CoSAI
Commission on Sustainable Agriculture Intensification

Effective approaches and instruments for research and innovation for sustainable agri-food systems

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Contents

Acronyms

ABI	Agribusiness Incubation
ACIAR	Australian Centre for International Agricultural Research
AECF	African Enterprise Challenge Fund
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
BPD	Business Planning & Development
CCAFS	Climate Change, Agriculture and Food Security
CCRP	Collaborative Crop Research Programme
CENTEV	Centro Tecnológico de Desenvolvimento Regional de Viçosa
CFC	Common Fund for Commodities
CGP	Competitive grant program
CIAL	Comité de Investigación Agrícola Local (Local agricultural research committee)
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
CoSAI	Commission on Sustainable Agriculture Intensification
CRDF	Civilian Research and Development Foundation
CRG	Competitive research grant
CSV	Climate-smart village
CURAD	Consortium for enhancing university responsiveness to agribusiness development
ECF	Enterprise challenge fund
ENoLL	European Network of Living Labs
FAIR	Farmer Access to Innovation Resources
FaReNe	Farmer-led research networks for agroecological intensification in Burkina Faso and Mali
FAO	Food and Agriculture Organization
FARA	Forum for Agricultural Research in Africa
FCDO	Foreign, Commonwealth & Development Office
FFS	Farmer field school
FMD	Foot and mouth disease
FRG	Farmer research group
FRN	Farmer research network
FRS	Farmer research structure
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Development Agency)
GSMA	Groupe Speciale Mobile Association
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IAP	Innovation Against Poverty
ICIMOD	International Centre for Integrated Mountain Development
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and communication technology
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development

IFC	International Finance Corporation
IFSF	Innovation fund for smallholder farmers
IF&G	Innovation funds and grants
IIRR	International Institute for Rural Reconstruction
INIR	National Irrigation Institute (Mozambique)
KI	Key informant
KIC	Kosmos Innovation Centre
KIT	Royal Tropical Institute
LIL	Learning and Innovation Loans
LISF	Local innovation support fund
LL	Living lab
MALL	Metro Agri-Food Living Lab
MENA	Middle East and North Africa
MICF	Malawi Innovation Challenge Fund
M&E	Monitoring and evaluation
NAADS	National Agricultural Advisory Services (Uganda)
NAIP	National Agricultural Innovation Project
NGO	Non-governmental organization
NUCAFE	National Union of Coffee Agribusinesses and Farm Enterprises
OECD	Organisation for Economic Co-operation and Development
PAEPARD	Platform for African European Partnership on Agricultural Research for Development
PELUM	Participatory Ecological Land Use Management
PFI-FFS	Promoting Farmer Innovation in Farmer Field Schools
PICG	Campos dos Goytacazes Innovation Hub
PV	Participatory video
RBC	Results-based contract
R&D	Research and development
REFOOTURE	Food Futures Eastern Africa
SAI	Sustainable agricultural intensification
SBIR	Small Business Innovation Research
Sida	Swedish International Development Cooperation Agency
SME	Small to medium-sized enterprise
SMMP	Social Management and Monitoring Plans
SSPF	Small-scale Project Fund
SWOT	Strengths, weakness, opportunities and threats
UFV	Federal University of Viçosa
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UniBRAIN	Universities, Business and Research in Agricultural Innovation
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
US/USA	United States of America
USIU	United States International University-Africa
WEF	World Economic Forum
WUR	Wageningen University & Research

Executive summary

The traditional linear technology transfer model has limited effectiveness in promoting the uptake of technologies and innovations. It fails to account for complexity within the agri-food system, is too simplistic and does not fully consider forward and backward feedback loops in the food system or pay adequate attention to context. There is, therefore, an increasing interest in investors and decision-makers making use of alternative instruments (such as innovation platforms or accelerators) to support innovation processes. Furthermore, there is growing consensus for a paradigm shift in agriculture. The current focus is primarily on increasing productivity, with sustainability considered a secondary outcome, if anything. By contrast, sustainability is at the core of sustainable agricultural intensification (SAI).

The Commission on Sustainable Agriculture Intensification (CoSAI) was established to increase effective investment in innovation for SAI in the Global South, to support the United Nations Sustainable Development Goals and the climate goals of the Paris Agreement of 2015. CoSAI commissioned a study to investigate different investment instruments with the potential to support transformation of the sector. The objectives of this study were to summarize current evidence on how well different investment instruments to promote innovation have supported the multiple objectives of SAI, and to develop lessons and guidance based on this evidence to help innovators and investors choose the best funding instruments to support SAI innovation.

More specifically, the study was designed to answer the following three key questions: (1) What types of investment instruments have been tested to support innovation in agri-food systems in the Global South, and how can these be categorized into a working typology? (2) What is the evidence on how well different instruments have supported SAI's multiple objectives (e.g. social equality and environmental) at scale and what contextual and design factors affect their success or failure in achieving these objectives (e.g. type of value chain, who participates)? (3) What advice can be given to innovation investors and practitioners about the instruments selected for different objectives and contexts, and how can selected instruments be designed to achieve better impacts?

For this study, the focus was on instruments – defined as arrangements for financing or disbursing support to those engaged in research and/or innovation (i.e. research performers). The process of gathering data included a rapid, purposive review of gray and peer-reviewed literature. In addition, interviews were conducted with various key informants to draw on their experiences, obtain useful documents, and to identify additional websites, individuals and organizations to explore.

The 12 selected instruments were defined as follows: (1) Instruments that support entrepreneurship: incubators, accelerators, innovation hubs; (2) Instruments that finance innovation: challenge funds, innovation funds and grants, innovation funds for smallholder farmers, prizes and awards, results-based contracts; and (3) Instruments that support innovation in real-life contexts: innovation platforms, living labs, farmer research structures, farmer field schools.

The report provides a goal-oriented process to help investors and funders select the most appropriate instrument or combination of instruments, using the following questions:

1. Are you aware of the range of instruments available to support innovation in the agricultural sector that could support SAI?
2. Where do you want to have an impact in the agricultural sector?
3. Having selected an instrument, what do you need to consider in relation to design?
4. How effective are the instruments?
5. What must you consider when designing instruments to support innovation?

Design considerations for the different instrument types that emerged from the analysis are summarized below.

Instruments that support entrepreneurship: (1) Ensure that the team appointed to operate the facility has the correct suite of skills, knowledge, networks and understanding of the ventures that will allow them to meet the specific needs of the ventures and entrepreneurs. (2) If the facility is not permanently linked to an organization that will fund it, or subsidized by the government, make sure that a strong business mtaodel is developed that takes into consideration the capacity of the participants to pay for services, thereby ensuring continuity of these types of instruments. This has trade-offs for equity as it excludes less well-resourced entrepreneurs and enterprises. (3) Decide whether the facility will help a group of similar entrepreneurs to support each other or will effectively accommodate diversity. (4) Develop a business model based on the capital outlay required for service provision, facility expenses, and the mechanism to cover these operating costs. (5) Make sure that the criteria for selecting ventures and entrepreneurs to be supported can guide instruments to focus on innovation that address social, environmental and other crucial issues. However, this may be challenging when instruments are not subsidized and rely on generating revenue from their support ventures.

Instruments that provide financial support to innovation: (1) Choose and design the instrument based on the types of innovators you want to support and their needs. (2) If you want to allow users to define the research agenda and lead the innovation process, then choose an instrument that puts funds in the users' hands or design the instrument such that it allows for user involvement – which may be through a complementary instrument such as establishing an innovation platform. (3) If you want to design the instrument to ensure that marginalized groups (less-resourced or less literate, for example) can participate, then consider eligibility criteria and application processes, as well as covering the costs for farmer participation. (4) Consider the choice and design of instruments to increase the lifespan of the fund. For example, a results-based contract will see the initial investor recouping their investment and re-investing it. At the same time, an innovation fund for smallholder farmers can be made self-sustaining by diversifying the activities of the farmer group to include income-generating activities, or making the funds available as revolving credit. (5) Select and design the instrument to reduce transaction costs according to the funds available to support innovation and the program's objectives.

Instruments that support innovation in real-life contexts: (1) Ensure the correct mix of stakeholders participate but have a strong facilitator who can manage the power dynamics so that one actor cannot highjack the process. (2) Ensure that the stakeholder mix can also support market participation by farmers. Innovation related to strengthening primary production (such as new seed or new planting

methods) is unlikely to lead to livelihood impacts unless the process also supports and strengthens market participation of producers. Similarly, the development of new products or services also requires that market penetration is supported. (3) Make sure that the expected lifespan of the instrument is discussed with members throughout the program through which it is initiated so that a decision can be taken, based on the perceived benefits, on whether to terminate it or whether to find ways to prolong its lifespan. To ensure equity, this decision should also consider less-resourced members, who may not be able to participate indefinitely, leading to their possible exclusion. (4) Ensure that there are felt benefits for all actors required to participate in activities associated with instruments such as farmer field schools or innovation platforms; otherwise, they may not be willing to continue participating. It may be necessary to support the participation of certain actors, especially if they receive no short-term benefits.

Key recommendations that emerged from the study include the following:

1. Instruments need to be anchored within existing organizations during the course of the program that establishes them, or the business model must be designed to allow them to be self-sustaining (for example the CENTEV [*Centro Tecnológico de Desenvolvimento Regional de Viçosa*] incubator in Brazil is part of the Federal University of Viçosa in Brazil).
2. Institutional embedding of new instruments such as innovation platforms needs to be accompanied by changes of mandates and incentives; for example, the roles of extension agents or researchers need to change to accommodate their role as facilitator)
3. The heterogeneity of smallholder farmers should be recognized so that efforts are made to ensure equitable participation; for example, supporting the participation of farmers that cannot travel to meetings or co-designing activities so that they allow women to participate.
4. Challenges faced by farmers are generally complex, and bundling different types of innovations is likely to increase their impact; for example, a new production technique combined with an institutional innovation to share the necessary machinery or equipment.
5. Multiple forms of support are needed for effective innovation processes, which may require combinations of instruments; for example, combining innovation funds for smallholder farmers with the establishment of a climate-smart village.
6. Some instruments need to morph over time as the needs of the beneficiaries change; for example, a farmer field school may need to bring in new actors and operate as an innovation platform in order to address other challenges such as market participation.

While this analysis has focused on what particular instruments have been used for or have aimed to achieve, it is also important to consider how they could be designed to address additional objectives, in particular the principles of SAI. The literature review revealed many pilots and projects that have used different instruments to support innovation, yet critical appraisal of these initiatives is lacking. Where the effectiveness of the instruments has been documented, it is often too soon after the end of the project, such that the longer-term sustainability is not explored.

One finding that has emerged from the study is that many instruments, and the programs through which they are established, aim to put the end-user at the center of the innovation process so that they are an active stakeholder rather than just a recipient of the process outcome. These new approaches call for structural changes in terms of organizational mandates and new roles for researchers and extension staff, which in turn call for appropriate training.

The analytical approach adopted in this study, though valuable, was extremely challenging and not without shortcomings. This was largely because of high levels of variability across projects, organizations, sectors, regions and countries in terms of the design and operationalization, as well as monitoring and evaluation, of and reporting (including quality thereof) on, the different instruments assessed here. A more systematic approach to understanding, quantifying and reporting the impact that results from investment in innovation (as well as the costs, transaction costs and benefits) is, therefore urgently needed, given that it is a crucial component of impact investing. Finally, we strongly recommend that any potential investor or funder planning to make use of any of the instruments for investing in SAI innovation engage meaningfully with the evidence that we have drawn on for this study, and any other evidence they can source to guide the strategic design of their instrument of choice for the particular context in which they plan to use it. Even when the type of instrument selected is appropriate, uninformed instrument design increases the risk of investment not achieving the expected impact.

1. Introduction

The Institute of Natural Resources NPC[1] (INR) was appointed by the Commission on Sustainable Agriculture Intensification (CoSAI) in April 2021 to undertake the current study. CoSAI was established to increase effective investment in innovation for sustainable agricultural intensification in the Global South, to support the Sustainable Development Goals and the climate goals of the Paris Agreement (United Nations Framework Convention on Climate Change, 2015).

> For CoSAI, and for the purposes of this report in particular, sustainable agricultural intensification (SAI) is defined as transformative changes in agriculture and food systems that are urgently required to meet rapidly increasing global needs for affordable, nutritious, safe and healthy food, while protecting and improving the natural environment and promoting resilient livelihoods and social equity.
>
> Source: wle.cgiar.org/cosai/frequently-asked-questions

There is growing consensus for a paradigm shift in agriculture. The current focus is primarily on increasing productivity, with sustainability considered a secondary outcome, if anything; by contrast, sustainability is at the core of SAI (Rockström et al. 2017). The current agri-food system, based on Green Revolution technologies, has made significant strides in terms of increasing yields and productivity, but it has failed to deliver on environmental and socio-economic goals. In many cases, it has left farmers worse off and living in degraded environments (Westengen and Banik 2016; Davis et al. 2019). There is need to develop systems that increase productivity, but to do so in a manner that mitigates environmental degradation or promotes environmental gains, while also advancing socio-economic gains such as equity and inclusion.

This paradigm shift, which is underway in many parts of the Global South, is leading to an increased focus on *agricultural innovation*, defined as "the process whereby individuals or organizations bring new or existing products, processes or ways of organizing into use for the first time in a specific context to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability and thereby contribute to food security and nutrition, economic development or sustainable natural resource management" (FAO 2019). While the pool of funders focusing on agricultural innovations has grown, so has the number of deserving beneficiaries. This has necessitated more focused funding instruments and resulted in more results/impact-driven funders and funding strategies.

The traditional linear technology transfer model has limited effectiveness in promoting the uptake of technologies and innovations. It fails to account for complexity within the agri-food system, is too simplistic and does not fully consider forward and backward feedback loops in the food system or pay proper attention to context. This has created trade-offs in many instances, with well-intended interventions not delivering on outcomes or with project interventions not being sustainable (Hellin 2012). Sometimes, this is due to a breakdown in information flow from national research institutes to

[1] NPC stands for non-profit company

farmers, caused by poor relations with the technology transfer agencies that provide this technical support.

As a result, there is a recognition that co-development processes involving different development partners may be important in address the problem (Kaimowitz 1990; Kavoi et al. 2014). These processes require the participation of stakeholders to ensure ownership and learning from experience, and should draw on multiple sources of knowledge so that interventions are designed to be appropriate to a particular context (Butler et al. 2017; Devaux et al. 2018; Brookfield Institute 2018).

Some of the instruments developed to strengthen innovation and uptake focus on involving end-users in 'co-creation' or consultation, emphasizing that more relevant innovations will be used more effectively. Others focus on supporting farmers' and others' own innovation. Still others focus on speeding up the innovation and scaling process. However, there has been little examination across these instruments in terms of their design, focus, purpose, success and/or potential, or on the extent to which they have been incorporated into government and private systems (institutionalized). Research and innovation organizations have a deep interest in understanding the design, implementation and evaluation characteristics of instruments for investing in innovation and could benefit from practical information on what works best in what context and how to improve the design of these instruments. This forms the basis of the current study.

Objectives

The objectives of this study were to:

1. Categorize, tabulate and summarize current evidence on how well different **investment approaches and instruments to promote innovation** have supported the multiple objectives of SAI, drawing, where possible, on lessons learnt from other sectors and the Global North.
2. Develop lessons and guidance based on this evidence to help innovators and investors choose the best **funding approaches and instruments to support SAI innovation**.

To achieve the stated objectives, the study was undertaken in three phases. During the **inception phase**, basic background information was reviewed, and the scope, approach and work plan for achieving the requirements of the study were proposed, discussed and accepted. This was followed by the **main phase**, which comprised collecting and analyzing published material and engaging with stakeholders to gather more data. Lastly, the **reporting phase** involved the production of the final report, which will inform several other outputs, including policy briefs and peer-reviewed journal articles.

This report collates all the findings from the study and all materials and information sources that were used. The quality and shortcomings of all sources of information are indicated in the discussion.

Report structure

The report is structured as follows:

- The **methodology** for the study, which explains the process for selecting instruments for use in the study, and the methods used for gathering, processing and analyzing data.
- The **findings of the report**, which includes:
    - The establishment of a typology to divide the instruments into three different types (Type A, Type B and Type C).
    - Appraisal of the principles and functions of the instruments, which includes providing some examples of where the specific instruments have been used; all this formed an initial broad comparison of various instruments within each 'instrument type'.
    - A comparison of all 12 instruments in terms of area of focus, the portion of the sector in which they are used, the types of support provided and organizations that fund their use.
- **Guidance** for selecting the most appropriate instrument, which uses a series of questions to guide the decisions.
    - Where do you want to have an impact in the sector?
    - What do you want to achieve with the instrument?
    - How effective are the instruments?
    - What must you consider when designing instruments?
- **Recommendations and concluding remarks.**

2. Methodology

The methodology that was followed by the team when implementing the study is described here.

Definition of terminology to guide instrument identification

A preliminary review of the literature on agricultural innovation, during the inception phase, revealed the need to first define the terms 'investment approaches, instruments and tools' as this informed the keywords used to query the literature, categorize the findings, inform the language used in the stakeholder engagements and discuss the learnings that emerged from the study. There are indications in the literature that these terms are sometimes used interchangeably by different authors and organizations. For example, a study by De Koning et al. (2021) differentiated between approaches, methods and tools (for stakeholder engagement) to support transition pathways to sustainable food systems. Their means of differentiating between these three categories is that (1) approaches are the paradigms that inform the way that development/research is done (e.g. participatory approaches); (2) methods are the strategies and processes used in developing transition pathways (e.g. participatory design) and (3) tools are means that help to fulfill a task (in a research/development project) (e.g. SWOT analysis, rich picture). For example, in their study, living labs are defined as a research method (where new practices are evaluated in a multi-disciplinary manner in real-life situations).

For this study, we use the following definitions, which led to our decision to focus only on instruments:

- *Instruments:* arrangements for financing or disbursing support to those engaged in research/innovation (i.e. research performers) – adapted from a definition offered by the Organisation for Economic Co-operation and Development (Jacobs, undated).
- *Approaches:* ways of dealing with situations or problems, e.g., agri-food systems perspectives, socio-ecological systems approach.
- *Tools*: means of doing specific tasks, e.g. field demonstrations, multi-stakeholder platforms).

Approaches and tools were excluded from the study based on being too broad or too specific, respectively. For example, Schwester (2015) refers to in-depth interviews, focus groups, and field observation as empirical tools associated with qualitative research. This study did not aim to provide guidance at this level to decision-makers or investors. Similarly, in the fields of agricultural research and innovation, examples of approaches that are found in the literature include, participatory action research (Milich et al. 2020) and big data (Young et al. 2018).

Generation of the preliminary list of instruments

The process of identifying instruments to include in the study took into account the target audience, which comprises the direct investors and decision-makers who determine the type of activities to be funded and instruments to be applied. Starting with an extensive list of documented mechanisms that have been used to support innovation in the broad field of agriculture, those perceived to be tools and approaches were eliminated, leaving a list of 12 instruments.

Table 1. List of instruments covered in the study.

Types of instruments (in alphabetical order)
1. Accelerators
2. Challenge funds
3. Innovation funds for smallholder farmers
4. Farmer field schools
5. Farmer research structures
6. Innovation funds/grants
7. Incubators
8. Innovation platforms
9. Innovation hubs
10. Living labs (including climate-smart villages)
11. Prizes/awards
12. Results-based funding contracts (for innovation)

Data collection and assessment framework

The design of the framework for data collection and assessment (Table 2) was informed by the following:

1. Factors that define the context in which the instrument has been used;
2. Types of innovations being supported (products, processes, marketing strategies, institutional arrangements);
3. Types of instruments being used;
4. Sources of funding;
5. Intended impacts in terms of economic sustainability, productivity, environmental sustainability, social/relational effects, and human condition/wellbeing.

Table 2. Summary of column headings and drop-down options for the data capturing framework.

Column heading	Types as per drop-down menu options
Evidence type (based on the type of document)	Peer-reviewed article/Systematic and other peer-reviewed review/Project report/Internal project evaluation report/ External evaluation report/Project reports/Website info
Main instrument	
Supporting instruments	
Region	MENA/Sub-Saharan Africa/Asia/Latin America/Pacific/Multiple
Country	
Context (rurality)	Urban/Peri-urban/Rural
Type of farming system	Mixed/Livestock/Agronomic/Vegetables/Fruit/Aquaculture
Farmer types	Individuals/Groups/Collectives
Scale of production	Primarily subsistence/Small-scale commercial/Large-scale commercial
Implementing agency/Recipient of funding	
Funders	
Investment amount	
Overall project approach	Top-down/Non-participatory or bottom-up/Participatory
Clear gender focus	Yes/No
Clear youth focus	Yes/No
Clear economic objective	Yes/No
Clear social objective	Yes/No
Clear environmental objective	Yes/No
Clear productivity objective	Yes/No
Clear human wellbeing objective	Yes/No
Citation	
Source – website/DOI/Link	

Data collection

The process of gathering data used a mixed-methods approach that included quantitative and qualitative approaches:

- A rapid review (purposive) of the literature was conducted that covered gray and peer-reviewed literature.
- Interviews were conducted with various key informants to draw on their experiences, obtain useful documents, and identify websites, organizations to explore, and other individuals to interview.

While the geographical focus is on the Global South and agricultural innovation, examples of instruments used to support innovation related to SAI in the Global North and innovation within other sectors identified through the literature review and stakeholder engagement were also documented as part of understanding best practice and sharing lessons.

Key informant consultation

The two approaches used to engage key informants are described below.

Key informant interviews

Online meetings were set up with individuals identified by the CoSAI commissioners, suggested by other key informants, or responded to information requests. The purpose was to source relevant literature and information on sustainable agriculture innovation and intensification in the Global South that may have been overlooked or that was not otherwise accessible.

Requests for information

Requests for information were circulated via the following networks: Platform for African European Partnership on Agricultural Research for Development (PAEPARD), African Forum for Agricultural Advisory Services, Alliance for Food Sovereignty in Africa, Family Farming & Agroecology and *Souverainete Alimentaire*. Requests were also directed to contact persons within key organizations (these were identified from websites, through the commissioners or via snowball sampling). The KI interviews were conducted online and were in the form of semi-structured interviews, using a pre-formulated set of questions to guide the discussion.

Participation in conferences

Three virtual events, namely the Aspen Network of Development Entrepreneurs workshop, the African Green Revolution Forum's Annual Summit and the Asia-Pacific Association of Agricultural Research Institutions/CoSAI dialogue, provided opportunities to gather additional information. The project team made presentations at each side event, and panelists further explored the use of instruments to support innovation.

Review of the literature

The literature review involved exploring two subcomponents, namely gray literature and peer-reviewed material. The methods for these two categories of literature are described below. It was necessary to source multiple types of publications and topics in the literature to answer the following three key questions:

1. What types of investment instruments have been tested to support innovation in agri-food systems in the Global South? How can these be categorized into a working typology?
2. What is the evidence on how well different instruments have supported SAI's multiple objectives at scale? (e.g., social equality, environmental objectives). What contextual and design factors affect their success or failure in achieving these objectives (e.g., type of value chain, who participates)?
3. What advice can be given to innovation investors and practitioners about the instruments selected for different objectives and contexts, and how can these be designed to achieve better impacts?

Review of peer-reviewed material

The review of peer-reviewed material relied largely on searches of various databases of prominent scientific journals by Information Consultants at the Human Sciences Research Council using the search engine EBSCO-Host and was supplemented with searches on SAePublications, Sage, JSTOR and Academia.edu. Lists of abstracts were generated and screened by the research team and inserted into

the framework. In addition to using these search engines, the team also made use of forward and backward linkages from literature to expand the body of articles reviewed. Where cases were documented in papers, efforts were made to determine their status at the time of the study. It became clear that many of the initiatives using the instruments were no longer functioning or had reached the end of their lifespan.

Using the following search string given below on EbscoHost retrieved 2,105 items.

Agricultur* AND innovat* AND Challenge fund OR farmer innovation fund OR Innovation grant OR Prize OR Award OR Insurance OR innovation platform OR innovation hub OR farmer research network OR living lab OR farmer field school OR incubator OR accelerator OR results-based contract OR Broker OR intermediar*

After screening, only 721 of these were found to relate to innovation support and involved the use of the instruments identified during the inception phase. These documents formed the basis for the literature review, with gaps being addressed as required. When searching for literature using online databases, the decision was taken by the team to focus on agricultural innovation rather than on research and development, but the subsequent searches related to specific instruments using Google Scholar focused on those used in an agricultural context. It should be highlighted that the review was not exhaustive, and the selection of sources/information for review was purposive, based on the desired outputs, namely to provide evidence-based guidance to investors and funders regarding instruments that can be used to support innovation toward achieving SAI.

Review of gray literature

The review of gray literature included material that was sourced in the following ways: (1) that provided in response to the general requests circulated to networks, (2) that provided by key informants, (3) that identified by searching websites, (4) that identified via the Google search engine (combining terms related to instrument type, locality, and context – agriculture and farming), and (5) that which the team already had access to.

A scan of the websites of a range of organizations that fund and/or implement agricultural development or research and development was conducted. Those websites with a search function that had already been found to contain relevant material formed the basis for identifying project reports and evaluations that were included in the review. It is important to note that the research team had sufficient expertise in the subject area to be able to gauge the relevance of the gray literature and decide what was to be included/excluded.

Data capture

The extraction of relevant data from the literature (peer-reviewed and gray literature) into the spreadsheet tool was conducted by a subset of the research team. Documents that reviewed experiences with a particular instrument were captured separately from documents that provided more detailed information about a particular initiative. Data from these two types of literature reviewed were disaggregated within the spreadsheet.

Data analysis

The purposive review used a diversity of sources, including academic and gray literature and online sources. The type of information available also varied across instruments assessed to the extent that

certain types of analysis could not be applied across all instruments. It is instructive for the reader to know the types of information available across instruments before engaging with the information supplied in subsequent sections. Information on this is provided in Table *3*.

In the data collection framework, types of instruments are categorized primarily by investment type, then by the relevant scale of production and other characteristics to allow for the extraction of comparative lessons (such as whether they were implemented within a rural, urban or peri-urban context, or more or less market-oriented production systems).

Table 3. Summary of information sources (As indicated by X) used for each instrument in the study (left to right aligning with increased strength of the evidence base).

Instrument	Websites	Pamphlet/ PowerPoint	Policy briefs/ Guidelines/ Gray literature	Project reports	Journal articles	Review articles	Project evaluations
Incubators	X		X	X	X		X
Accelerators	X				X	X	
Innovation hub	X	X		X	X		
Challenge funds	X		X				X
Innovation funds and grants			X	X	X		X
Innovation funds for smallholder farmers	X		X	X	X		
Prizes and awards	X	X		X			
Results-based contracts	X		X		X		
Innovation platforms	X		X	X	X		
Living labs	X			X			
Farmer research structures		X	X	X	X		
Farmer field schools	X		X		X	X	

3. Findings

Exploration of instruments

In this section of the report, instruments with similar characteristics and functions have been grouped into types:

- **Type A Instruments that support entrepreneurship** (accelerators, incubators and innovation hubs).
- **Type B Instruments that primarily finance innovation** (challenge funds, innovation funds & grants, innovation funds for smallholder farmers, prizes & awards and results-based contracts).
- **Type C Instruments that support innovation in real-life contexts** (innovation platforms, living labs, farmer research structures and farmer field schools).

Based on the literature included in the study, a summary of each instrument's key functions and principles is provided for each of the instruments within an instrument type, together with information about specific examples where the instruments have been used. This is followed by a high-level comparative analysis across the instruments within the instrument type, which considers similarities and dissimilarities related to key functions and principles as well as the contribution that the instrument could potentially make to the multiple objectives of SAI (economic impact, increased productivity, social impact, human wellbeing and environmental impact), as well as the cross-cutting issues of gender and youth. The role of brokers and intermediaries was also explored as they are a key element of many of the instruments, including innovation platforms (see Box 1).

Box 1: Brokers and intermediaries

Many of the instruments described in this report (living labs, innovation hubs, incubators, etc.) play a brokerage or intermediary role, facilitating linkages between actors to provide access to resources, markets and so on (Fuzi et al. 2018a). An innovation broker is an individual, an organization or a body that can provide information about potential collaborators, brokers transactions between parties, and act as a mediator and go-between (Klerkx et al. 2009). Innovation brokering involves systemic facilitation, relating to several linkage building and facilitation activities in innovation systems. A key role of an innovation broker is to familiarize themselves with relevant research and then translate it into a more accessible language (Klerkx et al. 2012).

Some private companies are acting as intermediaries, having the role of taking research outputs and developing them further before they are disseminated (i.e. ensuring the economic use of knowledge), and it is recognized that an enabling environment must be created for them to operate effectively (Mgumia et al. 2015). A key reason for needing innovation intermediaries is that the key innovation actors often operate in isolation due to a lack of effective linkages (Mgumia et al. 2015). Some innovation intermediaries facilitate other actors to innovate; others carry technologies and bridge the gap between supply and demand. A study in Tanzania highlighted that most of this

happened within the scope of projects, and this was mostly funded by external donors (Mgumia et al. 2015).

Other roles of innovation intermediaries include demand articulation and stimulation, network building, knowledge brokering, innovation process monitoring, capacity building and institutional support (Klerkx et al. 2009; Dyck and Silvestre 2019). They may also play the role of fostering and catalyzing collective action (Hellin 2012; Ramirez et al. 2017). Importantly, they are required to coordinate multiple actors and build different forms of social capital (i.e. within the group and with other actors). Different types of organizations can play the role, but the type of organization may affect their objectives and functions and their capacity to remain neutral (Ramirez et al. 2017). Some organizations have a specialized role as innovation brokers (Kilelu et al. 2011). Innovation brokers need to have a particular skill set, including skills to support social learning if they have a role such as supporting action research (Hood et al. 2014).

Most of the literature related to brokers and intermediaries describes their role in supporting the production and marketing of agricultural commodities. Still, some cases expose producers to new technologies, and others focus specifically on innovation. One example of those that introduce new technologies to farmers relates to palm oil producers in Columbia. Intermediaries that are often private refinery organizations providing collective services and assisting small producers in supplying the oil refineries, also transfer technology from CENIPALMA[2] (technical arm of the palm oil federation) to the producers (Ramirez et al. 2017). The role of innovation intermediaries in building linkages in innovation systems (for example, between researchers and firms) and creating a more mature innovation system was explored in Chile. However, the focus was not on the agricultural sector. Some of the services they provided, specifically in the agricultural sector, were technology transfer, innovation network building, seeker-solver matching, technology screening, certification, innovation agenda articulation and fund procurement support (Klerkx et al. 2015).

Type A: Instruments that support entrepreneurship

This category of instruments includes those primarily focused on supporting entrepreneurship, but which also support innovation within these enterprises. They are all instruments that provide support to multiple enterprises. This category includes accelerators, incubators and innovation hubs.

A1 Incubators

Functions and principles

Incubators create, nurture and develop new enterprises, thereby improving their chances of success (OECD 2019). They can also bring new technologies, products and business models to the market by linking universities, research, enterprises and the market (Hjortsø et al. 2017). They reduce risk and vulnerability for early start-up stages by providing business skills support and support access to other actors and assisting with finance access (Ozor 2013). Besides supporting the innovation process by providing access to facilities and linking incubatees to actors with the necessary skills, incubators also provide coaching and mentoring to foster entrepreneurial and business skills, especially for agribusiness incubators, and provide networking opportunities. This requires suitably qualified and

[2] https://www.cenipalma.org/

experienced incubator managers with business and community development skills (Ozor 2013; Virgin et al. 2016). According to a KI who has direct experience with operationalizing an incubator, the sustainability or long-term effect of the investment can be safeguarded by following up on graduates of programs not only to see how they are progressing but also to identify whether they require additional funds support. Similarly, understanding their demise or failure to achieve their intended outcomes can be better understood.

Relevant examples

Given that the focus of the current study is on innovation, one must differentiate between incubators that focus only on 'incubating' entrepreneurs, and those that focus on establishing businesses that commercialize research outcomes or innovations, which can better be described as agribusiness innovation incubators (Ozor 2013). Two programs within the agriculture sector that have focused specifically on developing and commercializing technologies, include BioInnovate Africa[3] and UniBRAIN (Universities, Business and Research in Agricultural Innovation[4]).

BioInnovate Africa is ongoing and is based at the International Center of Insect Physiology. It is supported by the Swedish International Development Cooperation Agency (Sida). It links scientists and innovators to support the establishment of bio-based businesses in Ethiopia, Kenya, Rwanda, Uganda and Tanzania. Ultimately, the program aims to improve the productivity and livelihoods of smallholder farmers. The first call for applications was in 2017 for (1) Developing and piloting economically viable bio-based technologies and products (USD 750,000 available to the applicant) or (2) technology business incubation (USD 250,000 available to the applicant) – with 25% of the total project as matching funds. Examples developed thus far include a substrate for growing mushrooms, and novel food products from maize and millet (https://bioinnovate-africa.org/business-incubation-a-means-for-effective-business-development/). Some challenges are encountered with setting up and sustaining incubators. A review of four technology systems supported by BioInnovate concluded that project timeframes are frequently too short to move innovations into the market, and incubators focused on developing innovations do not always give enough attention to the requirements of the business component, namely developing business plans and undertaking market analyses. It is also difficult to finance the services offered by incubators and for enterprises to access venture capital to commercialize the products (Virgin et al. 2016).

The UniBRAIN facility, which was hosted by the Forum for Agricultural Research in Africa (FARA) and funded by Danida (Denmark's Development Cooperation), ran from 2012 to 2015, and a number of the incubators it established are still functioning. One of these is CURAD (Consortium for enhancing university responsiveness to agribusiness development) https://www.facebook.com/curadincubator/), which is an agribusiness incubator that was started in Uganda in 2009. Makerere University promotes CURAD, the National Union of Coffee Agribusinesses and Farm Enterprises Limited (NUCAFE), and National Agricultural Research Organization, the University of Copenhagen and NIRAS International (a private consultancy)[5].

[3] https://bioinnovate-africa.org/business-incubation-a-means-for-effective-business-development/
[4] http://exploreit.icrisat.org/resource_data/project_indetail/1173)
[5] http://nowaduganda.org/our-partners/curad-incubator/

CURAD is registered as a non-profit company. According to one of the members interviewed during this study, CURAD provides space and human resources for its incubatees. It recruits incubatees based on their innovative ideas. It has an annual innovation challenge to recruit incubatees. While the incubator encourages youth and women, it does not preclude more mature applicants or men. A mechanism they are using to ensure the initiative's sustainability in the longer term when donor funding is unavailable is an anchor tenant that can subsidize the incubatees' costs.

Another example of an incubator is the Kosmos Innovation Centre (KIC) in Ghana (https://www.kosmosinnovationcenter.com/), which is referred to as an *incubation hub*. It is an initiative of Kosmos Energy, and the KIC has centers in Mauritania, Cote D-Ivoire, Ghana and Senegal. The KIC has two programs, the one is the 'business booster', which targets existing start-ups and provides support through bootcamps (i.e. short, intensive courses) to revise their business plans and network with investors and other entrepreneurs. The 'start-up incubator' is a physical facility and provides support to entrepreneurs. The KIC has both an incubator and accelerator program because they address the needs of two different customer groups.

A publication by InfoDev (2011) handpicked and documented several programs using incubators. These included Villgro[6], CENTEV/UFV[7], and a business incubation initiative of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India (Karuppanchetty et al. 2014), all of which are still operational.

Villgro is a rural business incubator in India (InfoDev 2014a). Villgro Innovations Foundation is a non-profit business incubator, while Villgro Innovations Marketing Pvt. Ltd, a former incubatee, operates a network of retail outlets (Villgro Stores) in underserved rural areas in South India, where products developed in the incubator are marketed. Some of the major donors that have supported Villgro include the Lemelson Foundation, the Rockefeller Foundation, Hivos People Unlimited, Aspen Network of Development Entrepreneurs and The Sir Dorobji Tata Trust.

CENTEV (*Centro Tecnológico de Desenvolvimento Regional de Viçosa*) is attached to the Federal University of Viçosa (UFV) in Brazil, which is a well-known agricultural university in Brazil. The university partially funds it but it also receives state and private grants. CENTEV was established through an initial state grant of USD 8 million, of which USD 6 million was used for infrastructure development. UFV's innovation capacity has been supported by the FUNARBE Foundation (Fundacao de Arthur Bernandes), which aims to facilitate partnerships between the UFV and public and private entities to diffuse the technology generated on campus. FUNARBE assisted UFV in securing financing from state and federal R&D institutions and development agencies and access to potential private sector partners (InfoDev 2014b).

The business incubation initiative in India is of interest, given that it is a government-driven initiative. Through the National Agricultural Innovation Project (NAIP), Business Planning & Development (BPD) Units were started in 2008 by the Indian Council of Agricultural Research, which falls under the Department of Agricultural Research and Education in the Ministry of Agriculture.

[6] https://villgro.org/
[7] http://www.centev.ufv.br/en-US/

The BPD Units were set up to support technologists and scientists to commercialize research outputs by engaging with entrepreneurs, start-up ventures, and public and private sector companies. NAIP appointed ICRISAT and its Agribusiness Incubation (ABI) Program to mentor the BPDs. The ABI-ICRISAT Program was established in 2003, with the support of the Department of Science and Technology of the Government of India. The incubator at ICRISAT was the first agribusiness incubator in the country, and ICRISAT was the first among CGIAR institutions to have one. Besides approaching various government ministries to secure their support, ABI-ICRISAT also identified other sources of revenue such as membership fees, incubator service packages, consultancy assignments, etc. (Karuppanchetty et al. 2014).

A2 Accelerators

Functions and principles

Accelerators (including terms such as start-up accelerator, business accelerator and impact accelerator) are instruments that provide short-duration support (1–12 months in length) to early-stage ventures to speed up their growth (Cohen et al. 2019). They get the enterprises to a point where they can secure funding from other sources. Some accelerators provide a co-working space and associated support (training, mentorship, access to knowledge and networking with other entrepreneurs). They also act as brokers, facilitating access to other actors such as investors and markets (Cohen et al. 2019). They contribute to supporting innovation by helping businesses to develop new ideas (Crișan et al. 2021). They also focus on product development and validation of new products and finding markets for new products.

Through an application process, accelerators target established enterprises/entrepreneurs with strong potential for growth (i.e. those with well-established ideas that can be scaled up rapidly) (OECD 2019). The accelerators often provide relatively small capital to the enterprises through equity investments (Crișan et al. 2021), or charging success fees (Kimle 2014). Still, the intention is to position the enterprises to secure additional funding from venture capitalists. Accelerators are mostly for-profit entities, sometimes funded by venture capitalists and other private and public sector actors (OECD 2019). Sometimes they are housed at universities or community-oriented organizations (Kimle 2014). The budget for an accelerator can be as low as USD 3 million or as high as USD 20 million for three to five years, depending on the program's scope and overhead expense structure (Kimle 2014).

Relevant examples

This study revealed three examples of existing accelerators that support innovation in the agricultural sector and one new program that has been recently established that will make use of accelerators. **The Grow Impact Accelerator (a Global Agrifoodtech Accelerator for Impact)**[8], backed by Agfund (a venture capital firm), is based in Singapore and has been functioning for some years. It aims to drive transformative change in the global agri-food system. Teams are encouraged to register their business and receive a cash injection, as well as the opportunity to attend a virtual program that strengthens their current business model. The accelerator also inserts members into the agri-foodtech network (for international expansion). The businesses supported by the Grow Impact Accelerator are innovative enterprises such as Seadling, which is exploring seaweed as a food source (https://www.seadling.com/about-us).

[8] https://www.gogrow.co/the-grow-accelerator

Village Capital[9] is an organization that aims to support entrepreneurship and innovation globally to develop smallholder farmers (Jackson 2019). The team supports seed-stage, impact-driven start-ups and has worked with 1,100 entrepreneurs from 28 countries. They currently have a program called **Agriculture Africa Accelerator Program**, which was initiated in 2019[10]. It has supported innovative business ideas such as Agro Supply Uganda (agrosupplyltd.com), an innovative financing system that allows farmers to put money aside ahead of time to cover their farming inputs. The extent to which the judicious use of inputs is supported is not clear.

The **Food Africa Accelerator**[11] is an initiative funded through the GIZ-funded Make-IT in Africa Tech Entrepreneurship Initiative, that is aimed at addressing food security through fostering innovation. The program is designed to support women- and youth-owned agri-based enterprises in Kenya to sustain business growth by facilitating access to financing, business support and technology adoption. This facility, which is currently operating, was initiated in 2020 and is an initiative of VC4A (https://consulting.vc4a.com/).

A recent initiative is Rockefeller's small to medium-sized enterprises (SMEs) accelerator called the Powering Agriculture and Protective Foods SME Innovation Accelerator. The program was initiated in 2020 and will run until 2025, with a budget of USD 5 million. The accelerator's purpose, which supports start-ups that have been in operation for a minimum of two years, is to bring together actors to finance SMEs and facilitate stand-alone investments in making nutritious foods accessible and affordable.

Incubators are another instrument that supports the establishment of agribusinesses. They share several characteristics with accelerators.

A3 Innovation hubs

Functions and principles

Whereas incubators may be more focused on supporting entrepreneurship than supporting innovation, the focus of innovation hubs is to support innovation – although most do this within the context of creating sustainable enterprises (Beesabathuni et al. 2021). Innovation hubs are generally recognized as physical co-working spaces where entrepreneurs working with technology at an early stage of development can network with each other and with other actors relevant for getting new technologies to market (Zimenez and Zheng 2021). One example of a virtual facility is the "Virtual Innovation & Entrepreneurship Hub", which operates from Bahrain, an online platform that aims to support entrepreneurs in Middle East and North Africa (MENA) countries. It provides access to resources and offers capacity development, with a strong focus on entrepreneurship. It facilitates linkages to financial institutions, while entrepreneurs can also link to each other and other actors such as mentors and experts[12]. Innovation hubs support local entrepreneurs and practitioners to advance productivity and sustainability enhancing innovations. They support a sense of community, even if they are for-profit facilities (Friederici 2015). They often focus on supporting networking within their

[9] https://vilcap.com/entrepreneurs/accelerating-startups
[10] https://vilcap.com/current-programs/agriculture-africa-2019
[11] https://foodafricaaccelerator.com/
[12] https://e-entrepreneurs.org/

members (i.e. social capital) for larger positive social change (Whitt 2016). According to Fuzi et al. (2018a), "hubs are collaboration platforms for positive change for those individuals and companies who strongly believe that the future of business is found in profit that serves both people and our planet".

A number of the publications related to innovation hubs focus on information and communications technology (ICT) and digitalization, some of which develop products and services that can impact the agricultural sector (Baumüller and Kah 2019; Miörner et al. 2019).

Innovation hubs encourage collaboration between members (Jiménez et al. 2017), especially where members work within a specific field such as ICT and digital technologies. They allow for experimentation with technologies (Miörner et al. 2019). The business support aspects are similar to those of incubators and include networking, training in business skills, developing business plans, assisting enterprises in finding investors (Miörner et al. 2019). Effective governance of the hub is essential, together with the necessary facilitation or brokerage skills, to ensure that members have access to organizations and individuals outside of the hub (Beesabathuni et al. 2021).

Relevant examples

Examples of existing innovation hubs within the agricultural sector include the Agribusiness Innovation Hub (iHub) in Ghana[13] and the Campos dos Goytacazes Innovation Hub (PICG) in Brazil (UNESCO undated). An initiative that was just being initiated in 2021 is the World Economic Forum's Food Innovation Hubs.

The iHub is a flagship youth-in-agribusiness-development initiative run by the Savannah Young Farmers Network (SavaNet-Ghana), a young farmer development organization that is an initiative of the Ministry of Food and Agriculture. Youth with smart agribusiness ideas pitch their plans under the iHub project's 'Agribusiness Ideas Porch' and on the 'Play with your Ideas and Challenges' programs. These programs have helped youth nurture their agribusiness ideas into viable agri-ventures. Young Agri-entrepreneurs supported by iHub include farmers, produce/product aggregators, processors, agro-input dealers and mechanization service providers. According to the website, the hub has launched more than 800 new agribusinesses and invested in 50 start-ups to support their growth, but the exact status of these enterprises is not clear. Graduates of iHub have included an entrepreneur who wanted to establish a marketing system for soy beans and shea nuts from smallholder farmers, and a group of women processing rice and shea butter. The hub has encountered many challenges, including shortages of staff to support the many youths that approach the hub for assistance and the unwillingness of financial institutions to invest in the agri-entrepreneurs' businesses (Savanet undated; Tia 2017). Another innovation hub in Ghana is Agriculture Innovations Hub[14], which JS Prestige Farms established in 2019, aims to find innovative solutions that will increase efficiency, conserve resources and improve human wellbeing. They also see opportunities for digitization within the sector. They work with start-ups that they perceive to be promising and innovative in terms of having *disruptive business models*.

[13] http://savanet-gh.org/?q=content/start-pilot-implementation-agribusiness-innovation-hub-%E2%80%93ihub-project-savanet-ghana-upper

[14] What we do > Agricultural Innovation Hub (agricinnovationhub.org)

PICG in Brazil has been operational since 2015. The hub aims to develop low-cost technological solutions that address environmental problems and improve the productivity of farmers. As required, students in technical and vocational education and training partner with various actors, including smallholder farmers and engineering companies. The hub also supports the participation of women, and has partnerships with the other innovation hubs in Brazil (sharing experiences between directors especially), strategic partnerships with the private sector, and collaboration with the local community (UNESCO undated).

The World Economic Forum plans to launch four Food Innovation Hubs[15] to support food system transformation (Beesabathuni et al. 2021). These hubs will be locally driven and owned, include multi-stakeholders, and thus create a community of practice to share learnings and build capacity. According to the World Economic Forum (WEF) website, they intended to catalyze three to four regional/country Food Innovation Hubs leading up to the United Nations Food Systems Summit in September 2021 and indicated that work was underway in Latin America (Colombia), Africa, India, and South-East Asia. The first hubs are being established in India, Europe and Colombia[16] (WEF 2021).

Broad comparison of instruments that support entrepreneurship

Functions and characteristics

Differences: The three instruments in this category differ in terms of the preferred growth stage of the enterprises that they support. Accelerators work with early-stage enterprises that are already up and running, and 'accelerate' their growth. Incubators generally work with entrepreneurs that wish to establish an enterprise – including initiatives that plan to commercialize research outputs. Innovation hubs are closer to incubators in that they support innovators to develop and commercialize innovations.

Similarities: Foremost, they all support the establishment of enterprises, and innovation by those enterprises. Generally, they support a group of entrepreneurs or enterprises, or are normally involved in related fields, even if that is limited to the agricultural sector. They support enterprises that process agricultural produce (such as the business processing shea butter and rice), that provide services to farmers (for example, the entrepreneur in Ghana that provided a market for produce from smallholders and the entrepreneur that provides the innovative financing system) and digital solutions such as providing drone services. These are all interventions aimed broadly at increasing efficiency and productivity within the sector. All three incubators provide networking opportunities for their participants – linking them to other entrepreneurs, knowledge holders, researchers, investors and/or markets. Similarly, all provide business skills training and mentorship support.

According to key informants interviewed as well as evidence from the failure of some initiatives that have been documented in the literature, the key challenge of all the instruments in this category is that if they are established through time-limited projects or programs, then the (financial) support has a limited timeframe and the facilities must find ways to generate income if they wish to sustain

[15] https://www.weforum.org/projects/innovation-with-a-purpose-strengthening-food-systems-through-technology

[16] General information FIH 3 pager .pdf | Powered by Box

themselves (as these are generally entities that should have a longer lifespan than a project). This is the case for several other instruments too (e.g. farmer field schools). Some facilities have used the approach of seeking another funder to continue providing support. In contrast, others have sought to cover their operating costs through mechanisms such as having an anchor tenant or charging participating enterprises for the services (sometimes only once the business is operating successfully) or taking equity in the enterprise. The extent to which this has been successful is unclear as these are generally cited as strategies for survival. The literature review found that several initiatives documented in peer-reviewed articles were no longer functioning. No sign of activity could be found on websites or in any other literature.

Contribution to SAI principles

Table 4 below summarizes the intended impacts of the cases reviewed in the literature for each instrument. This approach is followed for each instrument type.

Table 4. Extent to which evidence from study demonstrates that Type A instruments address principles of sustainable agriculture intensification.

Variable/ Instrument	Impacts sought through the use of the instrument						
	Economic	Productivity	Social	Human wellbeing	Environ-mental	Gender	Youth
Incubator							
Accelerator							
Innovation hub							

Green = all cases sought this impact; Orange = variation across cases related to using a particular instrument; Red = none of the cases reviewed indicate that they sought to achieve that particular impact.

From the literature it was not possible to determine whether the impact(s) targeted was achieved but it is clear that all instruments support innovation that aims to achieve economic, productivity and social impact and human wellbeing. While not directly mentioned by all literature on accelerators, it is a trickle-down effect of positive impacts on economic growth and productivity. The main point to note here is that the cases of accelerators and incubators reviewed in this study did not mention environmental objectives. The focus on gender and youth varied between cases for the instruments in this category, except for innovation hubs, which all intended to focus on youth. However, it should be noted that a focus on gender and youth could be built into the design of the instruments if, for example, it represents a focus of the funder.

Type B: Instruments that primarily finance innovation

While most instruments have multiple functions, some instruments' primary role is to finance innovation processes, including loans, debt, and equity. This category of instruments includes challenge funds, innovation funds and grants, innovation funds for smallholder farmers, prizes and awards and results-based contracts. The main types of innovators financed by each instrument are:

- Challenge funds: private sector, research organizations.
- Innovation funds and grants: non-governmental organizations (NGOs), private companies.
- Innovation funds for smallholder farmers: farmers, local artisans, local agro-processors.
- Prizes and awards: grassroots innovators, teams, private sector.
- Results-based contracts: NGOs, government, private sector.

B1 Challenge funds

Functions and principles

A challenge fund is a mechanism by which a funder can work with non-profit and business organizations to deliver solutions to difficult social problems, for example, related to poverty or environmental degradation (Tjornbo and Westely 2012). The challenge fund distributes (matching) grants (often from government or philanthropic foundations) together with equity participation and guarantees or concessional finance to profit-seeking projects on a competitive basis. Concessional finance includes loans with terms more generous than market loans – either through grace periods or lower interest rates. The funder defines the challenge, while the private sector designs/conceptualizes the solution, provides co-finance and implements the solution (UNDP 2016). Challenge funds stimulate innovation and risk-taking (Pompa 2013) because it is outcomes rather than the method of achieving it monitored by the funder. Thus, this instrument's results-based nature allows for this, as with other similar instruments such as pay-for-success prizes.

Another form of challenge fund is an Enterprise Challenge Fund (ECF), which is used to support the establishment of enterprises. One model for establishing an ECF is for a funder to subsidize private investment by new enterprises that had good medium-term prospects of being commercially viable, but which require subsidies or de-risking mechanisms to be initiated (Davies and Elgar 2014). Generally, the funds aim to support innovative projects that can commercial viability and have substantial social returns and are awarded through a competitive process (Pompa 2013). Some challenge funds also provide technical support to applicants, such as the Innovations Against Poverty Challenge fund of Sida (Andersson et al. 2014).

The costs for administration, financial management, and support activities have been found to range between 15 and 27% for challenge funds (Armstrong et al. 2011[17], cited by Andersson et al. 2014).

Relevant examples

Several challenge funds have been used to support change within the agricultural sector. One of those was Innovation Against Poverty (IAP), a pilot challenge fund launched by Sida in 2011, and implemented by a consortium led by a multinational company.

[17] Referenced in Armstrong et al, Enterprise Challenge Fund for the Pacific and South-East Asia (ECF) Independent Progress Report, October 2011, p. 3 (Cited by Andersson et al. 2014)

With its challenge fund, the IAP program ran until 2015 with a final total budget of SEK 83.5 million. The focus was on poverty alleviation rather than agricultural development but included providing affordable products and services. Of the applications received, 32% were related to agriculture and food. It was open to all countries but had a special focus on Zambia and the MENA and comprised matching grants of EUR 20,000 at the exploratory phase or EUR 200,000 at the piloting phase. An evaluation was conducted in 2014 (Andersson et al. 2014). The initiative provided financial and technical support to the grantees, knowledge exchange and the establishment of a monitoring system. They found that the implementation cost for the implementing agent was 53% of the total program volume based on grants already being disbursed – possibly because it did more than a conventional challenge fund by providing technical support, monitoring, and knowledge exchange.

Malawi Innovation Challenge Fund[18] (MICF) is another example from the literature (UNDP 2016). It is described as a 'competitive and transparent funding mechanism designed to meet the rapidly changing needs of the private sector'. The United Nations Development Programme (UNDP) engaged a private consulting firm, to provide fund management services for 2016 to 2019 (Nathan undated). The MICF provided risk capital in the form of matching grants to allow companies to link small and medium farmers and other enterprises to formal or structured market channels that provide access to higher-value markets and provide opportunities to increase incomes of the poor and the jobs that the economy needs. Since 2014, MICF has supported over 50 innovative enterprises in the manufacturing, agricultural, irrigation and financial sectors (for example, Grantee Roseberry farm[19] producing and marketing vegetables with an outgrower scheme). The challenge fund is still operational, with the most recent funding opportunity being a tourism sector recovery window, where funds have again been made available by UNDP (MICF undated).

NESTA UK is an independent innovation agency that supported the **Big Green Challenge**[20], which ran from 2008 to 2009 and provided a prize of GBP 1 million to community-led initiatives to reduce carbon emissions. The initiative explored the extent to which an outcome-based prize could stimulate innovation in communities and undertook an effective evaluation, drawing lessons about running effective social challenge funds, which are an effective way for funders to manage risk because resources are only allocated once it becomes clear which competitors are most likely to address the identified challenge effectively (Purewal et al. 2010).

The **African Enterprise Challenge Fund (AECF),** established in 2008, is a development institution that supports businesses to innovate, create jobs, leverage investments and markets to create resilience and sustainable incomes in rural and marginalized communities in Africa (UNDP 2016). It is a partnership with the Alliance for a Green Revolution in Africa and Syngenta and received start-up capital from the United Kingdom and Dutch Governments, the Consultative Group to Assist the Poor and the International Fund for Agricultural Development (IFAD). Between 2008 and 2018, AECF supported 268 companies in 26 countries in sub-Saharan Africa across agriculture, renewable energy, climate change adaptation, rural financial services and communication systems (AECF

[18] https://www.nathaninc.com/malawi-innovation-challenge-fund/
[19] https://micf.mw/meet-our-grantees/
[20] https://www.nesta.org.uk/project/big-green-challenge/

undated)[21]. One example of an initiative that the AECF supported was the establishment of a smallholders' pilot scheme to introduce Allanblackia nuts (a low-cost source of vegetable fat for export) in Tanzania. The grant was provided to Unilever for this initiative and benefited smallholders in Tanzania (Kikoki and Rutatin 2006).

Besides challenge funds, other instruments make grants and other forms of funding available to support innovation. These are explored in the next section.

B2 Innovation funds and grants

Functions and principles

Different forms of innovation funds and grants (IF&G) are used to support R&D and innovation. A number of them support innovators (including for-profit and non-profit companies and NGOs) and enhance their links to public institutions, private entrepreneurs, and other actors, such as groups of rural producers (Rajalahti and Farley 2010).

They are increasingly used to stimulate the private sector and farmer engagement in activities related to technology generation, technology dissemination and overall innovation processes. Mechanisms include competitive research grants (CRGs) that provide funding for research through a competitive review process that normally focuses on the relevance and robustness of the proposed research. Another form of innovation grant is a matching grant, structured so that funds from the granting organization (usually a public agency) are matched with funds from the beneficiary, for example, a company engaged in innovation (Rajalahti and Farley 2010).

In some cases, grants are largely used to support innovation at the stage of testing/piloting (when risk is highest). At the same time, loan investments are used to support innovations during dissemination (IFAD 2020). They also allow government or philanthropic organizations to subsidize R&D so that the private sector does not have to internalize the social benefits of the innovation (Howell 2017). Grants reduce the risk for innovating businesses (especially for a new business process) (Ton 2017). Matching grants are increasingly used to promote near-market technology generation, technology transfer and adoption, private economic activity, and overall innovation (Rajalahti and Farley 2010). This is often achieved by including multiple stakeholders in the innovation process. IF&G do not alleviate financial constraints just by providing funding but also increase enterprises' chances of accessing venture capital because they signal grantee quality (Howell 2017). Accessibility of funding schemes can be made more equitable by supporting the development of proposals by marginalized groups or enterprises or using other approaches such as limiting the size of the grants and limiting the size of the companies that can apply (Rajalahti and Farley 2010). This, of course, all depends on the aim of the specific funding scheme.

Relevant examples

Some examples of innovation funds are shared here to demonstrate the diverse ways in which they are funded and implemented. Some are permanent structures that make funds available to support innovation, while others are made available through projects with specific timeframes.

[21] https://www.aecfafrica.org/

The ***Groupe Speciale Mobile Association***[22] (GSMA) Innovation Fund for Digitization of Agricultural Value Chains is a current example where an industry body is supporting innovation within the sector. The fund aims to outscale digital solutions for farmers to improve market access, ensure financial inclusion and improve livelihoods and resilience. It is funded by the UK Foreign, Commonwealth & Development Office (FCDO) and supported by the GSMA and its members. Grants (up to GBP 220,000 per grantee) have been awarded to seven private sector organizations (MTN Rwanda, MTN Ghana, Vodacom Tanzania, Jazz Pakistan, Dialog Sri Lanka, PT Koltiva, Indonesia and Agromall, Nigeria). Each grantee formed a consortium with key local private sector agricultural stakeholders, such as agribusinesses and financial service providers, to launch and/or scale out solutions. The Fund prioritizes enterprise services targeted at organizations and enterprises that source produce from smallholders. GSMA has also contracted a consultancy that will support the grantees with product design (GSMA undated).

The **Civilian Research and Development Foundation**[23] (CRDF) is a US-based public–private partnership that provides CRGs (Rajalahti and Farley 2010). According to the website, the Foundation has several funders, including the United States Department of Agriculture (USDA) Agricultural Research Services, USDA Foreign Agricultural Services, Government of Canada, and US Bureau of Education and Cultural Affairs. It provides grants that support international scientific collaboration in several fields, including agriculture. Agricultural focal areas include commercialization of agriculture technology innovation (Agtech), agribusiness development and strengthening of research institutions and laboratory systems (CRDF undated). There are specific calls advertised on their website for grants, and applicants may only respond according to the requested type of research. There is very little documented on the website in terms of agriculture-related grants that have been disbursed.

Another example of an innovation fund that provides interesting lessons is **Learning and Innovation Loans (LIL)/INDÍGENA**[24], which was piloted in Bolivia between 2001 and 2005 with World Bank funds (Ton 2017). The LILs were the World Bank's customized learning instruments that have since been phased out (World Bank 2014). The LIL/INDÍGENA project evaluation showed that village organizations had successfully generated interest and ideas for economic initiatives. The groups that emerged from these processes often lacked the capacities needed to implement and manage the projects. Economic farmer organizations formally constituted as associations proved better suited to handle these business plans, especially organizations that had existed for some years. Organizations that submitted proposals to the fund experienced long administrative delays (usually several years), resulting in several business opportunities no longer existing when the grants were finally approved (Ton 2017). The World Bank evaluation report (World Bank 2006) provides useful information about such initiatives. It reveals that much of the available funds were not spent due to conflict and bureaucratic challenges. Finally, only 52 out of about 200+ applicants were provided with funds. Contextual challenges that may have contributed to the project's relatively poor performance included a change of government four times, which meant that there was no real, sustainable management body as a result. There was also some elite capture by certain indigenous

[22] https://www.gsma.com/mobilefordevelopment/agritech/innovation-fund/
[23] https://www.crdfglobal.org/grants/funding-opportunities
[24] https://documents1.worldbank.org/curated/en/405961468016779725/text/35911.txt

people organizations. Some of the funded organizations did not exist previously or were not well established, leading to weak project/business plans. This was partly alleviated by the intervention of training and technical assistance. An evaluation of LILs found that despite their intention to be accompanied by effective M&E processes to enhance learning, they did not prove to be effectively implemented relative to other financial instruments. They were also said to be too small to be effective, with a ceiling of USD 5 million (World Bank 2014).

B3 Innovation funds for smallholder farmers

Functions and principles

There is variation within and across these different grants in terms of the extent to which they involve the intended beneficiaries of the research in defining the research agenda or implementing and evaluating the research (Ton et al. 2011). This has led to the introduction of innovation funds for smallholder farmers, which differ in the extent to which farmers manage them.

There are several different forms of innovation funds for smallholder farmers. These instruments allow farmers direct access to resources such that formal research and extension actors do not have complete control over the research agenda (Triomphe et al. undated). They also enhance local innovation (Malley 2012). They acknowledge that smallholder farmers and agribusinesses are not just users of innovations – that they develop their own ideas and continuously improve upon introduced innovations. Local innovation support funds (LISFs) channel small amounts of funds to small-scale farmers for developing their innovations – the farmers are involved in managing and awarding the funds (Friis-Hansen and Egelyng 2007). Innovation funds for smallholder farmers generally rely on providing a grant via a service provider such as an NGO, community-based organization or input supplier. The farmer may or may not manage the grant (Ton et al. 2013; Malley 2012). Another form of an innovation fund for smallholder farmers is a competitive grant program (CGP). Still, these generally focus on commercially oriented farmer groups and small rural businesses and provide larger funding than LISFs. Generally, they support business and market-oriented activities (Triomphe et al. undated).

Sometimes innovation funds for smallholder farmers are used in conjunction with instruments that provide technical and institutional support to the innovation process, such as a farmer research network or local agricultural research committees (*Comités de Investigación Agrícola Local*; CIALs), which are covered in the next section of the report (Ashby et al. 2000; Polar et al. 2012).

It is generally recognized that smallholder farmers require multiple forms of support besides access to financial support (Ton et al. 2013). Farmers often need support with developing satisfactory proposals because of a lack of understanding of some technical aspects such as experimental design (DURAS 2010). Several programs have demonstrated that the governance and disbursement of innovation funds for smallholder farmers benefit from the involvement of high-level (apex) farmer organizations (Ton et al. 2013).

Innovation funds for smallholder farmers do not always make finances directly available to farmers and may use another mechanism to make resources available for innovation processes. For example, voucher systems have proven to lead to the uptake of practices that enhance innovation in the farming system. The extent to which voucher systems can enhance innovation depends on their design – for example giving a menu of options rather than a standard technology package. Input vouchers have

also proved effective as a mechanism to establish input supply chains in rural areas by providing sufficient demand for inputs in areas that have not previously been serviced (Ton et al. 2013). A new initiative that plans to use vouchers is the EU-funded S3FOOD project (**S**mart **S**ensor **S**ystems for **Food** safety, quality control and resource efficiency in the European food processing industry), which aims to modernize and digitize the food processing industry by supporting innovative SMEs. The program will offer three types of vouchers: Exploration, Validation and Application vouchers (maximum amount per SME being EUR 15,000, EUR 60,000 and EUR 60,000 respectively) depending on the Technology Readiness Level of the solution. For successful proposals, the amount requested will be provided as a lumpsum, and the monitoring will evaluate expenditure relative to achieved results (S3Food 2020).

Another option is business development grant systems (competitive grants), which focus on activities organized by groups of farmers that have some form of collective action (e.g., process or add value to their produce collectively) or enterprises that source from smallholders. These grants facilitate innovation in rural areas by enabling farmer organizations to seize business opportunities that they encounter, but social capital is a prerequisite for their effective use. Another interesting option is service voucher grant systems, which supports farmers and incubates some new service providers. With this arrangement, farmers can draw from a specific pool of service providers to develop knowledge, provide extension services or provide business support (Ton et al. 2013).

One of the suggestions from a key informant interviewed during the study was that funds for innovation should be administered in a business-like fashion and should be revolving; otherwise, they just get used up. An example used was that of the Nigerian Organic Agriculture Network, now the Association of Organic Agriculture Practitioners of Nigeria. The organization established the Organic Agriculture Innovation Platform[25] that made revolving funds (essentially loans) available to farmers. Still, no further detail was available regarding the effectiveness and longevity of the initiative.

Relevant examples

Different forms of innovation funds for smallholder farmers have been applied within different contexts. For example, in Uganda, the National Agricultural Advisory Services (NAADS) had a program that focused on providing extension support where the farmers had control over the service providers, which also supported some farmer experimentation. Farmer groups contracted service providers that provided advisory services and started by establishing a technology development site (experimental plot). However, farmers wanted access to inputs and support accessing markets (Ton et al. 2013). The NAADS approach required the establishment of farmer groups. Often, the members were more affluent than average farmers – when they realized that there was no access to inputs, the groups reorganized and focused on agricultural experimentation. The groups were represented by sub-county farmer forums, which were represented at district forums. Another challenge was that it focused on technology transfer and did not shift research focus to include farmers' own experimentation/innovation (Ton et al. 2013).

Small innovation funds have been a key element of CIALs established in Colombia. The International Center for Tropical Agriculture (CIAT) introduced CIALs in the early 1990s. As a farmer-led research service, they have been used to reduce costs and risks of experimentation (Ton et al. 2013). They are discussed in more detail in the next section of the report, only considering the funding element.

[25] https://www.facebook.com/Organic-Agriculture-Innovation-Platform-Nigeria-115193776978638/

The CIAL fund is an essential ingredient and not an optional extra – it covers the costs of experimentation. Generally, the CIAL funds received a one-off donation of seed funding from the facilitating organization (Ton et al. 2013). Replenishment of funds can be through the participants' enterprises, membership fees and applications to potential funders.

Prolinnova[26], a global network, has piloted LISF in various countries in Asia and Africa through the Farmer Access to Innovation Resources (FAIR) project (DURAS, 2010). The LISFs allowed small amounts of funds to be channeled to small-scale farmers, who then governed the funds themselves and engaged in innovation (Triomphe et al. undated). The FAIR project was initiated in 2005, starting with a feasibility study. One of the countries was Cambodia, and funds were released between March and October 2007 to 10 farmer groups. The implementing agencies and the LISF secretariat allocated the funds through the farmer associations to use as revolving funds. The program required two levels of institutional set-up comprising a national LISF committee and a local farmer association committee. The farmer association (farmer association committee) collated proposals for farmer experimentation from its members and submitted a proposal to the LISF committee. The farmer association committee was responsible for informing members about funding availability, developing the overall proposal, and managing the funds received. If the experiment failed, the farmer was not expected to pay back any interest on the initial seed money. One important lesson was the need to limit the use of the funds to experimentation activities and not just for expanding their businesses (Sam 2008). The FAIR project was also implemented in Tanzania, under the direct management of PELUM Tanzania, with a grant from the Rockefeller Foundation. It started in 2008, with selected districts within two zones that represented different agroecological zones. Structures were established at the zonal level reviewed proposals, while farmer innovator groups at the community level implemented the experimentation activities with government and civil society organization staff support. At the community level, the innovators managed the funds according to their activity plan. Individual grants ranged between USD 180 and USD 725. Some supporting organizations made direct payments to the farmer organizations, while others had systems that only provided inputs. These factors impacted the time to process applications, which were 392 and 79 days on average for the two pilot zones. An impact study found that farmer innovators had increased confidence due to their being recognized by the community (Malley 2012). Unfortunately, this was a pilot project. During the project's timeframe, it was not possible to find a mechanism to institutionalize the approach so that replenishment would be possible.

The GTZ-funded Small-scale Project Fund (SSPF) made funds available to support self-help groups, via a third part, to test and apply small innovations related to construction technology, renewable energy, sustainable land experimentation management, processing technologies and water recycling (Friis-Hansen and Egelyng 2007). The SSPF was an initiative of the GTZ program called the German Appropriate Technology Exchange, and it aimed to support the testing and dissemination of innovative technologies (Eldis undated). It relied on standard GTZ procedures for fund management. In terms of transaction costs, it took three to four months to process applications (each < USD 20,000), and the approach was probably not cost-efficient due to small grants being

[26] https://www.prolinnova.net/

administered. Furthermore, there was no replenishment strategy. Project liaison persons, independent experts known to GTZ, assisted communication between the executing organization and GTZ. The program was completed by the end of 2005, and there is very little information available about the program's impact, especially in English (Friis-Hansen and Egelyng 2007).

The last example presented here documents an interesting approach used to support farmers with developing proposals to apply for grants. Using participatory video (PV), five farmer groups were invited to apply for the grants using a 'video proposal' as part of a participatory action research process within the context of two ongoing agricultural research for development initiatives in Tanzania and Kenya in 2014. Group members collaboratively produced videos representing their problems, aims and innovation plans. The PV proposal process proved to be effective in motivating the farmers and creating ownership of the innovation process and allowed them to prepare a satisfactory proposal that would have been difficult if they had been required to use a conventional method, given existing levels of literacy and proposal writing capacity. While the cost of the action research project is not provided, the cost could be a factor that restricts the use of PV for proposal development outside of donor-funded projects (Richardson et al. 2019). It is likely that the process would still require support even though smartphones are fairly widespread now, and there was no evidence found to indicate that the approach was used outside of this particular research project.

B4 Prizes and awards

Functions and principles

The purpose of some initiatives that use prizes and awards is to incentivize participants to solve societal challenges and may even lead to major breakthroughs (Tambo 2018), while other initiatives recognize grassroots innovation that can potentially impact local contexts (NIF undated). They have the potential to accelerate and guide innovation or R&D processes (Cunningham and Cunningham 2016). Some schemes aim to recognize innovation by farmers to draw attention to the capacity of farmers, given that this is often not acknowledged (Tambo 2018).

Prizes that aim to induce innovation offer a reward to one or more entities who first, or most effectively, solve a pre-defined challenge. The reward is often financial but can also include additional support, such as technical assistance. While most prizes are awarded once the solution has been developed (i.e. *ex-post prizes*), some schemes award the prize based on a proposal and pay against predetermined milestones (i.e. *ex-ante prizes*). With ex-ante prizes, the funder has an opportunity to observe the R&D or innovation process before the results are known. Another type of reward mechanism is the proportional prize reward. With this prize, the funder chooses a continuous measure of impact, and the sponsor pays out based on the level of success achieved (Cunningham and Cunningham 2016). The timeframes of prize schemes vary depending on the field in which the innovation is being undertaken.

Prizes are distinct from other funding sources because they are temporary and additional. They usually do not cover the cost of innovation but provide some additional funding as a reward. This means that applicants need to have funds available themselves or some other source to invest in the R&D or innovation process (Cunningham and Cunningham 2016). The outcome must have a direct benefit for the innovator, given that the financial reward will not cover the innovation process itself.

Relevant examples

The **AgResults**[27] Program, supported by various multi-laterals, bilaterals and foundations, uses pay-for-results prizes to incentivize the private sector (e.g. agribusiness and livestock vaccine manufacturers) to invest in agricultural innovations that can have substantial impacts on the smallholder sector by strengthening food and nutrition security as well as livestock productivity. AgResults provides results-based monetary prizes to companies that meet pre-set criteria. This is in line with AgResults aim to overcome market failures. In this case, the model is similar to challenge funds that encourage (and fund) applicants to solve a challenge. At the same time, most awards aim to encourage innovation rather than cover the innovation process's total cost.

One of the projects that are still underway is the Foot and Mouth Disease (FMD) initiative. Over eight years, animal health companies interested in participating and incentivized to invest will develop and distribute a high-quality vaccine expected to reduce productivity losses and livestock owned by smallholder farmers[28]. The FMD initiative, which has a budget of USD 17.68 million, has two phases; the first phase, called the development phase, encourages the production of vaccines relevant for East Africa. The second phase is a cost-share phase where AgResults has committed to pay the vaccine manufacturers a portion of the purchase price to make the vaccine more affordable and stimulate its adoption (Hammond et al. 2021).

One AgResults initiative that has been completed is the Kenya On-farm Storage Challenge Project that ran from 2014 to 2018, with a budget of USD 12 million. It encouraged private sector competitors to develop, market and sell storage solutions to smallholder farmers. Eligibility to participate in the competition required that they reached a predetermined sales threshold. The structures had to control large grain borers effectively. Multiple companies that meet the threshold are eligible for a performance-based grant. However, the evaluation undertaken revealed some key lessons. For example, only competitors with access to finance could reach the threshold within the specified period. Smaller competitors would have benefited if prizes were associated with lower thresholds or annualized thresholds that released grant finance (AgResults undated). Note, pay-for-results prizes are similar to results-based contracts, which are discussed in the next section but differ in that several innovators/companies compete for the available funds. There is a benefit for them to meet the required criteria ahead of their competitors.

The **National Innovation Foundation-India**[29], an initiative of the Department of Science and Technology of India, builds on the Honeybee Network. It promotes grassroots innovation and traditional knowledge by awarding prizes. The most recent application call was in 2019 (The 11th National Biennial Competition for Scouting Green Grassroots Unaided Technological Innovations Traditional Knowledge). According to the announcement, outstanding entries received monetary rewards and support with prototype development and scaling up if they had sufficient potential for societal impact. The size of the awards offered in the announcement ranged between USD 1,400

[27] https://agresults.org/our-approach

[28] https://agresults.org/news-and-blog/fmd-vaccine/10-blog/156-new-agresults-project-encourages-fmd-vaccine-development-and-uptake-in-eastern-africa

[29] www.nif.org.in

and USD 10,500[30]. Details about the awards made for each call are available on the website, including 58 awards for very diverse innovations for 2019[31].

Another initiative that has used prizes is **Ideas to Impact[32] (I2I).** This action research program funded by UK Aid has used prizes to induce participants to solve a particular development challenge related to water and sanitation, energy, climate change adaptation, and mobility (Gould et al. 2020). Some advantages of this approach are that awareness is raised about the issue, and partnerships are facilitated. The prizes were awarded through participants fulfilling certain judging criteria (e.g. focusing their solutions and actions on benefiting the poor). It is being implemented in Ghana, Kenya, Rwanda and Nepal. The I2I program tested five prizes, namely the Global Leap (Off-grid cold chain and Off-grid refrigeration technologies), Dreampipe I and II (looked at reducing non-revenue water reduction in systems), Adaptation at scale (rewarded community-driven adaptation in Nepal), sanitation challenge for Ghana, Lake Victoria Challenge in Tanzania (this focused on drone technology) and the Climate Information Prize in Kenya (this rewarded innovation aimed at making climate information available to farmers), which were mainly results-based prizes (I2I website). The main advantage of using prizes is that multiple participants, using different approaches, work to solve a given problem, leading to innovation (Stott et al. 2020). Evaluation of the I2I initiative found that it achieved broad stakeholder engagement, an essential component of such a program. The program also achieved or exceeded expected outcomes in terms of value for money (Stott et al. 2020). An evaluation of one of the I2I initiatives called the 'Adaptation at Scale Prize' highlighted the challenges that small organizations with limited resources face when needing to invest upfront in order to participate in a prize without the guarantee of winning (I2I undated).

In Ghana, there was a **farmer innovation contest** sponsored by the German Federal Ministry of education and Research and implemented by the West African Science Service Centre on Climate Change and Adapted Land Use in collaboration with the Center for Development Research at the University of Bonn. The objective of this project was to identify farmer innovations and use an innovation contest with awards that functioned as an incentive for farmers to share their innovations. Interestingly, the contest surfaced existing innovations rather than encouraging the development of new ones (Wünscher 2017).

B5 Results-based contracts

Functions and characteristics

Another instrument that offers opportunities for supporting innovation is the results-based contract (RBC) – which is sometimes called a pay-for-success project (Deloitte 2015). Other results-based financing includes development impact bonds, social impact bonds, cash on delivery, output-based aid, performance-based loan and program for results (GPRBA 2018). They are similar to the results-based prizes described above RBCs are not implemented via contests where multiple companies are competing to be the first to reach a pre-defined solution. The advantage of results-based approaches is that they increase the focus on results and ensure accountability. They also appear to be an effective

[30] https://nif.org.in/dwn_files/announcement.pdf
[31] https://nif.org.in/biennial-award-function/22
[32] http://www.ideastoimpact.net/

way to involve private companies in addressing development challenges. However, the risky nature of agricultural research raises concerns as contractors may not be willing to take the risk unless the risk is priced into the contract. Contracts are designed and managed to align with strategic goals and outcomes, with agreements about the amounts of finance released if outcomes are achieved (Deloitte 2015). The instrument requires effective data collection and monitoring to manage the contract. Generally, the contracts are less specific about achieving the outcomes, which leads to more innovation (Janus and Holzapfel 2016). Many service providers that do not have the resources to invest upfront in the innovation process rely on finding another investor to cover the working capital (Deloitte 2015). Several investors are seeing the benefit in sponsoring the working capital because they will (should) be reimbursed when the outcomes are achieved and the main sponsor/funder releases the agreed-upon amount to the service provider/innovator – these are also known as development impact bonds (Janus and Holzapfel 2016).

Relevant examples

There has been very little experience developing impact bonds in the agricultural sector, particularly within an emerging economy. Impact bonds generally involve four actors: investor, service provider, outcome sponsor, and verifier (Belt et al. 2017).

In Peru, a development impact bond (Asháninka impact bond) aimed to strengthen cocoa and coffee production was launched in 2015 (Janus and Holzapfel 2016). The actors involved in this pilot initiative, which aimed to test this approach to funding development, included the Common Fund for Commodities[33] (CFC) – as the outcome sponsor, the Schmidt Family Foundation – as the investor, Rainforest Foundation UK– as the service provider, and the Royal Tropical Institute (KIT) – as the verifier. Thus, the Schmidt Family Foundation pre-financed the Rainforest Foundation UK to cover the costs of implementing the development impact bond's project activities. The Rainforest Foundation UK performed all activities with its partner organizations in Peru and was required to achieve the results defined by the development impact bond. CFC was the outcome sponsor committed to pay the investor for the results achieved, up to a maximum of USD 110,000 and lastly, KIT, as the independent party, was responsible for verifying the accomplishment of the jointly agreed results. While this particular initiative sought results such as 60% of members having improved their yields above a predetermined threshold, it would be useful to see what role innovation played in achieving these results. The agreement was that if the target for an indicator were 75% achieved, the outcome sponsor would reimburse the investor 75%; when 50% was achieved, the sponsor would reimburse 50%, and the outcome sponsor would not pay anything to the investor for targets which were not achieved. Ultimately, the target for the first outcome was 75% achieved, the target for the second outcome was not achieved. In comparison, the targets for outcomes three and four were both 100% achieved and the Smith Family Foundation, as the investor, was reimbursed accordingly (Belt et al. 2017).

Another case that was identified was the development impact launched by Village Enterprise.
In 2017, which saw USD 5.32 million being made available for poverty alleviation. The initiative supported first-time entrepreneurs to establish micro-enterprises and business savings groups. The performance outcomes were identified as increases in consumption and net assets. The outcome

[33] https://www.common-fund.org/completed-project-sustainable-cocoa-and-coffee-production

payers were the United States Agency for International development (USAID), US Development Innovation Ventures, the UK Foreign, Commonwealth and Development Office and an anonymous fund. They agreed to pay back Village Enterprise and its investors (pre-financers) the original investment plus a financial return if Village Enterprise delivered the outcomes (Village Enterprise undated).

Comparison

This category of instruments, which focus on providing financial resources for innovation, include challenge funds, IF&G, innovation funds for smallholder farmers, prizes and awards, and RBCs.

Functions and characteristics

Differences: The main differences between these instruments is that challenge funds, ex-post prizes (but not the case for ex-ante prizes) and RBCs all reward innovation that has led to an effective solution, while IF&G including innovation funds to support farmer innovation, make funds available upfront to support innovation. This has implications for the types of organizations that can participate in and benefit from schemes that use these instruments. The private sector can participate in these schemes that pay for results/success as they have the financial backing to innovate at risk. These instruments that focus on the result rather than the process should potentially allow more space for innovation by companies. Challenge funds that aim to support enterprises in developing countries need mechanisms to make funds available against milestones and provide technical support (and require matching funding from the recipient). The operational design of challenge funds has to be adapted to the context in which it is being used.

IF&G are highly variable in terms of their target beneficiary (e.g. private companies, NGOs, etc.) and operational design (e.g. what structure screens proposals and disburses funds), as are innovation funds for smallholder farmer innovation. Some programs make funds available as grants and others as matching grants, requiring co-funding from the applicant or loans. Generally, grants cover risky sections of the innovation pipeline, while loans cover upscaling and market penetration. There is variation across all these instruments (and within some of them) regarding the extent to which farmers (as users and innovators) are involved in the innovation process. Clearly, innovation funds for smallholder farmers place the greatest emphasis on including the farmer as an innovator. Most of them aim to reduce the risk associated with innovating – but this also depends on how the instrument is structured. For example, a challenge fund will not reduce risk unless there is assurance that the competitors will receive some financial benefit. In contrast, prizes do not reduce the risk unless they are ex-ante prizes (that make payments based on a proposal), and even so, prizes are not designed to cover the full cost of the innovation process.

A key difference between pay-for-results schemes or RBCs and conventional IF&G is that the former reduces the funder's risk (and transfers it from the funder to the innovating party) by committing to only pay if an effective solution is achieved. This is risky for organizations conducting research because of the inherently risky nature of research and would need to be addressed in the agreement's design.

Similarities: What is clear from the discussion above is that while they all provide some form of financial support for innovation, there are substantial differences across the instruments in this category. However, some show greater similarity (for example, pay-for-results prizes and RBCs have some similarities, although the latter generally commit to cover innovation costs while prizes generally only reward innovation). Many of the instruments can be designed to meet certain objectives, such as

allowing a certain beneficiary group's participation or driving the development of solutions for a societal challenge. The examples above provide some examples of how investors and funders have achieved this using the instrument selected for their program.

Contribution to SAI principles

From Table 5 it is clear that all these instruments have been used in programs that aim to achieve SAI's multiple objectives. However, the extent to which they have contributed meaningfully to achieving these objectives is not always clear. Some examples documented above are still underway, and not all the completed initiatives have been evaluated sufficiently rigorously to provide this evidence. However, there are opportunities to design them to address the principles of SAI, especially in terms of the criteria for awarding funds.

Table 5. Extent to which evidence from study demonstrates that Type B instruments address principles of sustainable agriculture intensification.

Variable/ Instrument	Impacts sought through the use of the instrument						
	Economic	Productivity	Social	Human wellbeing	Environ-mental	Gender	Youth
Challenge funds							
Innovation funds & grants							
Innovation funds for smallholder farmers							
Prizes and awards							
Results-based contracts							

Green = all cases sought this impact; Orange = variation across cases related to using a particular instrument; Red = none of the cases reviewed indicate that they sought to achieve that particular impact.

What is clear is that innovation funds for smallholder farmers have focused on including women but have not been found to focus on youth. This could be because agriculture is an aging sector, and most efforts to target youth have focused on agribusiness support (for example, incubators) rather than on primary production. The examples of RBCs have seen more focus on achieving broad societal or human wellbeing impacts and have not focused on women or youth. The role of insurance for innovation was also explored: the need to de-risk innovation was mentioned in a number of publications that were reviewed, but it was not considered as an instrument in the study (Box 2).

The next category of instruments focuses on those that allow for the development of innovations within real-life contexts, and there is some overlap with the instruments described above.

Box 2: Insurance for innovation

Related to the instruments that provide financial support for innovation is innovation insurance. This mechanism reduces the risk farmers, or other actors face if they wish to test new practices or innovations. Farmers do not adopt many innovations, such as high-yielding varieties or new fertilizer application processes, or adoption is delayed due to perceived risks (De Janvry et al. 2016; Hellin et al. 2017). This is especially the case for small-scale farmers (Herdt and Dehn 1978). Similarly, the uptake of conservation agriculture practices such as integrated pest management and split fertilizer application are the kinds of practices that farmers find risky to test/adopt.

Some examples of insurance are used to encourage innovation were encountered in the literature. The Global Environmental Facility (GEF) has promoted blended finance solutions (mainly non-grant instruments such as debt guarantees and equity) for de-risking innovation in high-risk areas such as land degradation and loss of biodiversity, where perceived risks are too high for commercial finance alone (GEF 2019). Piloting Innovative Investments for Sustainable Landscapes[34] was a GEF-funded project initiated in 2017 that piloted the de-risking of private finance in sustainable landscapes in Brazil, Indonesia and Liberia. The project objective was to maintain, restore or increase forest cover while intensifying agricultural production and improving the livelihoods of smallholders. The anticipated outcome was that private finance would be leveraged on a 5:1 ratio due to the de-risking funding provided by the &Green Fund in the seven landscapes across the three countries (GEF 2017). The example above does not clearly illustrate that innovation was supported within land management practices. A non-agricultural example that more clearly demonstrates innovation toward addressing environmental challenges is the GEF–International Finance Corporation (IFC) Green Shipping Initiative, which will establish a financing platform to accelerate fleets' retro-fitting to increase fuel efficiency. It will provide a de-risking structure that enables initial anchor investors to test the financial model and unlock private sector financing for greener shipping (GEF 2020).

Unfortunately, very little literature is available about current efforts to de-risk innovation for farmers. According to Cubie (1999), the agricultural insurance division of IGF Insurance intended to offer a policy to guarantee a new, innovative recommendation by a crop advisor that differed from the standard practice for the control of corn rootworm beetles. Tt was to cover the cost of a rescue spray if the scouting approach did not work and would be adjusted using a yield-loss predicting test. Similarly, the Agricultural Conservation Innovation Center, a non-profit partner with Natural Resources Conservation Service and the US Environmental Protection Agency, wanted to incentivize farmers to test the system of split fertilizer applications because it reduces the amount of fertilizer leached into water ways and ground water. Since split applications may be disrupted by rainfall events that prevent the farmer from accessing the field, they developed a rainfall-based risk management policy that indemnified the farmer if excessive rainfall occurred. It is not clear whether either of these policies was ever operationalized, but they demonstrate how de-risking mechanisms can encourage innovation.

[34] https://www.thegef.org/project/piloting-innovative-investments-sustainable-landscapes

Type C: Instruments that support innovation within real-life contexts

Four of the investigated instruments focused primarily on ensuring the involvement of farmers (and rural enterprises) as active participants in the innovation process – as with the innovation funds that support smallholder farmers (B3), rather than being passive recipients. These instruments included in this section include innovation platforms, living labs, farmer research networks and farmer field schools.

C1 Innovation platforms

Functions and principles

An innovation platform is a network of different actors (e.g., farmers, traders, processors, extension agents, researchers, government officials, etc.) that set themselves up around a particular commodity to collaboratively achieve a joint objective (Boogard 2013, Homann-Kee et al. 2013). The actors collectively identify agricultural challenges and develop solutions (Dondofema and Grobelaar 2020). They provide a space for learning and exchange and generate innovation, and sometimes they are used to operationalize research outputs to generate goods and services (Fatunbi et al. 2016). While those established at the regional or national level may be important for providing strategic direction, local-level innovation platforms are most likely to engage directly in innovation processes. They can combine indigenous knowledge, business interests and organizational skills of stakeholders to generate innovation (Nederlof et al. 2011). Actors may have divergent and even competing ideas and values, and the platform needs a strong facilitator who also acts as an innovation broker with specific skills requirements. Facilitators need to effectively manage power asymmetries (e.g. between different actors, especially in marginalized groups, including women). This may also require the design of activities in terms of time and locality to allow for the participation of women. Hand-over of the role of facilitation of the platform to an insider (local actor) may sustain the platform in the long term (Swaans et al. 2013).

One of the KIs with extensive experience with platforms indicated that some had been established to catalyze the adoption and dissemination of proven technologies and best practices. In this case, these targeted technologies are fed into the innovation platform for testing. One assumes that the platform members give attention to farmers' views and modifications that emerge from testing under local conditions. Innovation platforms are dynamic, and people/organizations can enter or leave at will, or change their roles as needed (Nederlof et al. 2011).

During one of the KI interviews, the need to use the market as an entry point for a commodity-focused innovation platform was highlighted. It was suggested that if an agreement is established [with a retail outlet or processing facility] that defines the quantity and other requirements that the market will buy, then the platform can be designed to ensure that effective demand is meeting a ready supply, which determines the number of producers required to meet the demand, as well as the technologies that are needed, which in turn informs the types of actors that need to be invited to participate.

Relevant examples

Several organizations and programs have promoted innovation platforms, including FARA and PAEPARD (Fatunbi 2016). Some of the relevant examples encountered through the study are shared here.

The Australian Centre for International Agricultural Research (ACIAR) funded a project called **Increasing irrigation water productivity in Mozambique, Tanzania and Zimbabwe through on-farm monitoring, adaptive management and agricultural innovation platforms**[35], which ran from 2013 to 2017 and had a budget of AUD 3.4 M for work across the various countries. In Mozambique, the activities occurred within a communal irrigation scheme south of Maputo called the 25 de Setembro irrigation scheme. When the project was initiated, the scheme had 38 members, of which 16 were women. The first meeting of the agricultural innovation platform took place in 2014. It included the irrigation farmers from the scheme and a range of stakeholders, including government departments, foreign donors, input suppliers, financial institutions and the farmers' union. The stakeholders collectively engaged in a visioning process and identified barriers to be overcome. Outside of the main meetings, there were informal meetings between small groups of stakeholders that were reported on to the national irrigation institute (INIR), which was coordinating the platform. There was a very strong participation of farmers in the innovation platform. Some of the identified challenges were outside of the platform members' scope. These were then passed on to the Mozambique Government by INIR, particularly the need to refurbish the irrigation infrastructure. In 2015, INIR managed to secure funding for refurbishing 3 km of the canals based on the shared identification of problems.

Furthermore, the finance organizations agreed during the platform meetings to provide credit to the farmers. The platforms also allowed farmers and buyers to enter into a functional relationship. The platform meetings also led to discussions about how to bring fallow plots back into production as some of them belonged to deceased farmers or to people that had left the area, while a group of seven young farmers were able to secure access to irrigation plots and the farmer association undertook to mentor them. The meetings also showed even participation of men and women farmers, indicating that both genders were comfortable within the space. The platform effectively introduced new stakeholders to the scheme, and the farmers improved their understanding of the value of information (Chilundo et al. 2020).

Innovation platforms have also been used to scale up the dissemination and adoption of agricultural technologies. This initiative, while led by the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), included scientists from the National Agricultural Research Systems and their local partners from six countries (Democratic Republic of Congo, Ethiopia, Kenya, Tanzania, Rwanda and Uganda) and staff from the International Potato Centre (CIP) and the International Maize and Wheat Improvement Centre (CIMMYT). The publication covers the innovation platforms that were established through the project titled **Dissemination of New Agricultural Technologies in Africa**, which was part of the broader Africa-wide project known as the "Promotion of Science and Technology for Agricultural Development", which was supported by the African Development Bank. The 49 innovation platforms' main objective was to scale up Quality Protein Maize and Orange-fleshed Sweet Potato. Some of the approach's benefits included improved coordination and communication among development agencies, ministries, research centers, private sector and NGOs. Some emerging principles summarized in the report include (1) ensuring a diversity of actors, (2) having a suitably skilled champion for the platform with good

[35] https://www.aciar.gov.au/project/fsc-2013-006

brokering capabilities, (3) a strong host organization, (4) effective governance of the platform, (5) good communication allowing for a flow of information, (6) innovative behavior to address challenges and exploit opportunities that emerge. It is also important to be aware of the relatively high cost of organizing, coordinating and facilitating platform operations and activities (Kimenye and McEwan 2014).

An example of governments' innovation platforms is India, where the government has announced the launch of six technology innovation platforms. The purpose of the initiative is to strengthen the manufacturing sector by developing innovative, indigenous technologies. The program will also organize challenges and contests to drive the development of technologies, demonstrating the benefits of combining instruments (India Brand Equity Foundation (IBEF) 2021).

C2 Living labs

Functions and principles

Living labs can be described as facilities or spaces (e.g. a selected village or group of households) that are user/citizen-centered and allow for user co-creation. The living lab allows creating, testing and validating new technologies within a real-life context. The users are involved in this process from an early stage, which allows for a socio-economic assessment of the innovations (Robles et al. 2015; Cunningham and Cunningham 2016). A current example is a Dutch-funded project in South Africa that brings Dutch and South African students together at the Durban University of Technology (virtually) to develop solutions to some challenges the municipality faces with water services provision (DUT undated[36]).

Living labs provide a neutral area for stakeholders to co-develop innovations. Some living labs focus on ICT and digitalization (Masi 2016), while others address social needs and broad community challenges (Musikoyo et al. 2017). Some living labs are physical spaces that house the stakeholders that are participating in the innovation process (Bronson et al. 2021) – similar to innovation hubs but essentially supporting more co-creation, while others are the community or village where this is occurring (Nylstrom et al. 2014; Aggarwal et al. 2018). Whatever the nature of the living lab, a coordinator is required to initiate and promote activities, and there is a clear role for brokers or intermediaries within a living lab (Nylstrom et al. 2014) – they are explored in the next section of the report in the category of Instruments that Enable Innovation. Users are key stakeholders in the co-creation process because they act as informants, understanding the users' environment, which is essential for the innovation design (Nylstrom et al. 2014).

An interesting point was raised during a KI interview that the participants of a living lab or similar instrument will remain as long as there is a perceived benefit. Drop out of participants from programs is normally recognized as a failure, and yet in one program involving living labs, it was found that some of the participants left because they had received what they needed from the program. This was especially the case for participants that had existing businesses when they joined the living labs program.

[36] https://www.dut.ac.za/iwwt/iwwt-research-2/

Relevant examples

Some diverse examples of living labs are shared here to illustrate the contexts in which they have been or are currently being used. It is important to note that there are also living labs established through no longer operational projects[37], which, as mentioned above about Type A instruments, highlights the challenge of self-financing beyond project timeframes. Several living labs are still in operation and can provide some lessons.

The **Metro Agri-Food Living Lab (MALL)** in Kenya was established through a collaborative effort involving the United States International University-Africa (USIU), Michigan State University, License to Grow and VHL University of Applied Science. It was funded by the International Development Research Centre (IDRC) and the ACIAR and ran over 18 months between 2015 and 2017. It was titled: Expanding Business Opportunities for Youth in the Fish and Poultry Sectors in Kenya. The initiative aimed to scale up technical and institutional innovations (such as novel marketing arrangements) and support youth, specifically women, to establish agribusinesses and the USIU used this as an opportunity to pilot its MALL model. The action research component of the project was aimed at drawing lessons regarding the application of the MALL model. During the pilot (action research) phase, the initiative supported approximately 200 youth (Musikoyo et al. 2017). While the overall MALL can be seen as an institutional innovation, the project also demonstrated the capacity of some of the youth to adapt and innovate. Building on the initial project, the ACIAR continued to support the MALL in partnership with IDRC and ran another project from 2018 to 2020 with a budget of AUD 741,000 that sought to further explore the effectiveness of the MALL for gender-inclusive youth entrepreneurship development in Kenya. While it was initially envisaged that the facility's focus included supporting innovation, the results documented indicate a greater focus on supporting entrepreneurship. For example, it was documented that it increased the number of participants to 1,200 and expanded the range of businesses beyond poultry and fish. In addition, it created benefits for an additional 15,000 youth as employees, suppliers and mentors[38] (ACIAR 2021).

Another example of a living lab providing business opportunities is the **Elimu Living Lab Elabs** in Sengerema, Tanzania (Cunningham and Cunningham 2016). Elimu LL provides an innovation space where computers, wireless internet, and other ICT equipment are available for the community members. Some of the innovative businesses that have been established are the manufacture of petroleum jelly, construction of water containers from recycled plastic water bottles, running a daycare center and developing an IT-based result management system for schools (Hooli et al. 2016). Its website describes it as a *social innovation hub* using innovation to reconstruct communities, youth and business incubation[39]. This description again highlights the interchangeability with which these terms are often used. Elimu Living Lab was established in 2012 by a passionate individual, Novat Karol, who wanted to make a difference within his community. He describes a living lab as a methodological approach focused on end-user driven open innovation.

[37] An example of this is the Siyakula Living Lab (SiLL) in South Africa, that was documented by Coetzee et al. (2012). There is still a website for the living lab (https://siyakhulall.org/), but there have been no updates on the website since 2015.

[38] https://www.aciar.gov.au/project/gp-2019-172

[39] https://www.facebook.com/elimulivinglab.elabs

End-user communities collaborate with various actors in the innovation system in real-life settings to co-create innovative products, services, processes and business models, sometimes adapting existing ones[40] (BizzAfrica 2021). While in Europe, the main role of living labs is to support co-creation between companies and end-users, in Tanzania (specifically in the Pamoja network), the focus has been on building community capacity to solve challenges themselves (Hooli et al. 2016).

Another living lab in Kenya is **Nakura Living Lab**, established through the REFOOTURE project (Food Futures Eastern Africa), which will also establish living labs in Ethiopia and Uganda (WUR 2021). The REFOOTURE[41] project was initiated in 2020, when Wageningen University & Research (WUR) and IKEA Foundation entered into a three-year collaboration. In total, IKEA Foundation has made approximately EUR 3.25 million available for the broader project. Egerton University also supports the Nakura Living Lab. The Nakura Living Lab[42] focuses on innovation for inclusivity, covering areas such as livelihood diversification, diversification of dietary sources, youth and women employment and entrepreneurship, affordability of basic necessities like energy, food, water, and closing the gap between formal and informal markets. One example on the Nakura website is the establishment of the Wanyororo Dairy Cooperative, where the members are marketing collectively, which is improving their milk price, and they have registered a trade name, Nakuru Fresh. They are also seeking to foster the integration of crop and livestock components and to close nutrient loops (Nakuru Living Lab undated).

The Agrolab[43] of the University of the Andes[44] is a facility established in 2019 that allows for collaboration and co-creation in the field of urban agriculture (Osma et al. 2019). Food production technologies and strategies within the facility are being explored and compared, generating educational and research outcomes. A key objective is to combine traditional experience and other sources of knowledge. Systems being investigated include vertical farming, hydroponics, aquaponics, and a robot that automates various farming activities, known as FarmBot Uniandes (Murcia et al. 2021).

Another concept closely aligned with living labs but focused on climate change adaptation is **climate-smart villages (CSVs).** Climate-smart villages are platforms that support adaptation efforts and build the capacity of local communities to adapt. CSVs provide a space where different stakeholders can collectively plan and implement interventions (Vidallo 2020).

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS[45]), which is a collaborative effort of The International Rice Research Institute, CIAT and the International Institute for Rural Reconstruction (IIRR), initiated smart climate villages in East Africa, West Africa, Latin America, South Asia and South-East Asia (Cambodia, Philippines, Myanmar and Vietnam) in 2011. The CCAFS program has a range of donors, including multi-laterals and bilaterals. In the

[40] https://bizzafric.wordpress.com/2020/04/29/meet-novat-karol-the-founder-of-elimu-living-lab/
[41] https://www.wur.nl/en/newsarticle/First-Eastern-African-food-systems-oriented-living-lab-opens.htm
[42] https://www.nakurulivinglab.org/nakuru-living-lab-agenda/
[43] https://www.facebook.com/ArqDisUniandes/posts/2978583752228812
[44] https://losandesfoundation.org/agrolab/
[45] https://ccafs.cgiar.org/

context of the CCAFS program, a CSV can be defined as an administrative unit recognized by local government or a naturally bounded area such as a micro-watershed. The scale of the CSV allows for some collective action, such as a campaign not to burn crop residues. Communities work with other stakeholders to test and develop climate-smart agricultural practices that are technically and gender-sensitive and aligned with the social context. As with living labs, evidence is generated within real-life settings, in this case, regarding the efficacy of climate-smart interventions (Gonsalves et al. 2015; Aggarwal et al. 2018). One of the CSVs is being supported by the IIRR in the village of Taungkhamauk in Myanmar. The program supports a range of coping strategies with farmers since the area is experiencing irregular onset and withdrawal of monsoons and erratic rainfall, affecting crop yields. The farmers are engaged in participatory research to find ways to address livelihood needs (Barbon et al. 2020). To indicate the scale of the initiative, we provide details about one of the CSVs established in the Philippines through the CCAFS program by IIRR in Guinayangan, Quezon, in 2014. The establishment of farmer learning groups was a key element of the CSV. They engaged in participatory action research to test and learn about climate-smart agricultural practices, including agroforestry and confined rearing of livestock. A total of 17 learner groups were established between 2014 and 2019, comprising 300 farmers. Farmer-to-farmer scaling has allowed the interventions to reach about 1,500 farmers (SEARCA 2019).

Although not located within the Global South, there is value in exploring the European Network of Living Labs (ENoLL), an initiative of the European Commission[46]. It is a global network of open innovation ecosystems (living labs). The network and its members provide innovation services for small and medium-sized international companies, the public sector, organizations and citizens (Bronson et al. 2021). The ENoLL international non-profit association that represents the network was founded in 2010. There is a specific focus on ICT innovation. As found elsewhere, some of the living labs have not survived beyond project timeframes, which has led to a decline in network members over time. Others were affected by the disappearance or change of activities of the host organization, or there were political, governance or leadership changes. Some of the living labs that are part of the network include the Bird Living Lab in Spain, which is hosted by GAIA (the Association of Industries for Electronic and Information Technologies in the Basque country) and develops technology (including ICT products) for monitoring changes in the natural environment. Another is the Energy Living Lab in Western Switzerland hosted by the University of Applied Science Western Switzerland. It involves users in developing products that increase energy efficiency – including biogas systems to valorize agricultural waste (Robles 2015).

C3 Farmer research structures

Functions and principles

Several different structures represent or support farmer research, including farmer research networks (FRNs), CIALs and farmer research groups (FRGs). An FRN is a collection of farmer groups that engage in research with researchers and development organizations (Richardson et al. 2021, Navarette et al. undated) – and in the work of the McKnight Foundation, these are fairly structured and scientific in their research approach. One benefit of FRNs is that they allow for data collection with many farmers (even thousands) across different agroecological zones and with different cultural contexts, which

[46] https://unalab.eu/en/project-partners/enoll or https://enoll.org/

allows for rigorous research (Richardson et al. 2021). CIALs were introduced to Latin America as a focal point for participatory technology development (Anchala et al. 2004). A CIAL is a group of farmers supported to form a team that engages in (joint) experimentation. CIALs also have a grasp of basic scientific methods for designing and implementing simple experiments and are a farmer-run research service that is answerable to the local community (Anchala et al. 2004; Friis-Hansen and Egelyng 2007). An FRG is a group of farmers that collectively engage in experimentation, which is frequently a joint innovation process involving other actors. They can be designed to include testing local innovations against conventional practices and introduced technologies (Steinmaier 2001). All these versions of the instrument benefit from access to a source of funds to support experimentation and reduce risks associated with testing new or unfamiliar technologies or systems (Friis-Hansen and Egelyng 2007; Kanoute et al. 2019).

These different options all catalyze the participation of farmers as researchers in their own right – either experimenting on their own or with other types of actors such that co-design of technical innovations is possible. While not a priority of all programs focused on R&D aspects, sustainability also requires that experimenting farmers be linked to local entrepreneurs and private sector markets (Friis-Hansen and Egelyng 2007).

Relevant examples

Different versions of farmer research structures are described below.

The first type of farmer research structure discussed is the CIAL, which is an approach developed by CIAT in Colombia in 2004, and which is still being used in Honduras. It is a farmer-run research service accountable to the local community or structure representing farmers elected to the research committee. The committee is expected to research topics identified through a process in which members of the host community can participate. Through the adaptive research process, which is funded by the CIAL fund or other resources, farmers evaluated technologies for themselves and made recommendations to each other (Polar et al. 2012). A study by Humphries et al. (2000) revealed that the community's very poor and landless segments were under-represented in the CIAL membership (possibly because they did not have the resources to participate in research or attend meetings).

The *Fundacion para la investigacion Participativa con Agricultores en Honduras*[47] (FIPAH) is a local NGO in Honduras (Humphries et al. 2016). FIPAH is funded by organizations such as the Inter-American Foundation, which made a grant available to assist small-scale producers to market their avocados (IAF 2021), as well as the organization Seed Programs International, which partnered with FIPAH (*In English: Foundation for Participatory Research with Honduran Farmers*) to build the capacity of research groups (CIALs) around plant breeding and seed conservation (Seed Programs International 2016). As of 2019, FIPAH was supporting 94 CIALs across five regions of Honduras. Based on CIAT's experiences with farmer-participatory research in CIALs, CIAT founded the Rural Innovation Institute[48] in Colombia in 2006. The institute focuses on catalyzing agro-enterprise development. This is done by supporting experimenting farmer groups' networks to link them to

[47] https://fipah-hn.org/

[48] http://ciat-library.ciat.cgiar.org/articulos_ciat/2015/Rural_Innovation_Institute_Executive_Summary_2003.pdf

local entrepreneurs and private sector markets. This is done by disseminating new information and ICTs to rural innovation and forming learning alliances.

An example of a program where FRGs were used is the Farmer Adaptation of Starter Technology (Steinmaier 2001). It used community groups formed through a previous initiative called Luapula Livelihood and Food Security Program in central Africa (Bultemeier et al. 2011). The FRGs, which engaged in a range of trials and demonstrations and supported knowledge exchange, were self-sustaining permanent structures that served as umbrella structures that represented farmers from community groups from several villages. Between 1995 and 1996, starter technologies related to maize production were introduced to the FRGs with the idea that they could either adopt or adapt the starter technology to suit their own needs. However, no evidence was obtained as to whether this was achieved. The paper by Steinmaier (2001) provides a useful example of the value of engaging with FRGs. Still, the focus is on the uptake and adaptation of the technologies rather than on the roles and functioning of the FRGs.

The concept of FRNs is a key component of McKnight Foundation's Collaborative Crop Research Programme (CCRP). Several initiatives that have been funded through CCRP are well documented. These include: (1) Strengthening Farmer-led research networks for agroecological intensification in Burkina Faso and Mali (FaReNe) that was implemented under the guidance of Prolinnova[49] and made use of participatory innovation development and established informal networks to support joint innovation in the field of agro-ecology (Kanoute et al. 2019), (2) Pathways to agroecological intensification of crop–livestock systems in southern Mali' (2016–2019), which also received support from the Africa RISING project funded by USAID which was administered by ICRISAT[50] (According to Descheemaeker et al. (2021) a FRN was initiated in 2012 with 12 farmers and it grew to 300 farmers in 2020), and which has a second phase called the Pathways to AEI-III running from 2020 to 2024[51], (3) Participatory Action Research FRN in Bolivia[52], (4) FRN-NGO in Western Kenya[53], (4) Best Bets FRN in Malawi[54], and (5) Seed Systems in Mali and other West African countries[55].

C4 Farmer field schools

Functions and principles

Another instrument that allows for the testing of new technologies is the farmer field schools (FFS). FFS are based on experiential learning, comparison (through simple experiments and group analysis) and non-hierarchical relations between farmers and trainers. The approach moves away from the idea of presenting generalized recommendations to farmers (FAO 2006). This form of adult education aims to empower farmers and improve agricultural outcomes through agricultural knowledge exchange (Waddington and White 2014, Mariyono 2019).

[49] https://www.prolinnova.net/farene
[50] https://expertfinder.cgiar.org/individual/grant8093563
[51] https://www.ccrp.org/grants/pathways-to-aei-iii/
[52] https://www.ccrp.org/stories/participatory-action-research-frn-in-bolivia/
[53] https://www.ccrp.org/stories/frn-ngo-in-western-kenya/
[54] https://www.ccrp.org/stories/best-bets-iii-frn-in-malawi/
[55] https://www.ccrp.org/stories/seed-systems-in-mali-and-other-west-african-countries/

The FFS approach was developed in the late 1980s in South-East Asia. It was specifically focused on introducing the concept of integrated pest management to small-scale rice farmers, with the idea that they could be engaged in an experiential learning process based on testing new approaches against their traditional practices (FAO 2006). More recently, the Food and Agriculture Organization (FAO) set up the Global Farmer Field School Platform[56] for sharing of information and expertise with the various organizations using FFSs (FAO 2018), as well as the East Africa Farmer Field School Hub[57] .

The FFS is a group-based learning approach. Generally, regular sessions are held across a full production season, or cycle and participants exchange knowledge and share experiences while gaining new knowledge (Duveskog et al. 2002). Testing introduced technologies and farming practices against conventional or traditional practices within a learning plot is a key aspect of an FFS (ICIMOD (SMMP) 2008). This approach facilitates effective decision-making and problem-solving by farmers (Davis et al. 2012), but achieving small step transitions is potentially more realistic than expecting farmers to make complex changes to their systems (Bakker et al. 2021). For this reason, where new packages of practices are being introduced, trials with specific components are recommended so that farmers can see the effects of different treatments (ICIMOD (SMMP) 2008). FFSs are normally facilitated by field staff of a collaborating organization (ICIMOD (SMMP) 2008). It has been demonstrated that social capital develops during FFS implementation, which contributes to co-creation and knowledge exchange (Charatsari et al. 2020). However, FFS are not always implemented as they were initially envisaged. For example, standardized curricula are developed instead of tailoring them to suit a particular target group) and have become technology transfer instruments (Waddington and White 2014).

For example, some collaborative projects have not tried to apply a standard curriculum to all farmer groups (Bakker et al. 2021). Some projects have also modified FFSs, for example introducing video-mediated learning (Ongachi et al. 2018). They have also been used to reduce gender inequality, focus on minority groups and strengthen producer groups (Waddington and White 2014).

One of the KIs highlighted the need to find markets for produce when designing instruments that support innovation. In support of this, the KI highlighted that with FFSs, the farmer groups generally migrate toward market orientation. The networks established through the FFS bonded the farmers and allowed them to access markets collaboratively. The KI also mentioned that some FFSs provide other services to the participants, such as establishing savings and credit facilities, strengthening farmers' opportunities to buy inputs or pay for services.

Relevant examples

There are limited examples where FFSs have been used specifically to support innovation. This section includes two examples.

The first case is **Promoting Farmer Innovation in Farmer Field Schools** (PFI-FFS), an initiative in East Africa initiated in 2001, aimed to increase farmer innovation and experimentation at the community level. The groups conducted season-long experimentation. It was funded by UNDP and implemented by FAO and the Government of Kenya. Besides establishing the FFSs, the project also

[56] https://www.fao.org/farmer-field-schools

[57] https://www.facebook.com/The-Eastern-Africa-Field-Schools-Hub-102824411388651/

identified farmer innovators who became members of the FFSs and were also resource persons, participated as guest trainers or hosted visits to their farms. This approach provided a basket of options, including innovations developed by members of the local communities, rather than only relying on externally derived technologies that were not always appropriate. While the PFI-FFS initiative showed opportunities to integrate external and indigenous sources of knowledge in the FFS, there was a challenge encountered, which was that identifying innovators took much longer than establishing the FFS (Duvescog et al. 2002).

IFAD introduced Livestock FFS in East and Southern Africa through four initiatives – a dairy program in Rwanda[58], mixed livestock support in Zanzibar, Tanzania[59], support to dairy and beef farmers in Malawi[60] and a small ruminant program in Madagascar[61]. The typical FFS approach was adapted to allow for it to be used with livestock. Instead of a growing season for crops, it covered a period from 'calf to calf' or 'egg to egg'. The improved social capital within the groups led to collective marketing, group business activities, and group savings and credit schemes. Active experimentation and learning by doing remained key elements of the FFS (Jordans 2021).

The Agricultural Climate Resilience Enhancement Initiative[62] is an initiative funded by the Adaptation Fund. It is a partnership program including the World Meteorological Organization, FAO and the Inter-Governmental Authority on Development. Through the program, 60 FFS groups are being supported across 30 communities in Ethiopia, Kenya and Uganda. The objective of the FFS to build knowledge about climate change adaptation. Each FFS group meets weekly during the production cycle and they also set up field experiments to test climate-smart practices (Mbatha et al. undated).

Comparison

Functions and characteristics

Differences: The main difference between these four instruments is that the primary objective of farmer research structures (FRSs) and innovation platforms is to support experimentation and innovation by farmers and other actors. At the same time, for FFSs and living labs, it is not always the main objective. For example, FFSs are sometimes seen to support technology transfer, and living labs are sometimes more focused on supporting entrepreneurship than innovation. There is a lot of

[58] Rwanda Dairy Development Program (RDDP) http://spiu-ifad.minagri.gov.rw/index.php?id=4

[59] Agriculture Sector Development Programme-Livestock (ASDP-L) https://www.ifad.org/en/web/knowledge/-/publication/impact-assessment-agricultural-sector-development-programme-livestock-asdp-l-and-agriculture-service-support-programme-assp-

[60] IFAD. 2019. Malawi, Transforming Agriculture through Diversification and Entrepreneurship Project Design Report (RLEEP = Rural Livelihoods and Economic Enhancement Programme; TRADE = Transforming Agriculture through Diversification and Entrepreneurship programme; SAPP = Sustainable Agricultural Productivity Programme)
https://www.ifad.org/documents/38711624/41463031/Malawi+2000001600+TRADE+Project+Design+Report+December+2019/6b36ade6-e02b-c7ca-5438-e0fccf2fefb7?version=1.0

[61] AROPA (Support Project for Farmers Organizations and Agricultural Services Centres), DEFIS (Inclusive Agricultural Value Chains Development programme). https://webapps.ifad.org/members/eb/122/docs/EB-2017-122-R-11.pdf

[62] https://www.adaptation-fund.org/project/agricultural-climate-resilience-enhancement-initiative-acrei-ethiopia-kenya-uganda/

literature related to FFS and innovation platforms – and it covers a substantial period, but far less material related to FRSs, and much of this is related to the work of the CCRP.

Similarities: While there are differences between the four instruments, there are some clear similarities. Firstly, they all allow for the testing of technologies within real-life contexts. They all involve users (and could be designed to be more user driven, with the user generally being a farmer or community member in the examples shared above). They all rely on an organization to play the role of broker or intermediary, providing access to knowledge and/or markets. These instruments also require that innovators have access to financial resources that can support innovation activities. Their focus is on strengthening social and human capital rather than providing access to finance.

Contribution to SAI principles

The extent to which the Type C instruments were found to address the principles of SAI are shown in Table *6*.

Table 6. Extent to which evidence from study demonstrates that Type C instruments address principles of sustainable agriculture intensification.

Variable/ Instrument	Sought impacts from review						
	Economic	Productivity	Social	Human wellbeing	Environ-mental	Gender	Youth
Innovation platforms							
Living labs							
Farmer research structures							
Farmer field schools							

Green = all cases sought this impact; Orange = variation across cases related to using a particular instrument; Red = none of the cases reviewed indicate that they sought to achieve that particular impact.

In terms of their contribution to the principles of SAI, these four instruments have all been used in contexts where these were intended outcomes. The only impact that was not clearly stated within the reviewed material was promoting youth participation, specifically for FFSs. Still, again the instruments could be designed to address the principles of SAI.

Comparison of individual instruments

This section of the report provides a comparative analysis across instruments (1–5) within each instrument type (A, B, C) as well as across types of instruments as shown in Table *7*. The instruments are categorized as follows, and the color coding shown in the table below carries through to the infographics.

Table 7. Summary of instrument types and instruments included in study.

A Instruments that support entrepreneurship
A1 Accelerators
A2 Incubators
A3 Innovation hubs
B Instruments that primarily finance innovation
B1 Challenge funds
B2 Innovation funds and grants
B3 Innovation funds for smallholder farmers
B4 Prizes and awards
B5 Results-based contracts
C Instruments that support innovation within a real-life context
C1 Innovation platforms
C2 Living labs
C3 Farmer research structures
C4 Farmer field schools

The instruments are being compared using the following lenses:

- The main objective of the program in which the instruments are used (research and development, entrepreneurship, human wellbeing and/or global resilience).
- The portion of the agricultural sector targeted as users of the instrument – *not necessarily where the impact may be felt* (subsistence farmers, small-scale commercial, SMEs, large-scale commercial and agribusiness).
- Types of support provided by the instruments (provide financial resources, build human capital, build social capital, provide infrastructure).
- Types of organizations funding the use of the instrument (various – ranging from global multi-laterals to national research organizations).

The infographics are summative representations of the qualitative findings of the literature review. Still, they do not preclude the application of the instruments within other contexts, nor does it preclude designing them to achieve specific objectives.

Broad focal area of the instrument

The first lens used to compare the instruments is the broad focal area of the instrument or the program in which the instrument has been used (Figure *1*). While all instruments reviewed can support innovation, some aim to innovation by entrepreneurs (which may even be related to upscaling of research outputs). In contrast, others aim to contribute to broader human wellbeing and solve global

challenges such as climate change. Some programs and initiatives aim to support basic or adaptive research that develops new technologies or practices that can address other challenges that we face. For example, challenge funds generally focus on global or societal issues related to human or environmental wellbeing. At the same time, innovation hubs and incubators are more focused on developing new technologies and embedding them within businesses or taking research outputs and translating them into socio-economic impacts. Some instruments have been found to cover a wide range of broad focal areas, and their design and application depend on the funders' priorities.

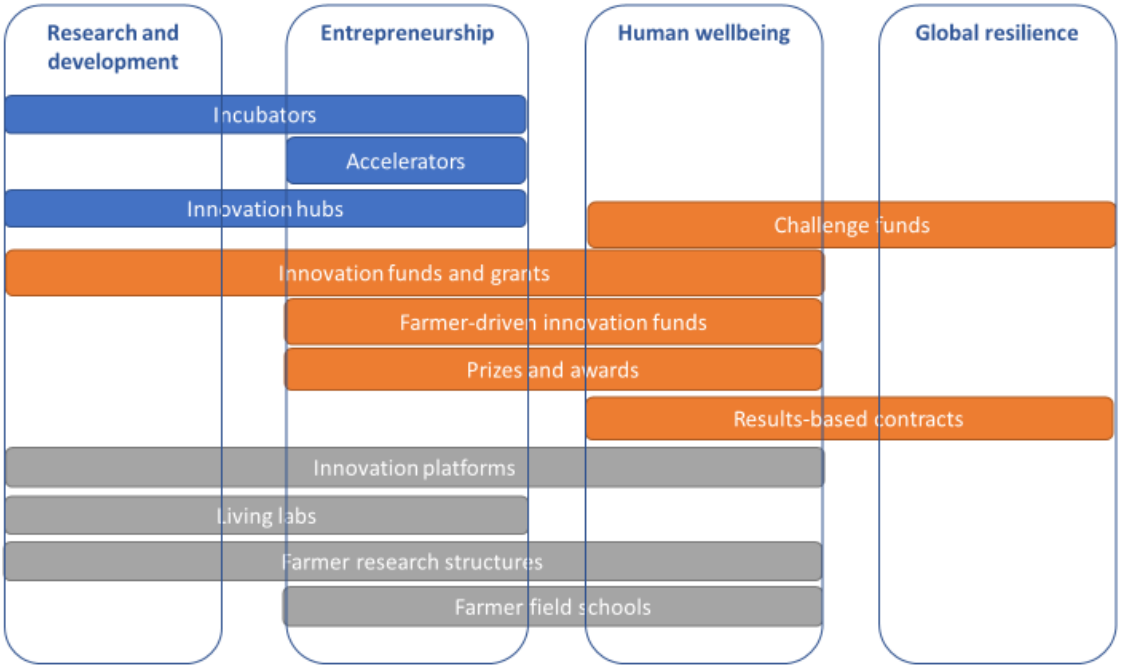

Figure 1. Broad objectives of programs where different instruments have been applied.

The portion of the agricultural sector targeted

The agricultural sector that SAI hopes to transform covers different scales of production and includes large and small businesses that provide inputs and services or act as a market for agricultural produce (Figure *2*). Again, some instruments are accessible to actors within specific areas of the sector, while others have been used across a wider range of areas. For example, prizes have been awarded to local innovators in rural contexts, small-scale commercial farmers, SMEs, large-scale commercial farmers, and even large agribusinesses that have developed a pro-poor product or a technology that reduces greenhouse gas emissions.

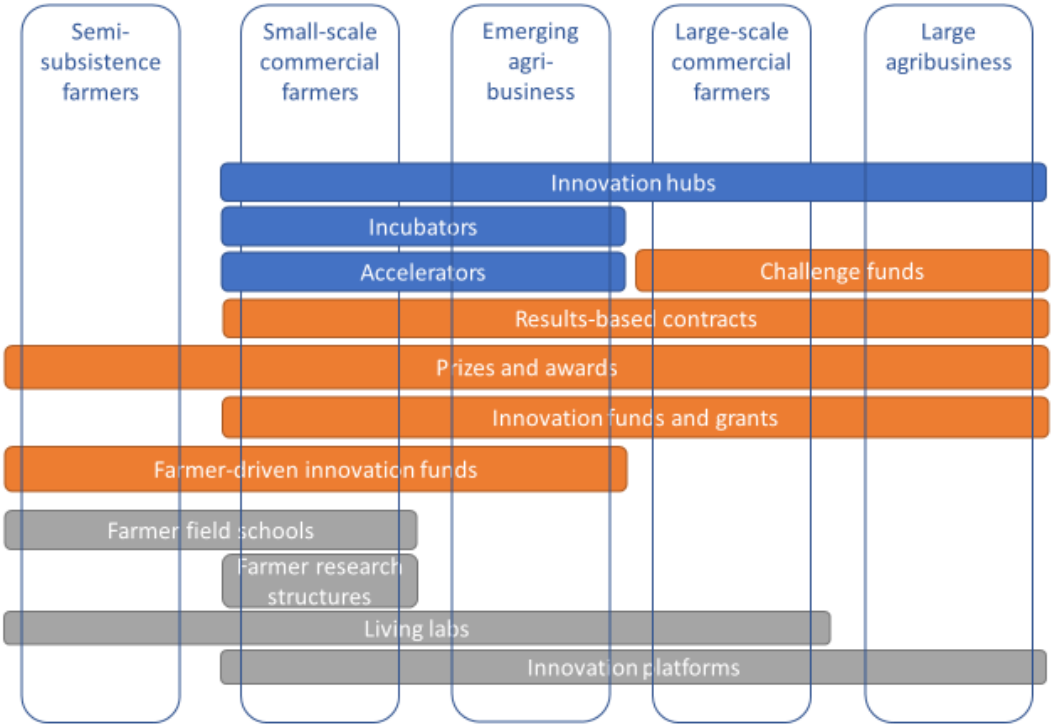

Figure 2. Area of the agricultural sector that receives support from a particular instrument (though impacts may be wider).

Types of support provided by the instrument

The type of support provided to innovation is another characteristic that differs across instrument types and even within sub-types (Figure *3*). For example, innovation hubs generally provide infrastructure, while a farmer research structure may build human and social capital. According to Fuzi et al. (2018a), focusing on urban innovation intermediaries, an innovation hub or co-working space allows for interaction with people from a range of backgrounds and disciplines and provides access to a collaborative community as well as shared facilities (generally toward achieving a common mission); while a living lab, which also allows for a diverse group of stakeholders to participate, specifically allows for end-user involvement in the innovation process (allowing for co-creation within a real-life setting to develop new services and products and societal infrastructure, ENoLL Website, cited in Fuzi et al. 2018a).

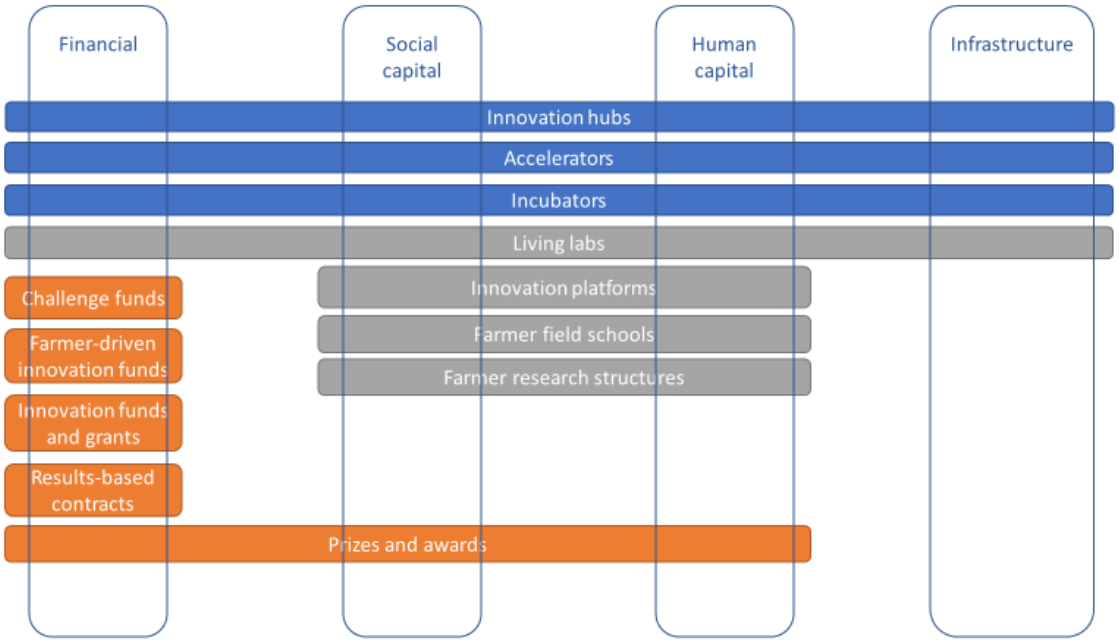

Figure 3. Types of support provided by different instruments.

Organizations investing in innovation

The study showed that a wide range of investors and funders support innovation within the Global South, as shown in Figure *4*. Some categories have supported a wide range of instruments – especially multi-lateral and bilateral organizations. Some categories of investors/funders were encountered far less frequently, for example, industry bodies and trade organizations. Similarly, some instruments have been used by a narrow range of organizations (e.g. living labs), while others have been widely used (e.g. innovation hubs) as they have been in use for longer.

The private sector has funded several instruments. An interview with an innovation manager from a European supermarket chain highlighted that some private sector actors see innovation support as a mechanism to strengthen their own business while also providing opportunities for innovators, thus contributing to local economic development. The KI indicated that their company has an innovative mechanism of supporting innovators to develop technologies and products that they can use within their stores or support their business. This approach sees funding being made available by a private sector partner to develop an innovation for which they can provide a market.

In low-income countries and some middle-income countries, many of the instruments have been introduced through programs funded by multi-lateral and bilateral organizations. There are limited examples of institutionalization of these instruments within government or academic institutions. However, some exceptions to this statement were identified. For example, the National Innovation Foundation in India falls under the Department of Science and Technology and awards unassisted innovation annually. In Brazil, the innovation activities of the prestigious agricultural university, Federal University of Viçosa, are supported by FUNARBE Foundation, which aims to diffuse technologies developed on campus. This led to the establishment of the Centro Tecnológico de Desenvolvimento Regional de Viçosa (CENTEV Development Center), which includes a technology incubator (InfoDev 2014b).

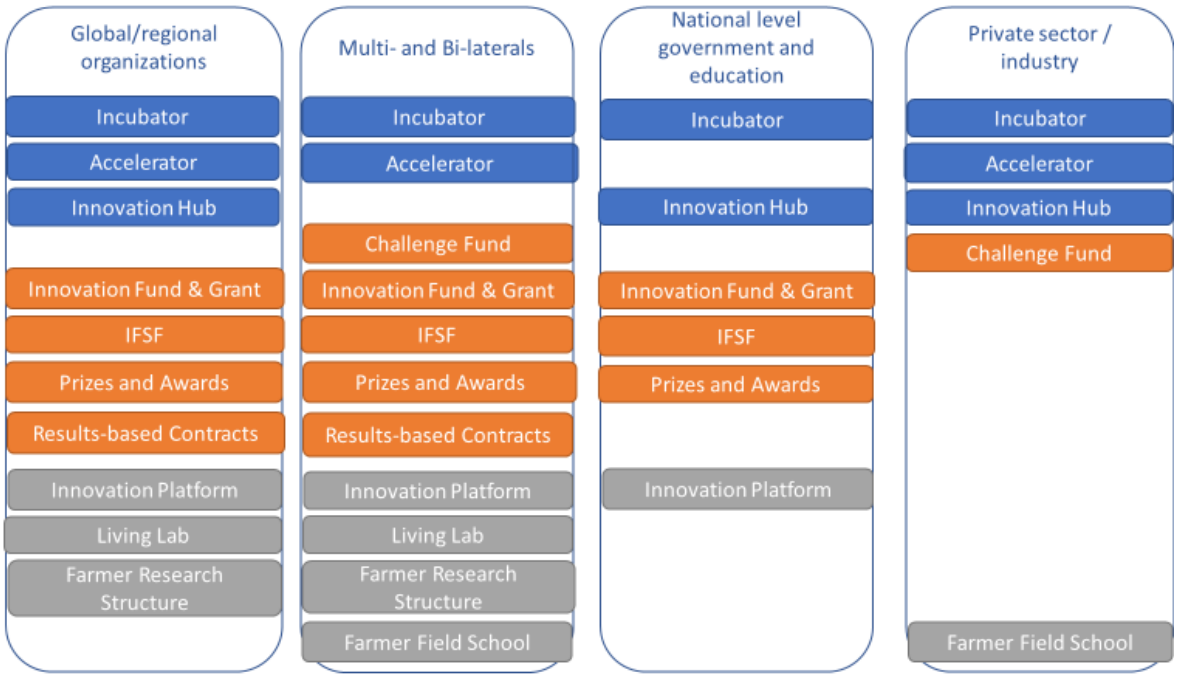

Figure 4. Categories organizations that were funding programs where different instruments have been used/applied, based on the literature reviewed.

IFSF: Innovation funds for smallholder farmers.

4. Guidance for selecting the most appropriate instrument

This section of the report provides a goal-oriented process to assist investors/funders with selecting the most appropriate instrument/combination of instruments.

In many enterprises and other organizations that include investment in their business model, decision-making is both a crucial and a challenging task. Despite this, many decisions are often based on experience and intuition rather than on evidence supported by research. This process is not beneficial for the investor/funder and potential beneficiaries.

Using a series of questions, arranged hierarchically in terms of instrument typology structure set out in Figure 5, the investor/funder is guided to select the instrument(s) that best meet their goals. Throughout the process, the investor/funder's decision-making is supported by evidence gathered and analyzed (qualitatively) as part of the systematic literature review. Despite the lack of evidence in the literature related to the design and persistence of some of the instruments, we have highlighted, where possible, relevant criteria. We have had to make some suggestions where evidence is lacking since some of the instruments are relatively new and have thus not provided the opportunity for rigorous evaluation. We have drawn on evidence related to other, similar instruments to make these suggestions.

The decision-making process is a two-phase process. The first three questions provide technical support and contextualization to the process, and the second phase allows for instrument interrogation and alignment to the investment case.

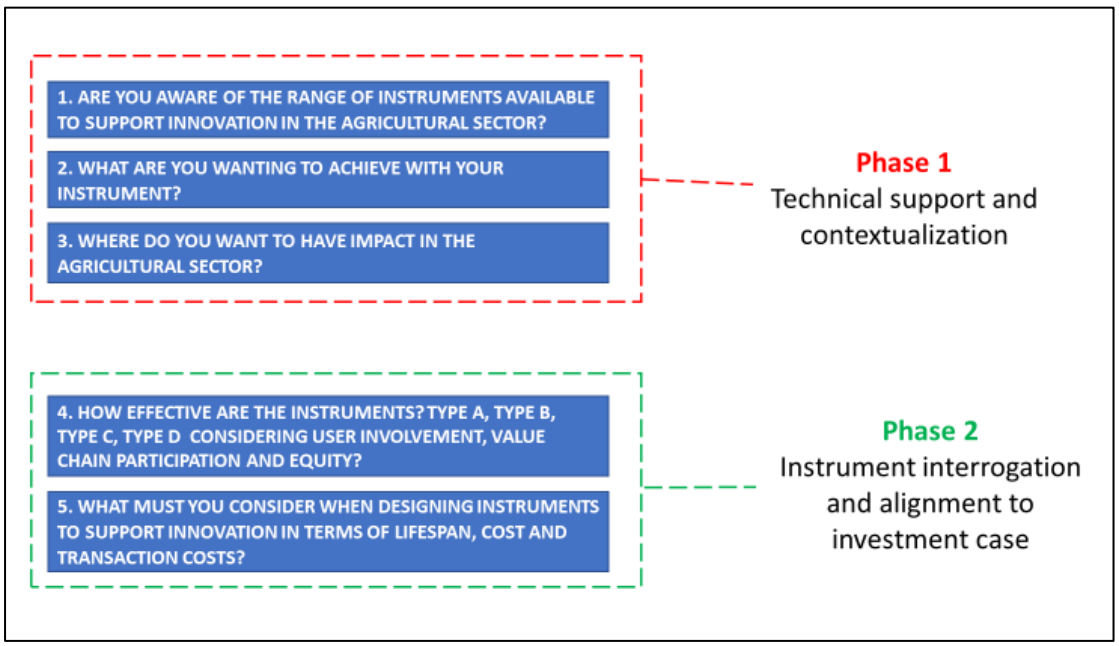

Figure 5. Goal-oriented decision-making process for investors to select the most appropriate instrument/combination of instruments.

Are you aware of the range of instruments available to support innovation in the agricultural sector that could support SAI?

Throughout this study, we have categorized instruments as follows:

Instrument type	Description of instrument
Type A (Instruments that support entrepreneurship)	
A1 Incubator	• Incubators are facilities that create and nurture **new enterprises** to bring new products to the market.
A2 Accelerator	• Accelerators are facilities that provide short-term support to **early-stage ventures** so that they reach a stage where their products and enterprises can obtain finance/investment.
A3 Innovation hub	• Innovation hubs **support innovation processes** (often developing new digital technology) while also creating sustainable enterprises.
Type B (Instruments that finance innovation)	
B1 Challenge funds	• Challenge funds are mechanisms for funders to make funds available to enterprises/agribusiness to **solve complex social problems**.
B2 Innovation funds and grants	• A range of grants and loans **provide financing to support innovation** – including CRGs and matching grants.
B3 Innovation funds for smallholder farmers	• Innovation funds for smallholder farmers are mechanisms where funds are put into the hands of local structures representing farmers and local artisans **to allow them to drive the research agenda**.
B4 Prizes and awards	• Prizes and awards are mechanisms to **incentivize, guide and reward innovation** but typically do not cover the cost of the innovation process.
B5 Results-based contracts	• The results-based contract is a **specific financial instrument** that allows a third party to reimburse costs covered by an upfront investor if **specific predetermined results** are obtained, allowing for investors' resources to serve as a revolving fund.
Type C (Instruments that support innovation in real-life contexts)	
C1 Innovation platforms	• Innovation platforms are **networks of different actors** that collectively innovate to solve challenges related to a particular commodity (e.g. production or marketing related).
C2 Living labs	• Living labs are facilities (including rural contexts) that allow for **testing and validation of technologies** in real-life contexts and include users.
C3 Farmer research structures	• Farmer research structures comprise various arrangements of farmers involved in research – with FRNs being **collections of farmer groups** working with other organizations to **conduct research**.
C4 Farmer field schools	• FFS are a **group-based approach** that involves regular sessions across a complete production cycle that allows them to **test new technologies** against the practices usually used by the farmers.

Where do you want to have an impact in the agricultural sector?

Your selection of instrument type should consider the positions within the sector and along the innovation/commercialization process where the instrument(s) are commonly used. Some instruments focus mainly on supporting innovation within primary agriculture – depicted by the lower part of central box in Figure *6* (i.e. agriculture). In contrast, others focus primarily on supporting innovation within the agribusiness sector (the upper part of the central box in Figure 6, termed Agribusiness). The agribusiness sector includes the delivery of goods and services for primary production, and processing products and by-products (including food waste) from primary production. It is also worth noting that Type B instruments lie outside the boxes representing the sector components. Most of them cut across both components or can be designed to support innovation within each component.

Furthermore, while the diagram shows the most common area of use, there are occasions when the instrument is used to link the components (e.g. innovation platform) or support innovation by actors in the other component. The combinations of boxes and arrows above and below the sector components represent innovation trajectories associated with each component. Considering the top trajectory, one sees that outputs from formal R&D, applied research and innovation feed into new ventures or established companies that then enhance the products and feed them into the market. The lower trajectory represents the development of innovations related to primary production, which may include technical and non-technical outputs (such as new marketing systems or institutional arrangements). They can be taken up and scaled within the farming system through testing, adapting and disseminating (in varying sequences of activities).

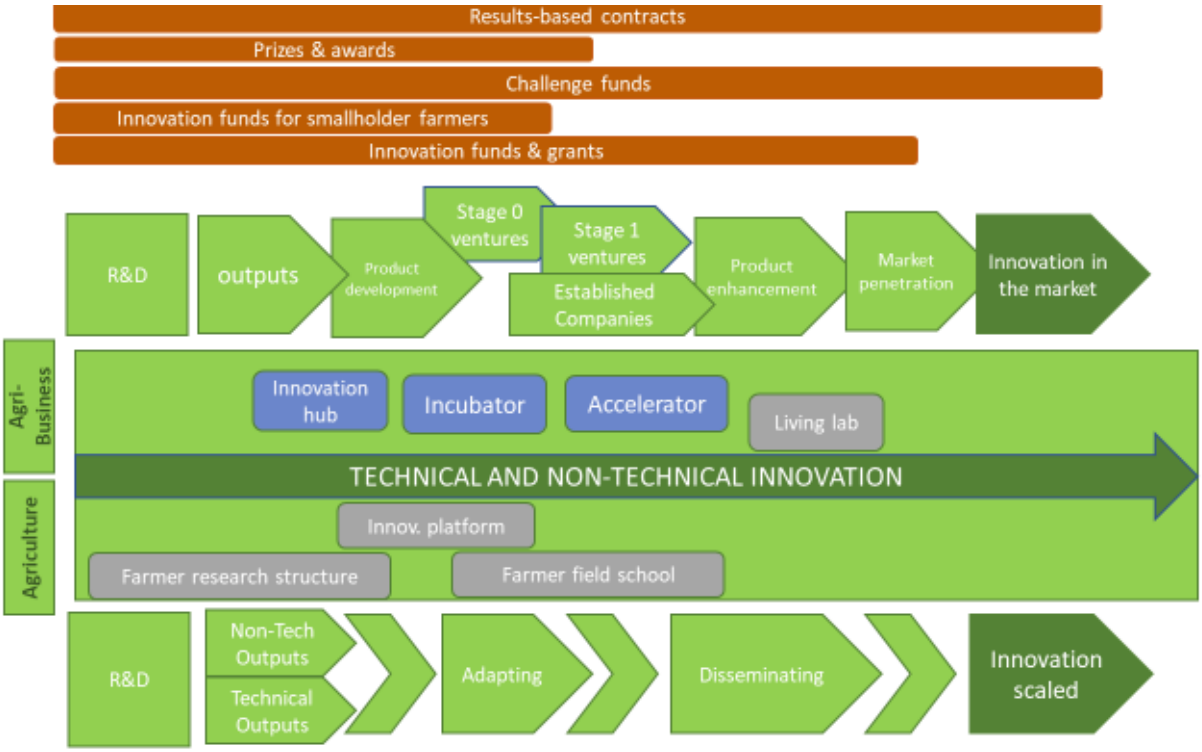

Figure 6. Innovation system showing common positions where instruments are used in terms of innovation trajectories associated with the agricultural sector's agribusiness and primary production components.

What do you need to consider regarding design having selected an instrument?

Since many of the suggestions for implementation are similar across instruments within a specific type (i.e. Type A, Type B and Type C), we have focused on the instrument type. Still, we have drawn on specific examples that pertain to instruments within that category. We have also provided potential solutions that could address identified challenges, especially where evidence was not available.

Type A (Instruments that support entrepreneurs)

This instrument type comprises incubators, accelerators and innovation hubs. The main commonality across the three instruments is that they aim to see new technologies or innovations entering the market by establishing new enterprises. Incubators develop and nurture new enterprises (OECD 2019), accelerators provide support to early-stage ventures (Cohen et al. 2019), and innovation hubs support early-stage development of productivity- and sustainability-enhancing innovations by entrepreneurs (Beesabathuni et al. 2021).

Government bodies and international organizations seeking to promote instruments that support innovation through sustainable enterprises must pay closer attention to the existing institutional support in the specific environment in which the instrument is embedded (Jiménez and Zheng 2017). For example, the AgResults program has developed a four-part evaluation framework to confirm the feasibility of an initial concept. One of the factors considered is the enabling environment in terms of whether the context and enabling conditions are neutral to supportive (AgResults 2021a) and whether, together with the policy environment, it allows for legitimate and fair competition (AgResults 2021b).

Design consideration: Identify which existing policy frameworks or organization will support a particular instrument to achieve its objectives and determine how best to tap into them.

All three instruments must provide multiple forms of support to the participating entrepreneurs and ventures – training in business skills (Miörner et al. 2019) and facilitation or networking to establish access for participants to actors outside of the facility (Ozor 2013; Virgin et al. 2016; Hjortsø et al. 2017; Beesabathuni et al. 2021) including investors (Cohen et al. 2019)

Innovation hubs require technical skills (or access to technical skills through networks) to support innovation processes. The support provided in incubators and accelerators is mainly aimed at getting technology or service into the market. Here the focus is on product validation, financing and marketing the innovation (Ozor 2013; Crișan et al. 2021).

Some accelerator programs tailor activities and mentor relationships based on the knowledge and needs of the entrepreneur/venture (Cohen et al. 2019a). Such bottom-up approaches to establishing and operationalizing facilities are time-consuming, and many are top-down in their arrangements and the type of support provided (Hjortsø et al. 2017).

Design considerations: (1) Ensure that the team appointed to operate the facility has the correct suite of skills, knowledge, networks and understanding of the ventures that will allow them to meet the specific needs of the ventures/entrepreneurs; (2) Utilize a more co-creative or adaptive approach based on specific needs and knowledge of the facility and the venture being supported.

These three instruments are often established to become self-sustaining entities such as the CURAD incubator (NoWad undated) or have linkages to an organization such as a university, as with CENTEV/UFV (InfoDev 2014b). Project timeframes (three to five years) may be too short to establish a self-sustaining facility. It is extremely difficult to transform an organization established through a donor-funded project into a self-sustaining commercial enterprise (Hjortsø et al. 2017).

Design consideration: If the facility is not permanently inked to an organization that will fund it, or subsidized by the government, then a strong business model must be developed that takes into consideration the capacity of the participants to pay for services, thereby ensuring continuity of these types of instruments. This has trade-offs for equity as it excludes less well-resourced entrepreneurs/enterprises.

All three instruments provide innovation support to groups of entrepreneurs and ventures. In the case of accelerators, these are generally cohorts of ventures that go through a support program and graduate together. They generally allow for some level of co-working or co-learning (Jiménez and Zheng 2017), even if participants are not all operating from within the facility. In some facilities, participants do not collaborate with other participants, reducing opportunities for brainstorming and supporting each other with problem-solving (Jiménez and Zheng, 2017).

Design consideration: Decide whether the facility will support a group of similar entrepreneurs to support each other or will effectively accommodate diversity.

The resources required to establish and operationalize, for example, an accelerator, can be very diverse, depending on the nature of the established facility – its scope and overhead expense structure (Kimle 2014). For example, an accelerator may take equity in a venture (Crișan et al. 2021) or charge accomplishment/achievement fees (Kimle 2014).

Design consideration: Develop a business model based on the capital outlay required for service provision, facility expenses, and the mechanism to cover these operating costs.

It is largely the objectives of the programs through which these instruments are established that determines the extent to which they address SAI principles. For example, Village Capital's Agriculture Africa accelerator did not have a clear gender or youth focus (Jackson 2019). Alternatively, the Villgro incubator (InfoDev 2014a) and the Food Africa Accelerator specifically support marginalized groups (Food Africa accelerator, undated). Economic and productivity-related objectives are common across instruments – for example, the Global Agrifoodtech Accelerator for Impact (GROW undated) and an innovation hub established in Kigali through the Rwandan Agency for Economic Development (Friederici 2018). There is less frequent mention of environmental objectives in the literature about these instruments. One example is the Campos dos Goytacazes Innovation Hub (PICG) in Brazil that focuses on developing clean production technologies (UNESCO undated).

Design consideration: The criteria for selecting ventures and entrepreneurs to be supported can guide instruments to focus on innovation that addresses social, environmental and other crucial

issues. However, this may be more challenging where the instruments are not subsidized and rely on generating revenue from their support ventures.

Type B (Instruments that provide financial support to innovation)

This instrument type comprises challenge funds, IF&G, innovation funds for smallholder farmers (IFSFs), prizes and awards and RBCs. While they all provide financial support to innovation processes, there are some differences. Firstly, RBCs are one of several similar instruments (e.g. development impact bonds) and some programs using them focus more on service delivery (e.g. improving the agricultural extension service in Rwanda (Janus and Holzapfel 2016), while others have been used to foster innovation – although risk averseness frequently limits the amount of innovation demonstrated (Sumo et al. 2016). Prizes and awards differ from the other Type B instruments because they generally do not cover the full cost of innovation. Thus, the innovation must create value for the recipient of the prize that exceeds these costs (i.e. they must recoup their investment (Cunningham and Cunningham 2016b). The Type B instruments are often not used in isolation but complement other instruments such as innovation platforms (Adekunle and Fatunbi 2013) and farmer research networks/groups (Ashby et al. 2000).

Design considerations: Design a Type B instrument based on the types of innovators you want to support and their needs.

The instruments are also quite diverse in terms of user involvement in the innovation process. IFSFs specifically aim to support grassroots innovation by farmers, artisans and so on (Triomphe et al. undated). For IFSFs to effectively achieve the growth of an enterprise, initial organizational social capital is essential (Ton et al. 2013). Furthermore, support organizations need to provide mentoring to fund administrators (Triomphe et al. undated). For IF&G and challenge funds, the focus is often on finding solutions for the poor, although some are designed to involve users (Davies and Elgar 2014).

Design considerations: (1) If you want to allow users to define the research agenda and lead the innovation process, then choose an instrument that puts funds in the users' hands or design the instrument such that it allows for user involvement – which may be through a complementary instrument such as establishing an innovation platform; (2) Similarly, you may want to design the instrument to ensure that marginalized groups (less-resourced, less literate, for example) can participate – this should consider eligibility criteria, application processes, as well as covering the costs for farmer participation

Some programs have specific design features to accelerate uptake, such as subsidizing the cost for the user to encourage uptake (Hammond 2021), while others rely on the involvement of the user in making sure that innovations are suited to user needs and contexts (Tambo 2018; Ashby et al. 2000). Some instruments that provide financial support have complementary activities such as showcasing events that may support the uptake of the innovations (Friis-Hanssen and Egelyng 2007). Scaling up of innovations also requires that organizations providing support involve local and national extension and research partners (Triomphe et al. undated).

Unlike the Type A instruments, these instruments do not have the same issue of becoming self-sustaining entities. Most are time-limited and run over several years (Pompa 2013; Rajalahti and Larson 2011; Howell 2017), which may be linked to the lifespan of another instrument such as an innovation platform (Adekunle and Fatunbi 2013). However, cases were identified where IFSFs have not been time-bound and have become permanent resources (Ashby et al. 2000). Similarly, a case was identified where the government of India had institutionalized the rewarding of unassisted innovation, so it is no longer a time-bound instrument (NIF undated; Friis-Hansen and Egelyng 2007).

Design consideration: Consider the design of instruments to increase the lifespan of the finance. For example, a results-based contract will see the initial investor recouping their investment and re-invest it. At the same time, an innovation fund for smallholder farmers can be made self-sustaining by diversifying the activities of the farmer group to include income generation activities or making the funds available as revolving credit.

The amounts of finance made available through Type B instruments can be highly variable – from very large amounts for challenge funds to very small amounts to reward grassroots innovation. The size of prizes, grants and loans needs to be aligned with the purpose of the intervention – is it to reduce the risk for innovation and provide matching funds (Pompa 2013; Davies and Elgar 2014; UNDP 2016) is it to support local innovation by smallholder farmers (Triomphe et al. undated)? How much funding is available to support innovation?

The appointment of a professional consulting firm to handle applications and associated administration-related activities will increase the transaction costs (Tjornbo and Westely 2012). Some suggestions are made to reduce transaction costs, such as defining eligibility more clearly to reduce the number of applications to be reviewed (Rajalahti and Larson 2011). The transfer of costs to local organizations, especially structures representing users (Friis-Hansen and Egelyng 2007), must be critically considered as the time of farmers and community members, and NGOs should not be undervalued. The procurement process needs to be streamlined as much as possible (Harvard Kennedy School 2016) and systems to monitor outcomes – although this was not specifically covered in the literature.

Some interesting design considerations should be given attention. For example, with IF&G, decisions must be taken about focusing on early-stage or late-stage enterprises. There is evidence that more impact may be achieved by having numerous small early-stage grants than fewer large late-stage grants. This emerged from a study conducted by the US Department of Energy's Small Business Innovation Research (SBIR) program, which awarded USD 884 million in awards to 7,436 small high-tech firms from 1983 to 2013. The SBIR program had two stages, the first one being a competition for awards of USD 150,000. Phase 1 winners could apply nine months later for USD 1 million Phase 2 awards received two to three years after Phase 1. There is evidence that more impact may be achieved by having numerous small early-stage grants than fewer large late-stage grants. The early-stage grants were found to have large, positive effects on cite-weighted patents, finance, revenue, survival, and successful exit. It appears that the reason for this is that the grants overcome firms' financing constraints. Thus, the grant enables proof of concept work that the firm would not otherwise be able to finance (Howell 2017).

The design of prizes and awards can be highly variable. For any high-impact prize program, it must propose an achievable but challenging goal. Furthermore, timing is key because technological progress changes what it is possible to achieve and changes in socio-economic conditions affect the acceptability of possible solutions (Cunningham and Cunningham 2016b).

Design consideration: Design the instrument to reduce transaction costs according to the funds available to support innovation and the program's objectives. **Refer to the references above for some options for achieving this.**

There are several challenges related to monitoring the effectiveness of these instruments. Firstly, it is often difficult to attribute measured outcomes to the instrument (e.g. grant) alone because it only covers a portion of investments needed and marketing strategies and organizational capabilities are affected by other factors. There are often delays before the economic benefits materialize (Ton 2017). This is even more challenging when using results-based approaches because it can be difficult to measure the predetermined outcomes (such as improved food security) or confirm that yield improvements can be attributed to the innovation and not weather conditions. It may be easier to measure intermediate outcomes such as the increased area under production (Gould et al. 2020).

Design considerations: (1) Design the selected instrument and its associated M&E process in such a way that the outcomes can be established effectively; (2) Given the risk associated with agricultural research, be realistic in terms of expected outcomes and aim for a level of success across an innovation portfolio rather than considering each process individually

Type C (Instruments that support innovation in real-life contexts)

This instrument type comprises innovation platforms, living labs, FRNs and FFS. These are instruments that strengthen the social and human capital required for effective innovation.

User involvement in innovation processes is a key element of all these instruments. However, the extent to which users contribute to a co-creation process varies across them, or depends on the design and implementation of the instrument. For example, innovation platforms bring together different actors (Homann-Kee Tui et al. 2013; Mabeya et al. 2020), but users' roles in the platform can vary. This is similar to living labs (Mutanda et al. 2011), where some actively involve users in creating, validating and testing innovations (Nystrom et al. 2014; Masi 2016; Osma et al. 2019). FRNs (and other farmer groups) actively involve farmers in experimenting, but the extent to which they drive the research agenda is variable (Descheemaeker et al. 2021; Kanoute et al. 2019). Similarly, with FFS, some retain the principles of being farmer led and include the testing of local innovations (Duvescog et al. 2002; Nyajani 2003; Charatsari et al. 2020), while others have become technology transfer mechanisms and mainly focus on introduced technologies (Waddington and White 2014).

Some of the Type C instruments specifically focus on achieving equity within the sector by supporting the participation of marginalized groups. Innovation platforms can potentially address this, but only if the participation of these groups is encouraged and supported (Adam et al. 2018). Similarly, with living labs, the potential can only be realized if users (and marginalized groups in particular) are equivalent to other producers such as researchers and the private sector (Nystrom et al. 2014). While certain

instruments focus on users as key actors, the equity agenda needs to be actively pushed, for example, using participatory approaches, if it is to be achieved. This relates specifically to FRNs (Descheemaeker et al. 2021; Richardson et al. 2021) and FFSs (Waddington and White 2014).

Design consideration: Ensure the correct mix of stakeholders participate but have a strong facilitator who can manage the power dynamics so that one actor is unable to hijack the process.

Commodity value chain participation, which refers to the participation of farmers in value chains, is covered by many of the Type C instruments. It is essential for achieving impact from innovation processes, especially if they are not market-related innovations. Innovation platforms include actors from along the value chain (Homann-Kee Tui et al. 2013; Fatunbi et al. 2016; Adam et al. 2018; Agboton et al. 2018). In some cases, they actively link producers to markets (Mabeya et al. 2020). Regarding the other instruments, some living labs focus on market penetration for the products developed (Musikoyo et al. 2017), and so do some FRNs (CIAT 2003; Descheemaeker et al. 2021). While FFSs originally focused more on strengthening primary production, there does appear to be a movement toward considering the entire value chain (input from key informant interview).

Design consideration: Ensure that the stakeholder mix can also support market participation by the farmers. Innovation related to strengthening primary production (such as new seed or new planting methods) is unlikely to lead to livelihood impacts unless the process also supports market participation of producers where it is weak. Similarly, the development of new products or services also requires that market penetration is supported.

Type C instruments accelerate the uptake of innovations by including users as actors in the innovation process. However, their design needs to be such that this is enhanced. For example, suppose innovation platforms are well facilitated and allow researchers to introduce new technologies so that users understand. In that case, this is likely to enhance uptake, which can be further enhanced by the involvement of actors such as NGOs that have access to potential users (Agboton et al. 2018). Living labs will support market penetration by the enterprises they support if they go beyond the co-creation and testing of products (Osma et al. 2019). FRNs accelerate the uptake of the technologies they develop through specific activities like field visits (Descheemaeker et al. 2021), which are also used in FFSs. Still, the dissemination of information and technologies beyond members of FFSs is not well evidenced. This could be because it requires experiential learning to achieve uptake (ICIMOD 2008; Waddington and White 2014).

While Type B instruments were generally time-bound, some of the Type C instruments can potentially become self-sustaining entities that persist beyond project timeframes, for example, innovation platforms (Adam et al. 2018), living labs (Musikoyo et al. 2017; Osma et al. 2019), FRNs (Anchala et al. 2004; Descheemaeker et al. 2021) and FFSs (Davis et al. 2010). For this to be possible, they either have to diversify their activities to become self-sustaining or operate in association with other organizations such as universities or NGOs.

Design consideration: The expected lifespan of the instrument should be discussed with its members throughout the program through which it is initiated so that a decision can be taken,

based on the perceived benefits, whether to terminate it or find ways to prolong its lifespan. To ensure equity, this decision should also consider the less-resourced members, who may not be able to participate indefinitely, which may lead to their exclusion.

The costs of establishing and operationalizing the instrument and the transaction cost implications for all actors must be considered. It should also not be assumed that an instrument that does not provide physical facilities (such as an innovation platform) will not be costly as they are likely to require activities such as the capacity building of members and the facilitator to operate effectively (Homann-Kee Tui et al. 2013; Adam et al. 2018), which is similar for FFS (Waddington and White 2014). The costs associated with innovation activities associated with the instrument must also be considered – do innovators need access to funds to cover start-up costs (Musikoyo et al. 2017) or do farmers need inputs to allow for experimentation that must be covered by donors (Richardson et al. 2021).

Transaction costs are also important considerations when designing Type C instruments. Evidence regarding consideration of transaction costs is thin, but that there are resource implications for organizations such as NGOs (Kanoute et al. 2019; Richardson et al. 2021), and there are costs incurred by all actors that participate in activities, whether they are platform meetings or labor-intensive field trials (Waddington and White 2014).

Design consideration: Ensure that there are felt benefits for all actors required to participate in activities associated with instruments such as FFS or innovation platforms; otherwise, they may not be willing to continue participating. It may be necessary to support the participation of certain actors, especially if there are no short-term benefits for them.

What do you want to achieve with your instrument?

Questions to direct choice of instrument	Most appropriate instruments	Example of a relevant case
1. Do you want to support start-up or emerging/**new enterprises**?	A1 Incubator, A2 Accelerator, A3 Innovation hub	Village Capital's **Agriculture Africa Accelerator** Program
2. Do you want to support the **production of innovative goods and services** to support sustainable agriculture?	A1 Incubator, A2 Accelerator, A3 Innovation hub	**UniBRAIN** (Universities, Business and Research in Agricultural Innovation) established incubators
3. Do you want to support changes from within **farming systems – either large-scale or smallholder systems**?	C1 Innovation platform, C2 Living lab, C3 FRNs, C4 Farmer field school	**CSVs** were established through the **CCAFS** program to introduce and test climate-smart agricultural practices
4. Do you want to support **local agro-processing**?	A1 Incubator, A3 Innovation hub	**iHub in Ghana** supported rice processing by women's groups.
5. If you support established enterprises, then you might only need to **de-risk the innovation process**.	B2 Innovation grants and funds, B5 Results-based contracts	**GEF**'s instruments to de-risk innovation for environmental benefit
6. If you support smaller, established companies, you may need to **cover the cost of innovation**.	B2 Innovation grants and funds, B3 Innovation funds for smallholder farmers	**GSMA** Innovation Fund for Digitization of Agricultural Value chains
7. Do you want to **avoid the risk of not achieving impact**?	B5 Results-based contracts	The Asháninka impact bond involved the Schmidt Family Foundation (SFF) – as the investor and Rainforest Foundation UK – as the service provider, to improve cocoa production
8. Do you want to support the **transformation of the commercial farming sector**?	B1 Challenge fund, B2 IF&G, C1 Innovation platform, B4 Prizes and awards. And what about adapting other instruments such as FRSs, that could	Innovation platforms have been used in New Zealand to reduce nitrate leaching in livestock production systems and to improve heifer rearing practices (Turner et al. 2020)

	also allow for sharing and learning between farmers	
9. Do you want to support the **commercialization of R&D outputs**?	A1 Incubator, A3 Innovation hub	A technology incubator like CENTEV, established at Federal University of Viçosa (UFV) to diffuse technologies already developed on campus (InfoDev 2014b)
10. Do you want to support the **adoption/ uptake of R&D outputs** on farms?	C1 Innovation platform, C2 Living lab, C3 FRS, C4 Farmer field school	McKnight Foundations introduces technologies developed by formal researchers through FRNs, such as the Best Bets Program in Malawi
11. Do you want to **reward and encourage** rather than fund the full cost of innovation?	B4 Prizes and awards	The Ideas to Impact Prizes funded by UK AID to encourage innovation to solve development issues (including climate change adaptation) ran over six years ending in 2020

How effective are the instruments?

Three aspects that should be considered include the extent to which the instruments (1) allow for user involvement in the innovation process, (2) allow the beneficiaries to engage in value chain participation, (3) ensure equitable access to resources and (4) accelerate the uptake of innovations.

Regarding equity and equitable participation in innovation processes and access to resources, we have focused mainly on whether the instruments and the projects in which they have been used give attention to gender or youth because it was difficult to unpack this in more detail and to address other aspects of equity such wealth, ethnicity, caste, etc. Some of the literature does refer to the inclusion of marginalized groups, but this is not always clearly stipulated. They do not explain how their approach addresses the lack of money, skills, and time required to participate effectively. Given that smallholder farmers are not homogeneous and that there can be substantial variation between farmers within a given community or village, they are unlikely to all participate equitably. The developed innovations are unlikely to benefit all of them equally.

The color coding for the table represents the extent to which a particular instrument addresses the element being described (user involvement, value chain participation, equity and accelerated uptake) as follows: Green = No, Beige = yes if addressed in the design of the instrument, Blue = yes inherent in the instrument.

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
Type A instruments (those that support entrepreneurs)				
Incubator	One specific example that documented the involvement of users was that of Villgro, where users in rural areas have the opportunity to **screen, test and refine** agricultural products developed in the incubator (Villgro.org).	Given the focus on taking early-stage enterprises to a point where they have a product and are starting to generate revenue. Thus, the **focus is on market penetration** for the entrepreneurs developing the technology /service rather than being on the value chain participation of farmers. One mechanism encountered was an incubator taking the entrepreneurs' products to the market through its network of rural retail outlets (InfoDev 2014a).	Some have specifically targeted marginalized groups – either **supporting women entrepreneurs** or supporting initiatives that ensure **impacts for women and girls**. They monitor their portfolio to ensure that women-founded ventures are represented (InfoDev 2014a).	**Creating awareness** about technologies accelerates uptake (Hjortsø et al. 2017) while **passing them on to companies** wanting to diversify takes them effectively into the market (InfoDev 2014a). Some focus specifically on **commercializing R&D outputs**, especially if linked to an educational/ research organization (InfoDev 2010).
Accelerator	Potential customers (who may use or sell the product) are often invited to **demonstration days** at the end of a support cycle (Cohen et al. 2019).	Accelerators link ventures to potential customers and therefore enhance **entry of the product into the market**. Some of the services offered are product validation and market access (Crișan et al. 2021).	Some programs have specifically targeted **women and youth** (Cohen et al. 2019b) regarding the supported ventures. 'Open application processes' (Cohen 2019b) are still likely to exclude marginalized persons. Furthermore, the focus on **post-**	They speed up innovation by helping companies to develop new ideas and provide **services** (standard or tailored) that **deliver them to the market** (Crișan et al. 2021; Cohen et al. 2019a). Providing **links to investors** also allows for the uptake of innovations (Kimle 2014).

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
			revenue ventures may also exclude marginalized groups.	
Innovation hub	Some innovation hubs have found that by engaging with local communities, they can **identify locally appropriate** and affordable **solutions** (UNESCO).	Events are widely held to **link entrepreneurs/companies to potential customers,** while at least one hub was identified that supported the participation of farmers and agro-processors in new markets (Tia 2018).	Some have targeted marginalized women for activities such as capacity building (UNESCO) but making facilities self-sustaining leads to **pricing models** that sometimes **exclude marginalized groups** (Friederici 2018), even those with sound innovative ideas.	Funding **proof of concept** allows for the innovation to expand (Tia 2014).
Type B instruments (those that primarily finance innovation)				
Challenge funds	The focus is often on finding solutions to alleviate poverty and improve the social wellbeing of the poor. Some challenge funds encourage user involvement in the development of solutions (Davies and Elgar 2014).	There was no focus in the literature on commodity value chains or on getting these innovations into the market.	Some challenge funds target organizations in low and middle-income countries to fight poverty and reduce degradation (UNDP 2016). Furthermore, some target community organizations and limit entry barriers to encourage maximum participation (Tjornbo and Westely 2012). Eligibility criteria vary from fund to fund but can target specific groups of applicants (Popmpa 2013). Some funds require that the	With challenge funds, there is an expectation that the solutions developed will be commercially viable with measurable social and/or environmental benefits. This is assumed to be characteristics that will lead to accelerated uptake (UNDP 2016). However, social innovations often cannot be scaled up immediately after award because they may be too radical and cause disruptions. It may also not be possible for the public to afford the innovations and may thus require intervention by a third party

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
			consortium include strong partners and organized poor communities or NGOs (Davies and Elgar 2014).	such as the government (Tjornbo and Westely 2012). In some cases, if solutions prove viable and effective, they may be taken up by private sector funders that aim to commercialize them (Davies and Elgar 2014).
Innovation funds and grants	Innovation funds will not necessarily ensure user involvement unless it incentivizes collaboration and involvement of participants (IFAD 2020). Some funds support high priority research or new fields of expertise, which may not involve users (Rajalahti and Larson 2011). Some programs through which funds are made available specifically target user involvement, such as the Integrated Agricultural Research for Development (IAR4D) program of FARA (Adekunle and Fatunbi 2013).	Innovation funds often have support activities that run in parallel and which aim to address market development. They also incentivize the collaboration between different actors in the value chain (Rajalahti and Larson 2011). Some funds specifically target innovation that improves the performance of the food system and fund activities related to marketing and consumption, which have clear value chain relevance (IFAD 2020). If used with instruments that focus on value chain development, such as innovation platforms, this becomes a clear focus (Adekunle and Fatunbi 2013).	Some innovation funds specifically target gender equality, women empowerment and youth, and smallholder farmer groups as beneficiaries (Adekunle and Fatunbi 2013; IFAD 2020), although the beneficiaries do not directly manage them. Looking at equity differently, grants may allow less-resourced companies (including start-up companies) to engage in innovation activities by enabling proof of concept work that they would not otherwise be able to finance (Howell 2017).	Some grants support adaptive research and aim to improve communication between farmers, researchers, and extension staff, intended to accelerate the uptake of new technologies (Rajalahti and Larson 2011).

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
Innovation funds for smallholder farmers	The funds encourage and expand the innovation capacity of smallholder farmers and local artisans (users) and allow them to engage in innovation (Triomphe et al. undated, Ashby et al. 2000).	Farmers can use these funds to address challenges along the value chain – including commercial sales and marketing if this is where the need lies (Friis-Hanssen and Egelyng 2007), and more so if the relevant actors are involved in the innovation process (Triomphe et al. undated).	IFSFs offer opportunities to the rural poor (producers and indigenous knowledge holders and vulnerable households) to pilot their innovations and possibly patent them (Ashby 2000; Friis-Hanssen and Egelyng 2007, Triomphe et al. undated).	Given that potential users vet applications, they are likely to be addressing real needs (Ashby et al. 2000). Commercialization of innovations is also supported by showcasing innovations to potential entrepreneurs and brokering linkages with the private sector (Friis-Hanssen and Egelyng 2007; Triomphe et al. undated).
Prizes and awards	The active involvement of users in the innovation process is not clear from the literature, except where grassroots innovators (as users) are receiving the awards – as in the case of the National Innovation Foundation in India (NIF undated). The Ideas to Impact program also stimulated innovation by partnerships that included users (NIF undated).	The design of some prizes is focused on ensuring that innovations penetrate the market – such as the AgResults program, which covered the production cost of some products such as livestock vaccines to enhance uptake by users (Hammond 2021).	Some contests have been designed to promote equity. For example, having separate prizes for men, women and youth. Applications can also be evaluated against gender responsiveness (Tambo 2018). Contests are generally open to anyone who feels eligible (Deloitte 2015), but does this ensure equity?	Some programs are designed to accelerate the uptake of innovations – for example, AgResults, where the cost-share aspect aims to create market stability and reduce the cost for the end-user – for example, purchasing Food and Mouth Disease vaccine developed through the program (Hammond 2021). Some prizes induce the development of low-cost agricultural innovations in developing country contexts (Tambo 2018).

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
Results-based contracts	While payment for outcomes may encourage experimentation and incremental innovation to achieve predetermined outcomes more cost-effectively (Janus and Holzapfel 2016; Sumo et al. 2016; Deloitte 2015), the extent to which this encourages input from the user is not documented.	The RBC or development impact bond design can link payments to outcomes that strengthen commodity value chains, such as increased market participation of farmers (Janus and Holzapfel 2016).	The RBC can be designed such that the outcomes to be paid for address equity issues, requiring evidence that systems are gender sensitive (Janus and Holzapfel 2016).	There is no evidence in the literature examined. Could the interventions that are being rolled out be technical or non-technical interventions that are being scaled in the farming system?
Type C instruments (those that support innovation in a real-life context)				
Innovation platforms	Innovation platforms bring different actors together and include users or representatives of user groups such as farmer organizations or cooperatives (Homann-Kee Tui et al. 2013; Mabeya et al. 2020). Some KIs referred to the need for platforms to focus more on users (i.e. user-led).	Innovation platforms can take a value chain approach, which informs the range of actors involved (Homann-Kee Tui et al. 2013; Fatunbi et al. 2016; Adam et al. 2018; Agboton et al. 2018). A value chain analysis identifies actors, challenges and opportunities for innovation (Adekunle et al. 2010). Some have actively linked producers to markets, including processors, organized consumer	The participation of both men and women farmers can be encouraged if participatory approaches are used, but the long-term outcomes regarding gendered benefits are not supported by evidence (Adam et al. 2018). Formal programs can hijack platforms, and they can be dominated by stakeholders wishing to extract resources,	Innovation platforms can help farmers learn and implement new skills and knowledge, especially by participating in exchange visits that promote knowledge and skills (Adam et al. 2018). Platforms also allow researchers to simplify the facts they share to make the information more accessible (Agboton et al. 2018). The joint exploration of opportunities and creation of innovative solutions within the platform should be supported by the capacity building where needed

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
		groups and allowed producers to tap into business opportunities (Mabeya et al. 2020).	dominate the research agenda (Boogard et al. 2013).	(Adekunle et al. 2010; Homann-Kee Tui et al. 2013). It generates a sense of ownership of the developed innovations, fostering research uptake (Agboton et al. 2018). For example, this FARA-funded initiative of Consortium Soja du Bénin led to the uptake of the new soy milk technologies by small-scale processors and the establishment of new processing groups (Agboton et al. 2018). The dissemination and uptake of the innovations can be facilitated by non-research actors such as NGOs, which increases their impact (Agboton et al. 2018)
Living labs	While living labs provide a platform for different actors to work collaboratively (Musikoyo et al. 2007) community members are sometimes users, not co-creators (Mutanga et al. 2011), although some LLs focus on including users as key	Fairly limited attention was given to value chain participation in the literature. However, it is recognized that building value chain skills enables participants to access markets for their new products (Musikoyo et al. 2017).	A living lab can focus on specific groups, such as youth, while still having a competitive application process (Muskoyo et al. 2017). They can be designed to include regional characteristics such as language and culture (Masi 2016). In multi-actor contexts, users should be seen as	Experiential learning and education are enhanced by activities related to business development, market participation and action research (Musikoyo et al. 2017). The focus in living labs is on the co-creation and testing of products or technologies (Osma et al. 2019), but the uptake of the technologies by the market or by users is not always clear. It is suggested

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
	actors and adopt a user-oriented approach to create, validate and test new products and systems, working with companies (Nystrom et al. 2014; Masi 2016; Osma et al. 2019), which also recognizes the heterogeneity of users (Masi 2016).		equivalent to other participants (Nystrom et al. 2014).	that living labs allow companies to project themselves more quickly into the global market because they have a stronger connection with users and understand their needs (Masi 2006).
Farmer research structures	These instruments allow for effective farmer involvement in innovation processes and co-designing of new technologies (including an approach called participatory innovation development) – as well as co-creating the research agenda (Steinmaier 2001; Kanoute et al. 2019; Descheemaeker et al. 2021, McKnight undated). The collective approach also allows for co-learning, development of human and social capital,	Besides focusing on innovation processes, several programs also support their participation in value chain activities, which allows for income generation (CIAT 2003; Descheemaeker et al. 2021).	The use of participatory approaches and iterative co-learning cycles is expected to build farmers' capacity and agency to engage effectively. These are aspects that can be integrated into farmer research structures. In addition, the incorporation of women's groups (and groups of farmers normally overlooked) also allows disadvantaged groups to get access to production assets that allow them to participate in innovation processes (Anchala et al. 2004; Descheemaeker et al. 2021; Richardson et al. 2021).	Integrating field visits, mini-workshops, FGDs and feedback sessions in the villages allows for continuous evaluation and adaptation of technologies while also addressing the institutional aspects of the program (Descheemaeker et al. 2021). Dissemination of results to other producers is also achieved through different channels, including community radio and awareness-raising sessions (Kanoute et al. 2019). Farmer-to-farmer exchanges and local sales of planting material allows for gradual dissemination of technologies (CIAT 2003). Effective dissemination of information, especially through a

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
	and the development of social and organizational innovations (Friis-Hansen and Egelyng 2007; Kanoute et al. 2019; Descheemaeker et al. 2021).			farmer-to-farmer exchange, may lead to accelerated uptake.
Farmer field schools	FFS involve farmers in testing technologies. They were originally intended to support individual and collective innovation in agriculture, but there has been a move toward using them for technology transfer (Waddington and White 2014, Bakker et al. 2020). In the review conducted by Bakker et al. (2020), it was found that in 11 of 19 assessments, the experts decided on the top and designed the curriculum, which illustrates that these applications of FFS have become less participatory in their nature. However,	While there was little in the literature regarding value chain participation, some key informants indicated that some FFSs are transforming into innovation platforms and are starting to support networking that enhances market participation.	Farmer field schools are expected to allow participation of marginalized groups – including women, poorer economic groups and farmers with low literacy levels (Davis et al. 2010). However, there is a concern that they favor more economically stable farmers. The marginalized groups need to be specifically targeted if equity is to be achieved, and there may be barriers encountered (Waddington and White 2014).	Dissemination of information and uptake of technologies beyond group members has not always been very effective because the uptake of technologies is enhanced by the experiential learning process (and without it, the uptake by non-members may be limited) (Waddington and White 2014, ICIMOD 2018, Goldstein 2020). There are sometimes concerns raised that the information is not always disseminated accurately, calling for more training of farmers and facilitators (Waddington and White 2014). An alternative view is that technologies should not just be shared as a standardized practice because they may not be appropriate for all farmers, even within the same locality (Bakker et al. 2021).

Instrument	User involvement	Support value chain participation	Equity	Accelerate uptake
	facilitators' correct design and capacitation can increase farmers' participation in experiential learning and the development of innovations (ICIMOD 2008; Charatsari et al. 2020).			

Green = No, Beige = yes if addressed in the design of the instrument, Blue = yes inherent in the instrument

What must you consider when designing instruments to support innovation?

Some instruments need to be designed to extend their lifespan; some have severe cost implications. Others have high transaction costs for investors/funders and/or other actors – especially the beneficiaries. In addition to the points raised below, the design of all instruments must consider the need for ensuring equity. They need to ensure that marginalized members of communities are not excluded, whether these are individuals or enterprises with limited resources, groups that are generally excluded from accessing resources such as land (women and youth in particular).

Instrument	Lifespan	Cost implications	Transaction costs
Type A instruments			
Incubator	They need to have strategic affiliations – for example, with a university (Infodev 2010) or for-profit activities to sustain them – **revenue from tenants, revenue from tenants' success** (equity or royalties), or	The CENTEV/UFH technology incubator, which can host 20 companies, cost USD 8 million to establish. Other than this case, there was **no reference to the cost**	As with accelerators, there is **very little evidence** provided regarding transaction costs.

	ongoing **sources of funding** – government or even public–private partnerships. The selection of participants may consider their potential to pay for services (Hjortsø et al. 2017). Some incubators are subsidized because they are part of the regional development strategy of local and state governments (Infodev 2014b)	implications of establishing or operating incubators.	
Accelerator	Accelerators are also organizations (Crișan et al. 2021). Though possibly not all, many are established through donor-funded programs; they can be more sustainable if linked to a university (Food Africa Accelerator undated) or another type of permanent organization. Universities, however, offer particular opportunities related to taking forward research outputs. They also devise **financial models to ensure sustainability** – such as taking equity in the ventures or charging participation fees or success fees, depending on the type of participants being supported (Kimle 2014). Facilities funded by the government generally require external funding to survive in the long term (Cohen et al. 2019b). **Venture capitalists** may see value in supporting accelerators as it allows them to screen potential investments (OECD 2019).	Most literature refers to costs per venture supported rather than the cost of establishing and operating the facility. The nature and scale of the facilities are highly variable. For example, Kimle (2014) indicates a range of USD 3 million to USD 20 million for a three- to five-year program and one US-based accelerator was said to have spent USD 20 billion for 700 start-ups. According to Cohen et al. (2019a), accelerators invest USD 20,000 for a small start-up team in exchange for 6–8% equity. In another study, investment ranged from USD 0 to USD 600,000 – with a mean maximum of USD 68,000 (Cohen et al. 2019).	The literature related to accelerators gave very little attention to transaction costs, although the paper by Cohen et al. (2019b) highlighted that having cohorts of start-ups moving through in cycles makes it easier for mentors to support multiple ventures.

Innovation hub	Variable arrangements are identified to ensure sustainability – for example, being **associated with an educational institution** and funded by the government (UNESCO undated) or having **a pricing model** to cover its costs – which may exclude some entrepreneurs (Friederici 2018). A **supportive environment** that legitimizes innovation hubs may also provide ongoing financial support (Jiménez and Zheng 2017).	Literature about innovation hubs that were reviewed did not make any reference to costs.	No direct reference to transaction costs associated with innovation hubs was identified.
Type B instruments			
Challenge funds	Challenge funds are usually time-limited and operate over a fixed period, such as five years (Pompa 2013). While the challenge fund itself has a limited lifespan, it is assumed that the services generated through the fund will continue beyond the project timeframe, possibly through uptake by the market (Davies and Elgar 2014).	Awards generally range from USD 100,000 upwards (Davies and Elgar 2014; UNDP 2016). For example, the Africa Enterprise Challenge Fund has a minimum grant of USD 250,000 per project, while Sida has a ceiling of EUR 200,000 (Pompa 2013). The private sector sees challenge funds as subsidies that reduce investment risk, and the applicant contributes at least 50% of the cost (Pompa 2013; Davies and Elgar 2014; UNDP 2016).	The cost of administering challenge funds is normally 12–30% of the fund's value (Pompa 2013; UNDP 2016). Some funders subcontract a professional consulting firm to support applicants to finalize applications. Sometimes the applicant must pay an administration fee and an evaluation fee for this service (Tjornbo and Westely 2012).
Innovation funds and grants	These are generally short to medium-term (two to three year) funding arrangements (Rajalahti and Larson 2011; Howell 2017). Some are linked to the duration of another	There is a lack of information about the cost of running an innovation fund. An indication of grant size for a two-phase approach was USD 150,000 awarded	Managers can reduce transaction costs by clearly defining the themes and strategic interventions supported by a grant scheme and the groups eligible for funding. It cuts

	instrument, such as an innovation platform (Adekunle and Fatunbi 2013).	for phase 1 and USD 1 million awarded for phase 2 of a small business innovation research program in the US.	down the number of applications that must be screened (Rajalahti and Larson 2011).
Innovation funds for smallholder farmers	IFSFs should be implemented as part of a systemic, long-term effort to promote sustainable farming systems (Triomphe et al. undated), which would, in turn, lengthen their lifespan. Some IFSFs have grown from year to year, which has allowed farmer groups to continue their research and address other needs such as the purchase of equipment (Ashby et al. 2000).	These funds provide very much smaller amounts than other innovation funds normally award. For example, Honeybee Network gave amounts of approximately USD 300 to USD 1,400, while grants awarded through the GTZ-funded SSPF were generally less than USD 20,000 for two years and the LISFs piloted by Prolinnova dispersed amounts of USD 10,000 to USD 60,000 per country platform, via the host organization, which then, in turn, dispersed the funds to farmer groups (Friis-Hansen and Egelyng 2007).	Cost efficiency for the funder is relatively high due to the reliance on volunteers, students and extended networks to implement the innovation fund (Friis-Hansen and Egelyng 2007). Experiences with IFSFs indicated that two-thirds of the fund value was needed for farmer support organizations managing the funds (Triomphe et al. undated). Alternative methods such as participatory video may be required to assist less literate farmers in applying for funds and owning the innovation process (Richardson et al. 2019).
Prizes and awards	These instruments are either implemented within a program of fixed length or are institutionalized within organizations that do not have a fixed lifespan, such as the National Innovation Foundation in India, which has annual prizes for unassisted innovation (Friis-Hansen and Egelyng 2007). Some comprise several stages, with each stage varying from two months to two and a	The value of prizes can be variable. For example, the Ideas to Impact program shared USD 4.7 million between 79 winning participants (An average of USD 60,000 each). In contrast, the scale of the AgResults program is demonstrated by the USD 17.68 million prize made available to the team developing a FMD vaccine over eight	No specific reference to transaction costs in the literature. However, there is a need to consider the cost of calling for and screening applications and then monitoring results to make awards (*some monitor performance and others just pay for results, which should reduce transaction costs for the investor/funder)*.

	half years (Gould et al. 2020). Prizes and awards can have longer-term impacts beyond the contest's timeframe by creating awareness and encouraging farmer innovation (Tambo 2018). Some prizes can move into the implementation phase and then have a longer timeframe (Deloitte 2015).	years (Hammond et al. 2021). Other prizes, such as those awarded by the National Innovation Foundation in India, are much smaller (maximum award being approximately USD 6,500) and are awarded directly to grassroots innovators (NIF undated).	
Results-based contracts	The lifespan of a specific contract is defined by the legal contract, which stipulates the goals, responsibilities and so on (Sumo et al. 2016) and may range from one to three years (Deloitte 2015). One challenge with RBCs is the lack of flexibility in setting outcomes, limiting their suitability for use in the agricultural sector (Janus and Holzapfel 2016), especially when supporting research and innovation where failure is a real possibility.	RBCs generally offer a fixed fee relative to performance, based on the agreement in the contract (Sumo et al. 2016). Some examples of amounts of funding disbursed include USD 110,000 for coffee and cocoa production in Peru (a development impact bond, 2014–2015), USD 7 million for a program promoting biofortified maize in Zambia (results-based finance, 2012–2019) and USD 144 million for reform of the agricultural sector in Rwanda (Results-based aid, 2013–2016). They are seen as an effective mechanism to leverage additional resources from private investors (Janus and Holzapfel 2016).	The contracts are very detailed and specific to reduce costs and risks (Sumo et al. 2016). Streamlining the procurement process can reduce paperwork and associated transaction costs (Harvard Kennedy School 2016). The funder may offer support and expertise, and external evaluators for monitoring (Deloitte 2015), but this is likely to increase the transaction costs further.

Type C instruments			
Innovation platforms	Most literature does not refer to timeframes that platforms operate. Since many have been established through programs with external funding (Adam et al. 2018), they have a limited timeframe. Institutional anchoring is a pre-stage for scaling innovation platforms (Seifu et al. 2020). Some platforms are innovative enough to evolve into independent self-organized entities (Adam et al. 2018). Due to the high cost of fostering partnerships, it is better to see platforms as longer-term initiatives (Homann-Kee Tui et al. 2013).	External funding is usually required to establish and run innovation platforms (and build the necessary capacity of members) because the process is costly, especially the cost of facilitating relationships to bring in necessary expertise (Homann-Kee Tui et al. 2013). External funding is usually required to establish and run innovation platforms (and build the necessary capacity of members) because the process is recognized as being costly, though details were not provided (Homann-Kee Tui et al. 2013; Adam et al. 2018). Local-level innovation platforms can find ways to sustain themselves, such as charging a membership fee (Adam et al. 2018), but this might exclude individuals from marginalized groups.	There is no mention of transaction costs for the participating actors – what does it cost them to attend meetings and activities and participate in innovation processes? Do the benefits justify the time spent?
Living labs	Living labs such as the Metro Agri-Food Living Lab (MALL) have been designed to be self-sustaining entities (Musikoyo et al. 2017), as has the Agrolab Uniandes, which is located within a university, which subsidizes running costs while applications are made	The nature of the living lab and its facilities affect the cost of establishing a living lab. For example, an ICT living lab that aimed to provide access for communities to ICT infrastructure was very costly to establish because of the	No information was available regarding transaction costs.

Type C instruments			
	for supporting activities within the LL (Osma et al. 2019).	infrastructure and equipment (Mutanda et al. 2011). The model for funding businesses within a LL also determined whether the resources must be available or whether loans must be obtained to cover start-up costs (Musikoyo et al. 2017).	
Farmer research structures	Some programs introduce FRSs without the intention to create a self-sustaining entity, but rather the timeframe is linked to the enterprise cycle, and it is sustained or terminated depending on the value it is providing to its members (Anchala et al. 2004). Other programs want their FRSs not to be project based (Steinmaier 2001). A key element of sustaining FRNs/FRGs beyond project timeframes is diversifying their roles beyond research to support value chain participation (Anchala et al. 2004; Descheemaeker et al. 2021). Embedding them within existing farmer organizations (Anchala et al. 2004) and using bottom-up and participatory approaches contribute to ensuring longer-term sustainability (Richardson et al. 2021).	The cost of establishing FRSs depends on whether they are building on existing research projects that have already established relationships with farmers or if they are being specifically developed as a new initiative (Richardson et al. 2021). Most FRGs and networks are established using donor funds (Anchala et al. 2004). The case of CIALs in Latin America was a different model because the funding model was not standard, and some were supported through their partnerships, while others submitted applications to donors.	If the FRSs are to be managed by NGOs or farmer organizations, then this has resource implications for that organization (Richardson et al. 2021), and these costs should not be overlooked. The administrative costs of facilitating the CIALs declined from USD 670 to USD 100 per year over six years (Friis-Hansen and Egelyng 2007). The average membership of the CIALs was 12 individuals. Costs included the salaries and associated costs of the agronomist and paraprofessional supporting the CIAT, together with experimentation costs (Humphries 2000). Where local innovation support funds (LISFs) are used as a mechanism to fund the innovation being undertaken by farmers,

Type C instruments			
			then the management of the LISF (screening applications, monitoring activities of beneficiaries) is a cost (mainly time and possibly local travel) for the local structure and its members – and there is a cost for the NGO supporting the local structure (Kanoute et al. 2019), while there are clearly also transaction costs for the farmers involved in terms of their time, labor, and travel costs to meetings (Martey et al. 2014).
Farmer field schools	FFS are difficult to sustain beyond project timeframes as they generally require ongoing formal activities to keep them active (Waddington and White 2014). However, the active presence of NGOs or agricultural programs may increase their sustainability (Davis et al. 2010).	There is concern that FFSs are not cost-effective to establish relative to traditional extension approaches because establishment requires start-up costs, capacity building of trainers and curriculum development, backstopping, as well as ongoing project management costs – which are estimated as costing USD 20 to USD 60 per participant (Waddington and White 2014).	Besides the costs of running FFSs incurred by the organization funding them, there are also costs for the beneficiaries to attend the meetings and implement the new technologies, which may be labor intensive (Waddington and White 2014).

5. Recommendations and concluding remarks

This final section of the report provides recommendations for designing and operationalizing instruments to support innovation, and some general concluding remarks. It follows from the previous section in terms of guiding investors/funders or innovation managers to choose instruments or combinations of instruments to invest in supporting innovation towards achieving SAI in the Global South.

General recommendations for using instruments to support innovation

This study and the comparative analysis undertaken has revealed some specific findings that should be considered by investors/funders and innovation managers looking to support innovation.

1. Many of the instruments have been introduced through programs funded by external donors, which limits their sustainability. There are **limited examples of institutionalization of these instruments** within government or academic institutions, with some exceptions. There are also examples of instruments (innovation platforms, living labs, etc.) established through projects that are no longer operational. This highlights the need to anchor instruments within existing organizations during the course of the program that establishes them. This can best be achieved by involving key authorities in designing and testing these new instruments (i.e. generating evidence at a local level). If the instrument is intended to have an extended lifespan but is not to be anchored within an existing organization, then attention must be given to designing a business model that will be able to sustain itself.
2. **Institutional embedding of new instruments** such as innovation platforms needs to be accompanied by a change to system-oriented R&D approaches. This requires various changes toward developing an enabling environment related to organizational mandates, incentives, procedures and capacity development (Schut 2016). This, in turn, requires commitment from organizations to develop capacities that facilitate multi-stakeholder innovation processes. It also requires a change in perceptions such that innovation is no longer seen as the domain of formal researchers, and the role of extension agents is not limited to transferring technologies without providing space for adaptation and testing.
3. While the challenges of introducing technologies from research centers are often recognized, it must also be noted that **technologies developed with farmers in one locality may not necessarily be appropriate for those in another area** and may require further testing and adaptation (Bakker et al. 2021). While this increases the transaction costs associated with scaling up innovations, it does need to be recognized. One solution is to develop new technologies that are flexible enough to be used in different localities with minor tweaking.
4. The involvement of farmers in innovation processes should not always be assumed to lead to an accelerated uptake of innovations beyond those who are directly involved. This is because **diffusion of information does not always occur effectively beyond the original participants** that are directly involved in the process of experiential learning (Waddington and White 2014). Other mechanisms may need to be used to share information and penetrate markets and farming systems; for example, supporting farmer-to-farmer sharing by holding events where videos and other material can be shared.

5. When instruments are designed and operationalized, the **heterogeneity of smallholder farmers should be recognized** so that efforts are made to ensure that less literate, poorer segments of the community can also participate. Similarly, the participation of women and youth may only be possible if their needs are considering when designing instruments (Elias et al. 2021). This calls for the co-design of instruments such that local needs are incorporated.
6. **Challenges faced by farmers are generally complex** and cannot be addressed by the introduction of a technical innovation alone. Thus, if an instrument is being used to address a technical need, then attention should also be given to the broader context. For example, it may be necessary to develop new institutional arrangements that allow for collective action by farmers, or it may be necessary to help facilitate linkages with markets. Bundling different types of innovations together is likely to increase their impact.
7. Many actors, though not all, require **multiple forms of support** (e.g. access to finance and to knowledge holders) if they are to engage effectively in innovation processes. Some actors, especially the private sector, require some de-risking mechanism to be in place. Most instruments covered in this study provide multiple forms of support. When they do not directly provide non-financial support (e.g. challenge funds, innovation funds/grants or IFSFs), a complementary mechanism can address non-financial needs (e.g. business skills or building social capital). Similarly, for instruments that do not provide financial support for innovation processes (such as an innovation platform), it would be useful to also find a way to make finance available to support innovation or to de-risk the innovation process. A combination of instruments seems a practical approach to pursue but must be based on local requirements, project intentions and local circumstances (Schut et al. 2016). Instrument combinations will depend on the needs of the actors involved in the innovation process. Also, the instruments may be used in parallel or implemented in successive steps. For example, participants that emerge from an incubator program may need to have access to an accelerator program.
8. **Some instruments need to morph over time** as the needs of beneficiaries change. For example, a farmer field school focused on testing new farming methods may over time draw in more actors and become an innovation platform that also provides access to markets. It is important for organizations supporting farmers to allow these changes to occur if they are to be effective in addressing needs that emerge over time.
9. It is clear that while instruments may not have been used specifically to address SAI principles, there is an opportunity to **design them in such a way that the multiple objectives** for sustainability are addressed. For example, criteria for supporting an organization or individual can depend on the extent to which the proposed innovation is expected to impact on poor communities, or society as a whole. Payments linked to impact can consider milestones that incorporate environmental measures, such as reductions in emissions or a reduction in sedimentation of rivers.

Concluding remarks

The purpose of this study has been to provide sufficient information based on the literature and experiences of key informants to inform potential investors/funders of innovation about the instruments that can be used within different contexts to achieve different impacts. While this analysis has focused on what particular instruments HAVE been used for, or have aimed to achieve, it is also important to consider how they could be designed to address additional objectives, in particular the

principles of SAI. For example, a focus on a specific group of people or theme is generally not intrinsic to an instrument, but it could be designed to address this. However, focusing on marginalized groups that are, for example, unable to pay for services can negatively affect the financial model of instruments that are expected to become self-sustaining entities.

The literature review revealed many pilots and projects that have used different instruments to support innovation, yet critical appraisal of these initiatives is lacking. Where the effectiveness of the instruments has been documented, it is often too soon after the end of the project, so longer-term sustainability is not explored. There is a real need to integrate future M&E for these instruments, given that the existing literature cannot build a strong evidence-based case for many of the instruments: there is only a handful of serious reviews, and these also suffer from a lack of underlying data.

One finding that has emerged from the study is that many instruments, and the programs through which they are established, aim to put the end-user at the center of the innovation process so that they are an active stakeholder rather than just a recipient of the process outcome. However, the use of new approaches such as innovation platforms, that deviate from conventional R&D and technology transfer processes, calls for changes at a system level in terms of organizational mandates and new roles for researchers and extension staff. Furthermore, when new participatory, bottom-up approaches are introduced into the programs of government and other actors, there is always a concern that they will not be operationalized according to their inherent design principles, and will instead be introduced in name alone, with no real change to the way that development and innovation takes place.

The analytical approach adopted in this study, though valuable, has been extremely challenging and not without shortcomings – largely based on the high levels of variability across projects, organizations, sectors, regions and countries in the design and operationalization as well as monitoring and evaluation of, and reporting on, the different instruments assessed here. A more systematic approach to understanding, quantifying and reporting the impact that results from investment in innovation is, therefore, urgently needed, given that it is a crucial component of impact investing.

Furthermore, we would suggest that a potential investor or funder planning to make use of one of these instruments for investing in innovation engagement must engage in depth with the material that we have drawn on for this study, and any other material they can source, to guide them towards the most appropriate instrument for the particular context in which they plan to use it.

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Annex 1: General findings from key informants

Besides the findings provided above, the KIs provided some additional information about using the different instruments. These may prove useful to investors exploring options and designing instruments that meet their own needs and the needs of the target beneficiaries, as well as reflecting on the process of implementing or using them.

1. The choice and design of instruments must be appropriate for the program's target group. If this happens to be marginalized communities, youth, or women, then the initiative must allow for their participation while addressing their specific needs. For example, according to one KI interviewed, the design of one living lab initiative enhanced women's involvement because the training was done at the people's place of residence, where they were engaged in the business. Thus, it allowed for the effective participation of women, who are often excluded from training events away from home.
2. The program's design must also be suited to its purpose – for example, is it aimed at an agribusiness that can operate from a physical space, or does it need to support farmers that are innovating on their own farms. A KI associated with one of the incubators established through the UniBRAIN initiative has provided technical support to incubatees and linked them to markets (some even provided refrigerated transport). Still, their farming activities happened outside of the incubator and on their farms.
3. Sometimes different instruments can be complementary and need to be included within one initiative or need to align initiatives. For example, graduates of incubators may benefit from entering an accelerator program, indicating that instruments might achieve greater developmental outcomes and economic growth when combined.
4. Another issue raised is that small-scale farmers' challenges are not likely to be solved by a 'gadget', but are rather "related to [the lack of] fairness and equity in the value chain". Innovation must focus on addressing these blockages if farmers are going to progress and participate more effectively in value chains.
5. Context is also very important in influencing how well an approach or instrument works. According to a KI, a program building agribusiness alliances was found to be effective in East Africa but not in West Africa, and this was related to the associated commodities with high-value crops with quick turnaround time versus much longer production cycles for crops like cocoa in West Africa Consideration must be given to the detailed design of programs to support small-scale farmers.
6. Working with individual farmers is often not practical, but grants are often too small to make a meaningful contribution for large groups, and loans are more appropriate as they can maintain the members' interest. Identifying the right farmers who are motivated and have access to some resources is crucial. Elite groups have hijacked some funding programs; others have failed because of the poor governance of the groups/structures receiving the funds.
7. It was suggested by one of the KIs that has explored the use of innovation grants to support smallholder production, that all instruments included in this study should be seen as transactions between innovators and funders and that ways must be found to ensure that the transaction costs are not prohibitive for small farmers, which generally requires working

through organized structures – small farmers need someone to facilitate or perform linkages on their behalf, whether it is an NGO or a farmer organization. Facilitators allow the farmer organization to generate some funds by charging a mark-up on transactions – a broker fee. The same KI also highlighted that working via a second-tier farmer organization that can vouch for their member organizations and provide additional support such as market access can assist with identifying the right grantees. If farmers stand to lose more than just access to a small grant (by not meeting compliance requirements), they are more likely to be held accountable.

8. A common challenge encountered with programs aimed at supporting innovation is that they do not continue to operate effectively beyond the project timeframe despite substantial investments. A range of factors is responsible for this and should be considered when conceptualizing and designing the programs and associated instruments. Firstly, all platforms/networks need a committed facilitator, be they farmers, researchers, or extensionists. One KI highlighted that the participants need to have a common vision beyond learning; otherwise, the groups disintegrate.
9. The choice of instrument might not be as important as the attention given to its governance arrangements. It is these that affect its potential to become self-sustaining.
10. With many of the instruments that involve some form of a multi-stakeholder platform, institutional changes are required during their establishment. Attention is not always given to the innovation platform and needed institutional changes. Yet, it is expected that the platform will continue after the project ends, and the actors are expected to self-finance their participation and that of the platform. Investors need to recognize the roles of the different actors that have participated and consider how to allow for the continued involvement of these actors beyond the timeframes of funded programs to ensure the continuance of their interventions.
11. Perhaps sustainability should not be judged regarding the instrument's persistence in its original form, as they are likely to morph and adapt as circumstances change. For example, it has been suggested that innovation platforms should have an unlimited lifespan. However, they are likely to go through different stages. They may even transform into another structure that meets different or extra needs, such as providing access to microfinance services or inputs. Similarly, a farmer field school or a FRNs can – and may need to – morph into an innovation platform over time when participants look at bringing in the market and business stakeholders to get their product to market.
12. An interesting approach used by FONTAGRO[63] (a regional fund for agricultural technology that supports most countries in Latin America), which might improve instrument use sustainability, is to ring-fence a small portion of the funds for capacity building of team members. The leader of each project is responsible for developing a training plan that addresses capacity needs – perhaps this could look at a capacity building that would allow for the operation of instruments beyond project time frames.
13. The importance of public funds channeled through national research organizations for supporting R&D and innovation should not be overlooked as some have been very effective. The Brazilian Agricultural Research Corporation (EMBRAPA) and its initiative involving

[63] https://www.fontagro.org/en/who-we-are/

commercial farmers in developing branded climate-smart of carbon-neutral beef have successfully marketed a specific brand of climate-smart meat products. Other examples of public funds being used to support innovation include a loan from the World Bank to Kenya Agriculture and Livestock Research Organization for work on climate-smart agriculture, as well as a competitive fund run by the Ministry of Agriculture in Chile, which has a foundation for agricultural innovation.

14. A number of the stakeholders engaged in this study have highlighted the need to establish an enabling environment where innovation can occur. Creating such an environment may require the inclusion of relevant policy actors within multi-stakeholder platforms. For example, having the right actors included in the innovation platform will allow farmers to articulate their challenges, informing the research agenda.

Annex 2: General development conclusions

This study has demonstrated a wealth of information regarding the use of some of the instruments used in the development space for relatively long periods, particularly FFS and innovation platforms. There is less information available for some of the instruments that have had less usage within the agricultural innovation context (such as living labs and incubators). A number of the initiatives documented in papers are no longer operational, highlighting the challenge of ensuring that interventions are sustainable in the long term if the intention is to establish self-sustaining entities that can continue to generate and upscale innovation that can address challenges that emerge within the agricultural sector. It proved challenging to identify evaluation studies and yet where they were available. They proved very useful in highlighting the types of real challenges that programs face in supporting innovation processes. Any organization or actor that intends to use any instruments to support innovation toward achieving SAI should draw on past experiences that could influence the instrument's design for a given context.

The literature review indicated that certain types of instruments are limited in terms of the clientele or varieties of agricultural enterprises/actors they generally support. However, they may also be helpful to support other types of actors or enterprises,. For example, incubators and accelerators may be effective to support subsistence farmers, and not only small-scale commercial farmers and SMEs, but to do so, they will require some adaptation. Adaptation is itself an innovation and could be tried across a range of instruments and target groups. However, this should be attempted with caution as farmers are generally risk-averse and may be averse to trying out innovations in new crops or commodities and practices without some guarantee/insurance to cover loss, especially if these are unfamiliar agricultural products or require capital intensive inputs. There may be ways to overcome this – subsidize participation in or use certain instruments to make them more accessible to a broader range of actors, e.g., subsidized innovation risk insurance may be an option for subsistence farmers as they attempt greater productivity and innovation. While subsistence is their lot or limit, they may still engage in sales and want to expand. Many innovate to improve yields. Reduction of innovation risks can help.

Instruments can be almost neatly divided into two groups when it comes to their focus on recipients – established and able to pay or partially contribute to resource costs versus those that are unable to pay but can play a role and make use of available resources. For 10 of the instruments covered, small-scale commercial, SMEs, large-scale commercial to agribusiness are the key target groups. But subsistence farmers are at the other end of the spectrum – limited in their ability to contribute resources other than knowledge and skills.

In conclusion, some of the challenges and opportunities evident from the literature review concerning the use of the instruments and equally relevant when considering possible adaptation are summarized. As previously pointed out, the literature review provided limited evidence of the assessment (internal and external) of the various instruments or the programs through which they have been initiated – especially the impact beyond the timeframe of the funded program. Some instruments have been recently applied. Some are in the design phase. Others are slight adaptations to previous attempts or even introducing these into the agricultural sector or new regions in the Global

South. The instruments with the longest history are FFS and local agricultural research committees, referred to here as a version of a FRNs. These have been around for a couple of decades and have undergone several adaptations.

Furthermore, some instruments are used or could be used in a combined or complementary fashion and not simply on their own. Such use would need careful design and piloting but could ensure greater economic growth. In much of the literature, processes seem to be overlooked in favor of outputs. It appears that neither are generally reported on in detail in journals or even through institutional reports.

Sustainability of certain instruments not achieved beyond project cycles

The literature review found that several instruments, such as accelerator, incubator and innovation hub initiatives documented in peer-reviewed articles, no longer function, or no sign of activity are found on websites or in any other literature. Except for some papers and reports indicating the early achievements or challenges in the first year or two, scant if any literature covers their evaluation of accomplishments or the progress and existence of incubatees and SMEs assisted. These instruments are thus often of short-term duration, dependent on initial funding and project lifecycles rather than being developed to ensure their continuity to support other businesses when initial clients progress and leave or when they drop out, as the case may be. The implication is that some instruments are not designed for long-term self-sustainability or continuance after the project cycle. The result can be unused facilities that are either sold, used for other purposes or simply become deserted and deteriorate. Better analysis of how these incubators, accelerators and hubs can achieve long-term existence is required and must be incorporated into the design and implementation. As with many national government involvements with development projects during the start-up stages, this support dries up at the end of project cycles or soon after that. Due to perceived failure, new and greater demands are often placed on Global South governments to improve and scale-out basic essential services, including health, energy, education, and water and sanitation. Such priorities take precedence over limited budgets.

Some instruments, including innovation funds but not excluding others, are often delayed or hijacked for political purposes – elite capture, which can impact the outcomes (LIL/INDÍGENA). Sometimes negatively and sometimes resulting in unintended outcomes. The latter may be beneficial to other actors but are often not aligned to project intentions and may result in termination of the use of specific instruments. Such situations can also lead to a rethink of the initial project. They can bring about improved changes in design or alternatively the same intentions in a different guise with a slightly different focus (LIL/INDÍGENA). However, the focus seems to be on the aims and intentions of project designers and planners without any real contextual or circumstantial evidence included in the design. In a sense, business as usual or relocating to other sites where it is assumed that such instruments will be more likely to succeed.

Post-instrument financing of businesses and post-project funding of instruments

Where successful businesses are developed through hubs and incubators, there seems to be a challenge in getting investment from financial institutions. As the accelerators and hubs turn out strong businesses, these seem to fall short of the investment demands of private financial institutions (iHUB and SavaNet in Ghana). The iHub launched 800 new agribusinesses and invested in 50 start-ups to support their growth, but these seem not to have received subsequent private sector finance. To

ensure the sustainability of enhanced business after they leave the hub, accelerator or incubator, there is a need to align their development with that of financial institutions. Such institutions should become partners or advisors during the development of the businesses so that businesses are ensured longer-term financial support. Relationships must extend beyond the instrument to ensure that enterprises and their networks continue and develop. Services provided need to be more robust than simply confined to training, business plan development and networking in the sense that they should include potential future partners during their implementation – which is the case in some incubators, where incubatees were provided with the opportunity to pitch their ideas to venture capitalists. By their nature, some instruments, such as IFSFs, only provide short-term financing for a specific purpose and do not require longer-term financing. This is satisfactory if they achieve objectives.

Bureaucratic and administrative delays

The literature reveals common development implementation challenges such as long start-up or inception phases due to bureaucracy, administrative and governance concerns, and the continuous negotiation between partners of different levels and with different functions. This situation and its subsequent delays in the project or program implementation reduce the project lifecycle and result in some potential businesses and even supporters dropping out (GTZ-funded SSPF). It also reduces the grant size, which is often based on a set timeframe (LIL/INDÍGENA, Prolinnova and Malley 2012).

Selection of partners and implementers

In some instances, multinational corporations become the recipients of funds, notably in the challenge funds, and they then disburse funds to implementing agents and identified recipients, such as farmers (IAP, AECF). Companies such as Unilever and Price Waterhouse Coopers were identified from the literature as implementation partners. It is unclear why such routes of disbursement are used instead of shorting the chain from applicant to recipient innovator/entrepreneur as substantial portions of funding do not reach the target group.

Selection of entrepreneurs – beneficiaries/innovators/farmers

The literature does not reveal much about how enterprises and individuals are selected to be involved in these instruments. However, there is mention of applicants pitching novel ideas or possibly having two to three years of experience or existence (Powering Agriculture and Protective Foods SME Innovation Accelerator). Individual and enterprise selection is crucial to ensure some success and continuity of the instrument. If one of these instruments performs well in its intended activities, then local economic growth needs to continue over the long term. They can facilitate more innovative enterprises and entrepreneurial acumen that should ensure continued contributions to economic growth if they do. The literature suggests that these are often one-off activities in different countries or by various financiers, with an overreliance on external financial inputs. In rare cases, it is revealed that usually independently initiated and existing accelerators, hubs or incubators were subsequently drawn into projects or programs and manage to keep going (CURAD with its strong ties to NUCAFE).

In contrast, others simply collapsed at the end of the project cycle. However, these facilities that remain after the project cycle still struggle with achieving income to ensure their continuance. Some attempt to overcome sustainability issues by acting as incubators and accelerators to attract clients with different needs, ideas and perhaps significantly, financial means so that cross-subsidization occurs.

Extending the reach of investments/funds

The literature does not reveal how the funding amounts allocated to many of these instruments are determined at the outset. One program may get USD 3 million, and another may get triple this amount (see Kimle 2014). Sometimes, significant amounts are allocated to successful applicants. Still, clarity is not provided about the amount received and who gets the allocation as applicants can be a consortium that includes a host institution or a government oversight department (BioInnovate Africa). While allocation can be related to scope, it is also determined by overheads and the use of expensive governance and accounting institutions, which can eat into a large portion of the budget. Such allocations range from 15% to 27% of the total budget, as in the case of challenge funds. In an extreme case, 53% of the total budget can be allocated to auditing firms (IAP). In these and other situations, the actual amounts allocated to enterprises/firms or individuals supposed to be assisted may be small.

IF&G are largely used to support innovation at the stage of testing/piloting, while loan investments are used to support innovations during dissemination (IFAD 2020). These instruments reduce financial constraints and increase enterprises' chances of accessing venture capital because they provide a signal about grantee quality (Howell 2017). However, as noted above, there is the need to ensure that markets and private investors recognize this quality to ensure enterprise continuity. Accessibility of funding schemes can be more equitable by supporting the development of proposals by marginalized groups or enterprises or using other approaches, including limiting the size of the grants and limiting the size of the companies that can apply (Rajalahti and Farley 2010). In the latter instance, we note the amount of money that went to the lead organization in the IAP program. This is far from ideal, and rethinking how more funds and grants can directly benefit emerging and developing enterprises is crucial.

IFSFs often give farmers direct access to and control over funds to improve on their innovations. Primarily the purpose is to provide funds to assist farmers to source necessary research support to develop innovations. This involves farmer-driven experimentation with the support of agricultural research or extension providers. LISFs typically focus on subsistence and small-scale commercial farmers. Competitive Grant programs generally focus on commercially-oriented farmer groups and small rural businesses and provide larger amounts of funding than LISFs. However, the latter seems more business and market-oriented, while LISFs focus on innovation development or enhancement. Yet nothing stops CGPs from focusing more on innovation development and support.

Ensuring the involvement of farmers (and rural enterprises) as innovators

The purpose of innovation platform networks, living labs, FRNs and FFS is to actively engage farmers and agribusinesses in the innovation process. This is done as active experimenters, users or testers and co-creators. These all take different forms, and many have been adapted over the years. They all rely on an organization to facilitate linkages, access to knowledge and/or markets. These instruments require that innovators have access to financial resources that can support innovation activities. Their primary focus is on strengthening social and human capital rather than providing access to finance. However, some have combined access to or links to finance as an addition or at least access to output markets. Except for living labs (which is more of a testing facility), most are co-creation activities in which farmers and researchers experiment or try out new technologies/innovations and often improve on these focusing on farmers contexts and circumstances. Yet, there are some risks involved

in such experimentation. There is a need to ensure that introduced technologies and innovations are locally suitable and desirable or can be adapted to local circumstances. When this does not occur, farmers may drop out of the program. This said, the FFS have introduced innovation into their programs and have illustrated the potential to integrate external and local knowledge. Yet, they also suffer from identifying collaborators who contribute and stay with the program (PFI-FFS).

Another evident weakness is that these are very short-term activities (crop lifecycle or animal lifecycle) and usually do not involve any extra capacity building beyond that of the technology/innovation being disseminated or adapted. Sometimes groups formed through these engagements may go on to collaborate among themselves. There is a lot of literature related to FFS and innovation platforms – and it covers a substantial period – but far less material related to FRNs, and much of this is related to the work of the Collaborative Crop Research Program.

During stakeholder engagement associated with this study, a common concern that has emerged is that farmers are still not at the center of the innovation process but are rather at the receiving end, despite all the efforts that have been made by many individuals, organizations and forums to promote farmer-led innovation and experimentation. Many innovations developed by farmers that can make real impacts are not particularly visible nor sophisticated. Several other key informants shared similar sentiments, highlighting that users are a key player in the articulation of needs and the development of appropriate solutions, leading to instruments such as user-led processes and user-led multi-stakeholder platforms, where users reflect on their challenges and then invite researchers to come in and work them to address the challenges. Similarly, PAEPARD has developed the concept of user-led AR4D (Agricultural Research for Development) as a mechanism to give farmers more agency. The general perception of stakeholders is that the more participatory the instruments and co-creative innovation development processes, the more likely they are to achieve their aims and address broader development challenges, which are often spinoffs of these instruments.

CoSAI desired impacts

Evidence from the literature varies regarding the focus on CoSAI required impacts of Economic, Productivity, Social, Human wellbeing, Environmental, Gender and Youth. Often productivity and economic improvement are the direct intended impacts. However, intentions are not always revealed due to the lack of sufficient evaluation plans. Similarly, there can be a focus on women and youth, but this can be negotiated, and older, more established males may be sought as clients. While the review illustrates the number s of youth and women, there is no evidence about the contribution to these groups without clear evaluation reports. The need for self-sufficiency may make some instruments overlook many of these desired impacts and focus, perhaps exclusively, on productivity and economic upliftment. This is the case when private organizations attempt to profit to keep accelerators and incubators, and similar tools on the go. The other desired impacts can be an afterthought and perhaps considered later if the initial impacts are achieved. Usually, these are seen as trickle-down effects of innovation and its attempt at economic improvement and productivity. Like any development intervention, there can be spinoffs and unintended consequences that may improve social and human wellbeing and may also result in the political empowerment of women and youth. The absence of a focus on something does not mean that it is excluded, but rather it is not a priority. But it goes without saying that if something does not consider environmental sustainability, it is unlikely to do so.

Annex 3: Summary of broad characteristics of instruments

Type and sub-type listing	**Instrument**	**Type of support**	**Intention to meet SAI principles[1]: Ec, P, Env, S, H**	**Usage relative to gender and youth focus[2]**
A1	Incubators	Build social, human and financial capital – and support/facilitate market access	Yes: Ec, S Variable: P, H No: Env	Variable: G, Y
A2	Accelerators	Provide infrastructure (generally) Build social, human and financial capital	Yes: Ec, S, P Variable: H No: Env	Variable: G, Y
A3	Innovation hubs	Build social, human and financial capital – and market access	Yes: Ec, S, P, H Variable: Env	Yes: Y No: G
B1	Challenge funds	Build financial capital (including de-risking innovation) *May also include technical and financial support*	Yes: Env, S, H, Ec Variable: P	Variable: G, Y
B2	Innovation funds/grants	Build financial capital	Yes: S, H Variable: Ec, Env, P	Variable: G, Y
B3	Innovation funds for smallholder farmers	Build financial capital for farmers' innovations *Generally, it needs to be complemented by efforts to build social and human capital*	Yes: H, S Variable: Ec, P, Env	Yes: G No: Y
B4	Prizes/awards	Build financial and human capital It may be complemented by technical support.	Yes: S, Env, P, H Variable: Ec	Variable: G, Y

B5	Results-based contracts	Build financial capital	Yes: Env, S, H Variable: Ec, P	No: G, Y
C1	Innovation platforms	Build social and human capital *Need to be complemented by resources for innovation (e.g. innovation grant)*	Yes: S, H, P Variable: Ec, Env	Variable: G, Y
C2	Living labs	Build social, human and financial capital	Yes: Ec, S, P, H Variable Env	Variable: Y, G
C3	Farmer research structures	Build social, human and financial capital	Yes: Pr, H, S Variable: Env, Ec	Yes: G Variable: Y
C4	Farmer field schools	Build human and social capital	Yes: H Variable E, S, Env, P	Variable: G No: Y

[1] Ec = Intended Economic Outcomes; Env = Intended Environmental Outcomes; H = Intended Human Wellbeing Outcomes; P = Intended Productivity Outcomes; S = Intended Social Outcomes

[2] G = Focus on Gender; Y = Focus on Youth

Annex 4: Use of instruments drawn from the reviewed literature

Instrument	**Context**	**Focus on the value chain**	**Types of innovations supported**	**Funders** ***Note investors are investing for economic and/or social returns on investment***	**Implementer**
A1 Incubators	Mainly urban	Small-scale commercial farmers, Agribusiness	Commercialize technologies; Market /organizational arrangements	• Government – bilateral • Private sector • World Bank • University • National government	• Global or regional forum • Innovation center • University
A2 Accelerators	Urban/rural *Virtual or physical*	Small-scale commercial farmers; Agribusiness	Process, Products (incl. services)	• Philanthropic organization • Venture capitalist • Private sector • Government – bilateral	• Venture capitalist • Accelerators
A3 Innovation hubs	Urban	Small-scale commercial farmers, Agribusiness	Variable	• Private sector • Industry • National research organization • Global organization (e.g. WEF) • Philanthropic organization • International research center • National government	• Tertiary education organization • Innovation center • National development agency
B1 Challenge funds	All	Small-scale commercial farmers (exports); Agri-business	Products, processes	• Independent innovation foundation • Government – bilateral • Government – multi-lateral	

B2 Innovation funds/grants	All	Subsistence, Small-scale commercial farmers		• Global industry association • Global or regional financial organization • National government • Government – bilateral • Global organization (e.g. FAO) • Producer organizations	• Global NGO • National government • Industry • National innovation fund • Producer organizations • Investor (Government/ Bilateral)
B3 Innovation funds for smallholder farmers	Rural	Small-scale commercial farmers (or commercializing subsistence farmers)	Multiple innovation types	• Philanthropic organization • Government – bilateral	• Global network/community of practice • Philanthropic organization • Global or regional forum
B4 Prizes/awards	All	Small-scale commercial farmers; Agribusiness	Products (technologies and services)	• Global – multi-lateral • Global or regional financial organization • Philanthropic organization • National government	• Global NGO • International research centers • Social development companies • National innovation fund • National NGO
B5 Results-based contracts	Rural	Programs for social impact (small-scale commercial farmers)	*Unclear*	• Government – multi-lateral • Government – bilateral • Philanthropic organization • Global or regional financial organization	• National government • Global NGO
C1 Innovation platforms	Mainly rural	Different production scales (subsistence to large-scale commercial farmers)	Multiple – marketing arrangements, products	• Global or regional financial organization • National government • Government – multi-lateral • Government – bilateral • Global or regional forum • International research center	• Global or regional forum • Producer organization • International research center • National research organization • Global NGO

				• National bank	
C2 Living labs	Urban and rural	Small-scale commercial farmers; ICT developers	Variable (multiple types, bundles, process)	• Government – bilateral • Philanthropic organization	• National research organization • Tertiary education organizations (incl. universities)
C3 Farmer research structures	Rural	Small-scale commercial farmers (or commercializing subsistence farmers)	Processes (farming practices); Bundles	• Philanthropic organization • Government – bilateral	• Global network/community of practice • NGO • Farmer organizations • Tertiary education organization • National research organizations • International research centers
C4 Farmer field schools	Rural	Subsistence farmers; Small-scale commercial farmers	Processes (farming practices); Bundles	• Government – bilateral • Government – multi-lateral • Private • Trade organization	• Independent development organization • National government • Civil society organization • Global organization (e.g. FAO) • Investor (Global/multi-lateral) • Producer organization • International NGO • Local farmer organizations • NAADS

Annex 5: Additional literature used for analysis

This is a list of paper used for the analysis of instruments but not referenced in the report.

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CoSAI
Commission on Sustainable Agriculture Intensification

The Commission on Sustainable Agriculture Intensification (CoSAI) brings together 21 Commissioners to influence public and private support to innovation in order to rapidly scale up sustainable agricultural intensification (SAI) in the Global South.

For CoSAI, innovation means the development and uptake of new ways of doing things – in policy, social institutions and finance, as well as in science and technology.

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