A decade of science for climate change adaptation and mitigation

An analysis of 300 outcomes enabled by CCAFS research, engagement, and outreach

Working Paper No. 410

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security
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Titles in this series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

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Abstract

This working paper synthesizes findings and reflections from an analysis of 300 CCAFS outcomes reported by project and program leaders between 2011 and 2020. The analysis, organized in the form of an outcome harvest, was aimed to distil typologies of outcomes achieved across geographies and groups of beneficiaries; the contributions of outcomes to program and institutional targets and sustainable development goals (SDGs) and targets; as well as key impact pathways derived from the activities, outputs and outcomes reported by CCAFS teams in relation to interventions targeting policy/investment and services/farm. The study also reveals examples of outcomes that progressed from one maturity level to the next, that expanded the scope of work, scaled to new geographies, or marked an increase in the number of innovations developed over the years, indicating a diversity of forms in which CCAFS outcome-oriented work has evolved towards increased impact.

Key findings:

- We identified 300 outcomes reported by CCAFS project teams between 2011 and 2020. Over a half of these were realized during CCAFS second phase (2017-2020).
- Most outcomes reported were related to development of/ changes in policy, followed by improved climate, information and financial services and improved programming. Almost a quarter of the reports cover two outcomes simultaneously, typically combining policy + programme and policy + services.
- More than half of the outcomes reported are at level 1 in their maturity, primarily focusing on design and planning of policies, strategies, or investments. Less than 5% of the outcomes present evidence of impact at scale (level 3 of maturity).
- Several outcomes were reported across multiple years, marking progression to a next level of maturity (typically from design to implementation), a diversified scope (from policy to farm, from plan to investment, etc.), a diversified partnership structure, or expansion to new geographies or scales.
- Most innovations linked with the achieved outcomes focus on research methodologies and communications tools, to production systems and management practices, and social sciences, indicating the distinctive approach to science promoted by CCAFS, which has been focused primary on systems thinking, including participatory, user-oriented science and tools, rather than on more traditional, linear, technology-led approaches such as breeding or biophysical research.
- Overall, outcomes contributed to 14 Sustainable Development Goals (SDGs) and 45 SDG targets. As expected, most reported contributions refer to SDG 13 (action to

combat climate change), followed by SDG 17 (strengthen means of implementation and sustainable development finance), SDG 1 (end poverty) and SDG2 (end hunger and achieve food and nutrition security).

- The different typologies of outcomes, outputs and activities have allowed distilling two major impact pathways representative of CCAFS outcome-oriented work: policy - investment and services - farm.
- We also identified several typologies of outputs, outcomes and linkages that were not initially contemplated in the initial CCAFS impact pathways, suggesting the importance of revisiting theories of change and underlying assumptions, as a key strategy for adaptive management and learning, for effectively responding and aligning to emerging needs and changes in context, and for maximizing impact.

Keywords

Agriculture; Climate Change; Outcomes; Impact pathway; Policy; Investment; Partnerships

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Contents

Acronyms

AR4D	Agricultural Research for Development
CCAFS	CGIAR Programme on Climate Change, Agriculture and Food Security
CSV	Climate smart village
IDO	Intermediate Development Outcome
LED	Low-Emissions Development
LTAC	Local Technical Agroclimatic Committee
MARLO	Managing Agricultural Research for Learning and Outcomes
NDVI	Normalized Difference Vegetation Index
OICR	Outcome Impact Case Report
PICSA	Participatory Integrated Climate Services for Agriculture
PRMF	Performance and Results Management Framework of OneCGIAR
SDG	Sustainable Development Goals
SRF	Strategy and Results Framework (of CGIAR)

Introduction

As the CCAFS Program is coming to an end and in the effort to synthesize reflections on CCAFS achievements, challenges, and gaps that can inform the design of future agricultural for research and development (AR4D) initiatives, we sought to understand the types of changes in behavior, relationships, activities and actions of immediate and indirect beneficiaries. This working paper presents a meta-synthesis and analysis of CCAFS outcomes achieved over the years 2011-2020. The assessment relies on information reported by CCAFS scientists (project leaders, regional leaders, projects staff) via different reporting tools (annual reports, outcome reports, case studies, etc.). Specifically, the study sought to: (i) identify and describe the different changes (actions, processes, decisions, both expected and unintended) that CCAFS, as change agent, has enabled over the years. (ii) assess the extent to which CCAFS outcomes have contributed to higher-level institutional and international targets, including the CGIAR System Results Framework (SRF), CCAFS sub-intermediate Development Outcomes (sub-IDOs) and Sustainable Development Goals (SDGs) and (iii) carve out major pathways that deliver policy-investment and service-farm outcomes, with the view to reveal key elements—including activities, outputs, innovations, and partnerships—that played in important role in the CCAFS outcome legacy.

This synthesis targets two types of audiences. First, it is directed to One CGIAR leadership, programme managers and implementers interested in learning from successful models of outcome-oriented research and impact pathways that have been enabled by CCAFS research and collaborations (partnerships) throughout the years. In this sense, the report can also serve as a feedback loop for planning future climate change initiatives within the new One CGIAR. Second, the synthesis document can also be relevant to an external audience, such as CCAFS partners interested in learning about how CCAFS initiatives have added value to the climate and agricultural development space. The report guides them through success stories, case studies and reflections on pathways to achieve different outcomes and impacts (at policy, investment, partnerships level). Moreover, the report can also be relevant to development practitioners seeking more general insights into the benefits of outcome harvesting approaches to inform planning and adaptive management of projects and programmes.

Research protocol

Data

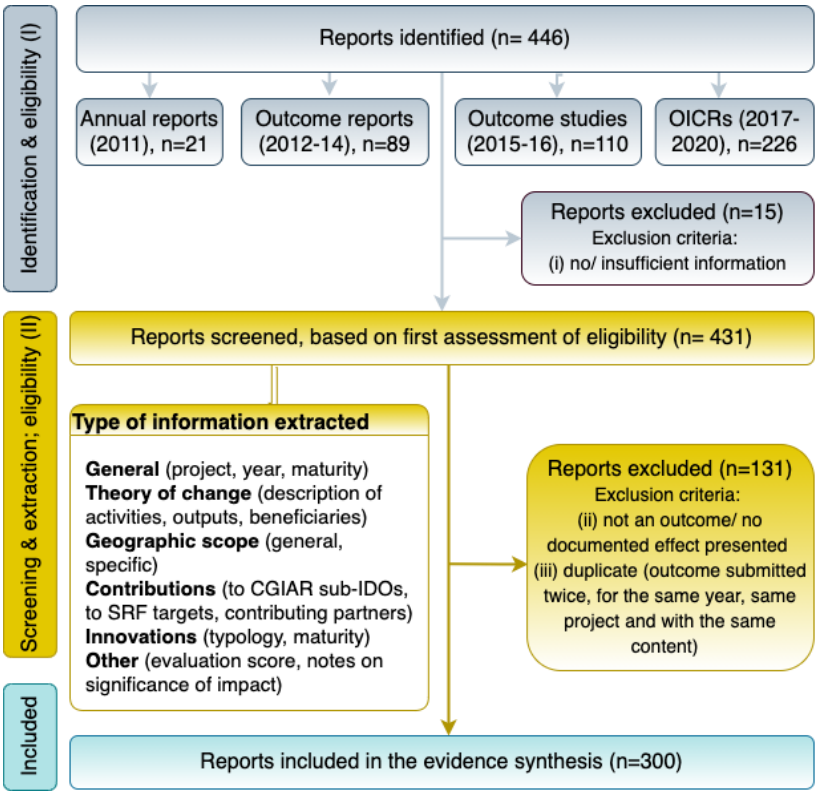
We screened documents with narratives of project outcomes submitted by CCAFS Project leaders as part of the CCAFS annual reporting process, covering CCAFS Phase I (2011-2016) and Phase II (2017-2020). These documents describe the activities conducted, the related research outputs, next users (e.g., governments at all levels, development banks, investors, non-governmental organizations, etc.), partners, quantifications (e.g., number of beneficiaries, of outputs produced, of area covered, etc.), and innovations developed. These reports also provide evidence on the contribution of the research efforts to the outcome, reported in the form of narratives and supporting documents. The structure and content of these outcome reports have changed throughout the years, with more level of detail and more rigorous documentation of outcomes observed in CCAFS Phase II (2017-2020, more precisely). Hence, our data source varied with the reporting year. For example, for the first CCAFS reporting year, we considered annual reports submitted by theme leaders and regional leaders, to document any evidence of early outcomes. For the subsequent years, we referred to outcome reports (2012-2014), outcome case studies (2015-2016) and outcome impact case reports (OICRs) (2017-2020).

We assessed the eligibility of the reports for our study in two stages. First, we assessed the level of information provided in the reports. We excluded the reports if (i) they did not provide sufficient information in any of the thematic areas of interest to this assessment (i.e., information that describes the outcome, outputs and activities). In the second stage, we looked at the outcome narrative and excluded those reports where (ii) the overall narrative of the report was referring to a project output rather than an outcome, with no documented effect (e.g., publication of a scientific article, a progress report, release of a methodology, a presentation given at a workshop, etc.); and (iii) the report was a duplicate (i.e., submitted twice, for the same year and project and with the same level of detail).

The document screening aimed at collecting information that describes what changed (the outcomes), for whom (the beneficiaries of those outcomes), where (the geographical context and decision-making level), when (which CCAFS Phase, year), and how (what activities and outputs led to these changes). The information extracted relates to the theory of change (i.e., information describing the activities and outputs that led to the outcome reported), geographical scope, contribution to CGIAR and CCAFS monitoring and evaluation (M&E) frameworks, innovations associated with the outcome case study, and general project

descriptors. A detailed overview of the research protocol with data sources, selection, exclusion criteria and information extracted is illustrated in Figure 1.

Figure 1. CCAFS outcome harvest research protocol



Analysis

Information collected from the reports was categorized to enable a systematic analysis of the qualitative information (i.e., types of outcomes reported and ancillary information). The information types for which we created typologies refer to: outcome type and subtype, outcome stage, activity type, output type, direct beneficiary type, contributing partners type, innovation type, and innovation stage. An overview of these typologies is presented in Table 1. Most of these typologies draw on CCAFS monitoring and reporting documentation—particularly CCAFS internal reporting platform, Managing Agricultural Research for Learning and Outcomes (MARLO)—, external evaluation reports, and peer-reviewed publications, with the view to ensure programmatic consistency in terminology and concept use. We also analyzed information in its raw format, as it was reported by project leaders in the respective outcome reports. This refers to: outcome identification (ID) number, reporting year, geographic scope (region, country), and contributions to CGIAR SRF and Sub-IDOs.

Contributing partner names were extracted from each outcome study report and included in the database, and then coded into categories to facilitate analysis. Because there was a range

of zero to 20 partners in each of the 300 outcomes, in total, 918 partners were listed; some partners participated in multiple projects. We used Python, an object-oriented programming language, to search each partner name in our database and extracted the corresponding "institution types" for each partner, based on the CCAFS partners acronym list[1]. The Sub-IDOs tagged in the OICRs were mapped to SDG Targets using an existing mapping developed by the Systems Management Office (SMO). The contributions to CGIAR SRF Targets were also mapped to SDG Targets, based on the CGIAR Performance Report 2017 (CGIAR 2018).

We followed the CGIAR definition of innovations, where these are described as "new or significantly improved outputs or groups of outputs - including management practices, knowledge or technologies". CGIAR distinguishes between six main typologies of innovations, including: genetic varieties and breeds (which covered 65% of 4154 CGIAR innovations developed between 2017 and 2020), research and communication methodologies and tools (representing 13% of all CGIAR innovations), production systems and management (12%), social science (7%), biophysical research (2%) and other (1%)[2] (CGIAR 2021) (Table 1). These typologies were also used by CCAFS teams to report on innovations developed as part of their projects. In our analysis, we used the innovation typologies as they were reported by project staff and adjusted the categorizations when the information was reported inconsistently across years (i.e., same innovation was reported under different typologies in different years), making those judgments based on the best knowledge of the authors and their experience with CGIAR and CCAFS-level reporting.

Table 1. Information typologies used for data analysis

Information type	Typologies and definitions	Source
Outcome type	• **Global/regional:** global and regional (continental) processes on climate change, agriculture and food security, including discussions, decisions, guidelines with a wide impact, informed by CCAFS science and engagement • **Policy:** changing or creating new policies, plans, budgets, investments (in part) based on engagement and information dissemination by CCAFS. • **Programming**: organizations adapt their plans or design new plans, projects and programmes based on CCAFS priority setting tools, analyses and other outputs • **Services**: public/private initiatives providing access to novel financial services and supporting innovative CSA business models, informed by CCAFS science and engagement	CCAFS Phase II Full Proposal (CCAFS 2016)

[1] This list contains 3,527 partners together with detailed descriptions of their full names, acronyms, geographical locations, and institution type.

[2] CGIAR Innovation Dashboard: https://www.cgiar.org/food-security-impact/results-dashboard/

	• **Farm:** outcomes observable at farm and landscape level, including changes in conditions of natural resources used for farming, in livelihoods, etc.	
Outcome subtype - policy	• **Plan, strategy**: a written decision or commitment to a particular course of action by an institution (policy); or a (government, NGO, private sector) high level plan outlining how a particular course of action will be carried out (strategy). • **Legal instrument:** law, defined as a Bill passed into law by highest elected body (Parliament, Congress or equivalent), or regulation, defined as a rule or norm adopted by government and backed up by some threat of consequences, usually negative ones in the form of penalties. • **Budget or investment**: an estimate of funds allocated for development (committed or disbursed). • **Curriculum**: planned means and materials with which students will interact for the purpose of achieving identified educational outcomes. This can be at any level of education and target group, ranging from university degree course to farmer-field school	CGIAR Policy indicators definitions (link)
Outcome stage	• **Level 1:** change in discourse and/or behavior among next users, which creates the context for improved action/ practice. This includes: (i) design/planning (initial conceptualization of policies, plans, strategies, services, products); (ii) discussions/negotiations (particularly in the ambit of the UNFCCC and other global processes); and (iii) global guidelines (guidelines of major donor/ fund strategies with global/continental impact) • **Level 2:** change in practice, typically of the end user or directly affecting the end user: This may refer to: (i) improving availability/ accessibility to information/services; (ii) improving adoption/use of info/service; or (iii) investment (committed or disbursed) • **Level 3:** observable outcome on the ground, linked with the final beneficiary (yields, livelihoods, resources)	Authors' classification, based on MARLO categories (Level 1, 2, 3)
Activity type	• **Evidence**: Generation of credible, scientific research • **Engagement**: Engaging partners in targeted and demand-driven research, use of participatory research approaches • **Outreach**: Capacity building, communications	(Dinesh et al. 2018)
Output type	• **Decision support tools, toolbox**: developed and curated by CCAFS and partners for helping to set priorities and targeting; indicators and metrics • **Data and analyses**: New evidence (data, databases, ex-ante and ex-post analyses) maintained on CCAFS and partner websites, including up-to-date downscaled climate information that builds on current data portals (e.g. ccafs-climate.org) • **Methodologies**: including interdisciplinary and participatory approaches • **Models and simulations**: climate, economic models of impacts on specific crop, fish and livestock species and quantification of uncertainties; simulations of CSA options under different climate-specific management options • **Partnerships, collaborations and business models**: including public, private and PP collaborations and business models, new collaborations on projects • **Syntheses, profiles** of CSA options, of findings, etc. • **Technical and policy guidance and recommendations**: manuals and frameworks for implementing and scaling initiatives • **Tested CSA options**: including climate-adapted germplasm, climate-smart villages • **Training materials and trainings**: developed and archived in the public domain, to strengthen the capacity of partners in applying decision tools in targeting, policy, and investment decision-making.	Informed by CCAFS Phase II Full Proposal (CCAFS 2016)
Direct beneficiary type	• **Policymaker**: national, subnational government/ governmental agency • **National development agency/ organization**: non-governmental organization (NGO,) civil society • **International development partner:** bilateral, multilateral partner, financial institution, international NGO	(Szilagyi et al. 2020)

	• **Service provider**: Public and private agri advisory (incl. extension agency), financial service provider (bank, insurance company), climate/ weather information provider (meteo agency), etc. • **Private sector**: Agribusinesses, multinational company • **Farmer**: individual farmers, farmer organization • **Multi-stakeholder platform**	
Contributing partner type	• Academia and research • Bilateral and donor governments • Community-based organizations (CBOs) and farmers' groups • Development organizations • Foundations and financial institutions • Government • National Agriculture Research and Extension System (NARES) / National Agriculture Research System (NARS) • Private sector • CGIAR • Other	(CGIAR 2021)
Innovation typology	• **Biophysical research**: includes the study of biological systems and may include computational biology, decision support tools, and geospatial analysis. • **Genetic (varieties and breeds)**: include new and adapted varieties, cultivars, lines, and breeds. Also includes more upstream genetic work like identifying genes. • **Production systems and management practices**: examples include integrated pest management, sustainable intensification, livestock management, post-harvest technologies or management practices for feed or food, natural resource management, vaccines and animal health services, etc. • **Research & communication methodologies and tools:** new or improved research and communication tools including Information Communication Technology (ICT) such as catalogues and databases to disseminate scientific information and research findings to the public and private sectors. They may also refer to apps or platforms that can be applied in novel or different ways or generate new types of information. • **Social science**: includes policy, economic, and behavioral research; research or creation of new/improved tools for market access, including financial and insurance products; nutrition research; methods, decision-support tools and models to design/improve programs and projects or to develop value chains, land use planning approaches, etc; • Other	(CGIAR 2021)

Review and substantiation

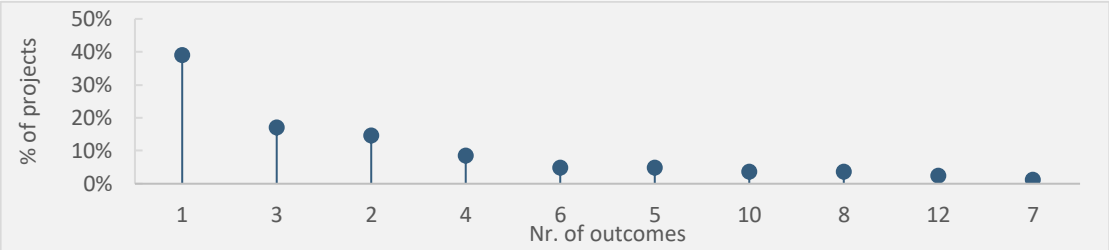
The study also draws on the knowledge and reflections of CCAFS staff who reviewed the findings of the analysis and helped to enrich the insights, by substantiating the outcome claims reported by project/programme leaders and the impact pathways carved out in this study. The study benefited from input and critical review from the Performance, Innovation and Strategic Analysis for Impact (PISA4) Program Unit of the CGIAR and CCAFS scientists during the CCAFS Science Meeting (Barcelona, 14-18 November 2021).

Results and discussion

The synthesis identified 300 outcomes linked with 82 projects. Forty-five outcomes could not be mapped against a project, as some of the reports—specifically the ones submitted in the early stages of CCAFS, between 2011 and 2014— did not provide a project number in the

description. Thirty nine percent (39%) of the projects report one outcome, 40% report between two and four outcomes and 21% report 5 or more outcomes (Figure 2). Five projects, P57, P66, 262, 264, and 267, report ten or more outcomes each over the period studied. They focused on mainstreaming climate-smart agriculture practices among smallholder farmers in WA and LA (P57), on global policy support for biologically diverse, climate-resilient agriculture (P66), on local to national/regional synthesis, research and engagement across LA (262, regional program) and SEA (P264, regional program), and on engagement, synthesis and support for low-emissions development (P267, flagship program). Most of the outcomes reported (179 of 300) were realized between 2017 and 2020, which corresponds to CCAFS Phase II.

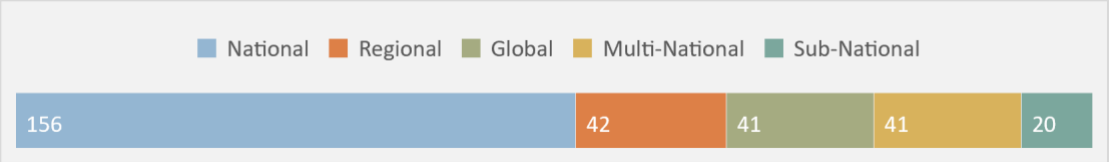
Figure 2. Projects reporting one or more outcomes



CCAFS work has focused on five regions – Latin America, West Africa, East Africa, South Asia, and Southeast Asia, aligning its geographical focus with the CGIAR SRF. Most outcomes included in this study were developed at national level (52%) (Figure 3). Most regional outcomes focus on Eastern Africa and Sub-Saharan Africa, which might be also explained by the priority in investment allocated to the African continent (42% of the investments compared to 39% in Asia and 19% in LA) (CCAFS 2016). The bulk of CCAFS work has been carried out in 21 countries and the outcomes reported by project staff follow these geographical priorities[3]. Countries with highest number of outcomes reported (>10) include Colombia (19 outcomes), Guatemala (16), Honduras (15), Nicaragua (14), Uganda (10), Kenya (9), Bangladesh (8). Eighty-one percent (81%) of the subnational, national and multi-national level outcomes focus on one country, seven percent (7%) on two countries simultaneously, and 12% on three or more countries.

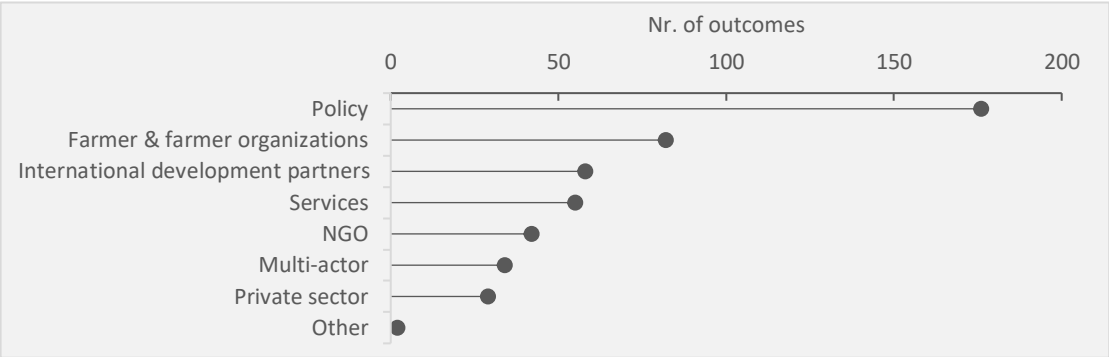
[3] Colombia, El Salvador, Guatemala, Nicaragua, Honduras, Mali, Senegal, Burkina Faso, Ghana, Niger, Rwanda, Ethiopia, Kenya, Uganda, Tanzania, India, Bangladesh, Nepal, Laos, Vietnam and Cambodia.

Figure 3. Number of outcomes by geographic scope



Of all immediate beneficiary (or next user) groups identified, policy actors (national and subnational governments) showed up most frequently in the database (Figure 4). They are followed by farmer and farmer organizations, international development partners, service providers (private, public), NGOs, multi-stakeholder platforms, and private sector actors. Outcomes typically target one specific beneficiary group (in 56% of the cases); combinations of two beneficiary groups are common across 30% of the cases (policy-services; policy-development partners; policy-NGOs; services-farmers), while three or more stakeholder groups are targeted in 13% of the cases, suggesting the multi-scale nature of projects.

Figure 4. Number of outcomes linked with an immediate beneficiary group

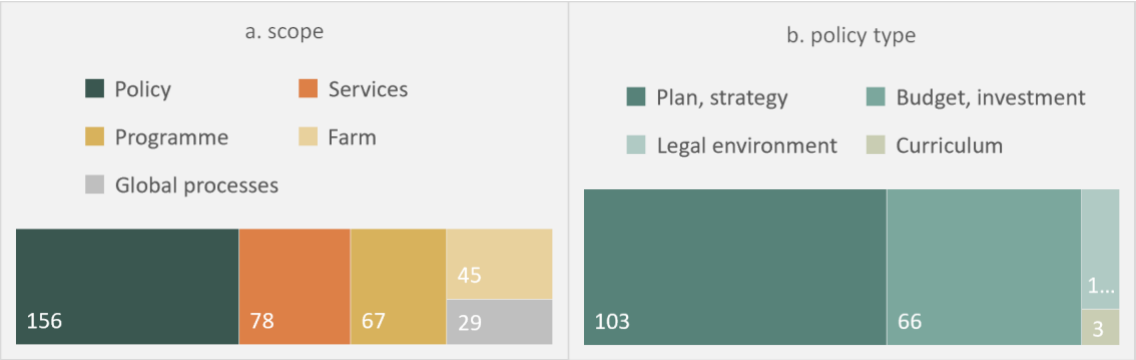


Typologies of outcomes

Most outcomes reported were related to development of / changes / improvements in policy, mentioned in relation to more than half (176) of the outcomes studied (Figure 5a). Outcomes related to improved climate, information and financial services are reported 26% of the times, improved programming is covered by 22% of the outcome cases. Outcomes related to farm-level changes (in livelihoods, in agri-environmental conditions) and global/ regional policy processes (i.e., UNFCCC negotiations, regional processes under the Southern Africa Development Community (SADC), the Asian pacific Economic Community (APEC), the Organization for Economic Co-operation and Development (OECD)), are reported 15% and 10% of the times, respectively. Almost a quarter of the reports (24%) cover two outcomes simultaneously, typically combining policy + programme (e.g., analyses and models to inform prioritization, design and operationalization of investments with policy actors, private sector and development partners) and policy + services outcomes (e.g., strengthening delivery of

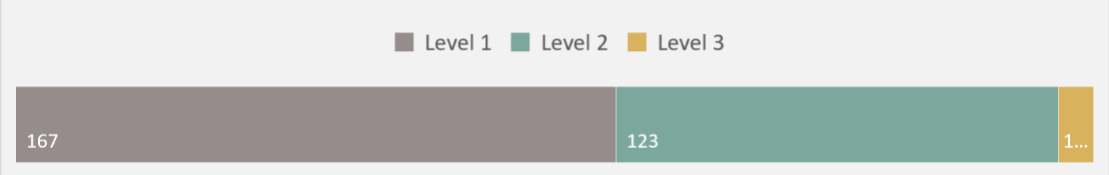
climate information and agro-advisory, improvement of early-warning systems, use of downscaled climate information for national policy planning / enhancement, etc.).
Most policy outcomes refer to the development and implementation of national and subnational agriculture and climate change plans and strategies (103 outcomes, representing 66% of all outcomes), followed by commitment and disbursement of budgets and investments for work related to agriculture and climate change (66 outcomes, representing 42%) (Figure 5b). Some fewer outcomes refer to the establishment of legal environments (i.e., laws and regulations) for implementation of climate change and food security-related policies, as well as to the design and implementation of curricula on climate-smart agriculture, targeted at extension services, higher education institutions, and technical vocational schools.

Figure 5 Outcomes by a) scope and b) policy type



More than half of the outcomes reported (167, representing 56% of all outcomes) are at level 1 in their maturity, primarily focusing on design and planning of policies, strategies, or investments (Figure 6). Forty-one percent (41%) of the outcomes are at level 2, focusing on committed/ disbursed investments, improved availability, accessibility, and adoption of services (e.g., climate information), inputs (e.g., improved varieties), and farm technologies and practices. Ten outcomes (3%) report changes at scale (level 3). This suggest that most outcome-oriented work at CCAFS has been primarily focused on generating evidence and engagements for changing knowledge of next users (i.e., use of research in design and planning phases and negotiations) and practices of end-users (i.e., improving availability, access and use of services). Fewer outcomes present evidence of impact at scale.

Figure 6 Number of outcomes by maturity level



Fifteen (15) outcomes in the database were reported in two or three consecutive years, indicating continuity and expansion of the work (Table 2). They largely mark progression to a next level of maturity (typically from level 1 to level 2, from policy / initiative design to actual investment), a diversification of outcome types (i.e., from policy to farm, from policy-plan to investment, from services to farm, etc.), or of partnership. Other outcomes changed the geographic scale (from global to regional, national to multinational) or expanded to new regions (e.g., gender and social inclusion work being taken up in UNFCCC submissions of the African Group of Negotiators in Eastern, Northern and Sub-Saharan Africa). Expansion to new countries was also detected, such as the case of CIAT-CCAFS-led research on agroclimatic predictions informing technical agroclimatic committees in Colombia and then in Guatemala, Honduras, and Nicaragua in the next year. One outcome reported in relation to uptake of research on nutrient management by fertilizer companies included new innovations in the second year (see Annex).

However, these results must be interpreted cautiously, as they may not tell the full story of how CCAFS outcome-oriented work has evolved in specific contexts (projects, geographies, etc.). Because outcome tagging by ID number in CCAFS reports and case studies has been inconsistent throughout the years[4], this database might not fully capture relationships between outcomes and nuances about their evolution. For that matter, Table 2 is aimed to offer examples—yet not a complete overview—of how outcomes have changed throughout the years and the different manifestations of these changes. For potential future analyses, a more accurate approach to assessing outcome evolution might be organizing the analysis around key themes, such as climate-smart villages, climate services and advisory, scenarios work, etc. This would allow capturing a wider spectrum of changes tied to similar activities implemented by different teams and across different contexts.

Table 2 Changes in outcomes reported across two or three years

[4] For example, OICRs from 2017-2021 were allocated specific identification numbers in MARLO, to allow consistent tracking over the years; case studies from 2015 and 2016 used a different numbering convention. Outcomes between 2011 and 2014 did not have any identification number in the reports we analyzed.

Out-come ID	Outcome theme	Years	Maturity level	Outcome type	Partner type	Geographic scope
2122	CSA Plan and Policy (Kenya)	2017, 2018, 2020	Yes	Yes	No	No
2026	Appropriate Nutrient Management with drones (Mexico)	2017, 2018	No	No	No	No
2042	Gender Action Plan (UNFCC)	2017, 2019	No	No	Yes	Yes
2131	Community seed banks approach (LAO)	2017, 2018	No	No	No	No
2144	Climate information services & advisory (Rwanda)	2017, 2018	No	Yes	Yes	No
2159	Investment prioritization (AfDB)	2017, 2018	Yes	Yes	No	Yes
2161	Climate information services & advisory (Ghana)	2017, 2018	No	No	No	No
2162	Investment prioritization (Private sector)	2017, 2018	No	No	No	No
2627	Climate information services & advisory (multiple)	2018, 2020	No	No	No	No
2628	Green Growth Policy (Colombia)	2018, 2020	Yes	Yes	Yes	No
3139	Integrated nutrient management approach (India)	2018, 2020	No	No	No	No
3162	Investment prioritization (ERA	2019, 2020	No	Yes	Yes	No
3135, 3838	Measurement, Reporting and Verification (Colombia)	2019, 2020	Yes	Yes	No	No
2007, 591	Sustainable livestock policy (Colombia)	2017, 2018	Yes	Yes	No	No
77, 121	Climate information services & advisory (Colombia and LAC	2016, 2018	No	Yes	No	Yes
2154, 581	Investment prioritization (World Bank)	2017, 2018	Yes	Yes	No	No

Note: Yes = presence of a type of change in an outcome from one year to another

Innovations were mentioned 239 times across all 300 outcome studies. Many innovations link to multiple outcome cases and are reported over multiple years, suggesting their continuity and relevance for achieving multiple outcomes. Some of the most mentioned innovations include: the climate-smart villages (CSV) approach implemented across all continents where CCAFS has been present (reported in more than 20 outcome studies), scenarios methods used across over 20 countries (including participatory scenario planning), resilient seed system in East and Southern Africa (including community seed banks), the Participatory Integrated Climate Services for Agriculture (PICSA) methodology reported across countries in Sub-Saharan Africa, Latin America, and Asia, or the Climate Smart Agriculture Country Profiles and Risk Profiles. Given the absence of a standard, consistently used method to tag and name innovations over the years, it was difficult to draw precise conclusions on the continuity and evolution of these innovations over time (some innovations used different IDs or names in different years, despite being the same output but implemented in a new project or geography, other innovations lacked an ID, particularly during CCAFS Phase I).

Half of all innovations identified (51%) refer to research and communications methodologies and tools, including the CSV approach, PICSA, the Evidence for Resilient Agriculture (ERA) database of farm management practices in Africa, the RUMINANT model for estimating etheric emissions, etc. Slightly less than a quarter (23%) refer to production systems and management practices (e.g., alternative wetting and drying technology for rice in Bangladesh, Vietnam and Burkina Faso, solar pump irrigators in India, analyses of low-emissions technologies and implementation models for the dairy sector in Kenya, etc.), and 21% refer to social sciences approaches and tools (e.g., weather index insurance in India, participatory scenario planning across multiple countries in Africa, Latin America and Asia, Local Technical Agroclimatic committees in Latin America, etc.). A minority of the CCAFS innovations refers to biophysical research (4%, including downscaled climate information in Senegal, next gen seasonal forecast systems in Guatemala, Honduras, NDVI crop algorithms to formulate nitrogen use recommendations for farmers in Mexico, biophysical models to estimate food insecurity in The Philippines, etc.) or genetic varieties and breeds (representing 1% of the innovations and including improved rice varieties for irrigated rice systems in Colombia). These finding prove the distinctive approach to science promoted by CCAFS, which has been focused primary on systems thinking, including participatory, user-oriented science and tools, rather than on more traditional, linear, reductionist and technology-led approaches such as breeding or biophysical research.

Contributions to CGIAR targets and SDGs

Contributions to SRF targets and sub-IDOs

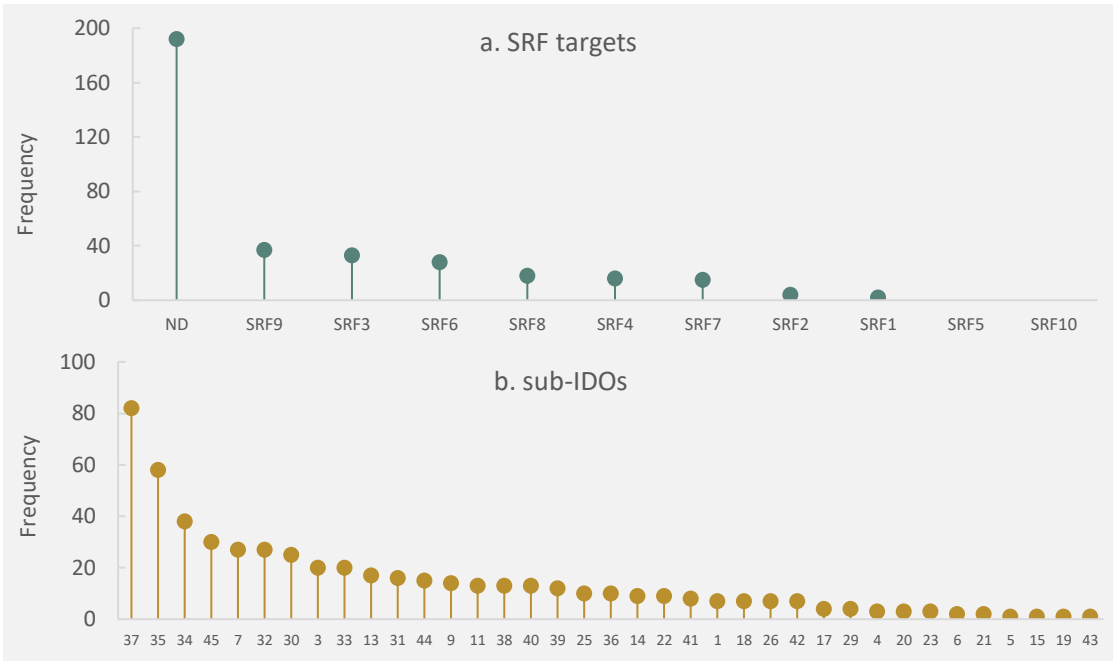
The CGIAR SRF frames the context and structure of CCAFS Phase II, when the programmatic approach shifted towards a results-based management framework focused on outcome delivery and monitoring progress of outcome contribution to higher-level goals and impacts. Three SRF targets have had highest coverage by the outcomes reported (Figure 7a). These refer to: reduced agricultural greenhouse gas emissions (SRF target 9), adoption of improved varieties and breeds by farmers (SRF 3), and support for people to exit poverty (SRF 6). Some outcomes also targeted increase in water and nutrient use efficiency in agro-ecosystems (SRF 8), support to ensure people meet minimum dietary energy requirements (SRF 4), and improved rate of yield increase for major food staples (SRF 7). Deforestation (SRF 2) and land restoration (SRF 1) targets were reported only a few times (4 and 2, respectively).

Targets related to nutrition, such as reduced micronutrients deficiency (SRF 5) and consumption of adequate number of food groups by women of reproductive age (SRF 10), were not covered by any outcome reported. This is surprising, given that 28% of the CCAFS

Phase II budget was to be allocated to achieving the system level outcome (SLO) on food security and nutrition: "For the food and nutrition security SLO, CCAFS aims to have removed by 2022 nutritional deficiencies of one or more essential micronutrients in 6 million more people, of whom 50% are women" (CCAFS Phase II Proposal). However, it must be noted that reporting against SRF targets was included in CCAFS annual reporting starting with Phase II, which explains the high amount of missing data and likely underreporting of contribution to some of the mentioned targets.

In relation to sub-IDOs, most outcomes reported contribution to a conducive agricultural policy environment (sub-IDO #37), enhanced capacity to deal with climate risks and extremes (#35), enabled environment for climate resilience (#34), and reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use (#45) (Figure 7b). These findings match the policy-oriented nature of outcomes discussed previously (Figure 5). Sub-IDOs mentioned only once refer to: enhanced conservation of habitats and resources (#5), increased access to diverse nutrient-rich foods (#15), increased safe use of inputs (#19), and increased above- and below-ground biomass for carbon sequestration (#43).

Figure 7. Contribution of outcomes to SRF targets and sub-IDOs



When examining the priority sub-IDOs targeted by CCAFS in Phase 2, we observed no clear relations between increased allocation of funding and increased frequency of sub-IDOs in outcomes reported. In fact, CCAFS priority targets are mentioned in less than a half (37%) of all outcome reports (Table 3). The sub-IDOs most frequently mentioned in reports and explicitly targeted by CCAFS budgets relate to enhanced capacity to deal with climate risks

(through institutions and initiatives that support farm household management of risks) and enabled environment for climate resilience (through new investments by state, national, regional and global agencies, informed by CCAFS science and engagement); however, these were allocated a modest proportion of the budget (7% each). More significant budgetary allocations (11-19%) covered sub-IDOs related to improved forecasting of climate impacts, gender-equitable control of productive assets and resources, improved access to services, innovation capacity of partner organizations, and reduced production risks; these sub-IDOs were common among very few outcome reports (between 0.6 and 4.6% of the 300 reported considered in the analysis). Yet the fact that most of the outcome targets have been achieved by now—some even significantly overachieved (see Annex 4)—might suggest that outcomes could have been considerably underreported in CCAFS project documents or that sub-IDOs tagging has been biased by the subjective interpretation of these contributions. In addition, many of the frequently reported sub-IDOs are not reflected in the CCAFS priority targets. These include: sub-IDOs related to a conducive agricultural policy environment (#37), to reduced net greenhouse gas emissions from agriculture (#45), or enhanced adaptive capacity to climate risks (#7). This reveals the importance of periodically revisiting theories of change to ensure that actions and targets are aligned to emerging project needs.

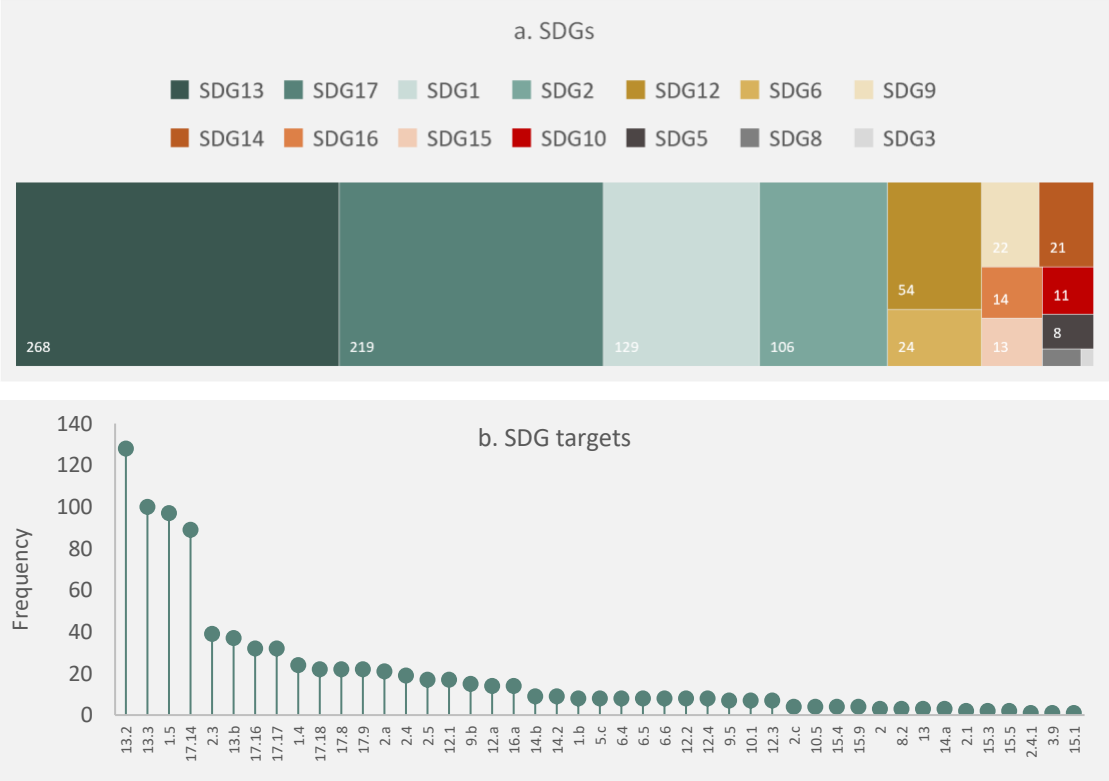
Table 3. Select sub-IDOs targeted by CCAFS: comparing budget proposed meet sub-IDO targets and sub-IDOs representation in CCAFS outcomes (n=300)

sub-IDO #	Sub-IDO	Percent CCAFS budget proposed for the sub-IDO (%)	Percent outcome reports with reported sub-IDO (%)
33	Improved forecasting of impacts of climate change and targeted technology development	19.0	3.7
36	Gender-equitable control of productive assets and resources	13.0	1.9
9	Improved access to financial and other services	13.0	2.6
23	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	11.0	0.6
30	Reduced production risk	11.0	4.6
34	Enabled environment for climate resilience	7.0	7.1
35	Enhanced capacity to deal with climatic risks and extremes	7.0	10.8
25	Reduced net greenhouse gas emissions from agriculture, forests and other forms of land use	7.0	1.9
24	Optimized consumption of diverse nutrient-rich foods	5.0	0.0
22	More efficient use of inputs	3.0	1.7
41	Improved capacity of women and young people to participate in decision-making	2.0	1.5
21	Land, water and forest degradation minimized and reversed	2.0	0.4
		100.0	36.8

Contribution to SDGs

Overall, outcomes contributed to 14 SDGs and 45 SDG targets (Figure 8). As expected, most reported contributions refer to SDG 13 (action to combat climate change), followed by SDG 17 (strengthen means of implementation and sustainable development finance), SDG 1 (end poverty) and SDG2 (end hunger and achieve food and nutrition security). SDGs 5, 14 and 15 were also mentioned as key focus SDGs in the CCAFS Phase II Proposal (CCAFS 2016), but they were linked with fewer outcome reports, as this analysis shows. Four SDG targets have been reported by more than 30% of the outcomes, namely: strengthening climate resilience and adaptive capacity to climate-related hazards and natural disasters (SDG 13.1), improved education, awareness-raising and human and institutional capacity on climate change adaptation and mitigation (13.3), building resilience of resource-poor people and reducing their exposure and vulnerability to shocks and disasters (1.15), and support for developing countries for attaining long-term sustainability through coordinated policy (17.4).

Figure 8. Contribution of outcomes to a) SDGs and b) SDG targets, based on reported sub-IDOs



Impact pathways

The different typologies of outcomes and ancillary elements discussed in the previous sections allowed distilling two major impact pathways representative of CCAFS outcome-oriented work: (i) policy and investment (Figure 9) and (ii) farm and services (Figure 11).

These impact pathways were drawn based on a qualitative analysis of 300 outcomes in the database and aim to synthesize the types of activities and outputs that have led to broadly defined outcomes and to illustrate relationships between these elements. The outcomes are relevant to each of the pathways presented and cover different maturity levels (from level 1 to level 3), to allow for a nuanced understanding of the conditions under which different types of policy / farm-level outcomes occur. For each impact pathway, we also provide information on innovations and partners, to highlight examples of key types of innovative tools/approaches and partnerships that have helped achieve the outcomes highlighted. We distinguish between "one-time" innovations (white clouds) and innovations mentioned in relation to two or more outcomes ("grey clouds"), to illustrate examples of innovative work that have helped achieve multiple benefits (outcomes) over time. For the partnership type, we look at top three most mentioned partners in relation to the identified outcomes.

The impact pathway mapping helped us identify outputs, outcomes, and relationships among theory of change elements that have not been initially contemplated in the theory of change of CCAFS Phase II. More specifically, we looked at theory of change hypotheses (H) linked with each flagship program (FP) (Annex 3) and compared it against the impact pathways derived from this outcome harvest. Outputs, outcomes, and relationships that were not reflected in the formulation of the FP hypotheses were illustrated with dotted boxes (for output and outcomes) or lines (for relationships) (see Figures 10 and 12). Results from this exercise helped us to identify elements that played in important role in the CCAFS outcome legacy, despite not being integrated in the initial program design.

Policy-investment pathway

We identified four major types of outcomes relative to policy and investment and aligned the three levels of maturity discussed previously, namely: (i) policy and plans are designed / developed and they support food and nutrition security and poverty reduction under climate change (maturity level 1), (ii) policy and plans are implemented and institutional changes are in place to support food, nutrition security and poverty reduction goals (level 2), (iii) new investments are committed and disbursed (level 2), and (iv) livelihoods and agri-environmental outcomes are visible at scale (level 3). Figure 9 illustrates these typologies in relation to clusters of outputs and activities, suggesting no single recipe for success. Not one type of outcome has been informed by a single type of output or activity, but by a combination of these (usually a mix of participatory, stakeholder-focused activities / outputs and science-led approaches). Outputs range from climate analyses and models to user-centered decision-support tools, reports and syntheses laying out recommendations for priority setting, capacity building and awareness raising, science-policy dialogues and learning alliances, participation in high-level events, as well as metrics for monitoring and evaluation. Activities have been clustered around evidence generation (climate risks and

vulnerability assessments, institutional analyses, evaluation of context-specific options), engagement (participatory identification and testing of options and priorities, long-term engagement with partners), and outreach (knowledge dissemination in workshops and technical support and training).

The impact pathways mapping also reveals a high concentration of innovations around Outcome 1, suggesting that most of the innovative outcome-oriented work at CCAFS has helped to inform the design / development of policies and plans. This is not surprising, given that most of the outcomes in the database are at level 1 of maturity (which match outcome 1 in the policy-investment pathway). Several of the innovations identified have helped to achieve various types of policy outcomes (suggested by grey-colored clouds). These include, among others: suitability and exposure maps (informing outcomes 1 and 3), climate-smart (CS) maps (outcomes 2 and 4), CSA Profiles (outcomes 1 and 2), CSA Investment Plans (CSAIP) (outcomes 1 and 3), Climate-Smart Villages (CSV) approach (outcomes 1, 2, and 3), RUMINANT model (outcomes 1 and 2), etc. Moreover, three types of partners have been most frequently reported (almost) consistently across all policy outcomes: government, academia and research, and development organizations. Other partners were also mentioned sporadically across the outcomes.

The CCAFS Phase II theory of change (ToC) contains three hypotheses relevant for the policy-investment pathway (Figure 10). They relate to (i) improved targeting and implementation of policies and programs at various scales (FP1- H1), (ii) scaling of CSA (FP1 – H2) and (iii) implementation of low emissions development (LED) policies and programs at large scales (FP3 – H2). We identify a fourth outcome derived from CSA adoption / scaling, namely the achievement of livelihoods and agri-environmental benefits at scale. In addition, the impact pathway mapping and comparison to CCAFS ToC also allowed us to distil more granular information regarding the types of outputs that have contributed to achieving flagship outcomes. These include a focus on recommendations on priorities and options, user-centered DST, science-policy dialogue platforms and capacity-building and awareness raising, which complement the broadly0defined approaches initially envisioned in the ToC (e.g., projections and scenarios methods, priority setting tools, evidence, capacity and incentives for LED, etc.).

Services and farm pathway

Five major types of outcomes stood out in relation to the services and farm pathway: (i) improved capacity of partners to deliver information / services / inputs to farmers (level 1 of maturity); (ii) improved availability and access to information / services / inputs (level 1); (iii) increased use of information / services / practices (level 2); (iv) improved livelihoods and

agri-environmental conditions on the farm; and (v) improved livelihoods and agri-environmental conditions at scale (level 3). Figure 11 illustrates these typologies in relation to clusters of outputs and activities, suggesting no single recipe for success. Similar to the policy and investment impact pathway, service and farm-level outcomes have been informed by a combination of science-informed and user-driven outputs and activities. Activities include advance climate, crop, statistical modeling techniques and data, participatory research to understand context and/or to select, text and evaluate options, technical back-stopping, capacity building, gender-focused trainings on production and marketing, and establishment of novel knowledge dissemination channels. Major types of outputs refer to beneficiaries of capacity building, decision-support tools and data delivered in accessible formats, farm management options tested and evaluated with local communities, services developed (insurances, financial mechanisms, climate, and agro-advisories, etc.), partnerships and alliances established, among others.

Many of the innovations developed to support these outcomes refer to climate and agro-advisory methodologies and tools (PICSA, LTACs, digital advisory platforms), testing and scaling of farm-management options (particularly through CSVs), and decision-support tools for prioritizing farm-level interventions (e.g., climate risk profiles, climate smart maps, etc.) or for formulating site-specific recommendations (e.g., GreenSeeker, MeghDoot app, etc.). While most innovations support outcomes that reached level 1 of maturity at the time of reporting, there are indications of innovative outputs developed to deliver livelihoods and agri-environmental changes at farm and at scale (Figure 11). In addition, the types of partnerships that have been most frequently reported in relation to these typologies of outcomes are similar to those for the policy and investment impact pathway, namely: government, academia and research, and development organizations.

The CCAFS Phase II ToC contains six hypotheses relevant for the services-farm pathway (Figure 12). They relate to: (i) Context-specific knowledge on CSA practices and outcomes leads to local-level adoption of CSA (FP2- H1), (ii) Knowledge on adoption barriers and strategies to overcome them led to adoption of CSA at scale (FP2 – H2); (iii) Low emissions development (LED) practices significantly reduce GHG emissions while ensuring rural food security and improved livelihood options (FP3-H1); (iv) Improved evidence, capacity, incentives for LED will support implementation of LED policies and programs at scale (FP3-H2); (v) Effective use of climate enables more climate-smart agricultural systems and climate-resilient farmer livelihoods (FP3 – H1); and (vi) Increasing availability of climate information will lead to more effective use of climate information by farmers (FP4-H2).

While we did not identify gaps in the outcomes originally envisioned in the ToC, we mapped additional outputs (Figure 12, dotted boxes) and relationships (dotted arrows) between ToC elements that have been achieved through CCAFS research, engagement, and outreach activities. These suggest the multifunctional nature of activities and outputs and their ability to unlock multiple types of outcomes. In addition, we observed no proven direct linkages between practices and on-farm (mitigation and livelihoods) outcomes (see FP3, H1) based on the reports we reviewed, but rather identified a "missing middle" from the initial ToC, which refers to the knowledge and ability to use the information on improved practices and technologies that allows the change in behavior / action, which in turn unlocks higher-level outcomes related to mitigation, resilience and livelihoods. In a broader sense, results from this exercise reaffirm the importance of periodically and critically reviewing theories of change and assumptions, as a key strategy for adaptive management and learning, which allows to effectively respond and align to emerging needs and changes in context and to maximize impact.

Figure 9. Types of policy- and investment-related activities, outputs, outcomes, innovations, and partnerships drawn from 300 outcome reports

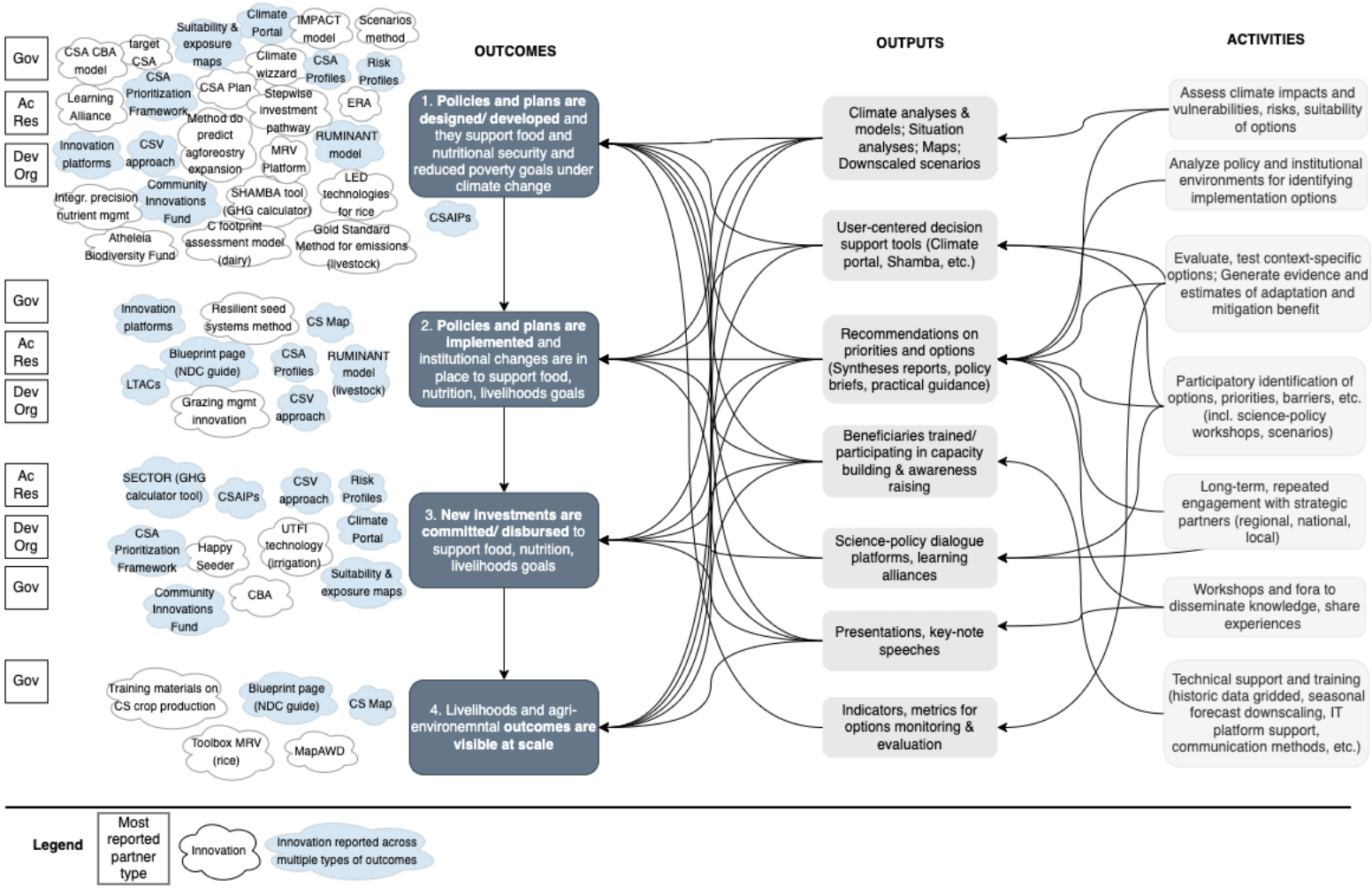
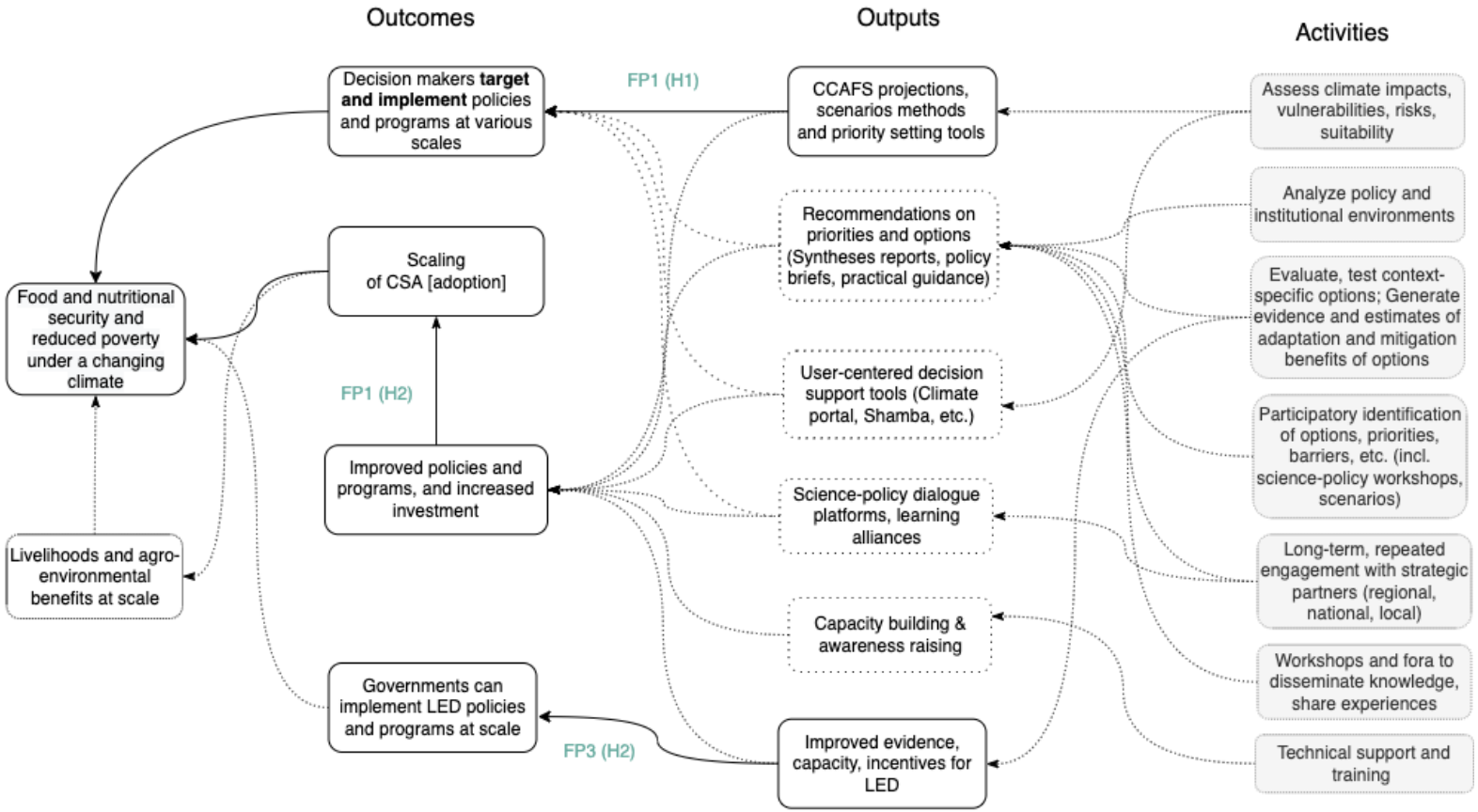


Figure 10. Revisiting the CCAFS theory of change relevant to policy and investments



Flagship (FP) and theory of change hypothesis (H)

Dotted boxes and lines represent outputs/outcomes and relationships that were not captured by CCAFS Theory of change Phase II
Activity boxes are drawn exclusively from the outcome harvest.

Figure 11. Types of service- and farm-related activities, outputs, outcomes, innovations and partnerships drawn from 300 outcome reports

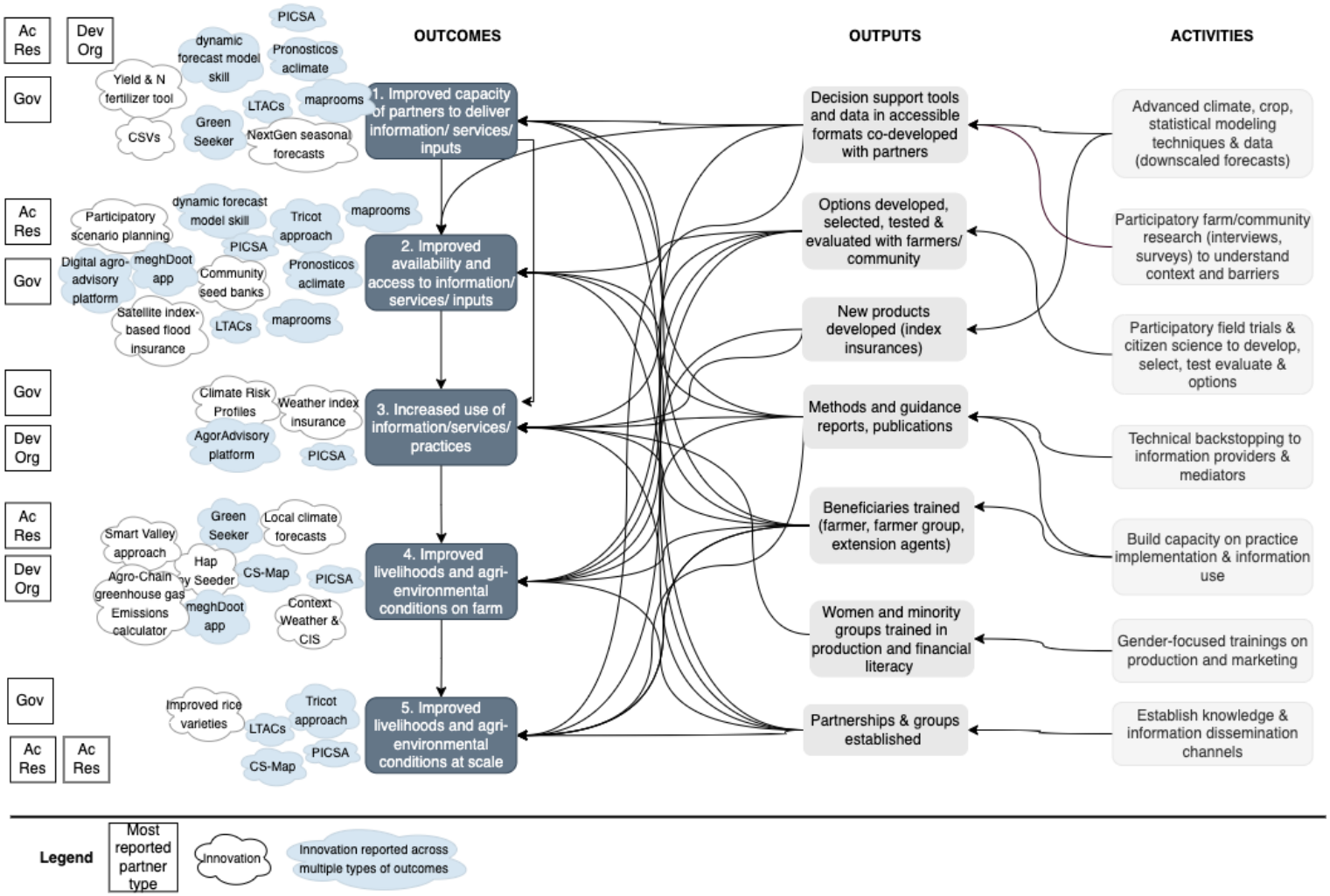
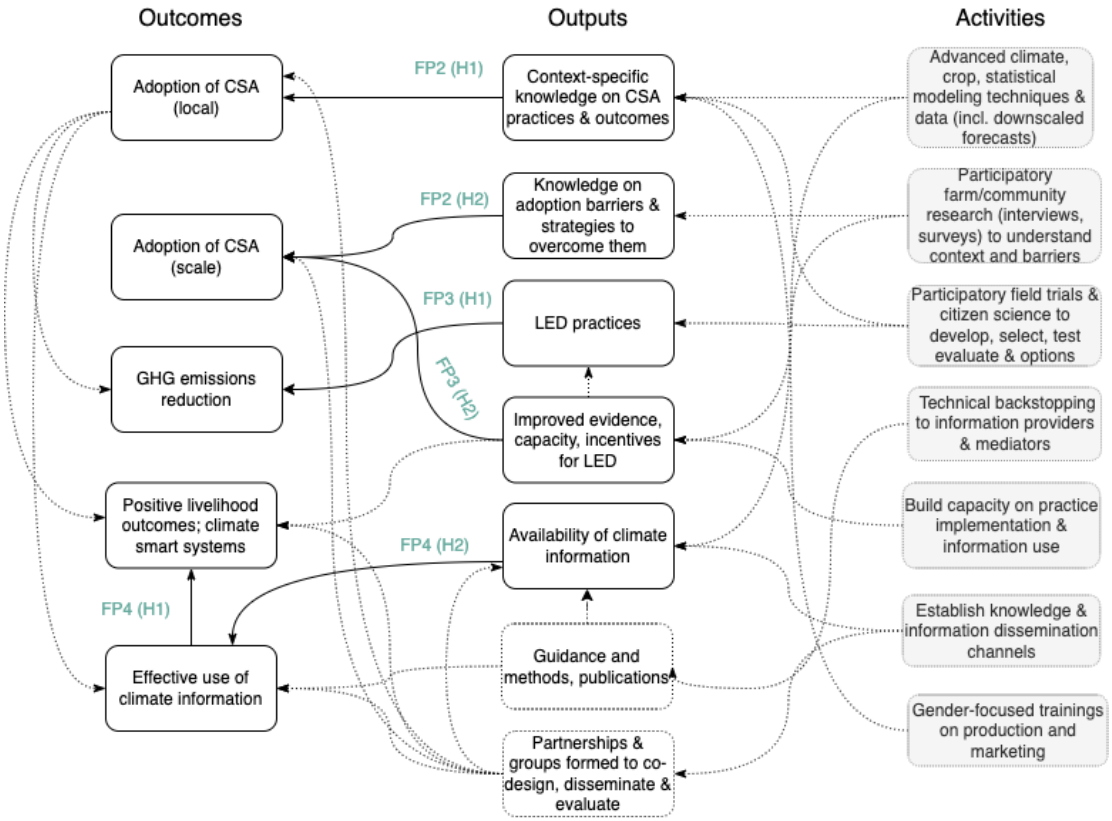


Figure 12. Revisiting the CCAFS theory of change relevant to services and farm-level changes



Flagship (FP) and theory of change hypothesis (H)

Dotted boxes and lines represent outputs/outcomes and relationships that were not captured by CCAFS Theory of change Phase II
Activity boxes are drawn exclusively from the outcome harvest.

Conclusion

CCAFS has focused well beyond delivery of outputs. The amount and diversity of outcomes achieved over the years—particularly in CCAFS Phase II—is illustrative of an outcome-delivery focus. Indeed, the "knowledge-to-action-to-outcomes" approach has been a distinctive feature of CCAFS research over the years. The major wins of the three-thirds approach followed by CCAFS researchers—which postulates that research efforts should be allocated in thirds: creating credible evidence, engaging partners and designing effective outreach strategies (Dinesh et al. 2018; Thornton et al. 2017)— are visible in the hundreds of outcomes enabled over the years, at different scales. From facilitating the design user-tailored analyses and tools to understand contexts or to prioritize options, to strengthening services that enable farm investments (agro-climatic, financial) or participatory farm trials and analyze, the legacy of activities and outputs developed have earned the trust of hundreds of partners and donors, increased the legitimacy and credibility of the institution, its researchers and *modus operandi*, and most importantly, have helped create significant change at the top and lower levels of decision -making.

We argue that, to achieve transformation across all nodes of the food systems and within the different relationships between the players of the system (from farmers to consumers, from policy makers to private sector actors, etc.), a variety of outcomes will be needed. This diversity is important not only in relation to the types of outcomes targeted (e.g., policy, investment, services, farm, etc.) but also with regards to the level of maturity reached by those outcomes. While changes in behavior achieved at scale (level 3) are desirable and critical for the transformation, design of new plans, policies, changes in attitudes and knowledge, or livelihood improvements in pilot contexts are important in their own way, as they provide the foundations, the experiences, and learnings necessary for bringing change to the next level. This approach has been actively used by CCAFS over the years and has helped to provide a healthy balance between resource-intensive M&E (required by level 3 outcomes, which are heavily information- and time-intensive) and more strategic, low-hanging outcome opportunities, which are highly valuable in sourcing additional funds and providing the necessary groundwork for scaling.

To unlock this richness of outcomes, an increased allocation of research funds will be required to conduct impact studies that will allow assessing the maturity of outcomes more accurately (i.e., with improved, robust evidence). In addition, new and more varied partnerships will need to be considered (e.g., private sector, civil society, consumer groups,

etc.), while conserving the more traditional ones that have proven fundamental for delivering, disseminating, and using research for achieving outcomes on the ground (i.e., policy actors, research, and development organizations at large). Throughout the years, CCAFS has proven creative, strategic, and opportunistic when it comes to the stakeholders engaged in the research development and dissemination process, forging partnerships and alliances that not only helped to co-design the research agenda and to increase its visibility, but also facilitated its use in concrete actions (in policies, programs, investments, and on-farm actions). In order to harness the potential of research in food system transformation, scientist will need to push the boundaries even further, to cast a wider web of partnerships, even when those are not soft or easy options.

Significant investment in strengthening monitoring, evaluation, reporting and learning capacity will be needed to further realize the potential for outcome-oriented research. While reviewing the outcome reports we noticed that the quality of the write-ups was highly variable, that the evidence provided was insufficient to prove the outcome claim, and that predefined typologies (e.g., of outcomes, of partners, of innovations, etc.) were not used consistently across projects and years. This has put various limitations on the analysis, particularly in relation to mapping the evolution of outcomes and innovations over time and to distilling learnings from these evolutions. In addition, many valuable outcome stories may have been missed from this harvest, given the poor quality of the write-ups. While CCAFS has made major efforts to improve outcome reporting in its second phase, through its online reporting platform, MARLO, opportunity for improvements remain, particularly when it comes to the use of consistent tagging and more synthetic and structured methods to collect information on activities and results. In addition, building human capacity to monitor and report outcomes and to periodically revise theories of change will be critical for the learning process. This may include increased allocation of staff time to M&E but also additional investment to achieve a harmonized understanding of M&E concepts, indicators, and methodologies to measure, monitor and evaluate results.

Appendix

Annex 1. List of documents consulted

Year	Data source (Document type)	Number of outcomes revised
2011	Annual reports (regional and thematic)	21
2012	Outcome reports (regional and thematic)	40
2013	Outcome reports (regional and thematic)	33
2014	Outcome reports (regional and thematic)	16
2015	Outcome case studies	64
2016	Outcome case studies	46
2017	Outcome impact case reports	62
2018	Outcome impact case reports	69
2019	Outcome impact case reports	47
2020	Outcome impact case reports	48

Annex 2. List of SRF targets, sub-IDOs and SDGs with targets

a) CGIAR SRF Targets

1	55 million hectares (ha) degraded land area restored
2	2.5 million ha of forest saved from deforestation
3	100 million more farm households have adopted improved varieties, breeds or trees, and/or improved management practices
4	30 million more people, of which 50% are women, meeting minimum dietary energy requirements
5	150 million more people, of which 50% are women, without deficiencies of one or more of the following essential micronutrients: iron, zinc, iodine, vitamin A, folate, and vitamin B12
6	30 million people, of which 50% are women, assisted to exit poverty
7	Improve the rate of yield increase for major food staples from current <1% to 1.2-1.5%/year
8	5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse
9	Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO2-e yr–1 (5%) compared with business-as-usual scenario in 2022
10	10% reduction in women of reproductive age who are consuming less than the adequate number of food groups

b) CCAFS Sub-IDOs

1	Agricultural systems diversified and intensified in ways that protect soils and water
2	Appropriate regulatory environment for food safety
3	Closed yield gaps through improved agronomic and animal husbandry practices
4	Diversified enterprise opportunities
5	Enhanced conservation of habitats and resources
6	Adoption of CGIAR materials with enhanced genetic gains
7	Enhanced adaptive capacity to climate risks (More sustainably managed agro-ecosystems)
8	Enrichment of plant and animal biodiversity for multiple goods and services
9	Improved access to financial and other services
10	Improved water quality
11	Increased household capacity to cope with shocks
12	Increased availability of diverse nutrient-rich foods
13	Increased conservation and use of genetic resources
14	Increased resilience of agro-ecosystems and communities, especially those including smallholders
15	Increased access to diverse nutrient-rich foods
16	Increased access to productive assets, including natural resources
17	Increased genetic diversity of agricultural and associated landscapes
18	Increased livelihood opportunities
19	Increased safe use of inputs
20	Increased value capture by producers
21	Land, water and forest degradation (Including deforestation) minimized and reversed
22	More efficient use of inputs

23	More productive and equitable management of natural resources
24	Optimized consumption of diverse nutrient-rich foods
25	Reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use (More sustainably managed agro-ecosystems)
26	Reduce pre- and post-harvest losses, including those caused by climate change
27	Reduced biological and chemical hazards in the food system
28	Reduced livestock and fish disease risks associated with intensification and climate change
29	Reduced market barriers
30	Reduced smallholders production risk
31	Increased capacity for innovations in partner research organizations
31	Increased capacity for innovations in partner research organizations
32	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities
33	Improved forecasting of impacts of climate change and targeted technology development
34	Enabled environment for climate resilience
35	Enhanced capacity to deal with climatic risks and extremes (Mitigation and adaptation achieved)
36	Gender-equitable control of productive assets and resources
37	Conducive agricultural policy environment
38	Conducive environment for managing shocks and vulnerability, as evidenced in rapid response mechanisms
39	Enhanced individual capacity in partner research organizations through training and exchange
40	Enhanced institutional capacity of partner research organizations
41	Improved capacity of women and young people to participate in decision-making
42	Increase capacity of beneficiaries to adopt research outputs
43	Increased above- and below-ground biomass for carbon sequestration
44	Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research
45	Reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use (Mitigation and adaptation achieved)
46	Technologies that reduce women`s labor and energy expenditure adopted

c) SDG targets

1.4 - By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance

1.5 - By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters

1.b - Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions

2.1 - By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round

2.3 - By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment

2.4 - By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

2.5 - By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant

banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed

2.a - Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries

2.c - Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility

3.9 - By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination

5.b - Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women

5.c - Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels

6.3 - By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.4 - By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 - By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 - By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

8.2 - Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors

8.5 - By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value

9.5 - Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending

9.b - Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities

10.1 - By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average

10.5 - Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations

12.1 - Implement the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries

12.2 - By 2030, achieve the sustainable management and efficient use of natural resources

12.3 - By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses

12.4 - By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

12.a - Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production

13.2 - Integrate climate change measures into national policies, strategies and planning

13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

13.b - Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

14.2 - By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

14.3 - Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

14.a - Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries

14.b - Provide access for small-scale artisanal fishers to marine resources and markets

15.1 - By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

15.3 - By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

15.4 - By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development

15.5 - Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

15.9 - By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts

16.a - Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime

17.14 - Enhance policy coherence for sustainable development

17.16 - Enhance the Global Partnership for Sustainable Development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the Sustainable Development Goals in all countries, in particular developing countries

17.17 - Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships

17.18 - By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts

17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology

17.9 - Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals, including through North-South, South-South and triangular cooperation

Annex 3. CCAFS Phase II: theory of change hypotheses by flagship program

FLAGSHIP (FP)	HYPOTHESIS (H)	
FP1: Priorities and Policies for CSA	1	CCAFS projections, scenarios methods and priority setting tools will help decision makers target and implement policies and programs at various scales that improve food and nutrition security and reduce poverty
	2	Improved policies and programs, and increased investments can facilitate the scaling of CSA, which will contribute to food and nutritional security and reduced poverty under a changing climate
FP2: Climate Smart Technologies and Practices	1	Context-specific knowledge on the impacts of practices, technologies, business models and information systems on CSA-related outcomes as well as on their cost-effectiveness advantages compared to current practice, leads to adoption of CSA at the local level
	2	Improving and applying knowledge on socio-economic, technical, financial and political barriers to incentives for investment in and adoption of CSA technologies and practices will lead to adoption of CSA at scale
FP3: Low Emissions Development	1	LED practices for agricultural landscapes and value chains significantly reduce GHG emissions while ensuring rural food security and improved livelihood options
	2	Improved evidence, incentives, technical capacity, social mobilization and other enabling conditions for LED will support farmers, governments, the private sector and donors to implement LED policies and programs at large scales
FP4: Climate services and safety nets	1	Effective use of relevant climate-related information by farming communities; and by the insurance providers, agricultural planners, food security safety net interventions that serve them; enables more climate-smart agricultural systems and climate-resilient farmer livelihoods
	2	Overcoming key gaps in available climate information, in knowledge and methods to effectively target and implement climate-informed services and interventions, and in the evidence of their benefits, leads to more effective use of climate information by farmers and by the institutions that serve them

Source: CCAFS Phase II Full proposal

Annex 4. Annotated table on changes in outcomes reported

	Outcome ID	Outcome theme	Year	Maturity level	Outcome type	Partner type	Geographic scope
1	2122	CSA Plan and Policy (Kenya)	2017	1	Policy-Plan	Gov + CGIAR	National
			2018	1	Policy-Plan	Gov + CGIAR	National
			2020	2	Farm	Gov + CGIAR	National
2	2026	Appropriate Nutrient Management with drones (Mexico)	2017	2	Services + Farm	No data	National
			2018	2	Services + Farm	Gov	National
3	2042	Gender Action Plan (UNFCC)	2017	1	Global/ Regional	Dev Org	Regional
			2019	1	Global/ Regional	Dev Org + other	Regional
4	2131	Community seed banks approach (LAO)	2017	1	Programming	Dev Org	National
			2018	1	Programming	Dev Org	National
5	2144	Climate information services & advisory (Rwanda)	2017	2	Services + Farm	Ac Res	National
			2018	2	Services	Ac Res + CGIAR	National
6	2159	Investment prioritization (AfDB)	2017	1	Programming	Dev Org + FI + Other	Global
			2018	2	Policy-Inv	Dev Org + FI + Other	Regional
7	2161	Climate information services & advisory (Ghana)	2017	1	Policy-Curr+ Services	Dev Org + CGIAR	National
			2018	1	Policy-Curr+ Services	Dev Org + CGIAR	National
8	2162	Investment prioritization (Private sector)	2017	1	Programming	Dev Org + CGIAR	Global
			2018	1	Programming	Dev Org + CGIAR	Global
9	2627	Climate information services & advisory (multiple)	2017	1	Programming + Services	No data	Regional
			2018	1	Programming + Services	No data	Multi-national
10	2628	Green Growth Policy (Colombia)	2018	1	Policy-Plan	Dev Org + Gov	National
			2020	2	Policy-Plan + Policy-Inv	Dev Org + Gov + Ac Res	National
11	3139	Integrated nutrient management approach (India)	2018	1	Policy-Plan	Ac Res	National
			2020	1	Policy-Plan	Ac Res	National
12	3162	Investment prioritization (ERA)	2019	1	Policy-Plan + Programming	FI + Gov + Other,	Regional
			2020	1	Policy-Plan	Gov + FI + Gov + Other	Regional
13	3135	Measurement, Reporting and Verification (Colombia)	2019	1	Policy-Plan	No data	National
	3838		2020	2	Policy-Plan + Programming	Private	National
14	2007	Sustainable livestock policy (Colombia)	2017	2	Policy-Plan	No data	National
	591		2018	1	Policy-Plan	Gov + multi-actor	National
15	77	Climate information services & advisory (Colombia and LAC)	2016	2	Services	Ac Res + CBO + Gov + Other	National
	121		2018	2	Services + Farm	Ac Res + CBO + Dev Org + Gov + Other	Multi-national
16	2154	Investment prioritization (World Bank)	2017	1	Programming	No data	Global
	581		2018	2	Policy-Inv + Programming	No data	Global

Note: Ac Res=Academia and Research; Dev Org=Development organization, CBO= Community-based organization; Gov=Government FI=Financial institution; Inv=Investment

Annex 5. Sub-IDOs targeted by CCAFS, budgets, targets and achievements

#	SUB-IDO	2022 OUTCOME DESCRIPTION	BUDGET PROPOSED USD M (%)	TARGET	ACHIEVED
34	Enabled environment for climate resilience	New investments by state, national, regional and global agencies, informed by CCAFS science and engagement	25 (7)	USD 600 M	USD 3400 M[1]
35	Enhanced capacity to deal with climatic risks and extremes	Institutions or major initiatives that use CCAFS research outputs for services that support farm households' management of climatic risks	25 (7)	40	ND[2]
36	Gender-equitable control of productive assets and resources	National/state organisations and institutions adapting their plans and directing investment to increase women's access to, and control over, productive assets and resources	12 (3)	20	17
		Development organisations, with the focus on investments for CSA activities, adapting their plans or directing investment to increase women's access to, and control over, productive assets and resources	36 (10)	35	39
9	Improved access to financial and other services	Sub-national public/private initiatives providing access to novel financial services and supporting innovative CSA business models	35 (9)	15	15
		Farm households with improved access to capital, with increased benefits for women (millions)	15 (4)	8 M	ND[3]
41	Improved capacity of women and young people to participate in decision-making	Organisations adapting their plans or directing investment to increase women's participation in decision-making about LED in agriculture	6 (2)	15	13
33	Improved forecasting of impacts of climate change and targeted technology development	Countries/states where CCAFS priority setting used to target and implement interventions to improve food and nutrition security under a changing climate	19 (5)	20	18
		Site-specific targeted CSA technologies/practices tested, with all options examined for their gender implications	52 (14)	50	57
23	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	Policy decisions taken (in part) based on engagement and information dissemination by CCAFS	41 (11)	51	65
21	Land, water and forest degradation minimized and reversed	Area targeted by research-informed initiatives for restoring degraded land or preventing deforestation	9 (2)	0.8 Mha	53.25 Mha
22	More efficient use of inputs	Agricultural development initiatives where CCAFS science is used to target and implement interventions to increase input efficiency	12 (3)	20	15
24	Optimized consumption of diverse nutrient-rich foods	Organisations and institutions in selected countries/states adapting plans and directing investment to optimise consumption of diverse nutrient-rich foods, with all plans and investments examined for their gender implications	17 (5)	14	2

25	Reduced net greenhouse gas emissions from agriculture, forests and other forms of land use	Low emissions plans developed that have significant mitigation potential for 2030, i.e. will contribute to at least 5% GHG emissions reduction or reach at least 10,000 farmers, with all plans examined for their gender implications	27 (7)	10	16
30	Reduced production risk	6 million farm households receiving incentives (training, financial, programmatic, policy-related) for adopting CSA related practices and technologies that potentially reduce production risks	43 (11)	6 M	19.7 M

Notes:

1. See Kristjanson P. 2020. CCAFS Investment-Oriented Outcome Pathways: Lessons and New Directions.

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2. ND = no data, though estimated to be >40.

3. ND = no data, though estimated to be approximately 8 million.

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