compendium of innovations validated for agronomic gain and sustainability	All.	Programs on Breeding, Animal and Aquatic Foods, Climate, and Landscapes may contribute innovations into the compendium. Gender Accelerator and Climate Program contribute to sustainability validation and appraisal methods.		
Output 3	Prioritization tools and systems link solutions to contexts	Led by 8, all contribute.	CGIAR Digital Accelerator provide expert support and digital services; NARES and National Scaling partners trial and evaluate tools.		
Output 4	Co-created, farm-integrated solutions bundled with enabling services	Led by 7, all contribute.	NARES, national research partners, and farming communities co-create solutions. CGIAR Programs on Breeding, Animal and Aquatic Foods, and Landscapes to co-invest in co-creation.		
Output 5	Tailored training materials and curricula	1-7, support from 8	Capacity Sharing Accelerator advises. Universities, training institutions, and professional organizations co-create curricula.		
Output 6	Innovative capacity sharing models	Led by 8, all contribute.	Capacity Sharing Accelerator advises. Universities, training institutions, and professional organizations co-create models for professional training and continuing professional development.		
Output 7	Evidence for policy making and investments	1-7	CGIAR Policy Program		
Output 8	Partnership platforms	Led by 8	CGIAR Program on Scaling, Multi-lateral stakeholder networks. Many organizations to join platforms at different levels.		
Intermediary Outcome 1	Contextualized innovation bundles tested by partners	All	CGIAR Program on Scaling help broker demand and relationships, NARES and National Research Partners integrate bundle trials into their programming.		
Intermediary Outcome 2	CGIAR and NARES share data and analytics tools	8	CGIAR centers and NARES develop data sharing agreements and practices and co-develop and utilize analytical tools.		
Intermediary Outcome 3	Partners adopt our methods to co-create innovation bundles	7	NARES and National Research and Scaling Partners utilize developed methods.		
Intermediary Outcome 4	Partners scale contextualized innovation bundles	All	CGIAR Program on Scaling brokers demand and relationships, NARES and National Research Partners integrate scaling of farm bundles into their programming.		

ToC Element	Statement	Contributing AoWs	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator & target (2030 outcomes only)
Intermediary Outcome 5	Enhanced skills of farmers	8, all	Capacity Sharing Accelerator advises, National Scaling Partners and Media Organizations deliver messaging and training.	1. Prototype solutions are aligned to farmers' production objectives and needs, 2. Service providers have effective business models, enabling facilitation of the delivery and scaling processes.  1. Governments in the target areas have prioritized the sustainable intensification of smallholder farming and 2. the agricultural partner ecosystem contains all necessary services to deliver agronomic gain at scale.	
Intermediate Outcome 6	Enhanced skills of service providers and R&D partners	7, 8, all	Capacity Sharing Accelerator advises. Universities and training institutions deliver capacity sharing models and content.		
Intermediate Outcome 7	Farming communities adapt and adopt practices	All	Farmer organizations, communities, and farmers make use of enhanced skills and availability of innovations to improve farming practices.		
Intermediary Outcome 8	Agricultural services and institutions enable agronomic gain at scale	8, 7, all.	NARES, universities, commercial sector actors, policy actors, and national scaling partners improve practices based on capacity sharing.		
Intermediary Outcome 9	Decision makers invest in an enabling environment for the delivery of agronomic gain	All	CGIAR Program on Policy co-creates evidence. National and sub-national policy makers, commercial sector agricultural organizations, and policy fora engage with evidence and take informed decisions.		
Intermediary Outcome 10	Policy, civil society, commercial, and R&D organizations engaged delivery of agronomic gain at scale	All	National and sub-national policy makers, commercial sector agricultural organizations, national research partners, national scaling partners, and farmer organizations engage in platforms and modify their activities.		

ToC Element	Statement	Contributing AoWs	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator & target (2030 outcomes only)
2030 Outcome 1	CGIAR Centers are increasingly sharing learnings, tools, data, and other science-related products	8	CGIAR Centers constructively engage with novel innovations from the Sustainable Farming program, supported by the Capacity Sharing and Digital Accelerators' internal outcomes.	1. Genuine interest in delivering agronomic, plant health, and farming system solutions across the stakeholder ecosystem;	All CGIAR Centers and 50 partners are sharing data, tools, learnings, and other science-related products
2030 Outcome 2	National science partners are leading new research Initiatives with integration of learnt skills	All	NARES and national R&D partners integrate enhanced capacities and methods into programming.	2. Stability of the partnership platforms to accommodate complete validation, piloting, delivery, and scaling cycles with the necessary feedback loops;	25 national science partners gradually take over R&D activities and drive new research
2030 Outcome 3	Farmers take up innovation bundles at scale with positive impact on sustainability and agronomic gain	All	NARES, national scaling partners, and multi-lateral organizations, and farmer organizations support scaling of innovations and a capacity sharing. Enabling environments developed by commercial and policy actors. Collaboration with CGIAR Program on Scaling to monitor and maximize scaling.	3. enabling conditions are conducive for the uptake of above solutions, including input and output prices;	5 million farmers take up bundles of innovations for integrated farm management, on at least 2 million hectares of land.
2030 Outcome 4	Scaling partners integrate innovations in investments that are not supported by the Program	All	NARES, national scaling partners, and multi-lateral organizations, commercial organizations, and governmental organizations make use of innovations and capacities beyond the remit of the Sustainable Farming Program.	4. continued or enhanced investment from various funding sources in the areas of work prioritized by this Program; and 5. Appropriate incentive mechanisms for all stakeholders to remain engaged, including farming communities.	50 public or private development partners are facilitating the scaling of program innovations and integrating innovations in their investments, independent of program support.

ToC Element	Statement	Contributing AoWs	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator & target (2030 outcomes only)
Impacts	Increased production of nutritious food	All	CGIAR Program on Nutrition and Diets	Increased production of nutritious food combines with consumption-side measures to lead to better food and nutrition security.	
Impacts	More profitable and equitable farming enterprises and opportunities	All	Where is the poverty platform going to be placed?	Agronomic gain is sufficient to raise incomes to a meaningful degree, the necessary market infrastructure are in place, and elite capture of increased profits does not occur (supra-, inter-, or intra-household).	
Impacts	Socially inclusive and equitable farm innovations	All	Gender Accelerator	Inequitable cultural norms are not so entrenched that agronomic interventions can make no difference.	
Impacts	Improved soil health, nutrient and water use	All	CGIAR Program on Landscapes	Farm-level innovations can interact with landscape-level planning and management to deliver net positive impacts.	
Impacts	Climate-adapted farming systems	All	CGIAR Program on Climate	Climate projections and hazards can be meaningfully addressed with farm innovations, contributing to farming-system level adaptation.	
Impacts	Decrease in GHG emissions per unit of produce	All	CGIAR Program on Climate	Mitigation measures can be adopted at scale, monitored, and considered adequately long-term to be validated.	

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.1.1: High-level outputs and outcomes of AoW 1 (Climate Adaptation and Mitigation) and partner roles.

TOC Element #	Statement	Partner roles (including other AoWs or Program/ Accelerator)	Assumption (for outcomes only)	Target & Indicator (for 2030 Outcomes only)
Output 1.1	1.1. Quantified climate change-related hazards that affect the delivery of agronomic gain for prioritized geographies and farming systems. [with the Climate Action Program]	FFOs incorporation of multi-climate risk analysis into their intervention design/services platforms; Climate Action Program for developing high resolution and relevant multi-climate risk analysis for intervention co-design	Not required	Not required
Output 1.2	1.2. Climate hazard-specific inclusive sustainable farming system innovations with evidence on adaptive capacity and mitigation co-benefits at scale.	ARIS for co-developing state-of-the-art adaptation evaluation matrices, Climate Action Program for data-driven socio-technical evaluation of adaptation and mitigation effectiveness, trade-offs, FFOs for assessment on the ground	Not required	Not required
Output 1.3	1.3. Training materials to enhance stakeholder capacity for identifying and implementing sustainable farming system solutions for climate adaptation and mitigation	NARES, private and public sector for co-design, - testing mitigation and adaptation options for farming systems, Scaling for Impact Program for investment pipeline development	Not required	Not required
Output 1.4	1.4. Policy and investment-ready information on sustainable farming system solutions to adapt to and mitigate climate change-related hazards	NARES, government organizations will use the information to design enabling policies for investing in scaling climate adaptation and mitigation at farm level.	Not required	Not required
Intermediary outcome 1	Farmer facing organizations (FFO's) incorporate evidence, targeting tools, climate information on adaptation and mitigation options in farming systems	NARES, private and public sector, Capacity Sharing Accelerator, Scaling for Impact Program	We assume that the co-design, test, and evaluation process with partners would provide a solid basis for the acceptance and adoption of tested solutions; FFOs are willing to adapt their practice/services and are eager to invest	Not required
Intermediary sub-outcome 2	Governments adapt/modify climate related agricultural policies strengthening the enabling environment for scaling of adaptation/mitigation solutions	Governments, Climate Action Program, Policies Program	NARES capacity is sufficiently strengthened to facilitate the uptake of recommendations in the policy processes; the program will receive sufficient long-term funding to influence policies over time, and the policy MP will facilitate multi-stakeholder platforms/processes across CGIAR to enable policy influencing	Not required
Intermediary sub-outcome 3	Public and private sector invest in programs and services that scale up climate –specific agronomic solutions	Private and public sector, MFI's, IFI's, Climate Action Program, Scaling for Impact Program	MFI's, IFI's public and private sectors are willing to continue to invest in climate adaptation/mitigation solutions at farming systems; scientific evidence gets integrated into national investment plans	
2030 Outcome	Farmers have successfully integrated agronomic and plant health practices into their farming systems, enhancing their climatic resilience and reducing their GHG emissions per unit production area practices.	FFOs, MFI's, IFI's,	The provided solutions for farmers are contextually relevant, meet gendered preferences and capacity/resources, and provide projected benefits at scale; FFOs have successfully integrated evidence-based recommendations; policies are aligned and foster large-scale investment; MFI's and IFI's have invested at scale in the promoted solutions, farmers have adopted the promoted solutions at scale	At least five million farmers have adopted climate adaptation and mitigation options at farm level. Reduction of 15% GHG per unit production area. Additional 500 million USD investment. At least 20 policy changes related to agricultural adaptation/mitigation in priority countries

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.2.1: High-level outputs and outcomes of AoW 2 (Precision Nutrient Management) and partner roles.

TOC Element #	Statement	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator & target (for 2030 outcomes only)
Output 2.1	Spatially-explicit recommendation decision support models (i.e., AgWise) for soil nutrient constraints with demonstrated agronomic gain and return of investment (ROI) developed and integrated into advisory frameworks that deliver recommendations to users.	CGIAR, NARES and NGOs participate in development and validations of decision support models	Not required	Not required
Output 2.2	Expanded data-driven agronomic recommendations for site specific nutrient management with inclusion of nutrient balance, liming, soil health, and climate-related advisory services.	CGIAR, NARES, NGOs work together to integrate solutions to partner platforms and deliver agro-advisories to farmers	Not required	Not required
Output 2.3	Training materials to enhance stakeholder capacity for developing and delivering site-specific nutrient management recommendations for prioritized farming systems.	CGIAR, NARES, work together to develop training materials	Not required	Not required
Output 2.4	Evidence for policy recommendations for precision nutrient management and smart fertilizer subsidy programs.	CGIAR, NARES generate evidence and codevelop briefs to inform policy makers	Not required	Not required
Intermediary Outcome 1	Scaling partners delivering bundled solutions.	NGOs, NARES serve as scaling partners	Scaling partners participate through the solution development process and have functional platforms for agro-advisory delivery	Not required
Intermediary outcome 2	Farmers access bundled advisories delivered through scaling partners to overcome constraints.	NGOs, NARES deliver advisories, CGIAR takes learnings and integrates them in improving solutions	Scaling partners participate through the solution development process and have functional platforms for agro-advisory delivery	Not required
Intermediary outcome 3	Integration of precision nutrient management solutions into policy based on the demonstrated agronomic gain and ROI.	CGIAR, NARES communicate evidence to Policy makers who in turn develop supportive policies	Political climate is conducive and policy makers are supportive of policy change	Not required
2030-Outcome	Tools for guiding tailored nutrient recommendations for at least 15 crops including perennials are validated and in use in at least 15 countries, achieving at least 25% increase in at least 2 dimensions of agronomic gain.	National governments, major donors support scaling of precision nutrient management innovations.	Increased capacity of stakeholders and validated tools for management of nutrient constraints result in agronomic gain	At least 3 million farmers use validated agro-advisory recommendations to manage nutrient constraints increasing their productivity, profitability and food security

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.3.1: High-level outputs and outcomes of AoW 3 (Resilient Soils) and partner roles.

TOC Element #	Statement	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
Output 3.1	3.1 A soil health monitoring and assessment framework is operationalized and soil health data are incorporated into a digital information system to enable advanced data analytics including machine learning and AI.	CGIAR, NARES, ARIs and NGOs participate in development and validations of the assessment framework, data management and information systems.	Not required	Not required
Output 3.2	3.2 A network of long-term monitoring sites are established across diverse agro-ecosystems to conduct systematic assessments of aboveground and belowground carbon storage, hydrologic function and biodiversity overtime.	CGIAR, NARES, ARIs and NGOs participate in establishing long-term monitoring sites, data collection, analysis and modeling work.	Not required	Not required
Output 3.3	3.3 Impacts of agricultural practices on soil health across diverse contexts are quantified and catalogued to inform and prioritize investments.	CGIAR, NARES, and government organizations participate in synthesis of lessons from research and scaling activities to inform soil-related investments.	Not required	Not required
Output 3.4	3.4 Evidence-based information on the critical role of healthy soil is translated into accessible formats to inform decision making, including integrated in the national level policies and strategies.	NARES, and government organizations participate in synthesis of lessons from research and scaling activities to inform enabling policy design.	Not required	Not required
Intermediary Outcome 1	By 2030, science-based tools and methods to assess, monitor and interpret soil health status and track changes overtime are deployed across a network of long-term monitoring sites by at least 10 public and/or private sector partners to support decision-making on investment priorities.	NARES, ARIs and NGOs use the assessment framework, data management and information systems to enhance soil-related institutional research strategies.	CGIAR, NARES, ARIs and NGOs perceive the value of soil-related assessment framework and support research with additional investments.	Not required
Intermediary Outcome 2	Farmers have implemented science-based soil health practices, focusing on conserving and promoting biodiversity above and below ground, including integration of trees on farm, crop diversity, perennials and livestock.	CGIAR, NARES, and NGOs implement scaling-oriented interventions informed by research results aiming at enhancing soil health at farm and community level.	CGIAR, NARES, ARIs and NGOs perceive the value of soil-related innovations and invest in scaling interventions.	Not required
Intermediary Outcome 3	500,000 farmers have implemented practices that restore and enhance soil health and optimize resource use efficiency in farm systems, while also benefiting net carbon emission and water conservation targets.	CGIAR, NARES, and NGOs implement scaling-oriented interventions informed by research results aiming at enhancing resource use efficiency and soil health at farm and community level.	NARES, NGOs and international financial organizations perceive the value of soil-related innovations and invest in scaling interventions.	Not required
Intermediary Outcome 4	By 2030, at least five member states have integrated soil health targets into national policies and strategies. This can include NBSAPs, NDCs, Agricultural Strategies, National Soil Health Strategies coming out of the AFSH Summit, and repurposing of subsidies.	CGIAR, NARES, and government organizations use synthesis of lessons from research and scaling activities to inform enabling policy design.	CGIAR, NARES, ARIs and NGOs perceive the value of soil-related innovations and invest in scaling interventions.	
2030 Outcome	Farmers, farmer organizations and stakeholders scale soil health management solutions informed by the evidence generated within the soil health monitoring framework to ultimately reverse land degradation and enhance ecosystem services including carbon sequestration, hydrological function, above and below ground biodiversity and productivity.	National governments, major donors support scaling of resilient soil innovations.	Increased capacity of stakeholders and validated tools for resilient soils are materialized in agronomic gain and farmer wellbeing.	At least 500,000 farmers adopt resilient soil related innovations resulting in increased productivity, profitability and food security

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.4.1. High-level outputs and outcomes of AoW 4 (Plant Health and Mycotoxin Safe Crops) and partner roles.

TOC Element #	Statement	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
Output 4.1	4.1. Capacity and networks of plant health practitioners to diagnose, monitor and manage pests, and diseases and weeds improved.	CGIAR, ARIs, NARES and NGOs participate and support training events	Not required	Not required
Output 4.2	4.2. Improved high throughput cost effective PDW monitoring, data management and modeling tools	ARIs, NARS and academic institutions co-create and optimize tools, digital transformation program supports data management and modeling tools	Not required	Not required
Output 4.3	4.3 PDW surveillance data, prevention strategies, and policy briefs for decision makers available.	NARES, NGOs and CGIAR partners share surveillance data, digital data supports modeling exercises and Policy program supports policy analysis and development of briefs	Not required	Not required
Output 4.4	4.4 Eco-friendly, inclusive, affordable and scalable IPDWM and IMM options developed	NARES, NGOs and CGIAR contribute to validate and scale IPDWM and IMM options	Not required	Not required
Output 4.5	4.5 Cost effective and sustainable traceability system for mycotoxins and pesticide residues ensuring food safety validated.	NARES, NGOs and CGIAR contribute to validate and scale mycotoxin traceability systems.	Not required	Not required
Intermediary Outcome 1	Capacity of plant health stakeholders to detect, monitor and manage biotic threats improved.	Policy makers implement regulatory frameworks to support plant health management.	Stakeholders recognize the value tools and networks for biotic threats diagnostics and management and are willing to dynamically exchange information on a broad range of biotic threats.	Not required
Intermediary Outcome 2	Scaling partners support adoption and scaling of successful IPDWM and IMM packages.	NARES, NGOs, government and international organizations implement IPDWM and IMM scaling activities.	Stakeholders recognize the value of IPDWM and IMM and invest more financial resources in scaling of these approaches.	Not required
2030-Outcome 4.1	Losses to biotic threats reduced on farms.	National governments, major donors.	Increased capacity of stakeholders and affordable tools in biotic threat management leads to reduced losses in crop yields.	At least 1 million farmers reduce losses on their farms.
Intermediary Outcome 4.2	Scaling partners support adoption and scaling of gender-responsive and socially inclusive IPDWM and IMM packages	NARES, NGOs and private sector contribute to the availability and accessibility of IPDWM and IMM packages.	Stakeholders recognize the value tools and networks for biotic threats diagnostics and management and are willing to dynamically exchange information on a broad range of biotic threats.	Not required
2030-Outcome 4.2	Improved environmental & human health due to reduced pesticide use	National governments, major donors support investments in scaling IPDWM and IMM.	Increased capacity of stakeholders and affordable tools in biotic threat management leads to reduced losses in crop yields.	Use of environmentally harmful pesticides limited or reduced on 1 million hectares.
Intermediary Outcome 4.3	Governments adopt policies and infrastructure that support mycotoxin traceability	National governments design and implement policies that support IMM.	Governments recognize the importance of mycotoxin and pesticide contamination on population health.	Not required
2030-Outcome 4.3	Increased availability of safe food/feed to consumers and livestock	National governments and major donors support investments in IMM strategies.	Affordable and effective detection and traceability procedures supported by appropriate policies reduce prevalence of food borne toxins in the food chain	At least 10% of food in markets of priority locations below tolerance limits of mycotoxins and pesticide residues.

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.5.1. High-level outputs and outcomes of AoW 5 (Integrated Water Management) and partner roles.

TOC Element #	Statement	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
Output 5.1	Spatially explicit prioritization and suitability of water innovations and management practices to address water-related risks to and from agronomic gain assessed	ARIS, NARES, NGOs, university	Not required	Not required
Output 5.2	Socially inclusive water management solutions integrated into sustainable farming addressing water-related risks to and from agronomic gain	ARIS, NARES, private sector, Local communities, Water user associations, farming organization, NGOs, university	Not required	Not required
Output 5.3	Training materials and capacity sharing activities to develop and deliver integrated water management solutions	NARES, private sector, Local communities, Water user associations, farming organization, NGOs,	Not required	Not required
Output 5.4	Evidence developed for informing policy recommendations on agricultural water management practices in prioritized farming systems	NARES. Policy maker, private sectors, University	Not required	Not required
Intermediary Outcome 5.1	Farmer facing organizations (FFO's) incorporate the research evidence, tools and frameworks on innovative water technologies to address water scarcity and reduce unsustainable freshwater use in farming systems	FFOs, private and public sector	We assume that the co-development of suitable water solutions with FFO's provides a base for evidence generation. This together with training materials and capacity sharing activities will lead to its incorporation into their programs/investment design and implementation.	Not required
Intermediary Outcome 5.2	Governments use the evidence to modify or adapt agricultural water management policies resulting in increased water access, storage, and more sustainable water management.	Governments, NARES,	We assume that the capacity building of the governments and the co-creation and synthesis of the evidence will influence agricultural water management related policies	Not required
Intermediary Outcome 5.3	IFI's, private sector and public sector use the evidence of innovative water solutions for rainfed and irrigated systems to invest into water resilient farming systems.	MFI's, IFI's public and private sector	We assume that the evidence generated and communicated of tested solutions will attract new investments into agricultural water management targeted at enhancing water access, storage and reducing water use in agriculture; the investments increase the access to water innovations, practices, and knowledge in agriculture,	Not required
2030-Outcome 1	At least three million farmers have adopted water innovations increasing their climate resilience.	FFOs, Gov and private sector	Farmers have inclusive access to the water innovations and practices due to enhanced policies, better capacitated FFOs and large investments, and adopt these	At least 3 million farmers adopting and benefiting from integrated water management in at least 500,000 ha.
2030-Outcome 2	At least three million farmers have adopted improved water management practices leading to an increase of water productivity in 0.5 million ha.	FFOs, Gov and private sector	Farmers have inclusive access to the water innovations and practices including alternative water solutions and circular approaches due to enhanced policies, better capacitated FFOs and large investments, and adopt these	At least 3 million farmers adopting and benefiting from integrated water management in at least 500,000 ha.

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.6.1. High-level outputs and outcomes of AoW 6 (Scale-Appropriate Mechanization) and partner roles.

TOC Element #	Statement	Partner roles (including other AoWs or MPs)	Assumption (for outcomes only)	Target & Indicator (for 2030 Outcomes only)
Output 6.1	Social-inclusive SAMs that improve resource use efficiencies including labor productivity developed.	CGIAR, NARES, and ARIs co-develop SAMs in collaboration with farmers and private sector as well as Gender Accelerator	Not required	Not required
Output 6.2	Business models for the delivery of services to sustain the use of SAM options validated.	CGIAR, ARIs, NARES implement R&D activities and develop approaches with participation from government and private sector.	Not required	Not required
Output 6.3	Training materials available for value chain actors for designing, developing, testing, repairing, and providing service provision of context specific SAM options.	CGIAR, NARES, ARIs and private sector participate in training programs in collaboration with Scaling for Impact Program , gender and Capacity Sharing Accelerators.	Not required	Not required
Output 6.4	Evidence developed for informing policy on scale-appropriate mechanization, recognizing diversity within farming communities.	CGIAR, ARIs, NARES implement R&D activities and develop approaches with participation from government and private sector.	Not required	Not required
Intermediary Outcome 1	Stakeholders in different social groups use the acquired knowledge in their SAM-related business.	Private sector will design, develop, repair, and provide service provision of context specific SAM options. NGOs and NARES will test and disseminate service provision of context specific SAM options.	The developed products have new insights and are useful for the users	Not required
Intermediary Outcome 2	Stakeholders/partners use SAMs and their service provision.	NARES, government, NGOs, and private sector will disseminate the SAM and service provision models. Farmers and service providers will adopt SAMs and their service provision models.	The developed SAMs are economically viable for the users	Not required
Intermediary Outcome 3	Policy interventions and SAM support actions (e.g. subsidies) are introduced by policy makers and investors.	Government develops policy interventions and support actions, based on scientific evidence that CGIAR and NARES generate for supporting those interventions.	Policy interventions are effectively implemented by the government and investors.	Not required
2030 Outcome	Smallholder farmers benefit from scale appropriate, energy-efficient mechanization options and improve labor productivity by 25%.	Private sector, NGOs, NARES, and government support for scaling of scale-appropriate mechanization options; farmers and service providers use the options.	Partners continue investment in mechanization; public sector regulations are not adverse	At least 1 million farmers adopting and/or benefiting from SAM-related innovations.  Adopting farmers realizing at least 25% labor productivity improvement.

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.7.1. High-level outputs and outcomes of AoW 7 (System Integration through co-creation) and partner roles.

TOC Element #	Statement	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
Output 7.1	Bundled whole-farm innovations developed using system sciences, considering production factors limiting agronomic gain and diversity in farming communities (gender, youth, typologies) for priority farming systems and geographies.	ARIs, NARES, CGIAR Program Landscapes and Climate Action collaborate to gather data and estimate agronomic gain.	Not required	Not required
Output 7.2	Human-centered design and co-creation methods validated for bundling whole-farm innovations connected to system sciences and modeling approaches.	ARIs, NARES, CGIAR Program Landscapes, Climate Action, Policies and Scaling for Impact collaborate to define innovation bundles.	Not required	Not required
Output 7.3	Training materials and higher education curricula available to enhance stakeholder capacity for bundling farming system component solutions through co-creation methods.	ARIs, NARES, CGIAR Program Landscapes, Policies, Scaling for Impact, and Capacity Sharing, and Gender Accelerators collaborate to develop co-creation methods.	Not required	Not required
Output 7.4	Evidence available for policy advice on how to integrate and facilitate the delivery of bundled solutions to challenges in prioritized farming systems and geographies.	ARIs, NARES, CGIAR Program Scaling for Impact t, and Capacity Sharing, and Gender Accelerators collaborate to develop training materials and curricula.	Not required	Not required
Intermediary Outcome 7.1	R&D organizations use co-creation and system sciences methods to design integrated farm bundles.	CGIAR Program on Scaling for Impact, CGIAR Capacity Sharing Accelerator collaborate to strengthen NARES capabilities on co-creation and system sciences.	R&D organizations perceive the value of co-creation and system science methods for bundling innovations.	Not required
Intermediary Outcome 7.2	Implementing organizations scale bundles suited to context needs.	CGIAR Program on Scaling for Impact, CGIAR Capacity Sharing Accelerator collaborate to strengthen NARES capabilities to scale innovation bundles.	R&D organizations interested in scaling innovation bundles because they respond to needs and demands.	Not required
Intermediary Outcome 7.3	Educational institutions train future and currently practicing agricultural professionals and in co-creation and system sciences methods	Universities in both South and North, NARS, and CGIAR Capacity Sharing Accelerator participate in developing training materials and curricula for higher education.	University structures are open to develop and use innovative curricula for training the next generation of agriculture specialists	Not required
Intermediary Outcome 7.4	Governments, private sector, and international organizations invest in selected bundles and in mainstreaming co-creation and system sciences methods in their institutional approaches	NARES, NGOS, private sector participate in developing business plans and investment projects to mainstream co-creation and science methods in their strategies and interventions	NARES, NGOS, private sector perceive the value of mainstreaming co-creation and system science methods for bundling innovations	Not required
2030-Outcome 1	Farmers adopt and benefit from integrated bundles of innovations	National governments, major donors, private sector invest in scaling innovation bundles to farmers.	Innovation bundles respond to farmer demands and there are enabling conditions for adoption and scaling.	Number of farmers benefitting from innovation bundles.
2030-Outcome 2	Women, youth and other disadvantaged groups benefit from integrated bundles of innovations	National governments, major donors, private sector invest in scaling innovation bundles targeting specifically women and youth.	Innovation bundles respond to farmer demands and there are enabling conditions for adoption and scaling.	Number of women farmers benefitting from innovation bundles. Proportion of beneficiaries by gender and age.

## Section 6 Key areas of work (AoW): Appendix 3 Item 6.8.1. High-level outputs and outcomes of AoW 8 (Program efficiency and delivery) and partner roles.

TOC Element #	Statement	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
Output 8.1	A digitally enabled MELIA system with specific focus on the assessment of agronomic gain in real time and at scale across the other AoWs	All partners engaged in the Program (CGIAR, NARS, ARIs, Scaling partners, etc.)	Not required	Not required
Output 8.2	Tools, approaches, and infrastructure for the standardization, FAIRification, collection, and management of data, for hosting analytical and modeling products, and for assembling proven solutions, developed by the other AoWs. [with the Digital and Data Accelerator]	All partners engaged in the development and validation of agronomic, plant health, and farming system solutions (CGIAR, ARIs, NARS).	Not required	Not required
Output 8.3	Novel capacity sharing models for all relevant stakeholder categories. Integration training materials from the other AoWs. [with the Capacity Sharing Accelerator]	National science partners, other public and private stakeholders (extension, lead farmers, etc.)	Not required	Not required
Output 8.4	Multi-stakeholder partnership platforms assembled around the key services required to deliver and scale bundled solutions, including policymakers. [with the Scaling Program]	Scaling partners, service, providers, NARS, CGIAR	Not required	Not required
Output 8.5	Policy-related information integrated across AoWs in relation to enabling sustainable farming systems. [with the Landscapes and Policy Programs]	Policy-shapers and policy makers at national and sub-national level.	Not required	Not required
Intermediary Outcome 8.1	The Sustainable Farming program is using its own prioritization tools to guide spending of at least 75% of its resources in priority target areas on priority topics, in line with the overall CGIAR prioritization logic and supported by MELIA evidence	All Program partners	Program partners agree on the prioritization logic, including on the need to discontinue activities in de-prioritized areas	Not required
Intermediary Outcome 8.2	All program AoWs and at least 50% of CGIAR, NARS, and other science partners in the Program are using standardized and FAIR data and analytical processes, generating substantial insights and value through the deployment of advanced analytics, including artificial intelligence.	All science partners engaged in the Program	Scientific staff see sufficient benefits through their engagement in the Program's data and analytical processes	Not required
Intermediary Outcome 8.3	At least 15 partnership platforms are addressing key agronomic, plant health, and/or farming system challenges, engaged across AoWs and Programs to input on the design and bundling of farm level innovations, and that through this process they are ready to invest in or scale proven innovations and bundles	Various stakeholders required to deliver bundled solutions at scale	Stakeholders agree on the priority solutions for scaling and contribute their respective expertise in a coordinated fashion	Not required
Outcome 2030	CGIAR and partners staff use science and delivery services and generate benefits	All public and private, science, delivery, and scaling partners engaged in the Program	Program partners see sufficient incentives over time to engage with the Program's services, including the generation of tangible benefits	At least 75% of CGIAR and partners engaged in the Program

## Section 7 Country integration: Appendix 4 Item 7.2.1 Overview of selected work in top countries where the Sustainable Farming Program will operate (note this is a non-exclusive list, only for illustrative purposes)

Regions	Country	District/System	Area of work	Program and Accelerator collaboration	Key partners
East and South Africa	Ethiopia	Highland and lowland mixed farming systems including wheat, teff, sorghum, and maize: Amhara, Oromia, South, Central Ethiopia Rice-based systems in Bahir Dar region; potato and sweetpotato systems	i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing 4. Sustainable Animal and Aquatic Foods (SAAF)	Ministry of Agriculture, NARS (EIAR and Regional Agricultural Research Institutes), ATI, GIZ, LERSHA, Digital Green, national and international NGOs (Sasakawa Africa Association, Self Help Africa, Cristian Relief Services, InterAid France), Wageningen University, IFDC, AGRA and ISRIC
	Kenya	Maize-based cropping systems, Dryland cereal- legume systems, agro-pastoral systems, rice-based systems; and potato systems in Western Kenya, Rift Valley, Eastern Kenya, Central Kenya	i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing 4. Sustainable Animal and Aquatic Foods (SAAF)	Kenya Agricultural and Livestock Research Organization. Kenya Plant Health Inspectorate Services., The Nature Conservancy., Cereal Growers' Association of Kenya; respective County Governments; Kenya Meteorological Department; Mercy Corps; Ministry of Agriculture and Livestock Development; National Potato Council of Kenya (NPCK); Kenyatta University; GIZ; AGRA; AFAP
	Tanzania	Maize-based cropping systems, Dryland cereal- legume systems, agro-pastoral systems, rice-based systems, potato systems in Southern Highlands Central Zone, Lake Zone, western highlands, northern highlands	i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for delivery 3. Sustainable Animal and Aquatic Foods (SAAF)	AGRA; Bayer Crop Science; Rabobank; Syngenta; Syngenta Foundation for Sustainable Agriculture; TARI; Ministry of Agriculture; Tanzania Youth Espouse for Gender and Development, WFP, FARM to Market Alliance, BioVision; Sokoine University of Agriculture
	Malawi	Mixed crop-livestock farming systems; Cereal-root mixed crop-livestock farming system; Maize Mixed Farming Systems in Northern; Central and South Malawi	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact	Department of Agricultural Extension Services, Department of Agricultural Research Services, Solidaridad; Lilongwe University of Agriculture and Natural Resources; Meridien; National Association of Smallholder Farmers; Solidaridad; Root and Tuber Crops Development Trust; AGRA; Rothamsted Research.
	Madagascar	Rice-based farming systems, sweetpotato, potato systems, semi-arid systems in Menabe, Analamanga, Atsinanana, Itasy and Boeny regions, Grand Sud-regions	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing	Centre National de Recherche appliquée au Développement Rural. Malagasy-Norwegian Agriculture and Livestock Farming, Center for Manufacturing, Training, and Application of Agricultural Mechanization and Machinery IFAD, World Bank; EU; Centre Technique Agro-écologique du Sud

Regions	Country	District/System	Area of work	Program and Accelerator collaboration	Key partners
East and South Africa	Uganda	Mixed-crop farming systems in Doho and northern Olweny regions	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing 4. Sustainable Animal and Aquatic Foods (SAAF)	National Agricultural Research Organization
West and Central Africa	Ghana	Maize-mixed farming system; Crop-tree-livestock systems; Cereal-root mixed crop-livestock farming system in Northern region, Upper west, Savanna region Volta, and Ashanti region	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact	Local governments and the Council for Scientific and Industrial Research Institutes in Ghana; Forestry Research Institute of Ghana; Kwame Nkrumah University of Science and Technology; University of Energy and Natural Resources; Ministry of Food and Agriculture
	Rwanda	Root and tubers, maize-based systems, and rice-based systems in Northern Province, the Southern Province, the Eastern Province and the Western Province.	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing	Rwanda Agriculture Board; Rwanda Agriculture and Animal Resources Development Board; Rwanda Agriculture and Animal Resources Development Board; BK Techhouse
	Mali	Maize-based cropping systems, Dryland cereal- legume systems, agro-pastoral systems, rice-based systems in Sikasso, Segou, Koulikoro, Mopti	i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact	'Institut National de la Recherche Agronomique , AGRA, IFDC, CIRAD
	Nigeria	Maize-based cropping systems, Dryland cereal- legume systems, agro-pastoral systems, root and tubers, rice-based systems in Oyo, Benue, Kano, Kaduna, Niger Adamawa, Kano, Yos, Zamfara, Borno	i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact	National Cereals Research Institute; Sasakawa Africa Association; Agromall; ThriveAgric; Cocoa Research Institute of Nigeria
	Cote d'Ivoire	Cocoa and Coffee systems in Bas-Sassandra, Gôh-Djiboua and Comoé Regions, Man, Bouake, Sassandra-Marahoué and Vallée du Bandama Regions	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact	National Center for Agronomic Research; Ministère Des Forêts Et De La Faune), Société de développement des forêts, Universities (Félix Houphouët-Boigny, Nangui Abrogoua), Conseil Café Cacao, Agence Nationale d'Appui au Développement Rural

Regions	Country	District/System	Area of work	Program and Accelerator collaboration	Key partners
West and Central Africa	Senegal	Rice-based systems and Dryland cereal-legume systems of Delta of Senegal River Valley Sedhiou, Theis and kola regions	(i) climate adaptation and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing 4. Sustainable Animal and Aquatic Foods (SAAF)	Senegalese Agricultural Research Institute, National Society for the Development and Exploitation of the land of the Senegal River Delt
	Niger	Rice-based systems, Dryland cereal-legume systems, Cassava-based systems of Tillabery. Dosso. Niamey, Diffa, Maradi,	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing	Research Institute of Niger, University Abdou Moumouni
	Burkina Faso	Rice-based systems, Dryland cereal-legume systems, Cassava-based systems in Hauts-Bassins, Boucle du Mouhoun, Cascades, Center-Est	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Capacity Sharing	Institute of Environment and Agricultural Research, Burkina Faso
South Asia	India	Rice systems, wheat systems, Dryland cereal- legume systems in Bihar; West Bengal; Eastern Region, Odisha, Karnataka, Uttar Pradesh, Madhya Pradesh, Andra Pradesh, Punjab, Haryana	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Sustainable Animal and Aquatic Foods (SAAF) 4. Digital transformation Accelerator 5. Climate actions	Bihar Agricultural University; Borlaug Institute for South Asia; Department of Agriculture West Bengal (India); Indian Council of Agricultural Research Complex for Eastern Region; Indian Council of Agricultural Research; Indian Meteorological Department; State Agricultural Universities, State department of Agriculture of Bihar, UP, Odisha, Haryana etc., State livelihood programs (e.g. Jeevika, Mission Shakti); IKSL; Bayer; Corteva; BASF; Jain Irrigation; Machine manufacturers; Reliance Foundation;; Dr. Reddy Foundation; Orrisa Foundation, Center for Soil Salinity Research Institute
	Bangladesh	Rice-based mixed crop-livestock farming systems in Dhaka city; Gazipur,	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization, (vii) Systems Integration	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Sustainable Animal and Aquatic Foods (SAAF)	Bangladesh Rice Research Institute; Bangladesh Agricultural Research Institute; Bangladesh Livestock Research Institute; Department of Agricultural Extension; Department of Livestock Service; Bangabandhu Sheikh Mujib Rahaman Agricultural University; Sher-e-Bangla Agricultural University
	Nepal	Tree-forage-fruit-water farming systems in Halesi Tuwachung Municipality, Gurvakot Municipality; Indrawati Rural Municipality; Karnali Province; Koshi Province; Bagmati Province	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Sustainable Animal and Aquatic Foods (SAAF)	Nepal Agricultural Research Council Institute of Engineering, Center for Water Resources Studies; Agricultural Forestry University; Purbanchal University; Mid-Western University

Regions	Country	District/System	Area of work	Program and Accelerator collaboration	Key partners
Southeast Asia	Vietnam	Rice-based systems in Mekong River Delta (Can Tho, Dong Thap, Soc Trang, An Giang, and Kien Giang, Vinh Long) and Red River Delta (Hai Duong, Nam Dinh, and Thai Binh)	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Sustainable Animal and Aquatic Foods (SAAF)	Department of Crop Production; Sub-Department of Crop Production and Plant Protection; Cuu Long Rice Research Institute; Nong Lam University; Vietnam Rice Sector Association; Can Tho Sub Department of Crop Production & Plant Protection; Soil fertility Institute (SFI); Tien Giang University; Nong Lam University; Tu Sang Company; Binh Dien Fertilizer, MTK fertilizer, Ryan JSC, Plant Protection Research Institute
	Laos	Highland extensive mixed farming systems: silvopastoral and maize-based systems: Luang Prabang, Xiengkhouang provinces  Upland intensive mixed farming systems, cassava-based systems: Sekong province	(i) climate adaption and mitigation, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (vii) Systems integration, (viii) Integrated water management	1. Multifunctional landscape and agroecology 2. Sustainable Animal and Aquatic Foods (SAAF)	Livestock Research Centre, Crops Research Centre, Forest Research Centre of the National Agriculture and Forestry Research Institute, Lao Farmers' Network, International Maize Improvement Consortium, National University of Laos, GIZ, ACIAR Private sector: Isaan Seeds Ltd., Thailand; Grupo Papalotla, Mexico
	Philippines	Rice-based system in Ilo, Isabela (PHI), Los Banos (EiA)	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Climate actions 2. Scaling for Impact 3. Digital transformation Accelerator	Bureau of Plant Industry; PhilRice; Bureau of Agricultural Research; Department of Agriculture; Agricultural Training Institute; Civil Aviation Authority of the Philippines; Fertilizer and Pesticide Authority; Agridom Solutions Corp; New Hope Corp
	Cambodia	Rice-based system in Battambang; Kampong Thom; Takeo; Prey Veng	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) appropriate-scale mechanization, (vii) systems integration	1. Climate actions 2. Scaling for Impact	General Directorate of Agriculture; Cambodian Agricultural Research and Development Institute; Provincial Department of Agriculture, Forestry and Fisheries; Agri-Smart Innovations; Lung Heng; Brooklyn Bridge to Cambodia; Agricultural Systems Research Cambodia; Institute Technology of Cambodia; Helen Keller International; Good Neighbors
Central West Asia and North Africa	Morocco	Rainfed drylands, Cereal-based mixed crop livestock system in Central Morocco and Highlands; olive-based agro-forestry systems; integrated desert farming system	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact 3. Breeding for future	ONCA; African Plant Nutrition Institute; Université Mohammed VI Polytechnique; National Institute for Agronomy - ; Moroccan Ministry of Agriculture and Maritime Fisheries; DeepFaces
	Egypt	Cereal-based Irrigated drylands in Nile river basin and New lands (Desert reclamation area); integrated desert farming system	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Scaling for Impact 2. Climate action 3. Capacity Sharing 4. Breeding for future	Agriculture Research Center, Ministry of Agriculture and Land Reclamation; Ministry of Water Management

Regions	Country	District/System	Area of work	Program and Accelerator collaboration	Key partners
Latin America	Peru	Highland mixed crop system in the Andes region (Huancabamba, Sanchez Carrion & Paucartambo province)	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact	National Institute of Agrarian Innovation; National Service of Plant Health; Asociacion Pataz
	Colombia	Small-scale rice systems, maize systems and potato systems in Inter-Andean valleys and the lower Cauca and Magdalena valleys	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) appropriate-scale mechanization, (vii) systems integration	1. Climate Action 2. Scaling for delivery 3. Digital transformation Accelerator	Federación Nacional de Cultivadores de Cereales y Leguminosas; Corporación Colombiana de Investigación Agropecuaria (AgroSavia); CIRAD
	Mexico	Maize-based cropping systems: Guanajuato; Querétaro	(i) climate adaption and mitigation, (ii) precision nutrient management, (iii) Resilient Soil Systems, (iv) plant health and mycotoxin-free crops, (v) integrated water management, (vi) scale-appropriate mechanization	1. Multifunctional landscape and agroecology 2. Scaling for Impact	Federación Nacional de Cultivadores de Cereales y Leguminosas; Secretaria de Agricultura y Desarrollo Rural; Secretaria de Desarrollo Agroalimentario y Rural de Guanajuato; Sustentabilidad Agropecuaria de Querétaro AC

## Section 14 Funding sources: Appendix 5 Item 14.1. Overview of the key bilaterally funded projects aligned to the Sustainable Farming Program

No.	Project/program title	Lead CGIAR Center	Funder	Duration	K\$ 2025-30 Expected 2025—30 funding (kUSDs)	SP/Acc/AoW Relevant Program/ Accelerator areas of work, if known
1	Mastercard - RIZAO	AfricaRice	Mastercard Foundation	5.5 years (ending in 2029)	1451	
2	BMGF MultiHarvestRice	AfricaRice	BMGF-Bill & Melinda Gates Foundation	3 years	1060	
3	HealthyDiets4Africa	AfricaRice	EC-European Commission	6 years (ending in 2028)	707	
4	World Bank-Food Systems Resilience	AfricaRice	World Bank	3 years	665	
5	IITA/EC BRECOMA	AfricaRice	EC-European Commission	3 years (ending in 2025)	332	
6	DEFIS	AfricaRice	IFAD-International Fund for Agricultural Development	3 years (ending in 2026)	308	
7	IFAD Zero Hunger	AfricaRice	IFAD-International Fund for Agricultural Development	1 year	36	
8	CGIAR Contribution to the Food Systems Resilience Project	AfricaRice	Madagascar-MINAE-Ministere de l'Agriculture et Elevage	2.5 years (ending in 2026)	2700	AoW 6
9	ISSM4RICE-Netherlands Food Partnerships	AfricaRice	Senegal	0.5 years (2025)	30	
10	IRRI South Asia Regional Centre Phase II	IRRI	India-Department of Agriculture and Cooperation and Farmers Welfare	5 years (2022-2027)	1252	
11	Dry Direct Seeded Rice for the Indo-Gangetic Plains of India (PlantDirect)	IRRI	BMGF-Bill & Melinda Gates Foundation	5 years (2022-2027)	912	
12	ASEAN-CGIAR Innovate for Food Regional Program	IRRI	Multi-Funder	3 years (2023-2026)	1132	
13	Improving the quality of life of smallholder rice farmers in Asia and Africa through introduction, on-farm testing and scaling of improved germplasm and climate smart agronomy	IRRI	USAID-United States Agency for International Development	4 years (2022-2026)	773	
14	IRRI and UASB Partnership for Rice research and Development in Karnataka	IRRI	India-Government of Karnataka	6 years (2023-2028)	487	
15	Fertilize Right Vietnam	IRRI	United States Department of Agriculture	4 years (2023-2027)	474	
16	Reducing methane emissions from rice: from mechanistic understanding to scalable crop management options	IRRI	Shell India Markets Private Ltd.	5 years (2023-2027)	632	
17	ICAR 2023 - 2027	IRRI	India-ICAR-Indian Council of Agricultural Research	5 years (2023-2027)	75	
18	Credits Offsetting Rice Emissions	IRRI	Germany-GIZ-Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH	4 years (2022-2025)	216	

No.	Project/program title	Lead CGIAR Center	Funder	Duration	K\$ 2025-30 Expected 2025—30 funding (kUSDs)	SP/Acc/AoW Relevant Program/ Accelerator areas of work, if known
19	Mechanized dry direct-seeded rice (DSR) to increase yield, income, and resilience of smallholder farmers in selected rice producing states of India (DSR-India)	IRRI	India-Ministry of Agriculture and Farmers Welfare	2 years (2024-2025)	318	
20	Rice straw-based circular economy for improved biodiversity and sustainability (RiceEco)	IRRI	Mekong-Republic of Korea Cooperation Fund	3 years (2022-2025)	165	
21	Promoting Climate-Resilient Livelihoods in Rice-Based Communities in the Tonle Sap Region in Cambodia	IRRI	Global Environment Facility	5 years (2022-2027)	101	
22	Drones4Rice: Development of Standard Drone Application Protocols for Rice Production Systems in the Philippines	IRRI	Philippines-BAR-DA-Bureau of Agriculture Research-Department of Agriculture	4 years (2024-2027)	155	
23	Enhancing the resilience, income and livelihood of farmers in drought prone regions of Odisha	IRRI	India-Department of Agriculture and Farmers' Empowerment, Government of Odisha	2 years (2024-2025)	121	
24	Climate Resilient Agriculture in the Mekong Delta	IRRI	USAID-United States Agency for International Development	2 years (2024-2025)	150	
25	dynAg: An AI based Digital Extension Platform to Promote Peer-to-Peer Exchange and Deliver Dynamic Advisory to Smallholders	IRRI	Germany-GIZ-Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH	2 years (2023-2025)	75	
26	Multiple-Harvest Rice for Africa (MHRA)	IRRI	BMGF	2 years (2024-2025)	112	
27	Optimizing Management for Reduction of GHG in Rice (OPTIMA-Rice)	IRRI	BASF-The Chemical Company	2 years (2024-2025)	100	
28	Assessing the water productivity, soil health, yield and economics of rice-based cropping systems under transplanted and direct seeded rice in different agroecosystems in India	IRRI	Bayer BioScience Pvt. Ltd.	3 years (2023-2026)	199	
29	Climate-Smart Rice Value Chain in the Haor Region	IRRI	HSBC Bank	2 years (2024-2025)	65	
30	Project to Support the Sustainable Development of Agricultural and Livestock Value Chains in Burundi (Projet D'appui Au Developpement Durable Des Chaines De Valeur De L'agriculture Et De L'elevage Au Burundi)	IRRI	African Development Bank	2 years (2023-2025)	84	
31	Development of Innovation System for Climate Smart Pest Management in Rice (2024)-IRRI Component	IRRI	Philippines-BAR-DA-Bureau of Agriculture Research-Department of Agriculture	3 years (2023-2025)	130	
32	M4NCO: Microbe mediated methane mitigation and nitrogen cycle optimization in rice fields	IRRI	Ibaraki University	3 years (2024-2026)	86	
33	Rice Methane Reduction	IRRI	Kubota	2.5 years (2024-2026)	80	
34	Development of rice cropping systems toward carbon neutrality and food security in ASEAN countries	IRRI	Ministry of Agriculture Forestry and Fisheries - Japan	5 years	597	
35	Fertilize Right - Pakistan	ICARDA	United States Department of Agriculture	4 years (9/1/2023 - 8/31/2027)	972	
36	D-200347-India Collaborative Program 2022/2023 to 2026/2027	ICARDA	India-ICAR-Indian Council of Agricultural Research	5 years (2023-2027)	410	
37	D-200394-Program 2- International host / pathogen Differential Sets: Effective Genetic and Sustainable Management of Ascochyta Blight of Chickpea - Phase 2	ICARDA	Australia-GRDC-Grains Research and Development Corporation	4 years (2024 - 2027)	910	
38	D-200352-SOILS4MED -Soil Health Monitoring and Information	ICARDA	PRIMA-Partnership for Research and Innovation in the Mediterranean Area	4 years (2023- 2026)	668	

No.	Project/program title	Lead CGIAR Center	Funder	Duration	K\$ 2025-30 Expected 2025—30 funding (kUSDs)	SP/Acc/AoW Relevant Program/ Accelerator areas of work, if known
39	CARINA - CARinata and CamellINA to boost the sustain	ICARDA	European Commission	5 years (2022-2026)	668	
40	D-200364-Wheat Disease Early Warning Advisory System DEWAS	ICARDA	DEWAS	4 years (2023-2026)	395	
41	D-200371 Development and Scaling of Introduced Plant Species	ICARDA	Abu Dhabi Agriculture and Food Safety Authority	3 years (2023-2026)	348	
42	Egypt Bilateral Program	ICARDA	Egypt	3 years (2023-2025)	145	
43	D-200366-Innovative Desert Farming for Resilient Livelihoods	ICARDA	Spain-AECID-Agencia Española de Cooperación Internacional	3 years (2023-2025)	239	
44	D-200086-Ultra-Low Energy Drip Irrigation for MENA Countries	ICARDA	Massachusetts Institute of Technology	10 years (2016-2026)	625	
45	Morocco Collaborative Grants Program (MCGP) Phase IV 2025- 2030	ICARDA	Government of Morocco	2 years 2025-2026)		
46	D-100814-KFAED: Kuwait IDFS	ICARDA	Kuwait Fund for Arab Economic Development	5 years (2024-2028)	644	
47	D-100777-GCC Date Palm	ICARDA	GCC-Gulf Cooperation Council	7 years (2024-2030)	1009	
48	D-100894-BMGF: Preparatory phase for the Red Palm Weevil project	ICARDA	BMGF	7 years (2024-2025)	1094	
49	D-100860-PRIMA: Rain2Food - Deploying modern and ancestral rain capturing methods to maximize the resilience of Mediterranean dry farming communities	ICARDA	PRIMA-Partnership for Research and Innovation in the Mediterranean Area	4 years (2025-2028)	1276	
50	D-100865-PRIMA: Water Mellon: Harnessing water saving approaches, drought and salinity resilient species to address extreme drought in arid and semi-arid environments of the Mediterranean region to create sustainable and resilient agricultural systems on-farm	ICARDA	PRIMA-Partnership for Research and Innovation in the Mediterranean Area	4 years (2025-2028)	1276	
51	D-100867-PRIMA: Lost and found: Neglected and Underutilized Species (NUS) and water harvesting for building climate change resilience, soil fertility, dietary diversity, and women's empowerment	ICARDA	PRIMA-Partnership for Research and Innovation in the Mediterranean Area	4 years (2025-2028)	1276	
52	M-V0145-Sustainable AgriFood Systems Approach for Sudan - SA	CIMMYT	USAID-United States Agency for International Development	3.2 years (2022-2025)	14,649	
53	M-C0172 Sustainable Intensification of Smallholder Farming Systems (SIFAZ) in Zambia	CIMMYT	European Comission	7.4 years (2019-2026)	3,160	
54	M-V0146-AID-I : Southern Africa	CIMMYT	USAID-United States Agency for International Development	3.2 years (2022-2025)	2,356	
55	M-V0156-Wheat Disease Early Warning Advisory System (Wheat D	CIMMYT	BMGF	3.1 years (2023-2026)	867	
56	M-V0093-WAC/2020/148 Transforming Smallholder Food Systems i	CIMMYT	The University of Adelaide	5 years (2021-2026)	361	
57	M-C0248-RENEWAL: CSISA 4.0 Cereal System Initiative South As	CIMMYT	BMGF	3.5 years (2021-2025)	349	
58	M-W0505-India Contribution to CIMMYT 2024	CIMMYT	India-Department of Agriculture and Cooperation and Farmers Welfare	2.5 years (2024-2026)	306	
59	M-V0081-Abastecimiento Responsable, competitivo y sustentable	CIMMYT	Corporativo Bimbo, S.A. de C.V.	5 years (2021-2025)	282	

No.	Project/program title	Lead CGIAR Center	Funder	Duration	K\$ 2025-30 Expected 2025—30 funding (kUSDs)	SP/Acc/AoW Relevant Program/ Accelerator areas of work, if known
60	M-V0161-Plan Maíz Fase II	CIMMYT	Nestle	3.8 years (2023-2027)	266	
61	M-V0164-Zambuko - Conservation Agriculture and Mechanisation	CIMMYT	World Food Programme	2 years (2023-2025)	241	
62	M-C0244-FtF Integrated Pest Management	CIMMYT	Virginia Tech-Virginia Polytechnic institute and State University	4 years (2021-2025)	129	
63	M-V0183-Accelerating Impact of Agronomy at Scale to deliver	CIMMYT	IITA-International Institute of Tropical Agriculture	4 years (2023-2026)	128	
64	M-C0257 People's Republic of China (CIMMYT-China Henan or CCH)	CIMMYT	Henan Agricultural University	3 years (2022-2025)	98	
65	M-W0474-Managing wheat blast in Bangladesh: identification a	CIMMYT	ACIAR	4.6 years (2021-2026)	75	
66	M-W0473-New Sources of Genetic Disease Resistance through Ho	CIMMYT	KSU-Kansas State University	4 years (2021-2025)	47	
67	M-V0082-Responsible Sourcing in Mexico (Maize)	CIMMYT	Kellogg Company Mexico S. de R.L. de C.V	4.2 years (2021-2025)	42	
68	M-V0097-Originacion sustentable de maiz amarillo en Jalisco	CIMMYT	Ingredion Incorporated	3.5 years (2021-2025)	39	
69	Water Resource Accountability in Pakistan (WRAP) Component 1	IWMI	United Kingdom-FCDO-Foreign, Commonwealth and Development Office	8 years (2021-2028)	2,400	AoW 5, 1 and
70	Technical Assistance for the Revival of the Balochistan Water Resources Programme	IWMI	European Union	5 years (2022-2026)	1,074	AoW 5 and 7
71	Monitoring land and water productivity by Remote Sensing (WaPOR Phase 2)	IWMI	Netherlands - Ministry of Foreign Trade and Development Cooperation	5 years (2021-2025)	480	AoW 5 and 7
72	Mapping Aquifer Recharge Zones in Groundwater	IWMI	FAO	3 years (2024-2026)	348	AoW 5
73	Water Management for Enhanced Productivity	IWMI	United Kingdom-FCDO-Foreign, Commonwealth and Development Office	8 (2018-2025)	354	AoW 5, 1 and 7
74	Subsidy Soil Fertility Programme - West Africa	IWMI	Netherlands - Ministry of Foreign Trade and Development Cooperation	3 years (2024-2026)	1,800	AoW 3, 5 and 7
75	Feed the Future/Water and Food Systems for Resilient Communities Activity in Uganda	IWMI	USAID-United States Agency for International Development	6 years (2023-2028)	76	AoW 1 and 5
76	Feed the Future Innovation Lab	IWMI	USAID-United States Agency for International Development	3 years (2024-2026)	164	AoW 5, 7 and 1
77	Sustainable Resource Use in the Aral Sea Region	IWMI	Germany-GIZ-Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH	3 years (2024-2026)	121	AoW 5 and 1
78	IWMI - Tata Water Policy Research Program Action Research on Water for Livelihoods	IWMI	Sir Ratan Tata Trust	4 years (2022-2025)	84	AoW 7, 5 and 1
79	Preparation of Implementation Support Upper Mahaweli Watershed Management Plan	IWMI	World Bank	3 years (2023-2025)	83	AoW 5
80	IWMI Phase 2 Interim Work Plan on the Feed the Future Innovation Laboratory for Small Scale Irrigation (ILSSI)	IWMI	USAID-United States Agency for International Development	8 years (2018-2025)	169	AoW 5 and 7
81	Improving and Strengthening Water Security	IWMI	Germany-GIZ-Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH	3 years (2024-2026)	61	AoW 5 and 3

No.	Project/program title	Lead CGIAR Center	Funder	Duration	K\$ 2025-30 Expected 2025—30 funding (kUSDs)	SP/Acc/AoW Relevant Program/ Accelerator areas of work, if known
82	Lao PDR: Irrigation Sub-Sector Working Group Secretariat	IWMI	Asian Development Bank	3 years (2024-2026)	149	AoW 5 and 7
83	Integrated flood and drought management for enhancing resilience and improving food security in the Asian Monsoon region	IWMI	Japan Ministry of Agriculture, Forestry and Fisheries	4 years (2023-2026)	42	AoW 1 and 7
84	Water management for rainfed agriculture in southern Africa (Tanzania, Malawi, and Zambia)	IWMI	USAID-United States Agency for International Development	3 years (2024-2026)	2000	AoW 5 and 7
85	Solar irrigation for Agricultural Resilience - Phase II	IWMI	Swiss Agency for Development Cooperation	4 years (2025-2028)	2500	AoW 5 and 7
86	Sustainable Use of Aquifers for the Republic of the Niger	IWMI	USAID-United States Agency for International Development	2 years (2025-2026)	250	AoW 5
87	Adaptation Insights	IWMI	BMGF	3 years (2024-2026)	280	AoW 5
88	P-1568-WBS0-Developing Local Seed Potato Production System i	CIP	Government of West Bengal	4 years (2024-2027)	620	AoW 4
89	P-1520-GOO0-Sustainable Intensification of Potato	CIP	India-Government of Odisha	5 years (2022-2026)	533	AoW 1-6
90	1585-IITA Accelerated Innovation Delivery Initiative (AID-I) Mozambique	CIP	USAID - IITA	2 years (2024-2025)	277	AoW 1, 4, 5, 7
91	1475-GIZ0 Potato production through zero-tillage with straw mulch: an innovative technology for sustainable intensification and diversification of rice-based systems to improve livelihoods of small-scale farmers in Asia	CIP	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	5 years (2021-2025)	210	AoW 1, 3-5
92	P-1559-GOO0-Establishment and Operation of Aeroponics Facility	CIP	Government of Odisha	4 years (2023-2026)	175	AoW 4
93	P-1566-PSU0-Current and Emerging Threats to Crops Innovation Lab	CIP	USAID - Penn State University	3 years (2023-2025)	150	AoW 4
94	P-1540-IITA-TAAT Phase 2	CIP	African Development Bank - IITA	4 years (2022-2025)	56	
95	P-1547-MAP0-Fortalecimiento de la conservación y uso sostenible.	CIP	Ministerio de Agricultura - Perú	4 years (2023-2026)	46	AoW 1, 3-5, 7
96	UNITED KINGDOM - FCDO -iSPARK: Innovation in sustainability, policy, adaptation and resilience in Kenya (IA Lead of D511)	Alliance	FCDO-Foreign, Commonwealth and Development Office	3 years (2024-2026)	300	
97	Climate-smart Initiatives for climate change adaptation and sustainability in prioritized agricultural production systems in Colombia (CSICAP)	Alliance	Colombia-MADR-Ministerio de Agricultura y Desarrollo Rural	TBC	8000	
98	USAID - digital fertility mapping to improve agricultural soil management and efficiency of fertilization in Honduras	Alliance	USAID-United States Agency for International Development	4 years (2023-2026)	874	
99	USDA-USA-Cacao Research and Technology Transfer	Alliance	USDA-United States Department of Agriculture	5 years (2022-2026)	159	
100	Wageningen (Nestle) - Ground Zero	Alliance	Wageningen University	5 years (2022-2026)	66	
101	Seeds4Soils: regenerating soils with agrobiodiversity for climate resilience in Madagascar	WorldVeg	Defra, UK (Darwin Initiative)	4 years (2024-2027)	758	
102	AV4Resilience: African vegetables for enhanced functional diversity and resilience of production systems in Burkina Faso through women and youth empowerment	WorldVeg	McKnight Foundation	3 years (2024-2026)	300	
103	Building Capacity for Climate Resilience and Organic Farming among Vegetable and Fruit Growers in Sri Lanka	WorldVeg	Asian Development Bank	4 years (2023-2026)	500	

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104	Healthy Soils, Prosperous Farmers: Building knowledge on climate resilient and regenerative horticulture for smallholder growers in India	WorldVeg	Nunhems Netherlands BV	2 years (2024-2025)	129	
105	Onion Value Chain Improvements in Odisha State, India	WorldVeg	Government of Odisha, India	3 years (2023-2025)	285	
106	Opportunity vegetables in Ethiopia and Bangladesh	WorldVeg	FCDO Foreign, Commonwealth and Development Office	3 years (2024-2026)	463	
107	Vegetables for recovery, risk reduction and resilience in Ethiopia	WorldVeg	USAID	3 years (2024-2026)	1,000	
108	Scaling agroecological solutions and markets for more resilient production, income and healthy agroecosystems in Kenya	WorldVeg	Biovision Foundation	3 years (2024-2026)	405	
109	YUS159- USAID SERVIR West Africa 2 Activity	ICRISAT	USAID	6 years (2022-2027)	8,427	
110	YBH02- Sustainable Intensification and Diversification in South Bihar	ICRISAT	India	6 years (2023-2028)	1,006	
111	YFA85- Harnessing genetic resources for farming diversification to enhance income, food, and nutrition security in Southern Africa	ICRISAT	Malawi	4 years (2023-2026)	400	
112	YPEAT2- Improvement Plantix-App-Agricultural Support of Farmers in Telangana and Andhra Pradesh	ICRISAT	India	10 years (2016-2025)	86	
113	LEG4DEV - Legume-based agroecological intensification	ILRI	NUI-National University of Ireland	5 years (2022-2026)	672	
114	Land, Soil and Crop Information Services to support Climate Smart Agricultural (LSC-IS)	ILRI	Wageningen University	5 years (2022-2026)	470	
115	Linking East and West African Farming Systems Experience into a BELT of Sustainable Intensification	CIFOR-ICRAF	European Commission	6 years (2020-2025)	261	AoW 3
116	Evaluating the impacts of regenerative agriculture on soil health, agronomic gain, and landscape restoration in Kenya	CIFOR-ICRAF	AGRA	2 years (2024-2025)	397	AoW 3
117	DIGITAF DIGITAL Tools to help Agroforestry meet climate, biodiversity and farming sustainability goals: linking field and cloud	CIFOR-ICRAF	European Research Executive Agency	5 years (2022-2026)	134	AoW 3
118	Soil Values Program	CIFOR-ICRAF	International Fertilizer Development Center	10 years (2024 -2033)	2,171	AoW 3
119	Sustainable investments for large-scale rangeland restoration (STELARR)	CIFOR-ICRAF	International Livestock Research Institute	2 years (2024-2025)	210	AoW 3
120	TWENDE: Towards Ending Drought Emergencies: Ecosystem Based Adaptation in Kenya's Arid and Semi-Arid Rangelands	CIFOR-ICRAF	Ministry of Agriculture, Livestock, Fisheries, and Cooperatives. Kenya	5 years (2021-2025)	434	AoW 3
121	Delivering nature-based solution outcomes through strengthened policy implementation, institutional capacity, and enhanced monitoring and reporting of forest and landscape restoration in Kenya	CIFOR-ICRAF	UK Partnering for Accelerated Climate Transitions	4 years (2022-2025)	2,274	AoW 3
122	CIFOR-ICRAF Research Partnership - Soils East Africa / Kenya	CIFOR-ICRAF	United States Agency for International Development	6 years (2022-2027)	800	AoW 3
123	Improving soil health, reducing nutrient leakage and increasing water use efficiency in coffee farms under the V-SCOPE Program	CIFOR-ICRAF	Koninklijke Douwe Egberts B.V.	5 years (2021-2025)	200	AoW 3

No.	Project/program title	Lead CGIAR Center	Funder	Duration	K\$ 2025-30 Expected 2025–30 funding (kUSDs)	SP/Acc/AoW Relevant Program/ Accelerator areas of work, if known
124	Improving soil health and fertilizer use efficiency in pepper farms under the V-SCOPE Program	CIFOR-ICRAF	McCormick & Company	5 years (2021-2025)	250	AoW 3
125	Sustainable Land Management Project	CIFOR-ICRAF	Total Landcare	4 years (2022-2025)	201	AoW 3
126	Accelerating Impact of Agronomy at Scale to deliver Agronomic and Economic Gain	IITA	Qatar Fund for Development (QFFD)	(TBC) 2025 - 2027	7,000	
127	Soil Values	IITA	IFDC	4 years (2024 – 2027)	4,500	
128	Regional Hub for Fertilizer and Soil Health	IITA	World Bank (AICCRA)	2 years (2024 – 2025)	4,000	
129	Regional Hub for Fertilizer and Soil Health	IITA	OCP	5 years (2024 – 2028)	5,000	
130	Making Effective Bio-Inputs Work for Smallholder Farmers in Sub-Saharan Africa (BioSAA)	IITA	Bill and Melinda Gates Foundation	4 years (2024 – 2027)	5,000	
131	Accelerated Innovation Delivery Initiative	IITA	USAID	6 years (2022 – 2027)	6,500	
132	EU/IITA - FOOD SAFETY FOR AFRICA - ADDRESSING FO	IITA	European Union (EU)	4 years (2023 – 2027)	3,282	
133	Food Systems Resilience Program interventions in Feed Salone	IITA	World Bank	3 years (2024 – 2027)	768	
134	Legume-based agroecological intensification of maize and cassava cropping systems in Sub-Saharan Africa for water-food-energy nexus sustainability	IITA	European Union (EU)	5 Years (2021 – 2026)	463	
135	Building Resilience to Enhance Food, Incomes and Nutrition Security in the Comoros and Madagascar	IITA	European Union (EU)	4 years (2022 – 2025)	365	
136	Malawi Digital Plant Health Service (MaDiPHS)	IITA	Norwegian Agency for Development Cooperation	5 years (2022 – 2027)	281	
137	Counteracting the emergence of invasive and virulent plant-parasitic nematodes as driven by global warming and genetic selection	IITA	European Union (EU)	3 years (2024 – 2027)	200	
138	USDA Food for Progress (FFPr): Traceability and Resilience in Agriculture and Cocoa Ecosystems of Nigeria (TRACE) Project, Nigeria	IITA	USDA	3.5 years (2023 –2026)	150	
139	A Regional Emergency Response Plan to Control the Banana Bunchy Top Disease (BBTD) Outbreak in East Africa	IITA	USDA	2 Years (2023 – 2025)	135	
140	Emergency response to outbreaks of caterpillars of a transboundary noctuid pest moth	IITA	FAO	1 Year (2024 – 2025)	120	
141	IITA Accelerated Innovation Delivery Initiative (AID-I) for Mozambique	IITA	USAID	5 years (2024-2028)	2,500	
142	Reviving taro production in Western Africa: High throughput phenotyping and omics approaches to study taro diseases	IITA	Swedish Research Council	5 years (2020 -2025)	315	
143	Climate Smart innovations and measures for East African smallholder farming	IITA	Syngenta Foundation for Sustainable Agriculture	4 years (2023 – 2026)	110	

**Note:** This table is not intended to be exhaustive. It should provide sufficient information to support the assumptions made about the overall funding mix and high-level breakdown [e.g. the known projects that make up about 80% of bilateral and W3 funding managed by the Centers and mapped to the Sustainable Farming Program].