# Innovation portfolio management for responsible food systems transformation in the public sector: Lessons, results and recommendations from CGIAR

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## HIGHLIGHTS

- Innovation portfolio management is underutilized in the public research and development sector.
- CGIAR is mainstreaming an innovation portfolio management approach based on Scaling Readiness principles.
- The objective is to enhance CGIAR's effectiveness and performance in achieving its 2030 research and innovation strategy.
- Innovation portfolio management necessitates a holistic approach with investment in methods, mindsets, and mechanisms.
- Integrating this approach into decision-making and program cycles serves as a significant incentive for its adoption and success.

## GRAPHICAL ABSTRACT
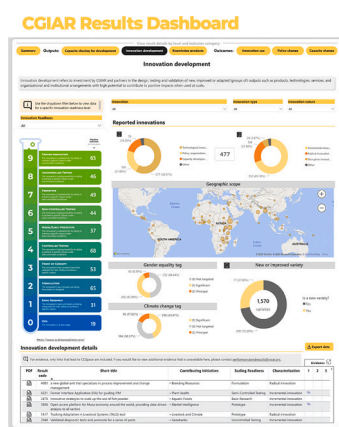


## ARTICLE INFO

## ABSTRACT

*CONTEXT:* Global food systems are confronted with multifaceted challenges, including climate change, malnutrition, and biodiversity loss, disproportionately affecting the livelihoods of millions, particularly in low- and middle-income countries. Recognizing its potential to address these challenges, innovation is increasingly central in public sector organizations. However, despite growing emphasis, the adoption of innovation portfolio management approaches remains limited.

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Responsible innovation
End-to-end innovation management

*OBJECTIVE:* Drawing on a case study of CGIAR, a global research partnership dedicated to agricultural challenges, this paper seeks to accomplish two objectives. The primary objective is to produce a set of best practices in innovation portfolio management that can benefit public sector organizations. The secondary objective is to demonstrate how this offers an important precursor to guide organizational decision-making and investment towards responsible food system transformation.

*METHODS:* An in-depth analysis of CGIAR's approach to innovation portfolio management is based on qualitative and quantitative data from sources such as interviews, observations, documents, and archival records. The study adopts a descriptive case study approach, utilizing an analytical framework that recognizes the importance of methods, mindsets, and mechanisms in describing and analyzing the CGIAR case.

*RESULTS AND CONCLUSIONS:* Key lessons encompass the need for a holistic perspective on innovation portfolio management. The paper advocates for the integration of an innovation portfolio management approach within broader (1) organizational processes, including human resources, finance, legal frameworks, and risk management; and (2) innovation systems where food system transformation is the outcome of interactions and partnerships between government, public and private sector organizations.

*SIGNIFICANCE:* This study furnishes actionable guidance to public organizations seeking to harness innovation portfolio management for responsible and impactful food system transformation.

## 1. Introduction

Global food systems face enormous challenges, including climate change, malnutrition and biodiversity losses (Myers et al., 2017; von Braun et al., 2023). These challenges compromise the livelihoods of billions of farmers, consumers and other food system actors world-wide, particularly in low- and middle-income countries. There is an overall belief that innovations can make a positive contribution to the food systems transformation required to deal with these challenges (Reardon et al., 2019; Klerkx and Begemann, 2020; Blakeney, 2022; Thornton et al., 2024). Over the past two decades, innovation has slowly, but steadily, gained presence in international (agricultural) development cooperation, influenced by the ambitious UN 2030 Sustainable Development Goals (SDG) agenda (Silva, 2021).

Innovations are generally defined as new or improved products, processes and services, or policy and institutional arrangements that intend to produce value (Nagji and Tuff, 2012). Innovations can be of a technological nature (a machine, new seed variety, digital tool or device) or a non-technological nature (capacity development approach, policy, business model, changing gender norms) (Geldes et al., 2017). It is often the combined availability and use of technological and non-technological innovations that allow for change or transformation to happen, which is referred to as an innovation package (Sartas et al., 2020) or innovation bundle (Barrett et al., 2022). Many innovations undergo a maturation process, evolving from an initial idea into a fully developed product or service. Maturation often happens as a result of basic research, design, rigorous testing, and adaptation in both controlled and uncontrolled environments. Once there is sufficient confidence that an innovation is proven to work, there is usually an aspiration to make it available to more clients or in other geographies. This is also referred to as innovation scaling – an important precondition for achieving impact (Woltering et al., 2019; Schut et al., 2020).

Inequity and social exclusion influence the extent to which innovation and scaling processes contribute to upward social movement (McGuire et al., 2022). Food systems actors of different genders, ages, resource endowment levels, and social statuses experience different types of challenges (McGuire et al., 2024). Enabling equitable and inclusive innovation is increasingly an explicit goal for research and development organizations. However, there is growing understanding that innovations can benefit some groups of food system actors more than others. It can widen gaps and increase inequalities between groups, depending on who has access to, can afford, and – ultimately – can benefit from agricultural innovations (de Roo et al., 2019; Hammond et al., 2020). The field of responsible innovation and scaling facilitates thoughtful consideration of the varying distribution of benefits resulting from innovation, as well as the anticipation and mitigation of unintended negative consequences or effects related to innovation use at scale (e.g. Owen et al., 2013; Wigboldus et al., 2016). In this paper, we discuss responsible innovation and scaling for food system transformation.[1] This encompasses socio-economic responsibility aspects, focusing on gender, inclusivity and equity, as well as environmental responsibility aspects, including the effects of innovation and scaling on greenhouse gas emissions and biodiversity.

Most public, non-for-profit research and development organizations (henceforth referred to as public R&D organizations) manage not just one, but a broad variety of innovations, innovation projects and interventions aimed at delivering (positive) societal impact (Proud et al., 2023). This is being referred to as an innovation portfolio. Depending on the size of a public R&D organization, a global portfolio could easily comprise of 1000s of innovations under development and in use. Innovation portfolio management refers to intentionally guiding innovation investments and decisions within an organization to advance its vision and strategy (OECD, 2021). Despite the growing emphasis on utilizing innovation portfolio management approaches and their benefits, public R&D organizations have shown limited adoption of such strategies, with well-documented case studies and experiences being even more scarce (Holden et al., 2018; Megersa, 2019; Schut et al., n.d. under review).

The research questions that this paper seeks to address are: What are key lessons, results, and recommendations from the design, operationalization, and implementation of an innovation portfolio management approach in a global public R&D organization, and how can these support other public sector organizations in using a portfolio management approach for responsible food systems transformation? The primary objective of this paper is to produce lessons for best practices in innovation portfolio management that can benefit public sector organizations. The secondary objective is to demonstrate how such best practices offer an important precursor to guide organizational decision-making and investment towards responsible food system transformation.

## 2. Methods

### 2.1. Case study approach and context

Given the limited number of public sector organizations applying an innovation portfolio management approach, an in-depth case study approach will be the main source of data for this paper. A case study approach is a research method that involves deep investigation and analysis of a particular organization or phenomenon. It focuses on studying a specific case within its real-life context, collecting qualitative and/or quantitative data through various sources such as interviews, observations, documents, and archival records (Yin, 2009). The case study approach used in this paper is descriptive. Descriptive case studies provide a detailed account of one or more cases to fully understand the

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[1] In some instances, we refer to 'responsible food system transformation.'

complexities and dynamics of the case. In this paper, a single case study approach is used and deemed appropriate for two reasons. First, due to the novel nature of the topic in the public sector, very few public R&D organizations have invested in an innovation portfolio management approach. Second, the case study that is described and analyzed is that of CGIAR which – as one of the world's most prominent agricultural innovation networks – is critical and important to document.

CGIAR (formerly known as the Consultative Group on International Agricultural Research) is a global partnership of research organizations dedicated to addressing complex agricultural challenges in collaboration with governments and the private and public sector. The CGIAR is a consortium of centers,[2] the first of which were established in the late 1960s. Formed in 1971 on the heels of the first celebrations of a Green Revolution in 1968, CGIAR was tasked with extending and translating that revolution in agricultural production to new countries and new crops. Over more than five decades, the CGIAR has undergone several reforms as donor funding models and stakeholder priorities shifted (McCalla, 2014; Leeuwis et al., 2018). Similar to other organizations in the public R&D sector, there is increased pressure on CGIAR to demonstrate how investments in science and innovation contribute to objectives such as those formulated under the United Nation's SDGs (Penfield et al., 2014; Glover et al., 2016; Leeuwis et al., 2018). It has resulted in a situation where a drastic transition was initiated to adapt the CGIAR structure for current food system challenges and dynamics (Barrett, 2020).

The transition of CGIAR is largely fueled by an ambition to develop and implement a more coherent research and innovation strategy aimed at "Ending hunger by 2030 through science to transform food, land and water systems in a climate crisis" (CGIAR System Organization, 2021). The transition responds to increased fragmentation in the CGIAR system, and the ambition to manage the CGIAR innovation portfolio in a more coherent way.

### 2.2. Conceptual framework

A holistic approach is used to describe and analyze the CGIAR innovation portfolio management case, which itself can be considered an innovation or change process (Proud et al., 2023). The holistic approach is rooted in an understanding that innovation or change processes often require a combination of (1) new methods (e.g. superior technical systems), (2) new mindsets (e.g. capacity, attitudes and belief), and (3) new mechanisms (e.g. policies, rules and governance) (Smits, 2002; Leeuwis, 2013).

Figure 1 illustrates how innovation portfolio management is as much about methods (systems to have timely access to quality data on innovation and transparent criteria to assess the portfolio) and mechanisms (incentives, resource allocation strategies, and governance approaches) as it is about growing the organizational mindsets (the underlying cultural and capacity growth dimension, and organizational leadership). This framework is inspired by Brink's theory of Behavioral Innovation, which is grounded in behavioral science, psychology and innovation practice (Brink, 2022). Brink use this framework to inform innovation practice at multiple scales. Though not the main objective, the paper reflects whether it can be applied scientifically, through the lens of organizational innovation portfolio management processes. Table 1 provides more detail on the specific design elements of this analytical framework.

### 2.3. Methods for data collection

#### 2.3.1. Data to document and analyze the CGIAR innovation portfolio management design, operationalization, and implementation process

Case studies often involve multiple data collection methods to draw

meaningful conclusions. In this paper the main source of information results from the authors' participation in the design, operationalization, and implementation of CGIAR's innovation portfolio management approach, which is also known as "autoethnography" (Adams et al., 2017). Autoethnography is an approach in qualitative research where the researchers (several authors of this paper) actively participate in the research process as both a researcher and a participant. In this method, the researchers' personal experiences, reflections, and interpretations are central to the study (Ellis et al., 2011).

The various key events, activities, and strategic decisions were analyzed against the design principles and elements presented in Table 1. As much as possible, events, activities, and decisions will be supported by written reports and other types of documentation and records. Analysis will mainly focus on the extent to whether and how design elements were considered, and their related implications for CGIAR innovation portfolio management.

#### 2.3.2. Data to document and analyze initial CGIAR innovation portfolio management results

Data on the initial CGIAR innovation portfolio overview was based on 2022 innovation data extracted from CGIAR Performance and Results Management System (PRMS) and the CGIAR Results Dashboard. PRMS is a comprehensive system designed to collect data, provide analytics, and support evidence-based management decision-making to enhance the efficiency and effectiveness of CGIAR's research and development investments. It focuses on reporting, monitoring, and evaluating outputs, outcomes, and impacts, ensuring accountability and promoting learning within the organization. By integrating performance indicators, evaluation tools, and adaptive management approaches, the PRMS fosters evidence-based decision-making and facilitates the continuous improvement of research and development initiatives (https://reporting.cgiar.org/).

The CGIAR Results Dashboard is the public interface of the PRMS where basic results and analytics (including innovation portfolio data) can be found. Descriptive quantitative statistics are used to generate examples of the kind of innovation portfolio management data and analytics CGIAR currently has access to (https://www.cgiar.org/food-security-impact/new-results-dashboard/). The reflection on how the innovation data was used in strategic decision-making will provide a starting point for discussing recommendations and next steps.

## 3. Results

### 3.1. Setting the scene

In 2019, a CGIAR reform was initiated that is generally referred to as the transition towards "One CGIAR" (CGIAR System Organization, 2019). An important element of the transition was to develop a 2030 Research and Innovation Strategy anchored in a unifying mission of "Ending hunger by 2030 – through science to transform food, land and water systems in a climate crisis," focused on five Impact Areas of nutrition, poverty, gender, climate, and environment (CGIAR System Organization, 2021). The 2030 strategy positions innovation and scaling at the heart of the CGIAR mission. CGIAR embraces an innovation systems approach that acknowledges that partnerships with governments and other public and private sector organizations are crucial to achieving impact at scale.

CGIAR's Performance and Results Management Framework (PRMF) is the companion document to the CGIAR 2030 Research and Innovation Strategy (CGIAR System Organization, 2021). It describes the key components of CGIAR's processes, tools, and performance management measures that will support portfolio delivery. A key novelty in the PRMF is the Scaling Readiness concept (Sartas et al., 2020). Scaling Readiness is an evidence-based approach to support the design, implementation, and monitoring of strategies to support innovation development and/or scaling. This approach embodies a new evidence-based way of tracking

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[2] https://www.cgiar.org/research/research-centers/
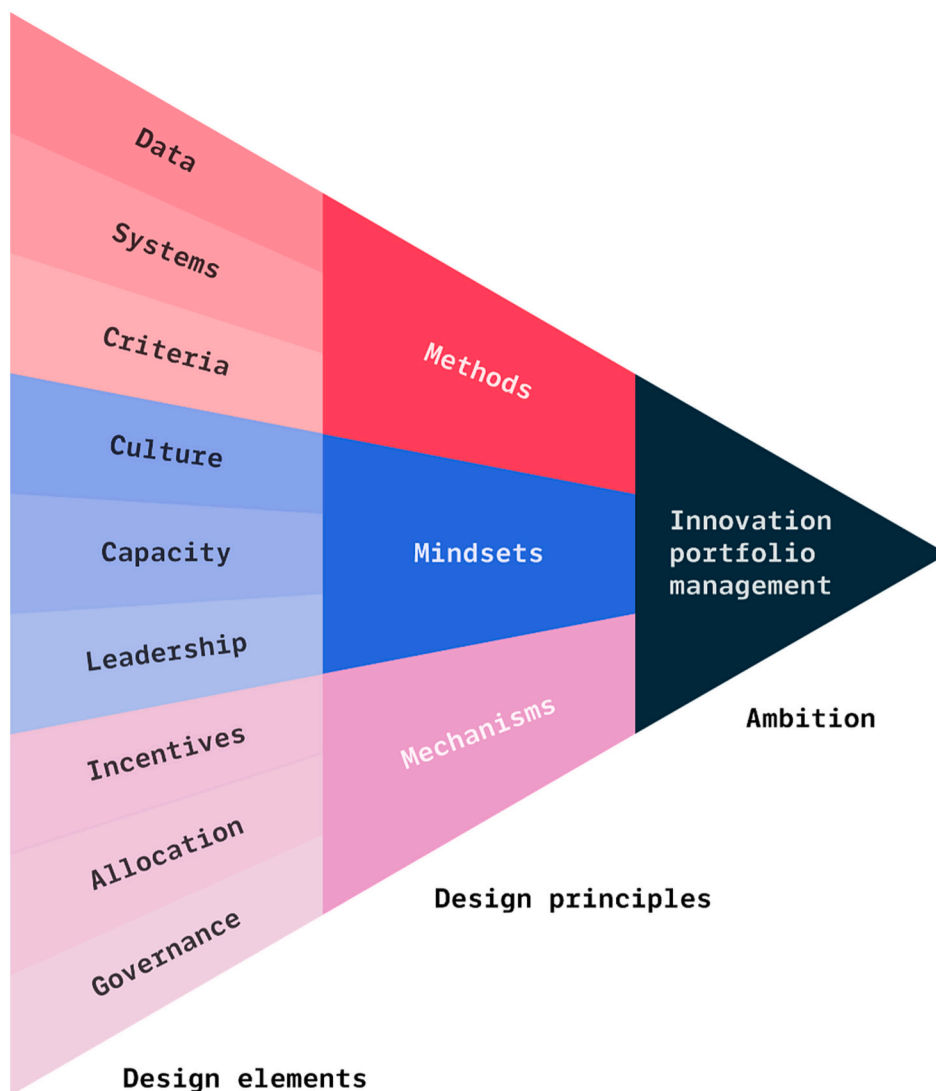
**Fig. 1.** Critical design principles and elements that need to be considered and aligned with the overall ambition of the innovation portfolio and its management (Proud et al., 2023).

**Table 1**
Basic description of innovation portfolio management design principles and elements (builds on: Proud et al., 2023).

| Design principles | Design elements | Basic description |
|---|---|---|
| Methods | Data | Information and metrics that are needed to support strategic decision-making |
| | Systems | Timely access to quality and evidence-based data and information |
| | Criteria | Hard and soft criteria to analyze and compare across the portfolio |
| Mindsets | Culture | Organizational culture growth that supports the portfolio management approach |
| | Capacity | Knowledge, skills, and attitudes required for meaningful innovation portfolio management |
| | Leadership | Strategic engagement of leaders and champions to support organizational culture growth |
| Mechanisms | Incentives | Policies, planning, and reward structures and how they enable innovation portfolio management |
| | Allocation | Clarity on how financial, human, and other resources will be allocated across the portfolio |
| | Governance | Procedures, roles, and responsibilities related to strategic sense- and decision-making |

innovations and managing them to scale through innovation packages. Its standardized methods and metrics allow for aggregation of data, which can inform the management of an innovation portfolio. This approach to innovation management, which is now being referred to as Innovation Packages and Scaling Readiness (IPSR), has never previously been attempted or implemented across the entire CGIAR. Table 2 provides key concepts and definitions used in this paper.

The PRMF is operationalized through CGIAR's Technical Reporting Arrangement (CGIAR System Organization, 2022) and the Performance and Results Management System (PRMS). The CGIAR Technical Reporting Arrangement fulfills the system-level programmatic reporting requirements set out in the Standard Provisions annexed to the Funding Agreement or Arrangement signed between each funder and the CGIAR System Organization. It provides operational detail on the content, timing, format, standards, and scope of technical reporting applicable to all pooled-funded Initiatives, representing approximately 30% (262 million USD in 2022) of overall CGIAR portfolio funding. The PRMS provides the digital infrastructure required to effectively collect, manage, and communicate CGIAR's performance and results data. Section 3.2.1.2 offers more details.

**Table 2**

Key concepts and definitions.

| Key concept: | Description |
|---|---|
| Innovation | New, improved, or adapted outputs or groups of outputs, such as products, technologies, services, organizational and institutional arrangements with high potential to contribute to positive impacts when used at scale. |
| Innovation Development | The process of developing innovations from an idea to a proven product, technology, service, or arrangement that is validated for its ability to contribute to positive impacts when used at scale. The process often includes basic research, innovation design, and improving innovations based on testing under (semi-)controlled and uncontrolled conditions.<br><br>Progress in innovation development is measured in an evidence-based way along the 0–9 levels of innovation readiness. |
| Innovation Readiness | A metric used to assess the maturity of an innovation, with a scale ranging from innovation idea (level 0) to (level 9) innovation validated under uncontrolled conditions. |
| Innovation Use | A metric used to assess the extent to which an innovation is being used, by which type of users and under which conditions, with a scale ranging from no use (lowest level) to common use (highest level). |
| Innovation Package | Combinations of interrelated innovations and enabling conditions that, together, can lead to transformation and impact at scale. They are context, time, outcome, and use-group specific and their ability to contribute to outcomes and impact can change over time. |
| Innovation Portfolio Management | The methods, mindsets, and mechanisms to intentionally manage innovation investments and decisions by an organization aligned to a common set of objectives. |
| Scaling Readiness approach | Evidence-based approach to support the design, implementation, monitoring, and optimization of strategies to increase readiness and use of innovations at innovation package and/or portfolio level. More information at: https://www.scalingreadiness.org/. |
| CGIAR Initiative | The main vehicle for delivery of research and innovation by CGIAR towards 2030. It includes major, prioritized areas of investment that will bring capacity from within and without the system to bear on well-defined major problem statements to deliver across five CGIAR Impact Areas. In the context of this paper, they include Impact Platforms that will foster critical thinking and use of evidence to improve their focus on the scaling of innovation and impact from research. |
| Innovation Packages and Scaling Readiness (IPSR) | This refers to how CGIAR is embedding key Scaling Readiness principles to improve innovation and scaling performance.<br><br>IPSR aims to accelerate the scaling of innovations by providing processes and tools to CGIAR Initiatives and other projects to achieve four key objectives: (1) Track the development of all innovations; (2) Create innovation packages and assess scaling readiness for specific contexts, (3) Develop and implement strategies to overcome bottlenecks to scaling, (4) Manage the innovation portfolio along an impact pathway or pipeline. |

Sources:
CGIAR MELIA Glossary (2021)
CGIAR Portfolio Narrative (2022)
CGIAR Results Dashboard Glossary (2023)

**Table 3**

Standard indicators and parameters for innovationsas defined in the CGIAR Standard Indicator Description Sheets.

| Indicators/ innovation data | Innovation Development | | Innovation Use | |
|---|---|---|---|---|
| Year | 2022 | 2023 | 2022 | 2023 |
| New or legacy innovation* | X | X | | |
| Newly reported or updated | | X | | X |
| Short title (10 words) | X | X | X | X |
| Title (30 words) | X | X | X | X |
| Description (150 words) | X | X | X | X |
| Theory of Change mapping | X | X | X | X |
| Geographic location (global, regional, national) | X | X | X | X |
| Partners and partner type (demand, innovation, scaling, other) (external collaboration) | X | X | X | X |
| Lead initiative/ project | X | X | X | X |
| Contributors (internal collaboration – Initiatives/ projects, and CGIAR-centre collaboration) | X | X | X | X |
| Gender and climate change tags | X | X | X | X |
| Nutrition, environment and poverty tags | | X | | X |
| Impact Areas and targets | | X | | X |
| Sustainable Development Goals and targets | | X | | X |
| Innovation nature (incremental, radical, disruptive, other) | X | X | | |
| Innovation type (technological**, capacity development, policy/ organizational/ institutional) | X | X | | |
| Anticipated innovation use (actor (actors disaggregated by type/sex/age), organization, other) | | X | | |
| Efforts made to promote Gender Equality and Social Inclusion (GESI) | | X | | |
| Efforts made to promote responsible innovation to limit unintended negative consequences/ impacts | | X | | |
| Intellectual Property Rights | | X | | |
| Innovation developer/ contact | X | X | | |
| Innovation collaborators (internal/ external) | X | X | | |
| Innovation team diversity | | X | | |
| Innovation Readiness level | X | X | | X |
| Scaling ambition | | | | X |
| Experts to support innovation package design | | | | X |
| Innovation Package | | | | X |
| Scaling Readiness (readiness and use of innovation package) | | | | X |
| Current innovation usage (actors disaggregated by type/sex/ age) organization, other) | | | X | X |
| Estimated USD investment in innovation development/ use by CGIAR and partners | | X | | X |
| Innovation Development or Use PDF report*** | X | X | | X |
| Evidence (of innovation readiness and use levels and quantified current innovation usage) | X | X | X | X |

\* Legacy innovations refer to innovations whose development started prior to 2022

\*\* Additional information on genetic innovation is collected (number of breeding lines)

\*\*\* If a PDF report is requested, additional data (funder acknowledgement, visuals, and reference materials) are collected.

### 3.2. The design, operationalization, and implementation process

#### 3.2.1. Methods

*3.2.1.1. Data.* Innovation portfolio management requires data to make decisions. It is important to make sure information is accurate, relevant, and of sufficient quality. CGIAR has developed a unified framework for

reporting innovation development and use across the portfolio. This means that the same data is collected on all innovations, irrespective of their nature (technological/ non-technological) and current maturity (idea or scaling-ready). Standard indicator description sheets (SIDS) were developed in 2022 and updated in 2023, while outlining the main parameters against which innovation data is collected (Table 3). The metadata associated with innovations enables comprehensive filtering and comparisons between – for example – countries, innovation types, thematic areas and maturity or readiness level. From 2023 onwards, mandatory updating of previously reported innovation results will allow for more dynamic trend data – for example – how innovations mature and reach more users over time as a result of investment. This will also allow CGIAR to demonstrate which innovation development or scaling processes were discontinued or put on hold, and for which reasons.

For each reporting period, two key metrics are captured: innovation readiness and innovation use. Both metrics emerge from the Scaling Readiness approach (www.scalingreadiness.org) that CGIAR has embraced as main framework for innovation portfolio management. Innovation readiness is a metric used to assess the maturity of an innovation, with a scale ranging from innovation idea (level 0) to proven innovation validated under uncontrolled conditions (level 9). Innovations often go through different stages of readiness and can start as an idea that is turned into a prototype, working model, or application that needs to be tested and validated under controlled and uncontrolled conditions. The readiness of an innovation is often context- and outcome-specific, and can change over time. Innovation use is a metric used to assess the extent to which an innovation is already being used, by which type of users and under which conditions, with a scale ranging from no use (level 0) to common use by target users or beneficiaries (level 9). An innovation that is only used by the innovation project team or its direct partners[3] will score low in innovation use. Innovations that are commonly used by anticipated end-users will score high in innovation use. Both innovation readiness and innovation use are assessed using evidence. Combined, innovation readiness and innovation use metrics can be used to calculate the Scaling Readiness or Scalability Potential of interrelated innovations (also referred to as an innovation package). Work by Sartas et al., 2020 offers a more detailed conceptual account of the Scaling Readiness approach. The application of the approach in CGIAR has been captured by Schut et al. (2022) and Damtew et al. (2023).

In 2023, several data fields were included that could offer overview of how CGIAR's innovation portfolio reflects key elements of responsible innovation and scaling. These include data on anticipated and current innovation usage (by actor type and disaggregated by sex/ age) and actions to promote Gender Equality and Social Inclusion (GESI) and to limit unintended negative consequences/impacts of innovation use at scale. Furthermore, capturing innovation team composition may offer important insights on how responsible innovation and scaling is influenced by the CGIAR and partner team diversity or lack thereof.

*3.2.1.2. Systems.* To ensure innovation data is collected in a standardized and timely way, functional data collection systems and processes are needed. To facilitate this, CGIAR developed a Performance and Results Management System (PRMS). PRMS is a web-based Management Information System designed to collect data on results achieved by multiple projects/Initiatives structured in a portfolio (Fig. 2). Data is collected manually or automatically and is organized following standards defined internationally and by the CGIAR (Tobon et al., 2022).

The second key feature is that data is validated using workflows to check consistency against defined criteria. CGIAR has put in place a rigorous Quality Assurance (QA) process ensuring that submitted

innovation data (as well as all other results) is evidence-based. For example, innovation readiness and use claims need to be accompanied by supporting evidence. Evidence can vary from idea notes and basic research to more rigorous scientific studies or impact assessments but should convincingly support the readiness or use claim. The team of quality assessors cross-verifies each result indicator independently and liaises with the innovation submitters in case improvements or changes are required. A third-party tiebreaker mechanism is used for priority innovation data fields to resolve disagreements. The QA team is provided with a protocol, which includes criteria and instructions for the quality assessment. Only innovation data that has been quality assessed will be used in official internal and external innovation portfolio decision-making, reporting, and communications, such as through the CGIAR Results Dashboard and with funders. The online system ensures a blind assessment and feedback process in which the assessor remains anonymous (Fig. 3).

Automatic validation, along with Artificial Intelligence (AI) for data standardization, has been recently incorporated (De Col et al., 2021). This integration of AI holds significant promise for enhancing data consistency and QA efficiency by minimizing the need for manual review.

The third feature is the capacity for the system to export data in different formats, starting from simpler tabular exports to more advance visual dashboards designed to aggregate data. The public Results Dashboard is where QA-ed data are presented and accessed by CGIAR funders and stakeholders in general (Fig. 4) (CGIAR System Organization, 2023).

PRMS has been developed as an evolution to the existing systems used in the previous 2017–21 reporting cycle: Managing Agricultural Research for Learning and Outcomes (MARLO) (Förch et al., 2015) and the Monitoring, Evaluation and Learning (MEL) platform (Holmes et al., 2018). These systems were designed around a different result framework with features not included in the scope of PRMS (e.g. activity management, evaluation and budgeting). They were lacking key aspects, such as proposal development and active theory of change management. In terms of innovation management, PRMS built on the work done by the CGIAR Research Program on Roots, Tubers and Bananas to develop an online catalog with an internal review process (Bonaiuti et al., 2021).

The system is evolving thanks to a periodic learning and optimization process through which the function and user-interface of the PRMS is improved over time (CGIAR System Organization, 2023). While the initial scope was primarily focused on reporting data from the pooled funded portfolio, the expectation is also to include non-pooled (bilateral) projects. Additional features are being built to support planning and risk management.

*3.2.1.3. Criteria.* Developing a set of innovation portfolio management criteria can guide innovation portfolio decision-making and prioritization. Criteria may be of strategic, financial, or risk-related nature so investments can be re-prioritized or stopped in case minimum requirements are not met.

Although its importance has been acknowledged, CGIAR does not yet have an agreed-upon set of criteria to manage its innovation portfolio. With the first data being reported in PRMS in 2022, questions on data analytics and meaning have emerged and are sparking discussions on how CGIAR would define innovation portfolio health, and what criteria could evaluate it. The innovation data that is currently being collected allows for advanced metrics and analytics to support decision-making, including:

- Innovation risk profiles: Data collected on the innovation nature (incremental, radical, disruptive) can inform risk-return discussion with incremental innovations often having lower risks and lower return, and disruptive innovations often having higher risks, but also higher potential returns. Many private sector organizations have set

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[3] Users that are directly incentivized by a project or intervention to use an innovation are considered project team or direct partners, which will score as low innovation use.
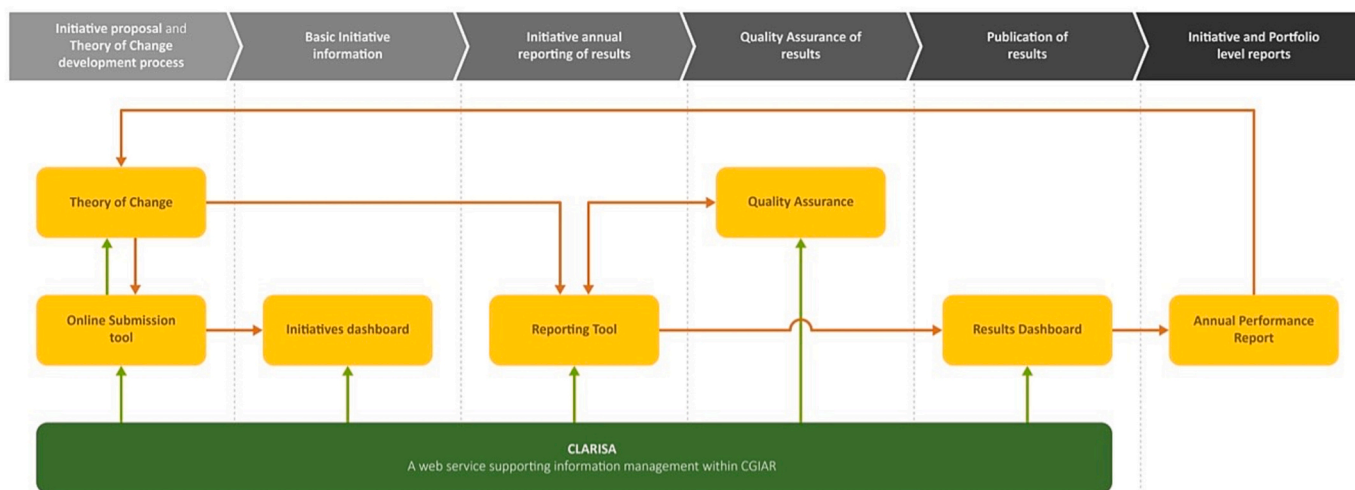
**Fig. 2.** Illustration of the PRMS structure and data flows (author M. Almanzar, CGIAR).
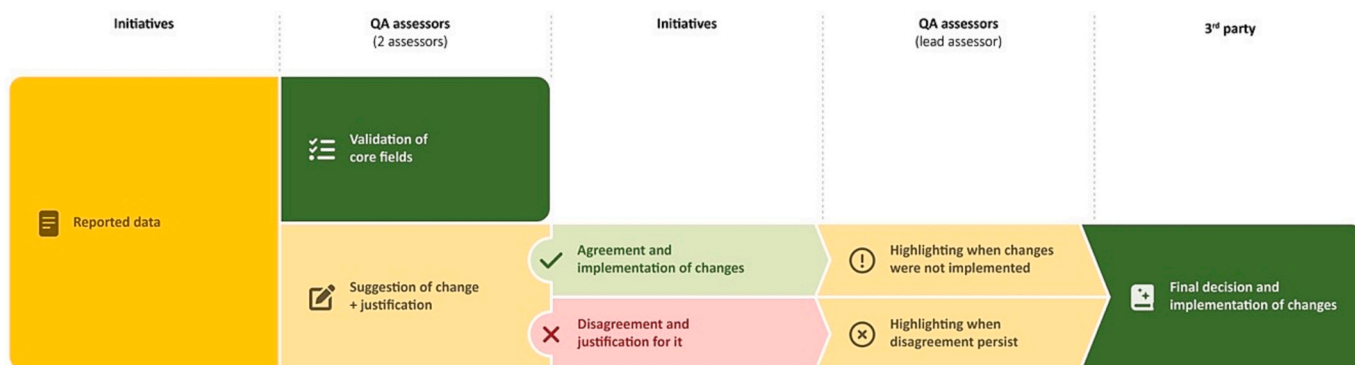


**Fig. 3.** Illustration of the CGIAR Quality Assurance process (author M. Mariani, CGIAR).

targets for the investment share that should go into these different innovation categories, for example 70% in incremental, 20% in radical, and 10% in disruptive innovation. Depending on the organization's risk appetite, investment focus may differ, as well as change over time.

- Impact focus: The CGIAR data systems collect detailed information on the intended impact focus of its innovations. Here two interrelated frameworks are being used, (i) the internal 2030 CGIAR Impact Areas and (ii) the 2030 United Nations SDGs. Both frameworks have a set of operational targets that represent the ultimate impact focus of innovations. The innovation data that CGIAR collects allows analytics on the number and USD investment in innovation across different impact domains, such as zero hunger, no poverty, and gender equality, among others.

- Investment data: From 2023 onwards, the estimated USD investment by CGIAR and partners in innovation development and use will be collected. This offers a starting point for: (i) tracking innovation investments over time, (ii) different types of return[4] on investment calculations, (iii) relative investment requirement for innovations of specific type, nature, or readiness level, and (iv) changes in CGIAR and partner co-investment in innovation and scaling. Investment data was not collected in 2022 but was seen as a key metric for

innovation decision-making by different groups of portfolio managers.

- Innovation pipeline health: The existing data collection framework enables CGIAR to meticulously track both the changes in quantity and monetary allocation into innovations across different readiness and use levels (see section 3.2.1.1). This capability empowers the organization to assess its efficacy in generating outcomes and impacts over short, medium, and extended periods. These assessments can be juxtaposed with guiding principles like "invest fewer resources in a broad variety of early-stage innovation" and "strategic allocation of resources towards fewer, high-potential innovations."

- Acceptance/kill-rates: As innovations evolve from idea towards a proven, scalable product, service, or institutional arrangement, decisions need to be made on which innovations to advance, and which ones to put on hold or stop. Such decisions are needed because (1) not all great ideas will become game-changing innovations; (2) of a need to free up resources to re-invest in new discovery and blue-sky research; and (3) innovations with high-impact potential are allocated more resources in order to not dilute investments and have a clear focus. CGIAR tracks which innovations are discontinued and for which reason(s), which allows for systematic reflection and learning.

- Responsible innovation and scaling: CGIAR collects data on (i) innovation usage (including information on current and targeted use of innovation by women and youths); (ii) the extent to which innovations contribute to promoting Promote Gender Equality and Social Inclusion (GESI); (iii) responsible innovation to limit unintended negative consequences/ impacts; and (iv) impact focus on SDGs addressing diversity, equity, and inclusion. These provide

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[4] Return can be defined as changes in readiness/use levels, as well as the ultimate returns related to innovation usage (e.g. changes in farm household productivity, income, health, etc.)
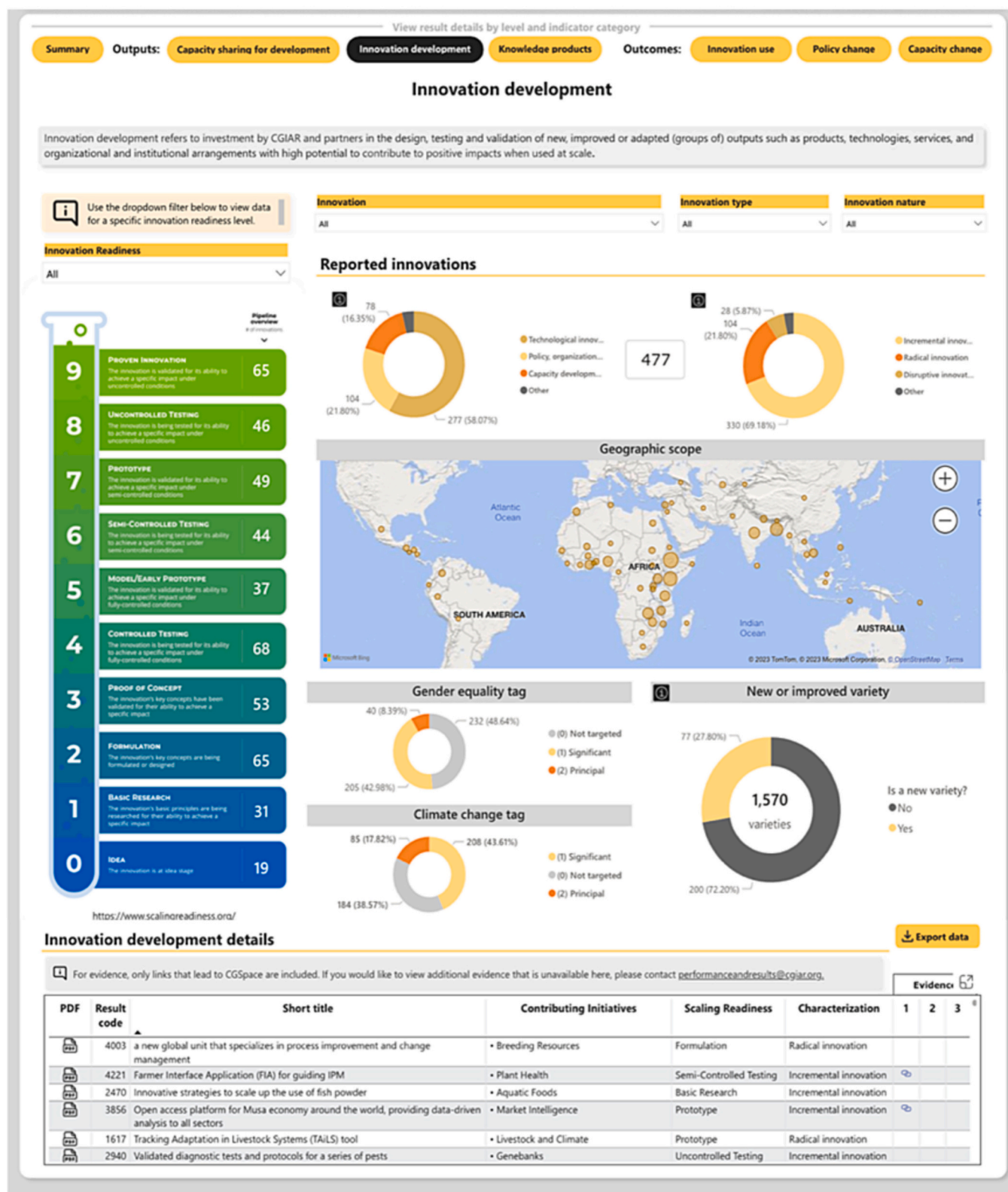
# CGIAR Results Dashboard



**Fig. 4.** A screenshot of the CGIAR Results Dashboard with, 2022 data, with dedicated pages on Innovation Development and Innovation Use.

important proxies on the extent to which CGIAR prioritizes responsible innovation and scaling investments.

The combined use of the above-mentioned analytics and metrics is powerful and can meaningfully inform criteria for portfolio management. Adding to the mix, data on geographical focus and innovation typology will further enrich the portfolio overview and support strategic decision making. It is important to mention that both quantitative or 'hard' criteria (e.g., progress in scaling readiness) as well as 'soft' criteria (e.g., demand and fundraising potential) provide input to management decision-making.

### 3.2.2. Mindsets

*3.2.2.1. Culture.* Initial engagements and discussions on innovation portfolio management with different groups of science and management stakeholders across the CGIAR system revealed some pushback on innovation portfolio management. Making full use of the innovation data represented a new challenge and opportunity for portfolio managers. A change-management expert was engaged to better understand portfolio managers' needs, objectives, and pain points.

In April and May 2022, three workshops were organized to define the destination and vision of success, developing a joint understanding on different types of personas that would influence the change or be affected by the change, and finally what it would take to develop and implement a change management strategy. The workshops generated several important insights for the team developing the innovation portfolio management approach. First, resistance to change is normal and part of any kind of change process. Second, it provided insight into the hopes and fears of different stakeholder groups. Third, the existence of champions and early adopters, who are very positive about the approach, could become important change agents. Fourth, a voluntary and gradual mainstreaming of the innovation portfolio management approach would have a higher likelihood of success, compared to more mandatory, systemwide implementation. Fifth, it is worthwhile to aim for early adopters and produce communication products to enhance peer-to-peer exchange and engage other practitioners over time.

"Start small and work with early adopters" became an important guiding principle. CGIAR Initiatives could indicate whether they wanted to be part of an early adopter group who would receive dedicated support in preparing and implementing innovation data collection and analytics. Four Initiatives were selected to represent different action areas (genetic innovation, resilient agri-food systems, system transformation, and regional integration) as pilot-Initiatives with whom all data collection, analyses, and reporting tools, systems, and processes were tested before making them available to others. Early feedback allowed optimization around any major concern or pushback received from the pilot-Initiative teams and improved the overall acceptance and credibility of innovation portfolio management approach. As a result, the original Scaling Readiness approach went through a redesign process that led to the following changes:

- Simplifying the data fields and protocols following a Minimal Viable Product (MVP) approach.
- Significant reduction in time needed to report innovations.
- Separating innovation development reporting (output) from innovation use reporting (outcome).
- Making innovation management part and parcel of annual reporting, planning, and budgeting cycles.
- Combining self-reporting with Quality Assurance to ensure the evidence-base for key innovation data and metrics.

After the first analytics were released in early 2023, several portfolio management champions and change agents were supported in generating analytics and data visualizations (see section 3.3). Innovation

profiles were created for scientists and partners, and innovation portfolio management reports were created for those managing a broader variety of innovations.[5] Once these were shared in (online) meetings, several requests for similar country, thematic, or Initiative portfolio overviews started to come in. It seemed that seeing the analytics and their potential use had – to some extent – taken away initial concerns related to the additional effort to report the innovation data. Positive feedback from Executive Management, CGIAR's System Board and System Council as well as funders also contributed to increased acceptance across the organization.

In November 2022 and October 2023, CGIAR organized a "week of scaling" in Nairobi, Kenya with the objective to bring together CGIAR experts, partner organizations and funders around the theme of innovation scaling (Schut and Pircher, 2022). Network, culture and community growth is an explicit outcome of these events. Multiple sessions related to innovation portfolio management gave people working on innovation and scaling their first occasion to familiarize themselves with this topic.

*3.2.2.2. Capacity.* Strengthening knowledge, skills, and attitudes in the organization to understand what portfolio management is and what it tries to achieve is essential to increase acceptance and implement innovation portfolio management in a meaningful way. Strengthening capacity happened in different ways, and targeted various stakeholders both inside (scientists and portfolio managers) and outside the organization (e.g., funders).

First and foremost, capacity was strengthened during the numerous information, training and drop-in sessions that were organized. During such sessions, the key concepts and operating procedures were explained, and questions were answered Individual engagements with Initiative leadership and dedicated innovation and scaling experts in CGIAR were especially important as they could convey the message and strengthen capacity within initiative/ project teams. Detailed technical reporting guidelines provided additional support.

Second, CGIAR together with Wageningen Univeristy developed an e-learning course on innovation and scaling (https://innovationandscaling.thinkific.com) that was promoted throughout the system. More than 2000 people enrolled since its launch in April, 2022. This free, three-hour course provided background on the key concepts underlying the CGIAR innovation portfolio management approach. Based on demand, the original English course was translated into French and Spanish to reach a broader audience.

Third, approximately 100 CGIAR scaling experts/facilitators were trained on how to collect quality innovation data for reporting in PRMS. Training events that build on the e-learning course were organized in Kenya, Mexico, Ethiopia, and Thailand in 2023, and graduates were certified and added to a CGIAR Scaling Directory (https://www.cgiar.org/scalingdirectory/). In all, 27 out of the 32 CGIAR Initiatives had an expert/facilitator trained by the end of 2023, and 10 partner organizations were trained.

Fourth, internal capacity to take innovation portfolio management to the next step was ramped up. The team grew from 1 to 4 people in 2022, with additional data analytics, project management, and community of practice capacity hired in 2023. Also in 2023, CGIAR initiated the recruitment of a senior innovation portfolio management advisor, and a PhD researcher on innovation portfolio management was recruited.

*3.2.2.3. Leadership.* Leadership support is critical, since whether or not senior and middle leaders support innovation portfolio management has a massive influence on broader organizational acceptance of the approach. As outlined in section 3.2.2.1, a number of champions and
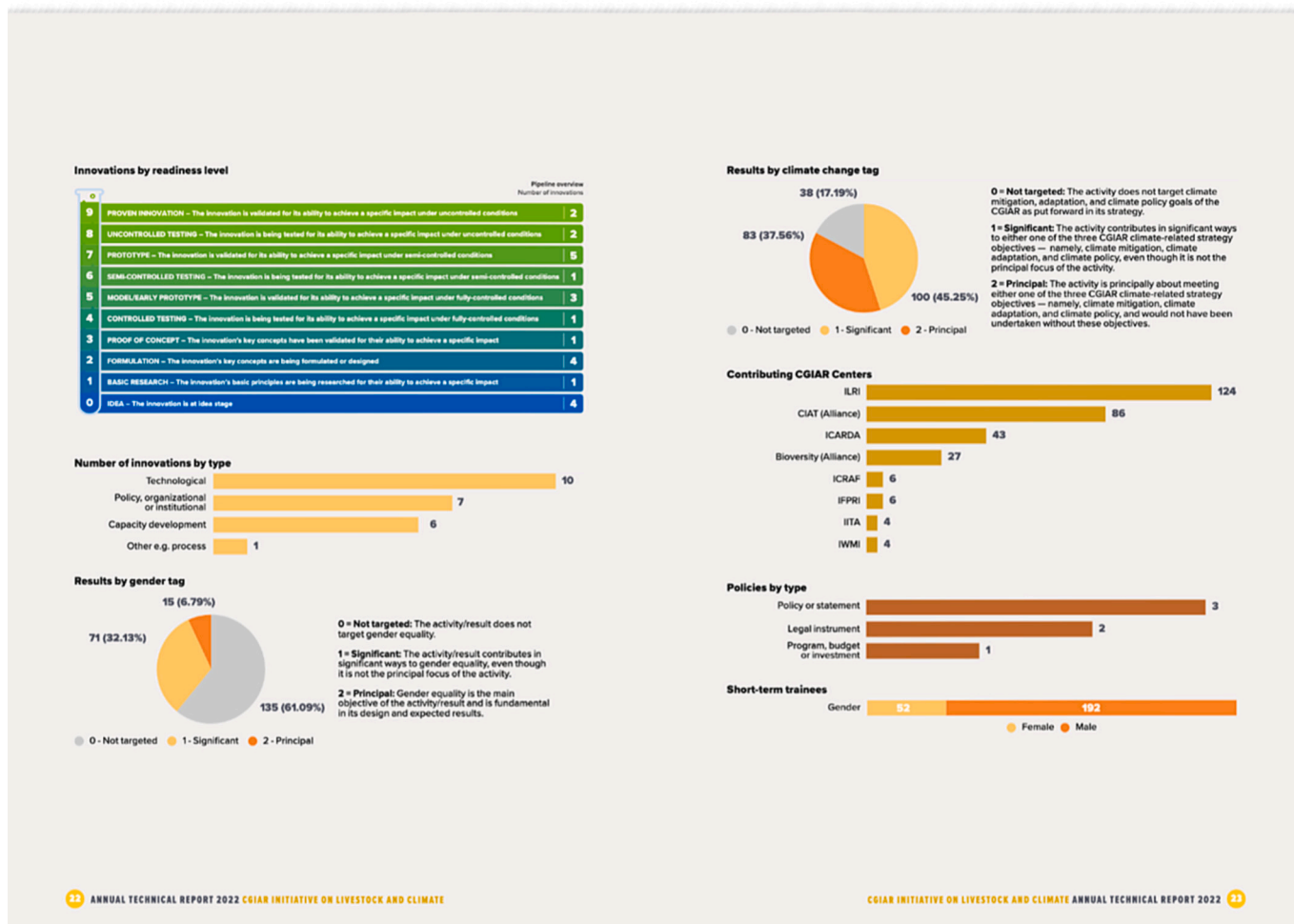
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[5] Examples can be found here: https://cgspace.cgiar.org/handle/10568/121923

**Fig. 5.** An example of innovation portfolio management data featuring in the CGIAR Initiative annual technical report.

change agents were purposefully involved, with a significant portion among them holding positions in middle or senior leadership. Their active promotion of innovation portfolio management at both internal and external public events substantially enhanced the momentum and extended the scope of the portfolio performance unit's mission.

In 2022, a needs assessment was carried out among different groups of innovation portfolio managers in CGIAR. Nine groups of portfolio managers were identified, with a total of 17 representatives from these groups taking part in a 30-min interview. Questions focused on their current innovation portfolio management practices; their usage of tools/

procedures/ systems; a self-assessment of their current practices and systems; ideas of what to improve; their views on what a 'healthy' portfolio is; aspired outcomes; features of innovation portfolio management dashboards; among others. It served two key purposes. First, it identified the needs of the managers and the overlaps and gaps between the approach that was under development. Second, it offered another opportunity to raise awareness and engage CGIAR's leadership. The survey revealed that – in the absence of a standardized innovation portfolio management approach – managers use their own systems and there is relatively limited use of tools in the organization to support

decision-making on innovations. Furthermore, portfolio managers did not rate their current innovation portfolio management practices as very effective and expressed the need for a system-wide approach. The survey showed that linking better to needs/demands of innovation users, mechanisms to align innovation to regional and country (policy) priorities, and using the data for fundraising are areas that need further action.

Staff and leadership have been involved across various levels and in different ways to support innovation portfolio management and broader PRMS improvements. A PRMS survey was rolled out across the organization which formed part of the Learning and Optimization process (CGIAR System Organization, 2023b) to collect feedback from colleagues and users with the aim to improve PRMS tools, processes, products, and overall user-experiences.

Strategic engagement with leadership in partner and funder organizations has been similarly important. Funders such as the World Bank, the Bill & Melinda Gates Foundation (BMGF), GIZ, USAID, and the Alliance for Green Revolution in Africa (AGRA) expressed interest in the CGIAR approach. In some cases, funder-specific analyses of the CGIAR innovation portfolio were created and presented to their leadership. BMGF is investing in CGIAR to design and mainstream a process to support the development of scaling strategies for those innovations with transformation potential. Two external advisors on (gender-)responsible innovation and scaling are part of that project.

### 3.2.3. Mechanisms

*3.2.3.1. Incentives.* Incentives are related to the organizational rules, procedures and policies supporting the desired innovation portfolio management behaviors, mindsets, and actions.

A first incentive mechanism was developed during the initial design of the CGIAR Initiatives in 2021. All Initiative proposals had a mandatory Innovation Packages and Scaling Readiness Plan section, where Initiatives had to describe how they expected to use the approach in advancing innovation development and scaling, and the dedicated budget allocation to innovation profiling, innovation packaging, and innovation portfolio management. Initiative proposals were evaluated on the quality of that section.

Currently, the most important incentive mechanism is the CGIAR Technical Reporting Arrangement, which is applicable to all CGIAR Initiatives and was endorsed by the CGIAR System Council in June 2022 (CGIAR System Organization, 2022). The document describes the key parameters of CGIAR's technical reporting as well as details on content, timing, format, standards, and scope of reporting. Every CGIAR Initiative report has a dedicated key results section that includes results on innovation development and innovation use, and a visual overview of their innovation portfolio using 'scaling readiness' metrics, among others (Fig. 5). Furthermore, the reported innovation data features prominently on the CGIAR Results Dashboard (Fig. 4), which is the public-facing interface for showcasing results (CGIAR System Organization, 2023). The Initiative-level reporting informs various other aggregate reports, including the CGIAR Portfolio Narrative, which has a dedicated section on Innovation Portfolio Management (CGIAR System Organization, 2023a).

The reporting step forms an important element in the annual "report -> reflect -> (re)plan" process. The Reflect stage supports adaptive management that provides Initiatives with a formal mechanism by which they can adapt their plans considering lessons learned, so they might better contribute to impact. Following the reflection, Initiatives revisit their Plan of Results and Budget (PORB) and annual financial report. In the PORB, Initiatives are requested to specify investments in Innovation Packages and Scaling Readiness, as well as the expected number of innovations and innovation packages to be reported annually.

As another incentive mechanism, only innovations that have been reported as "under development" in the PRMS can proceed to be reported "in use" under the Innovation Packages and Scaling Readiness approach. In a similar way, only innovations that have been reported as "in use" in PRMS could be eligible to receive expert and financial support to design scaling strategies under a so-called Scaling Fund.[6] This sequential approach creates an incentive for innovation reporting at development and use level, in order to be eligible for access to resources to support scaling strategy design and implementation.

*3.2.3.2. Allocation.* Allocation refers to assigning available assets, financial and human resources to ensure a healthy and diverse innovation portfolio. Deciding a strategy in advance will make it easier to make resource allocation decisions when actively managing the portfolio. Resource allocation strategies differ from criteria in the sense that allocation strategies focus on how to distribute resources (such as budget and manpower) efficiently among various innovation projects. Meanwhile, criteria refer to the specific evaluation and prioritization factors used to assess the potential value and alignment of these projects with strategic goals.

Although CGIAR has *not yet* clearly defined its resource allocation strategy, these below resource allocation strategies and considerations could be important:

- Balance between lower and higher innovation risk/ return profiles – for example allocating 70%–20%–10% of resources across incremental, radical, and disruptive innovation (see Fig. 7 for a basic description);
- Distribution of investment along innovation readiness levels – for example allocating 20% of the resources to 80% of the innovations with low readiness; allocating 80% of the resources to 20% of the innovations with high readiness;
- Distribution of resources across innovation types – for example aim for 50/50% allocation of human and financial resources for technological and non-technological innovation;
- Balance between CGIAR and partner co-investment in innovation development/ use – for example ensure that partners co-invest in innovation development/ use as a proxy for 'real' need or demand.

*3.2.3.3. Governance.* Governance refers to who will make decisions on portfolio allocation. This includes defining roles and responsibilities of the people involved, as well as processes for decision making across different levels.

The governance mechanism for innovation management is currently embedded in a so-called "report-reflect-plan" annual adaptive management cycle (CGIAR System Organization, 2023). The Reflect process within this cycle enables Initiatives to assess their results and make recommendations for how to adapt and evolve in the context of changing capacities, budgets, and circumstances. A summary of the results of this process is included in the Initiative Annual Technical Reports to demonstrate how the Reflect process facilitated strategic decisions to prioritize, and in some cases de-prioritize investment in innovation within the Initiatives and reallocate funds to respond to lessons learnt.

In total, 32 CGIAR Initiatives made 197 adaptive management recommendations in 2022 – an average of six recommendations per Initiative.[7] A selection of the key areas identified include:

- Revision of scope, targets, and theory of change due to budget reductions: Fund availability requires constant prioritization of innovations, geographical focus and outcome and impact targets.

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- Better coordination within and among Initiatives: Specific reference was made to the design of innovation packages as a mechanism to increase complementarity, collaboration, and coordination within and across Initiatives.
- Meeting demand: Linking the 'supply' of innovations and other types of results to concrete stakeholder 'demand' is essential. Alignment of innovation investments with national policies and strategic plans is essential for achieving impact.

In CGIAR, Adaptive Management is governed at the Science Group level,[8] with many key decisions made collectively among Initiatives within a Science Group. The outcomes of Initiatives' Reflect processes are used to inform investment decisions on innovation and other results by Science Group Directors.

### 3.3. Initial innovation portfolio data and results

In, 2022, CGIAR and its partners reported 477 innovations in the PRMS, surpassing the aggregate target of 250 that Initiatives had collectively set themselves for the entire, 2022–2024 business cycle. As a result of the change management work, a step-by-step approach to collecting innovation data was implemented. For example, in, 2022, the focus would be on reporting innovation development, and a simple way to report innovation usage, whilst more advanced innovation usage reporting would be introduced in 2023 (see Table 3). Data collection on responsible innovation and scaling (e.g. detailed innovation user details, efforts on Gender Equality and Social Inclusion (GESI) and responsible innovation, and innovation team composition) only started in 2023, and were not yet available at the time this paper was published. Consequently, the below overview only includes analytics of how innovations reported in 2022 target SDGs.

The 2022 innovation results showed that there is ongoing innovation development in 64 countries, with the top countries being Ethiopia (54), Kenya (48), and Bangladesh (42) (Fig. 6.). The focus is on technological innovation, which accounted for 58% of the innovation portfolio of which 28% were new or improved varieties or breeds. Policy/organizational/institutional innovations (22%) and capacity development innovations (16%) made up for the remaining share (4% was classified as 'other').

The 2022 portfolio consists of 28 disruptive innovations (6%), such as an Artificial Intelligence-based audio analytics tool for identifying farmers' needs and targeting digital extension services. Incremental innovations (69%) and radical innovations (22%) represent the rest of the innovations (4% was classified as 'other') (Fig. 7.). CGIAR partnered with 833 unique partners on innovation development. Top innovation development partners include the National Agricultural Research Systems (NARS) of Kenya, Zambia, Ethiopia and Tanzania, and Wageningen University, the Netherlands.

Evidence-based innovation readiness data allowed for a visualization of the CGIAR innovation pipeline (Fig. 8). There is a relative bias towards innovations with higher readiness (42% of the innovations scoring level 6 or higher).

Fifty-nine (59) innovation use cases were reported where CGIAR, along with 119 partners, reached more than 4 million innovation users (1.7 million females and 2.3 million males).[9] Innovation development and use targeted four key SDGs: SDG2 – Zero Hunger, SDG1 – No Poverty, SDG13 – Climate Action and SDG5 – Gender Equality. Innovations reported in, 2022 target SDGs addressing diversity, equity,

and inclusion such as SDG5 - Gender Equality (51%), SDG10 - Reduced Inequalities 10%, SDG4 - Quality Education 8% and SDG8 - Decent Work and Economic Growth 21% (Fig. 9).

The standardized way of data collection allowed for 'slicing and dicing' the innovation portfolio data in many ways. Different types of Initiative, country, Science Group and CGIAR-centre level portfolio analytics were created and published. An Initiative-level example can be found here: https://cgspace.cgiar.org/handle/10568/130462.

## 4. Analysis and discussion

The analysis and discussion section delves into four distinct facets of this paper. It begins by tackling the primary objective: to develop a set of best practices for innovation portfolio management that can advantage both CGIAR, as well as other public sector organizations, detailed in Sections 4.1 and 4.2, respectively. The secondary objective, illustrating the critical role of these practices in fostering responsible innovation and scaling for transformation of food systems, is explored in Section 4.3. The section concludes with broader reflections on innovation portfolio management research and practice, presented in Section 4.4.

### 4.1. Current state and next steps for innovation portfolio management in CGIAR

A reflection on the current practice of innovation portfolio management in CGIAR shows that the various principles and elements are at different stages of development and implementation. Table 4 offers an analysis that distinguishes between the following statuses:

- Optimal implementation (++): Current state is desired and meets expectations
- Functional with enhancements (+): Presently operational, but with room for improvement
- In progress (+/−): Undergoing development and refinement, not fully operational yet
- Monitored but incomplete (−): Not yet implemented, but actively explored
- Out of active consideration (−-): Not in use and not under active consideration

As Table 4 shows, the majority of the key principles and elements are being considered, designed, and/or implemented. Data, systems, leadership, and incentives mechanisms are functional, but have room for improvement. The PRMS is operational (though user-experience and data visualization could improve) and there is a process in place for annual review and updating of innovation data. Data collection is embedded into the annual technical reporting, which offers an important incentive for Initiatives to report their innovation data, with additional incentive mechanisms (e.g. access to financial support to design scaling strategies) underway. Areas that are in progress/under development are culture and capacity. Design elements that need attention are criteria, allocation strategies, and governance mechanisms.

Based on the analysis presented in Table 4, the following actions for advancing innovation portfolio management in CGIAR seem critical:

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[8] A Science Group is a collection of Initiatives that work in a specific Thematic Area. CGIAR has 3 Science Groups: Genetic Innovation, Resilient Agri-food Systems and System Transformation.

[9] Figures were much lower than CGIAR innovation usage reported prior to 2022. This was partly due to focus on innovation development reporting and the fact that many of the Initiatives were being initiated in, 2022.
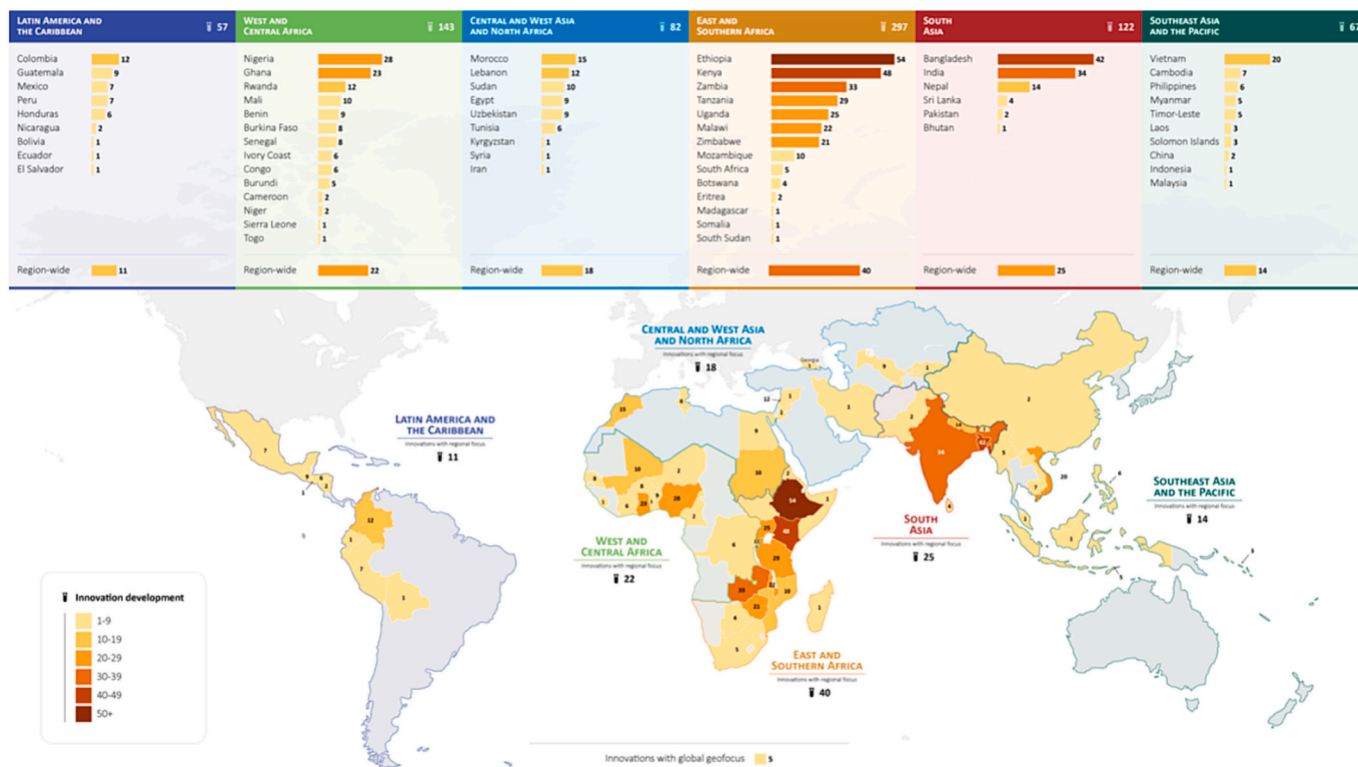
**Fig. 6.** A spatial overview of innovation development by CGIAR and partners in 2022 (total *n* = 477).
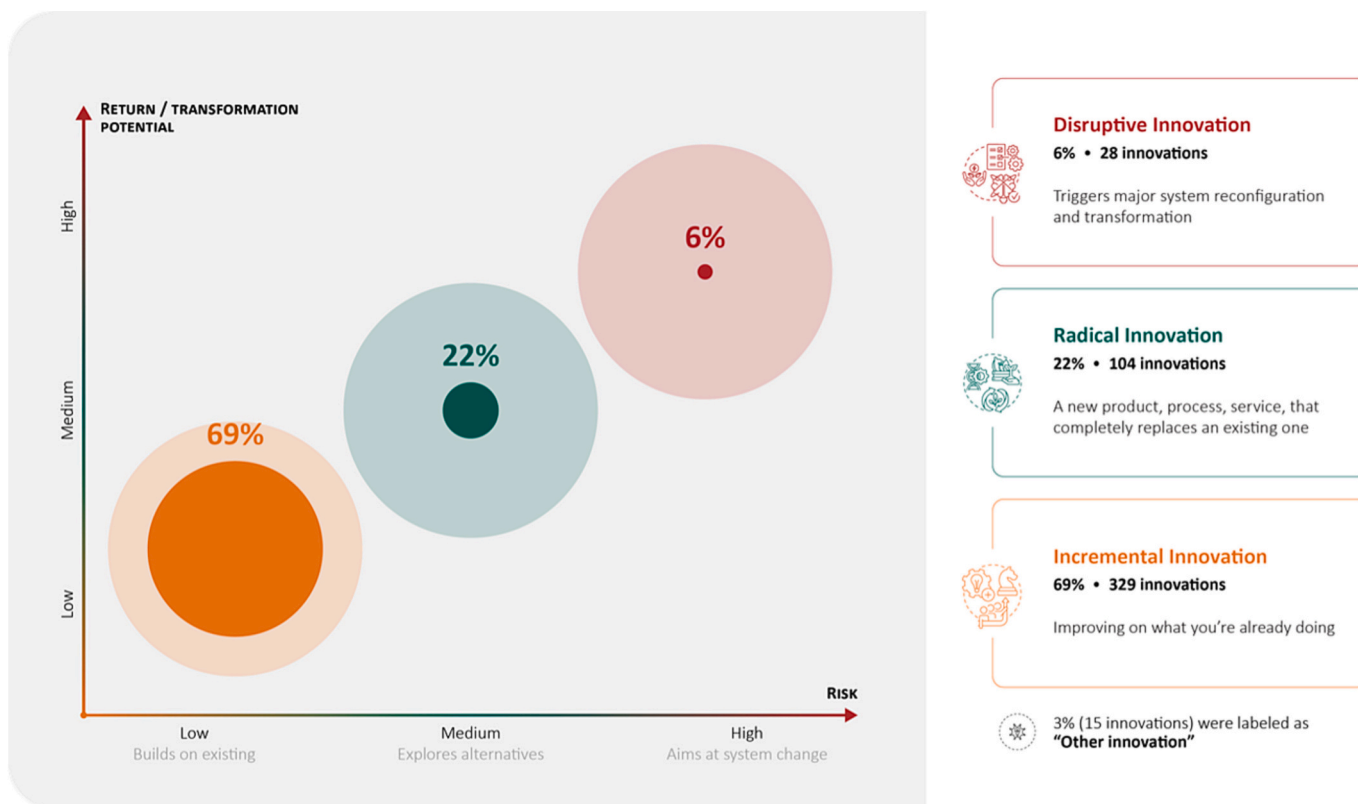


**Fig. 7.** Nature of innovations being developed by CGIAR and partners under the Initiative portfolio in, 2022, visualized as Risk-Return graphic (total n = 477).
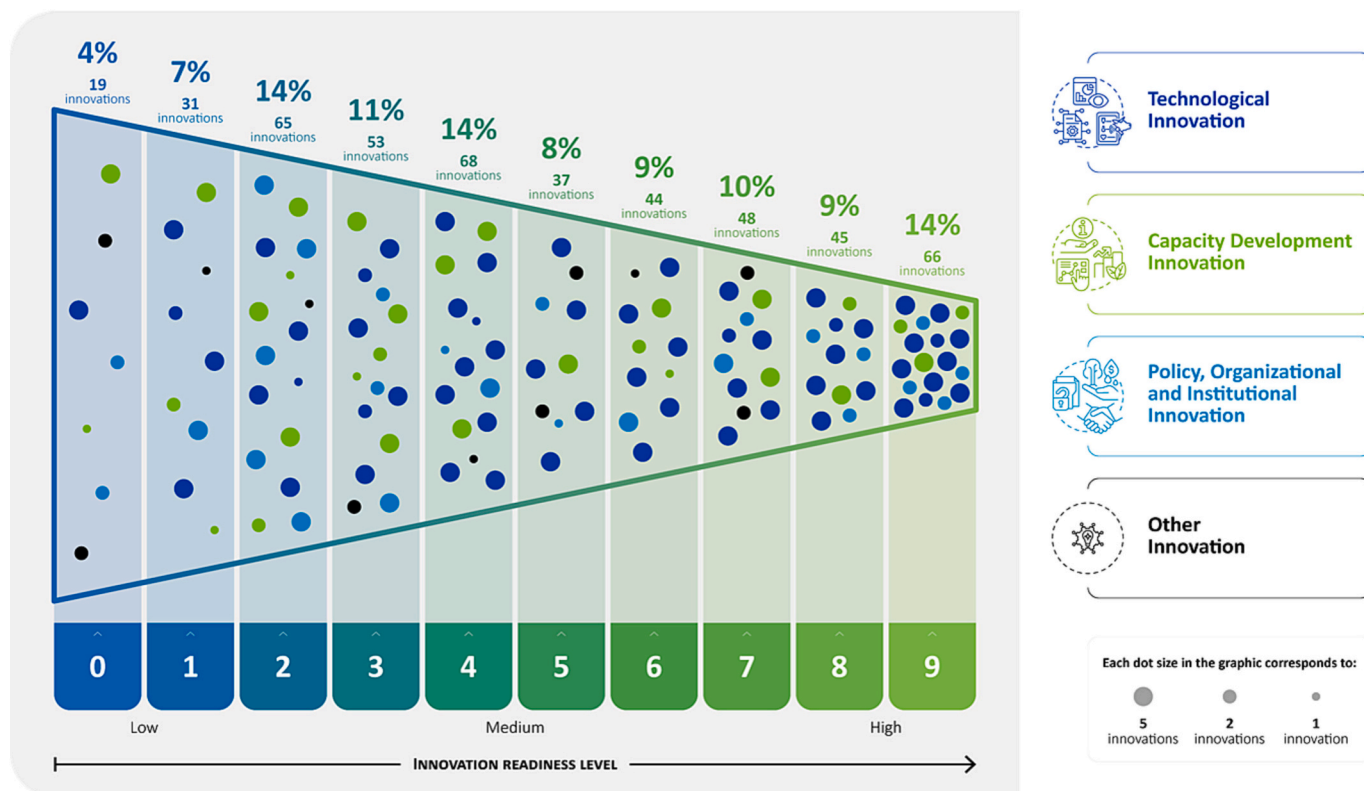
**Fig. 8.** Innovation Readiness levels of innovations being developed by CGIAR and partners under the Initiative portfolio in, 2022 (total n = 477).



| | | | |
|---|---|---|---|
| MM | SDG1 | **No Poverty** | 59% · 283 innovations |
| | SDG2 | **Zero Hunger** | 66% · 315 innovations |
| | SDG3 | **Good Health and Well-Being** | 6% · 31 innovations |
| | SDG4 | **Quality Education** | 8% · 38 innovations |
| | SDG5 | **Gender Equality** | 51% · 243 innovations |
| | SDG6 | **Clean Water and Sanitation** | 40% · 193 innovations |
| | SDG7 | **Affordable and Clean Energy** | 4% · 17 innovations |
| | SDG8 | **Decent Work and Economic Growth** | 21% · 101 innovations |
| | SDG9 | **Industry, Innovation and Infrastructure** | 2% · 8 innovations |
| | SDG10 | **Reduced Inequalities** | 10% · 47 innovations |
| | SDG11 | **Sustainable Cities and Communities** | 1% · 4 innovations |
| ∞ | SDG12 | **Responsible Consumption and Production** | 29% · 140 innovations |
| | SDG13 | **Climate Action** | 57% · 270 innovations |
| | SDG14 | **Life Below Water** | 2% · 10 innovations |
| | SDG15 | **Life on Land** | 27% · 129 innovations |
| | SDG16 | **Peace, Justice and Strong Institutions** | 13% · 63 innovations |
| | SDG17 | **Partnerships for the Goals** | 9% · 45 innovations |

**Notes**

SDGs targeted under innovation development (477 reported) and innovation use (59 cases reported)
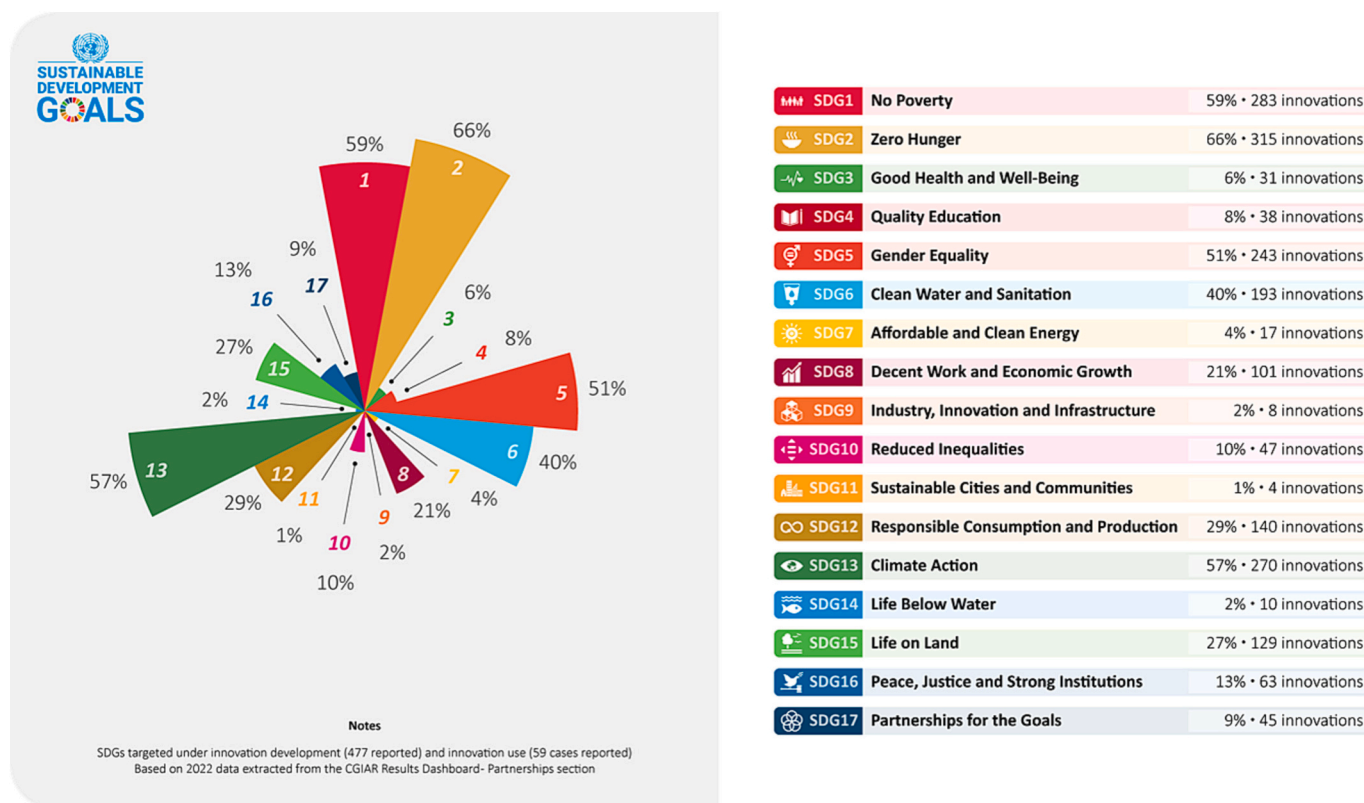Based on 2022 data extracted from the CGIAR Results Dashboard- Partnerships section

**Fig. 9.** Overview of how innovation development and innovation use in 2022 targeted the different Sustainable Development Goals (total n = 477).

**Table 4**
Qualitative assessment of the current state of different design principles and elements of the innovation portfolio management approach in CGIAR.

| Design principles | Design elements | Current status | Details |
|---|---|---|---|
| Methods | Data | + | Key metrics, indicators and parameters are reviewed and updated annually |
| | Systems | + | Functional PRMS system and related QA-module and dashboard are improved and updated annually |
| | Criteria | − | Key criteria for data analysis and interpretation have not been defined/ agreed upon |
| Mindsets | Culture | +/− | Ongoing culture growth process focused on improving acceptance and uptake of the approach |
| | Capacity | +/− | Focus on training experts to lead innovation portfolio management in various Initiatives |
| | Leadership | + | Expressed need for and growing enthusiasm about what innovation portfolio management offers |
| Mechanisms | Incentives | + | Innovation data collection firmly embedded in Initiative/project lifecycles and technical reporting |
| | Allocation | − | No resource allocation strategy has been defined and agreed upon - needs to be initiated. |
| | Governance | − | Part of report-reflect-plan cycle, but the rigor in decision-making and reporting can be improved |

### 4.1.1. Clarity on innovation portfolio management ambition

Figure 1 shows how the starting point for considering the 'right' mix or configuration of methods, mindsets, and mechanisms is a clear innovation portfolio management ambition. An important next step in CGIAR's journey, would be for leadership to define this ambition. In 2020, CGIAR defined four key principles for its Performance and Results Management Framework 2022–2030 (CGIAR System Organization, 2020):

1) Enable transparent, evidence-based allocation of resources
2) Support reflection, learning and adaptive management of CGIAR Initiatives
3) Facilitate performance management using specific indicators and metrics
4) Encourage innovation, creativity and action

These principles can be further operationalized to guide an approach that is embraced by CGIAR funders, partners, and staff, drive transparent and evidence-based decision making and resource allocation, and improve CGIAR's performance and impact delivery.

There is an overall need to better connect CGIAR innovation with the needs and demands of innovation users and/or national or regional priorities as was mentioned by CGIAR innovation portfolio managers. Until today, the CGIAR innovation portfolio management approach has mainly focused on mapping innovations that CGIAR and partners have on offer. How that 'supply' is informed by and linked to innovation user 'demand' is deemed important, but currently lacks well-defined mechanisms. In defining its innovation portfolio ambition, CGIAR has a unique opportunity to clarify what constitutes a 'healthy' innovation portfolio. This involves articulating a clear ambition for responsible (and demand-driven) innovation and scaling for food system transformation.

### 4.1.2. Criteria, allocation strategies and governance for decision-making

Although CGIAR collects high-quality innovation data, supported by evidence and a quality assurance process, there is no agreement yet on which metrics and analytics will inform decision-making (criteria), how that will trigger resource distribution (allocation), and what are the procedures and responsibilities through which such decisions are made (governance).

Criteria, allocation strategies, and governance mechanisms are closely interrelated. Criteria are used to monitor innovation development and use, whilst resource allocation strategies can help align the portfolio with the organizational strategy and vision. Governance mechanisms ensure transparency in decision-making procedures. Without criteria, allocation strategies, and governance mechanisms, the innovation portfolio management approach is unlikely to influence strategic decision-making in the organization, risking the innovation portfolio management approach to generate limited value for the organization (Fig. 10).

The cornerstones for decision-making at the Initiative level are embedded in the report-reflect-plan cycle and adaptive management report, but currently lack two things: (1) a more precise evidence-based report on which innovation investments are continued/ altered/discontinued and why; and (2) a clear(er) process that connects Initiative decision-making to Science Group and executive management decision-making levels in the organization.

### 4.1.3. Grow organizational culture and capacity for portfolio management

Though CGIAR has invested in organizational culture and capacity growth, this will require continued attention over a longer period of time. Historically, CGIAR has focused on conducting scientific research to advance technological innovation (McIntire and Dobermann, 2023). The systematized management of the creative process of science-based innovation development may feel counterintuitive to scientists focused on discovery and is likely to be met with resistance that needs to be acknowledged and handled sensibly (Meinke et al., 2023). Yet, having a level of standardization and common set of indicators and criteria across an organization is essential to ensure the innovation portfolio is well-balanced and responsible, as well as aligned with the short- and long-term organizational mission and strategy. Leadership and portfolio managers - who increasingly request and use the innovation portfolio
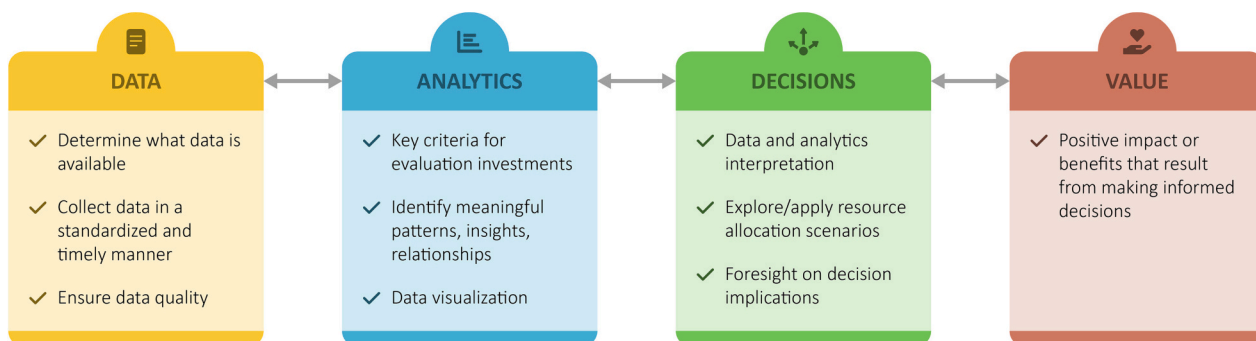


**Fig. 10.** Relationship between data, analytics, decisions, and value as critical stages in innovation portfolio management.

data and analytics for their strategic decision-making, communication, and fundraising – should play a more prominent role in the change management process and foster broader acceptance of a portfolio management approach.

Investment into capacity to manage innovations along an impact pathway and the role of CGIAR herein is widely debated (Leeuwis et al., 2018; Conti et al., 2024). CGIAR does not have the same historic comparative advantage in scaling innovations and depends to a large extent on its partnerships with National Agricultural Research Systems, development organizations, governments, and private sector to achieve its scaling ambitions. It is only recently that more explicit organizational capacity and structures have been put into place to support the scaling of innovation through partnerships, both within CGIAR-centres, as well as at the system level. Although CGIAR does not have to lead the scaling itself, it can take a leading role in igniting and cultivating scaling partnerships and developing evidence-based scaling strategies with partners. In 2023, 100 staff as well as external experts were trained on innovation packaging and scaling for impact. These innovation and scaling experts are expected to play an important role in 'powering' the CGIAR innovation portfolio management approach. Although this is a step in the right direction, such individuals will need broader institutional support at Initiative, CGIAR-centre and -system level to fully turn their newly acquired capacities into action (Turner et al., 2017).

### 4.2. Lessons for innovation portfolio management in other public R&D organizations

With studies on innovation portfolio management in the public sector being scarce (Holden et al., 2018; Schut et al., n.d., *under review*), the CGIAR case offers unique insights and learning opportunities for other public sector organizations that consider an innovation portfolio management approach. As per the primary objective of this paper, the five key lessons to date are as follows:

#### 4.2.1. Lesson 1: Take a holistic view on innovation portfolio management

It is essential to take a broad perspective on innovation portfolio management that takes into account methods, mindsets, and mechanisms. There is a general tendency to focus on methods and quality data-collection systems, but without the appropriate investments in incentives and governance mechanisms, capacity, behavioral, and culture growth, the process is unlikely to be successful. It helps to view innovation portfolio management as an organizational change process that needs to be adequately managed and supported.

#### 4.2.2. Lesson 2: Involve leaders early in defining portfolio goals, criteria, strategies, and governance mechanisms

The CGIAR innovation portfolio management journey has – so far – focused on developing systems for data collection, quality assurance and reporting, and on incentive mechanisms to ensure timely data reporting. To ensure that data and analytics influence decision making and create organizational value, it is important that organizations consider defining a clear innovation portfolio ambition/intent and criteria, allocation strategies and governance mechanisms to actively manage the innovation portfolio. This is preferably done during the early stages of designing the innovation portfolio management approach.

#### 4.2.3. Lessons 3: Start small, focus on minimal viable product and pockets of support, and grow from there

For many, the systematized management of the creative process of science-based innovation may feel counterintuitive. Yet, having a well-balanced portfolio is important to achieve an organizational mission and impacts (Nagji and Tuff, 2012). It is good to realize that innovation portfolio management is not necessarily embraced by the entire organization. CGIAR started with early-adopter Initiative teams, developed simple Minimum Viable Product (MVP) tools, and showed early results which created modest enthusiasm and a starting point for

mainstreaming, growth, and more advanced innovation portfolio management. In many other public sector organizations a similar approach may be useful.

#### 4.2.4. Lesson 4: Ensure strong incentive mechanisms

Incentive mechanisms relate to both intrinsic and external motivation. Intrinsic motivation refers to the motivation that comes from within the individual. External motivation comes from external factors or rewards. In the CGIAR case, both are being supported. Intrinsic motivation is supported through having access to state-of-the-art innovation data and communication materials, such as the innovation profile and innovation portfolio management reports, and being part of the CGIAR innovation and scaling community (e.g., through the training of IPSR facilitators). External motivation and incentive mechanisms may include embedding portfolio management data collection and decision making in project design, implementation, and reporting cycles, as well as making it part of a process to access (scaling) funding or other types of support.

#### 4.2.5. Lesson 5: Demonstrate how innovation portfolio management adds value

Innovation portfolio management can produce powerful data analytics and visualizations that can support engagement with partners, funders, and the general public. Based on its first round of data collection in, 2022, CGIAR received various requests from partners and funders to share the innovation portfolio management approach. Analytics were also requested internally by Initiative, country, and thematic leadership to showcase results as part of strategic communication and events.

### 4.3. Innovation portfolio management as a precursor for responsible innovation and scaling

The secondary objective of this paper was to demonstrate how best practices in innovation portfolio management are essential for responsible innovation and scaling as part of food system transformation. For organizations like CGIAR, managing hundreds or thousands of innovations along an impact pathway, it is clear that assessing whether innovations will contribute to responsible impact at scale is a crucial activity. It starts with defining a clear ambition or vision of what constitutes responsible innovation and scaling for food system transformation. This can then inform the data that needs to be collected and the criteria and resource allocation strategies that can be applied to ensure the portfolio is aligned with that ambition or vision.

CGIAR has started collecting responsible innovation and scaling data on anticipated and actual innovation usage (e.g. does the innovation target women and youth), the extent to which innovations promote Gender Equality and Social Inclusion (GESI), actions to limit unintended negative consequences/impacts, CGIAR and partner innovation team diversity, and the extent to which SDGs on diversity, equity, and inclusion are targeted. Capturing these data nudge innovation teams and create awareness. It can trigger discussion about criteria (what do the figures mean, are they good or bad) and can inform resource allocation strategies (shouldn't we be investing more in innovations that target marginalized groups). So even without a clearly defined ambition or vision, it may spark internal debate and action towards responsible innovation and scaling for food system transformation.

All other best practices of innovation portfolio management apply to strengthening responsible innovation and scaling. Methods need to produce timely, appropriate, and quality data that can inform analytics and decision making. Investments in mindset and organizational culture growth are required to ensure a certain level of understanding, capacity and buy-in for monitoring and managing for responsible innovation and scaling. And finally, mechanisms that inform allocation strategies towards responsible innovation and scaling need to be defined and governed.

*4.4. Broader reflections for innovation portfolio management studies*

The methods, mindsets, mechanism framework (Fig. 1) by Proud et al. (2023) was useful to describe and analyze the CGIAR innovation portfolio management case. In general, the framework resonates well with studies that take a holistic approach to change and innovation (Smits, 2002; Leeuwis, 2013), and the key principles align well with studies on private sector innovation portfolio management (Holtzman, 2014; Holden et al., 2018). Further stress-testing and validation of the framework by applying it to other organizational case studies is recommended.

To fully understand and strengthen the contribution of an organizational innovation portfolio management approach to responsible food systems transformation, two additional analytical perspectives need to be considered.

The first is a broader organizational change perspective. This perspective recognizes that the success of an organizational approach to innovation portfolio management will to a large extent depend on whether that approach is supported by broader institutional legal, finance, and administrative processes that – directly or indirectly – affect innovation performance (Woltering et al., 2019). Such an embedded approach is often referred to as end-to-end innovation management and can include, but is not limited to, the following adjacent management processes:

- **Human resource management** – Do current contracting modalities and performance appraisal encourage experimentation, failure, and learning as part of the innovation management?
- **Partnership management** – Are innovation and scaling partnerships managed based on best-fit and due-diligence principles and are partners sufficiently co-investing as a proxy of ownership and innovation demand?
- **Financial management** – Do funding modalities and financial management processes and systems offer an enabling environment for data-driven innovation portfolio management?
- **Risk management** – What mechanisms are in place to identify and mitigate potential negative impacts from innovation use at scale and ensure responsible innovation?
- **Legal and regulatory framework management** – Are there policies to support the active management of intellectual property rights and mechanisms to reinvest possible financial gains in the organization?

End-to-end innovation management forms a powerful mechanism to stimulate internal linkages, coherence, and collaboration between – for example – research, finance, legal, and human resources teams. In CGIAR, small institutional changes are being witnessed, such as the ability for Initiatives to adaptively manage their Plan of Results and Budget (PORB) following the annual "report -> reflect -> (re)plan" process.

The second perspective is that of broader system transformation that acknowledges that many public sector organizations, such as CGIAR, work on wicked challenges in complex, adaptive innovation systems (Leeuwis et al., 2021). It means that no matter how well an organization manages its innovation portfolio, it will be but one part of the broader system (Proud et al., 2023). There are simply too many interdependencies and dimensions involved that cannot be tackled by a single organization. Here, partnerships between government, public and private sector and collective action around development challenges or priorities form the heart of any kind of sustainable or responsible food system transformation pathway. CGIAR's innovation portfolio management approach acknowledges that CGIAR innovations can only contribute to transformation and impact if they are part of context-specific innovation packages that often include behavioral, finance, policy, and market enablers that are provided by other food system players (Schut et al., 2020; Schut et al., 2022).

As a final point, innovation portfolio management studies – as an emergent topic of scientific inquiry – could make an important contribution to scientific debates on impact-oriented research and innovation in the public sector. This includes debates on Mission-oriented Agricultural Innovation Systems (Klerkx and Begemann, 2020), System Transformation (Leeuwis et al., 2021), Complex Adaptive Systems (Hall and Clark, 2010), and Science of Scaling (Schut et al., 2020). It fits particularly well with more action-oriented system approaches to innovation, such as Scaling Readiness (Schut et al., 2020), Impact Pathways (Douthwaite et al., 2003), Theory of Change (Douthwaite and Hoffecker, 2017; Maru et al., 2018), and Reflexive Learning and Adaptive Management (van Mierlo et al., 2010). Those approaches aim at finding the right balance between understanding and analyzing system complexity on the one hand and informing intervention and action on the other hand.

Before reaching the conclusions of this paper, it is important to acknowledge the ongoing bidirectional learning process where CGIAR not only cross-fertilizes other public sector investments in innovation management, but also assimilates insights and practices from these organizations, enhancing its own approach for greater effectiveness. Such ongoing exchanges include, but are not limited to, FAO's Agrifood Systems Technologies and innovations Outlook (ATIO) (FAO, 2022), the Innovative Food Systems Solutions (IFFS) portal (https://ifssportal.nutritionconnect.org/), and the African Development Bank Group e-catalog for Technologies for African Agricultural Transformation (https://e-catalogs.taat-africa.org/).

## 5. Conclusions

The case study of CGIAR offers valuable lessons into the design, operationalization, and implementation of innovation portfolio management in a public research and development organization. Not all public research and development organizations need to invest in innovation portfolio management but, especially for those that manage large, geographically dispersed, and complex portfolios the benefits seem huge. The CGIAR case study emphasizes the importance of a holistic approach that combines methods, mindsets, and mechanisms. Although CGIAR needs to further optimize several crucial principles and elements that underpin its innovation management approach, the lessons learned can serve as a beacon for other public research and development organizations, guiding them in their innovation portfolio management endeavors.

In terms of its ambition to support responsible innovation and scaling for food system transformation, CGIAR has important steps to make. Collecting data on innovation users (e.g., gender/age), efforts made to promote gender equity and social inclusion, and responsible innovation from 2023 onwards is an important step in the right direction. However, it needs to be complemented with clear criteria and allocation strategies to ensure that such data influence decisions and add value to the organization and its mission to support responsible innovation and scaling.

To move forward, the public sector needs to become more aware of the costs and benefits of innovation portfolio management. It is important to recognize that innovation portfolio management is not a mere administrative task but a catalyst for organizational change. It requires strong leadership, phased implementation, robust incentive structures, and demonstration of tangible value addition. Moreover, integrating innovation portfolio management into broader organizational culture growth processes is paramount, aligning human resources, partnerships, finances, legal frameworks, and risk management to ensure that innovation becomes ingrained in the organization's mission.

**CRediT authorship contribution statement**

**Marc Schut:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Julien Colomer:** Conceptualization, Funding acquisition, Investigation,

Methodology, Project administration, Supervision, Writing – original draft. **Emma Proud:** Conceptualization, Validation, Visualization, Writing – original draft, Writing – review & editing. **Enrico Bonaiuti:** Conceptualization, Methodology, Resources, Software, Visualization, Writing – original draft. **Iddo Dror:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft. **Edwin Kang'ethe:** Conceptualization, Investigation, Methodology, Validation, Writing – original draft. **Lorena Esquivias:** Conceptualization, Investigation, Project administration. **Cees Leeuwis:** Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Writing – original draft.

## Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT-3.5 in order to improve readability and language, and as search engine. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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