




CGIAR Research Initiative on **Digital Innovation**

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This publication has been prepared as an output of the CGIAR Research Initiative on Digital Innovation. Any views and opinions expressed in this publication are those of the author(s) and are not necessarily representative of or endorsed by the CGIAR System Organization.

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CGIAR Technical Reporting 2023

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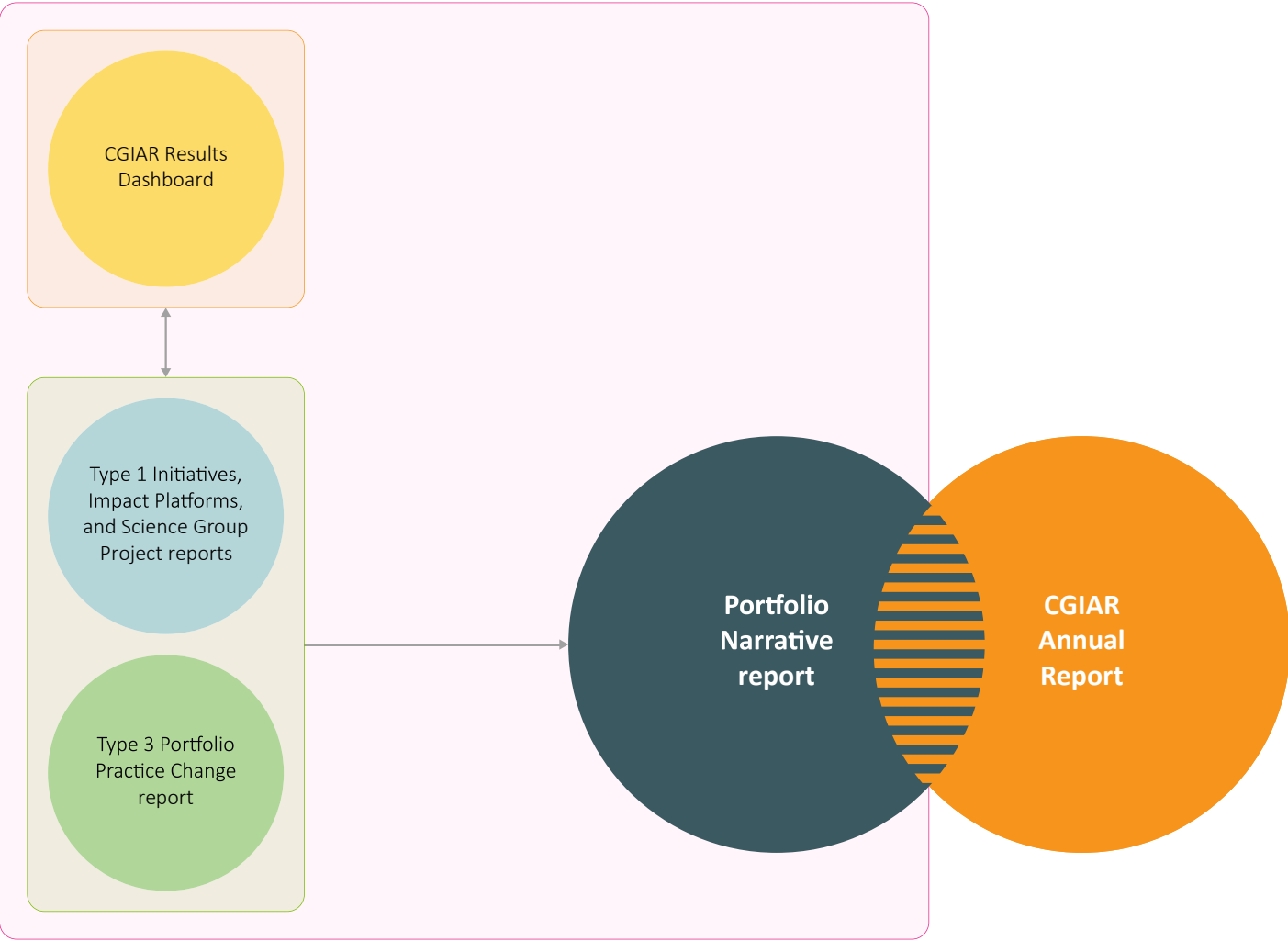
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CGIAR Technical Reporting has been developed in alignment with the [CGIAR Technical Reporting Arrangement](#). This Initiative report (“Type 1” report) constitutes part of the broader [CGIAR Technical Report](#). Each CGIAR Research Initiative submits an annual “Type 1” report, which provides assurance on Initiative-level progress towards End of Initiative outcomes.

The [CGIAR Technical Report](#) comprises:

- Type 1 Initiative, Impact Platform, and Science Group Project (SGP) reports, with quality assured results reported by Initiatives, Platforms and SGPs available on the CGIAR Results Dashboard.
- The Type 3 Portfolio Performance and Project Coordination Practice Change report, which focuses on internal practice change.
- The Portfolio Narrative, which draws on the Type 1 and Type 3 reports, and the CGIAR Results Dashboard, to provide a broader view on Portfolio coherence, including results, partnerships, country and regional engagement, and synergies among the Portfolio’s constituent parts.

The CGIAR Annual Report is a comprehensive overview of CGIAR’s collective achievements, impact and strategic outlook, which draws significantly from the Technical Report products above. For 2023, the Annual Report and Technical Report will be presented online as an integrated product.



Section 1: Fact sheet and budget

Initiative name	Digital Innovation and Transformation
Initiative short name	Digital Innovation
Initiative Lead	Jawoo Koo (j.koo@cgiar.org)
Initiative Co-lead	Andrea Gardeazabal (a.gardeazabal@cgiar.org)
Science Group	Systems Transformation
Start – end date	01/01/2022 – 31/12/2024
Geographic scope	Countries Bangladesh · Botswana · Egypt · Ghana · Guatemala · India · Indonesia · Kenya · Malawi · Mexico · Mozambique · Nepal · Rwanda · South Africa · Zimbabwe
OECD DAC Climate marker adaptation score ¹	Score 1: Significant The activity contributes in a significant way to any of the three CGIAR climate-related strategy objectives – namely, climate mitigation, climate adaptation and climate policy, even though it is not the principal focus of the activity.
OECD DAC Climate marker mitigation score ¹	Score 0: Not targeted The activity does not target the climate mitigation, adaptation and climate policy objectives of CGIAR as put forward in its strategy.
OECD DAC Gender equity marker score ²	Score 1B: Gender responsive On the top of the minimum requirements for 1A, the Initiative/project includes at least one explicit gender equality outcome, and the Initiative/project team has resident gender expertise or capacity. The Initiative/project includes indicators and monitors participation and differential benefits of diverse men and women.
Website link	https://www.cgiar.org/initiative/digital-innovation/

¹ The Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) markers refer to the OECD DAC [Rio Markers for Climate](#) and the [gender equality policy marker](#). For climate adaptation and mitigation, scores are: 0 = Not targeted; 1 = Significant; and 2 = Principal.

² The CGIAR Gender Impact Platform has adapted the OECD gender marker, splitting the 1 score into 1A and 1B. For gender equality, scores are: 0 = Not targeted; 1A = Gender accommodative/aware; 1B = Gender responsive; and 2 = Principal.

These scores are derived from [Initiative proposals](#), and refer to the score given to the Initiative overall based on their proposal.

EXECUTIVE SUMMARY

In its second year, the CGIAR Research Initiative on Digital Innovation has achieved substantial progress, generating 207 results, including 101 knowledge products, 43 innovations, 18 capacity sharing activities, 4 policy change results, and 4 innovation use results. We focused on developing innovations across five Work Packages in 2023, such as online platforms for research and learning, digital twin systems, an index for assessing digital inclusiveness, and remote sensing analytics – we are on track to achieve all End of Initiative outcome goals in 2024.

In 2023, the rapid development of artificial intelligence (AI) underscored the transformative role of data and digital technologies in the sustainable transformation of agrifood systems. Our AI pilots developed 14 results that highlighted the strength and weakness of advanced analytics when applied to CGIAR’s data and knowledge assets. Despite technological advancements, our three challenge areas remain valid: the digital divide, inadequate information systems, and limited digital capabilities, particularly in low- and middle-income countries in the global South.

Challenge area 1: The digital divide. Significant progress was made in promoting inclusive digital agrifood systems. ILRI’s [G20 policy brief](#), CIMMYT’s strategic partnerships in Latin America, and IWMI’s development of the [Multi-dimensional Digital Inclusiveness Index](#) and the Alliance of Bioversity International and CIAT’s user research toolkit are examples of our research outputs designed to address the digital divide. The [ICTforAg 2023](#) Conference and the Inspire Challenge also contributed to achieving key outcomes in fostering a global digital technology community and enhancing women’s participation.

Challenge area 2: Inadequate information. Our focus on improving information systems has led to the development of [digital twins](#) for water management in Southern Africa by IWMI, new [information systems for livestock in Nepal](#) by ILRI, and [monitoring crop production](#) in Kenya and Senegal by IRRI. These innovations aim to provide stakeholders with timely, reliable, and actionable data, enhancing decision-making processes and promoting sustainability.

Challenge area 3: Limited capabilities. Capacity-building efforts across the Initiative trained over 1,100 individuals. IWMI’s partnership with the United Nations Children’s Fund (UNICEF) and CIMMYT’s launch of new [WhatsApp-based training programs](#) aim to further enhance digital literacy and skills, particularly among women and youth.

Overall, our efforts collectively led to significant achievements towards our End of Initiative outcomes. We have surpassed the goals of developing collaborative partnerships, promoting gender-responsive services, enhancing digital skills, and improving information systems and organizational capabilities. Notable achievements include the successful organization of ICTforAg events, partnerships for natural resource management, and innovations for improving digital advisory services.

As we move forward in 2024, our research and partnership activities will focus on further achieving outcomes and impacts. Our commitment to enhancing digital ecosystems, capabilities, and information systems aims to create more sustainable, inclusive, and efficient food, land, and water systems.

	2022	2023	2024
PROPOSAL BUDGET	\$9.00M	\$10.00M	\$9.00M
APPROVED BUDGET ¹	\$4.82M	\$4.94M ²	\$3.73M ³

¹ The approved budget amounts correspond to the figures available for public access through the [Financing dashboard](#).

² This amount includes carry-over and commitments.

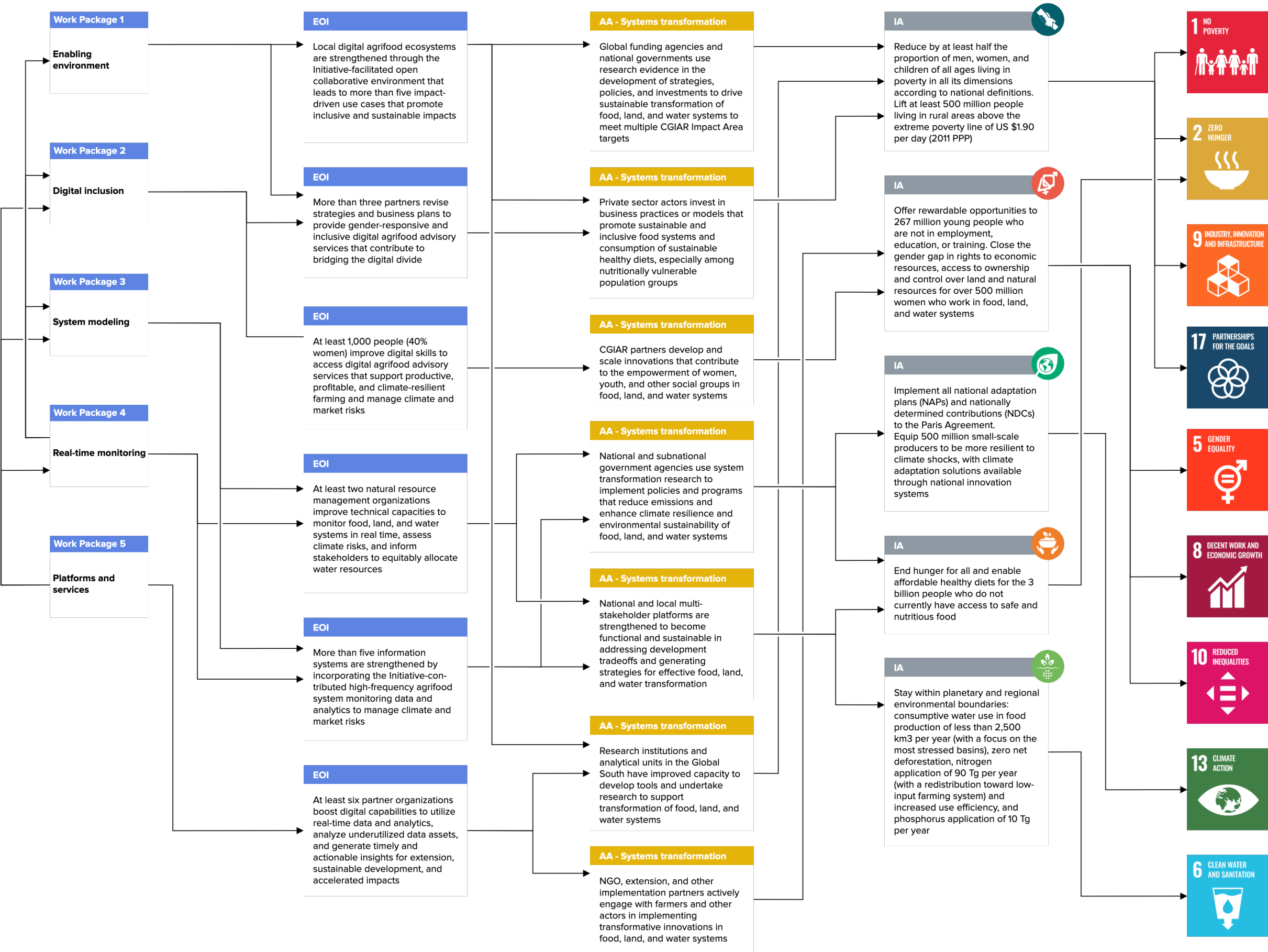
³ This amount is an estimation of the 2024 annual budget allocation, as of the end of March 2024.



Section 2: Progress on science and towards End of Initiative outcomes

Initiative-level theory of change diagram

This is a simple, linear, and static representation of a complex, non-linear, and dynamic reality. Feedback loops and connections between this Initiative and other Initiatives’ theories of change are excluded for clarity.



Note: A summary of Work Package progress ratings is provided in Section 3.



A rice farmer in Indonesia uses the Rice Crop Manager mobile app to receive automatically generated management guidelines.
Credit: Benedict Jardinero (IRRI)

Summary of progress against the theory of change

In its second year, Digital Innovation developed 207 results, including 101 knowledge products, 43 innovation developments, 18 capacity sharing activities, 4 policy change results, and 4 innovation use results. The Initiative particularly focused on the further development of innovations across our five Work Packages, including online platforms for collaborative research and self-guided learning, digital twin systems at multiple scales from [plots](#) to [river basins](#), a new index to assess [digital inclusiveness](#), and [satellite remote sensing-based analytics](#) for estimating crop production and assessing climate adaptation. Partners have already started adopting our innovations, and we anticipate increased adoption and scaling of innovations in 2024, further extending their impact and achieving outcomes.

In 2023, the transformative role of digital technologies in accelerating the sustainable transformation of food, land, and water systems became more pronounced with rapid developments in the artificial intelligence (AI) field and the renewed interest in making quality open access data to improve machine learning models. Fourteen results assessed the potential of applying AI to analyze large datasets to generate insights such as agronomic field trials, audio recordings, smartphone photos, satellite remote sensing data, and publications. Beyond the promising potential, however, we found generative AI applications should be cautiously applied in user-facing innovations to ensure the reliability and accuracy of the AI-generated content. Even with the advancements in analytics, we argue that our three primary challenge areas, the digital divide, insufficient information systems, and limited digital capabilities in low- and middle-income countries, remain unchanged.

This section provides updates on our progress towards the theory of change for each challenge area.

Challenge area 1: The digital divide

Despite the potential of digital technologies, their reach is not universal. In what ways can policymakers, investors, and innovators effectively address the digital divide in food, land, and water systems?

In 2023, we made progress in shaping policies and strategies for promoting inclusive digital agrifood systems, both locally and globally. In India, ILRI contributed a [G20 policy brief](#) that advocated digital public infrastructure in agriculture. In Latin America, CIMMYT formed a strategic alliance with the Inter-American Institute for Cooperation in Agriculture (IICA) to promote inclusive digital agriculture practices across the region. In Maharashtra, India, CIMMYT collaborated with the World Bank to support the state government's initiatives to digitalize [Farmer Producer Organizations](#). In Guatemala, CIMMYT created the Data Hub platform to aid the government's data-sharing efforts among public and private digital agriculture stakeholders. Additionally, IWMI led the development of [Multi-dimensional Digital Inclusiveness Index](#) to assess the inclusiveness of digital innovations, and the Alliance of Bioversity International and CIAT developed a comprehensive user research toolkit to promote gender equality and social inclusion in the digital ecosystem.

To nurture the information and communication technology (ICT) community in the global South, we organized the [ICTforAg 2023 Conference](#). Organized virtually over three days, the conference gathered over 1,700 participants from more than 100 countries to share knowledge, showcase innovations, and develop new partnerships, all of which contributed to three End of Initiative outcomes on strengthened digital ecosystems, information systems, and organizational capabilities. We also organized the ICTforAg+ Satellite Events in four countries, contributing to the End of Initiative outcome on strengthened digital ecosystems in Indonesia, Mexico, India, and Nepal. Additionally, we launched the Inspire Challenge, a novel Pay-for-Results program aimed at boosting women's engagement in five selected digital agrifood advisory services, contributing to the End of Initiative outcome on gender-responsive services.

We anticipate that our research and partnership activities will promote innovation-enabling partnerships, policies, and investments that foster digital inclusion, leading to increased job opportunities and reduced poverty.

Challenge area 2: Inadequate information

Access to timely, reliable, and actionable information is a major challenge faced by decision-makers in the global South. How can information systems improve their services and products to be more timely, accurate, actionable, and inclusive?

In 2023, we focused on the development of information systems for monitoring livestock, diet quality, crop production, and water management, directly contributing to the End of Initiative outcome on the strengthened information systems. In Nepal, ILRI developed a [new information system](#) for livestock keepers to record cow and herd management data and analyze them through a conversational interface. In Rwanda, IITA and the Alliance of Bioversity International and CIAT generated a [high-frequency diet quality](#) and food flow information system to support the development of a digital twin for food systems. At the river basin level, IWMI developed [digital twin systems](#) for managing water resources in the Limpopo river basin and the Inkomati river basin in Southern Africa, leveraging a large amount of complex water management data, [seasonal forecasts](#), and [hydrology models](#).

Progress by End of Initiative outcome

EOIO 1: Strengthened digital ecosystems.

We aimed to develop more than five impact-driven open collaboration partnerships to strengthen local digital ecosystems. As of December 2023, we have achieved the goal. Building on CGIAR's scientific knowledge and research outputs, we developed enabling partnerships that spur digital innovations across our focus geographies, including [citizen science programs](#) in South Africa, livestock farmers in Kenya, [humanitarian assistance organizations](#) in Rwanda and Guatemala, [digital extension programs](#) in Uganda and India, and public-private partnerships for digitalizing [farmer organizations](#) in India. Additionally, we organized the [ICTforAg 2023](#) conference and its four locally organized satellite events that gathered more than 1,700 attendees from 100 countries, featuring 145 speakers across 40 sessions. Under the theme of Cultivating Inclusion, the events facilitated knowledge sharing and meaningful partnerships in the local digital ecosystem.



EOIO 2: Gender-responsive services.

We aimed to engage with more than three organizational partners to revise their strategies and business plans to provide gender-responsive and inclusive digital agrifood advisory services. As of December 2023, we have achieved the goal. We launched the Inspire Challenge – a pay-for-results program where five digital agriculture organizations are selected from a rigorous selection process that reviewed 80 applications – to support incorporating gender-responsive practices in their respective programs and services that empower women and increase their participation.

EOIO 3: Improved digital skills.

We aimed to enhance the digital skill levels of at least 1,000 individuals (40 percent women) to facilitate their access to digital agrifood advisory services. As of December 2023, we are on track to achieve the goal. The cumulative number of Initiative-trained trainees in Guatemala, Kenya, and India reached 1,110 with 27 percent women. CIMMYT developed new WhatsApp-based [micro-training programs](#), set to launch in 2024, which should significantly increase trainee numbers. Additionally, IWMI’s recent partnership with UNICEF is expected to further boost training efforts, particularly among women and youth, within local digital ecosystems.

EOIO 4: Equitable resource allocations.

We aimed to engage with at least two natural resource management organizations and improve their technical capacities to monitor food-land-water systems in real-time, assess climate risks, and inform stakeholders to equitably allocate water resources. As of December 2023, we are on track to achieve the goal. IWMI’s river basin-level [digital twin systems](#) have been co-designed with the Limpopo Watercourse Commission and the Inkomati-Usuthu Catchment Management Agency to address their challenges in sustainably managing natural resources.

EOIO 5: Strengthened information systems.

We aimed to strengthen more than five information systems by incorporating high frequency agrifood systems monitoring data and analytics. As of December 2023, we are ahead of schedule to achieve the goal. We developed Data Hubs to enhance data exchange between public and private sectors in Guatemala and Kenya. Additionally, we improved CIMMYT’s [e-Agrology](#) system to aid partner organizations like PepsiCo, Kellogg, Heineken, and Bimbo enhance the sustainability of their sourcing practices. In Rwanda, the ongoing use of the Diet Quality Questionnaire system by IITA continues to produce valuable [diet quality and food flow data](#), supporting government and humanitarian agency operations. Also, utilizing innovative generative AI techniques, we have enabled ILRI to [enhance data analytics](#) for cow and herd management in Nepal and more effective local-level [agroclimatic advisories](#) in India.

EOIO 6: Strengthened organizational capabilities.

We aimed to improve the digital capabilities of at least six partner organizations to utilize real-time data and analytics more effectively. As of December 2023, we are ahead of schedule to achieve the goal. In India and Indonesia, IRRI supported Bayer Crop Science and the Agricultural Instruments Standardization Agency, respectively, to incorporate site-specific nutrition management tools to improve digital advisory services for rice farmers. In Uganda, CIMMYT supported [Farm Radio International](#) to utilize AI to analyze listeners’ voice mails in real-time to improve their advisory service programs. In Kenya and Senegal, IRRI’s collaboration with National Agricultural Research and Extension Systems (NARES) partners facilitated [near real-time monitoring of rice production](#) using satellite remote sensing and crop modeling.

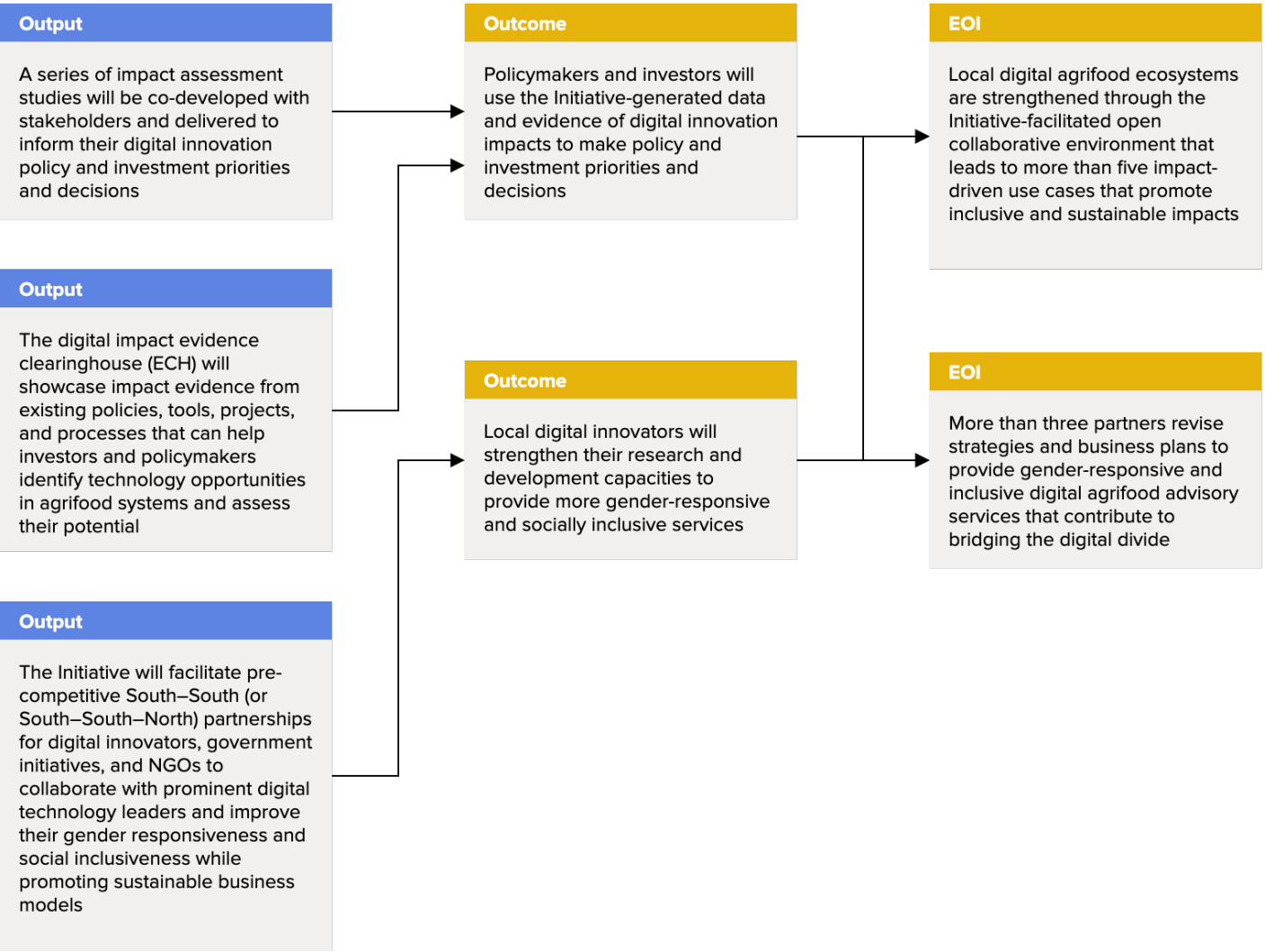


Farmers testing the usability of a mobile app.
Credit: Mariette McCampbell (Wageningen University)

Section 3: Work Package progress

WP1: Enabling environment

On track



Work Package 1 progress against the theory of change

Work Package 1 focuses on cultivating an enabling environment for responsible, inclusive, and scalable advancements in digital ecosystems, aiming to achieve two outcomes: “enabling policies and investment priorities” and “gender-responsive and socially inclusive services”.

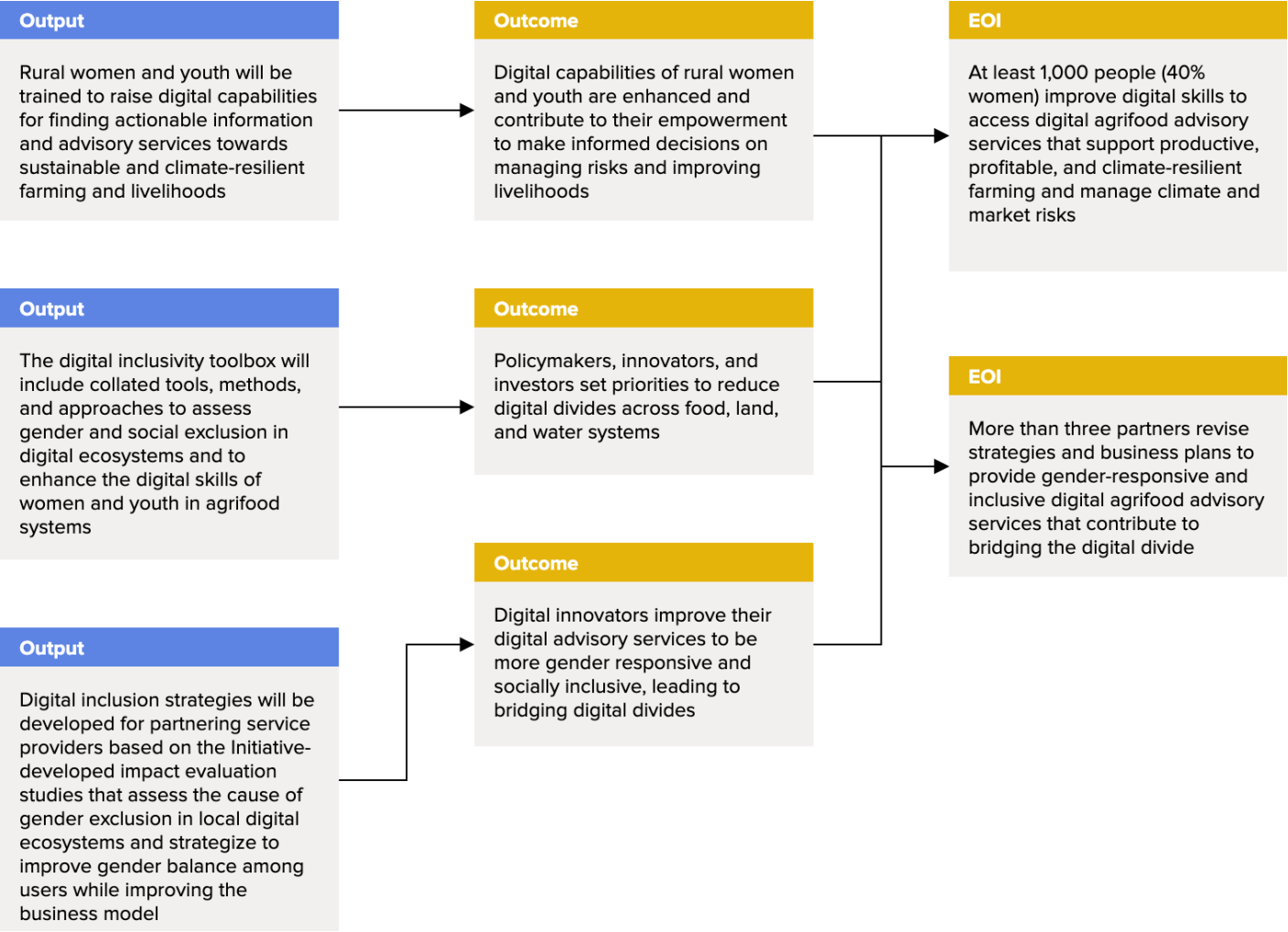
The Initiative has made notable progress in shaping policies and strategies for digital agriculture, both locally and globally. In India, ILRI contributed a [G20 policy brief](#), advocating for the establishment of digital public infrastructure in agriculture. In Latin America, CIMMYT formed a strategic alliance with the Inter-American Institute for Cooperation in Agriculture (IICA), promoting inclusive digital agriculture practices across the region.

In Maharashtra, India, CIMMYT collaborated with the World Bank to support the state government’s initiatives to [digitalize farmer producer organizations](#) (FPOs). This involved organizing a multistakeholder forum that facilitated connections between FPOs, agricultural technology startups, and public sector entities. In Guatemala, CIMMYT created the Data Hub platform to aid the government’s data-sharing efforts among public and private digital

agriculture stakeholders, with implementation in collaboration with [AgriLAC Resiliente](#).

The Initiative has focused on nurturing a dynamic global information and communication technology (ICT) community in the global South, highlighted by the [ICTforAg 2023 Conference](#). This annual event, supported by a United States Agency for International Development (USAID) grant to IFPRI, is a key platform for diverse ICT stakeholders to exchange knowledge and collaborate within the agrifood sector. The ICTforAg 2023 conference, organized virtually over three days, gathered over 1,700 participants from more than 100 countries. Additionally, the Initiative introduced the Inspire Challenge, a novel pay-for-results program aimed at boosting women’s engagement in digital agrifood advisory services. The ICTforAg+ Satellite Events were also launched, consisting of locally led events in four countries (Indonesia by IRRI, Mexico by CIMMYT, Nepal by CIMMYT, and India by IRRI and CIMMYT). Furthermore, CIMMYT developed the ICTforAg Learning Network, an online platform to enhance the digital impact evidence base and facilitate collaboration within the global ICTforAg community of practice.





Work Package 2 progress against the theory of change

Work Package 2 addresses the challenges in the digital divide and limited capabilities, aiming to achieve three outcomes, “enhanced digital capabilities of rural women and youth”, “policy and investments for digital inclusion”, and “gender responsive and socially inclusive digital advisory services” to improve digital equity.

The Initiative organized a range of capacity sharing programs to raise technical capabilities of rural women and youth. As a part of the ICTforAg effort, CIMMYT launched the ICTforAg Learning Network, an online platform that provides a virtual assistant to help identify evidence-based opportunity in digital development and provide micro training courses through WhatsApp. The ICTforAg 2023 conference agenda was co-developed with youth community and featured youth-oriented sessions to share inspiring digital development stories of junior data scientists in the global South.

The Initiative developed the [Multi-dimensional Digital Inclusiveness Index \(MDII\)](#) for digital advisory services to assess the inclusivity of their innovations and develop strategies to improve them. Developed by IWMI, in collaboration with IRRI, the Alliance of Bioversity International and CIAT, ILRI, and CIMMYT, the MDII was

crafted following a [comprehensive literature review](#), user needs assessments, and [stakeholder consultations](#) in India and Bangladesh. The Initiative is now in the process of applying the MDII in real-world settings, collaborating with partners such as the Food and Agriculture Organization of the United Nations (FAO), Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA), and the CGIAR Research Initiative on Diversification in Eastern and Southern Africa for its further testing and refinement.

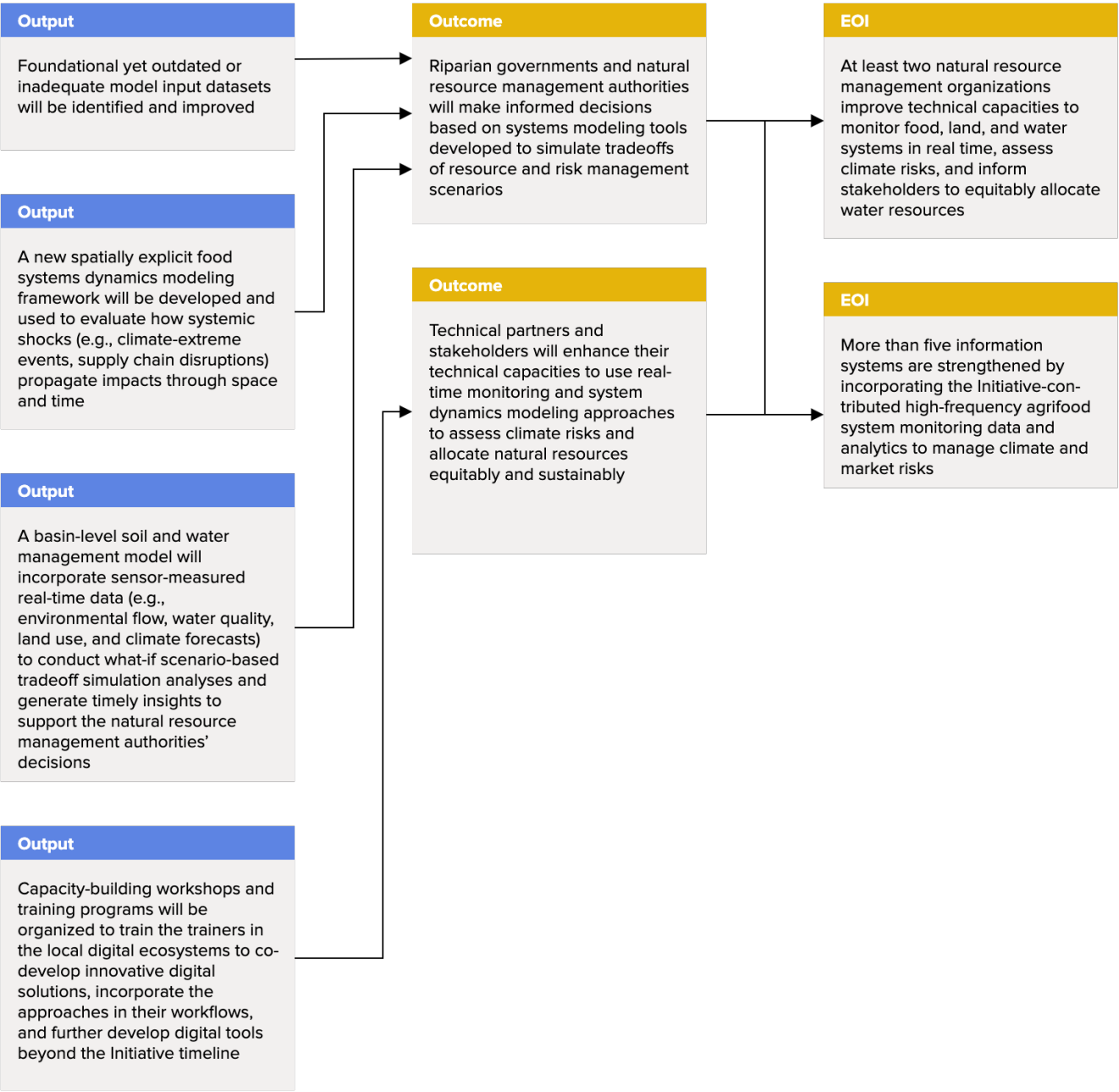
Additionally, the Alliance of Bioversity International and CIAT has taken significant steps to promote [human-centered design](#) (HCD) among CGIAR and its partner digital advisory services. This includes organizing a Human-Centered Design Workshop for trainers and launching Uxtools4ag, an online resource aimed at simplifying the user research process and integrating it into digital development projects. The HCD approach has also been applied within the Initiative, particularly in [diet quality monitoring activities in Guatemala](#), where it identified communication challenges with women through the interactive voice response (IVR) system due to their mistrust of calls from unknown numbers.



A farmer in Guatemala answers questions on her information needs. Credit: Anna Muller (Alliance of Bioversity International and CIAT)

WP3: Systems modeling

On track



Work Package 3 progress against the theory of change

Work Package 3 addresses the inadequate information challenge, aiming to achieve two outcomes, “sustainably managed food, land, and water resources” and “stakeholders’ use of systems modeling approaches,” to support data-driven decision-making at the river basin level.

In 2023, the Initiative primarily targeted the Limpopo river basin and the Inkomati river basin in Southern Africa to develop key data and analytical components of a basin-level digital twin system. Led by IWMI, the digital twin system leverages a large amount of complex water management data and a hydrology model to provide key water management to stakeholders with a suite of tools that

access real-time data and test what-if scenarios in a user-friendly and informative way. Addressing stakeholders’ challenges and needs, specific components developed for the digital twin system include sub-seasonal-to-seasonal drought and flood forecasts, near real-time river discharge data, [environmental flows](#) (e-flows), water availability forecasts, water quality monitoring, and the use of citizen science monitoring of river health data. A particular emphasis has been put on the management of e-flows which are essential for long term sustainability of natural resources yet historically have been poorly managed. The Initiative piloted cutting-edge near real-time natural resource monitoring tools, such as [AI-powered mobile apps](#) for the

collection of citizen science data, water quality sensors mounted on the backs of fish to monitor river health, satellite remote sensing data for irrigation mapping, unmanned aerial vehicles for high resolution survey of rivers, unmanned surface vehicles for [bathymetric surveys](#), and [3-dimensional modeling of river](#)

[sections](#) with stream-flow hydraulics to enable determination and management of e-flows.

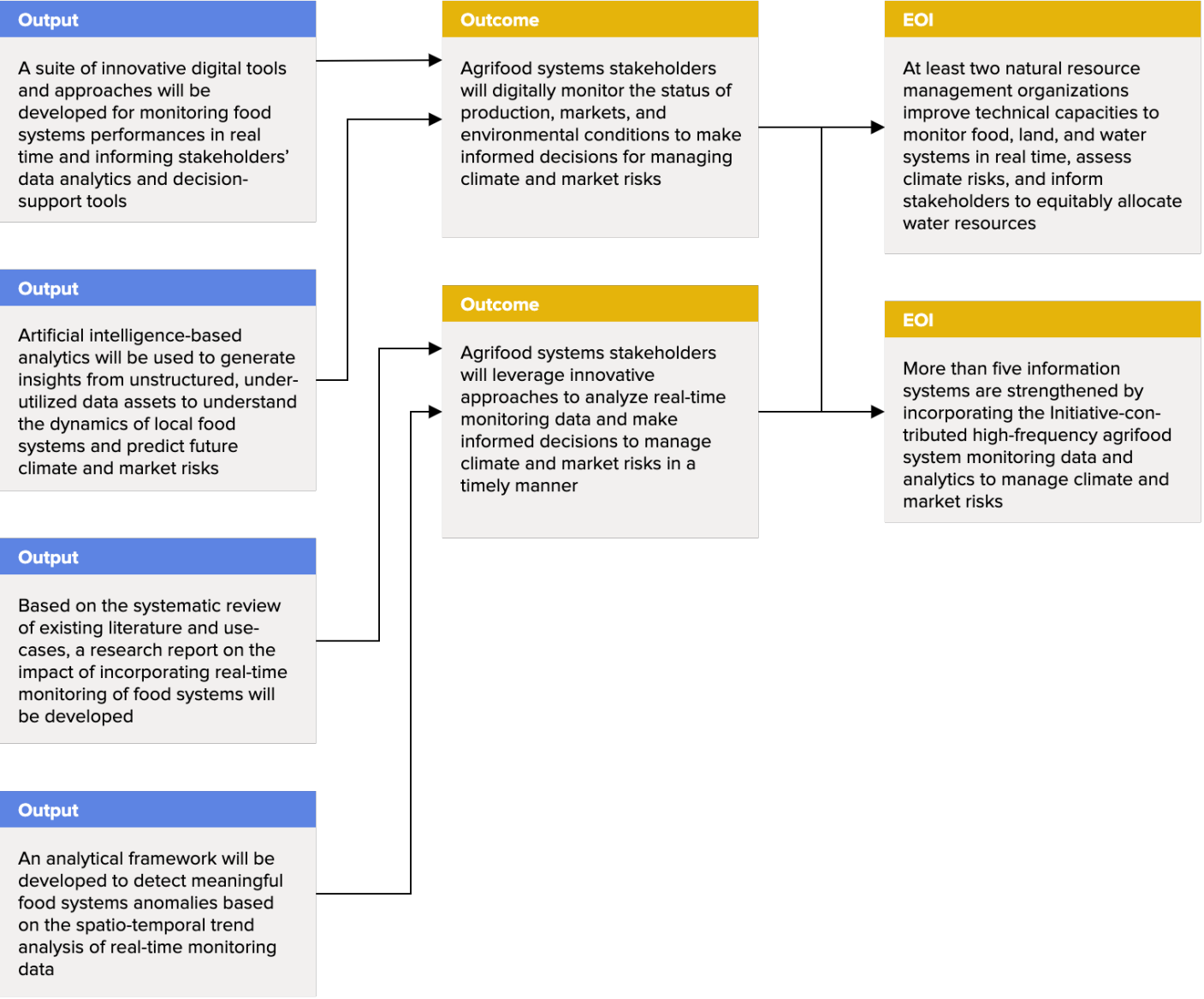
Additionally, based on extensive [consultation with the Limpopo Watercourse Commission](#), the primary beneficiary, the Initiative initiated the design of digital infrastructure to bring the extensive data and modeling tools together to deliver the digital twin system.



An unmanned surface vehicle used for bathymetric surveys in South Africa. Credit: Jawoo Koo (IFPRI)

WP4: Real-time monitoring

On track



Work Package 4 progress against the theory of change

Work Package 4 addresses the inadequate information challenge, aiming to achieve two outcomes, “improved food systems monitoring capabilities” and “timely managed climate and market risks”. In 2023, the Initiative focused on the development of real-time monitoring systems for livestock management data in Nepal, diet quality and food flow data in Rwanda, country-wide rice monitoring data in Senegal and Kenya, and plot-level data in Guatemala.

In Nepal, ILRI introduced a new [mobile app for livestock keepers](#) to record cow and herd management data. Additionally, they piloted an AI-powered tool designed to enable stakeholders to analyze data and obtain insights through a [conversational interface](#).

In Rwanda, IITA and the Alliance of Bioversity International and CIAT amassed [high-frequency data on diet quality](#) and food flows

from over 20,000 responses. This comprehensive data collection effort, including information from over 5,000 vendors across 70 markets, aims to support the development of a digital twin for food systems in 2024. Furthermore, IITA conducted a [validation study on crowdsourced diet quality data](#), finding that it offers a valid and cost-effective supplementary method to traditional data collection techniques.

In Senegal and Kenya, IRRI [collaborated with national research partners](#), Institut Sénégalais de Recherche Agricole and the National Irrigation Authority, respectively, to trial satellite remote sensing-based rice production monitoring systems. This effort included analyzing rice cultivation metrics in near-real-time for the 2023 seasons. The findings were shared with key stakeholders in Dakar

and Nairobi, supporting strategic planning for nationwide adoption and sustained use of the systems.

In Guatemala, the Alliance of Bioversity International and CIAT developed a [plot-level digital twin system](#) called “digital plot” at the Centro Universitario de Oriente (CUNORI). This system, designed as a

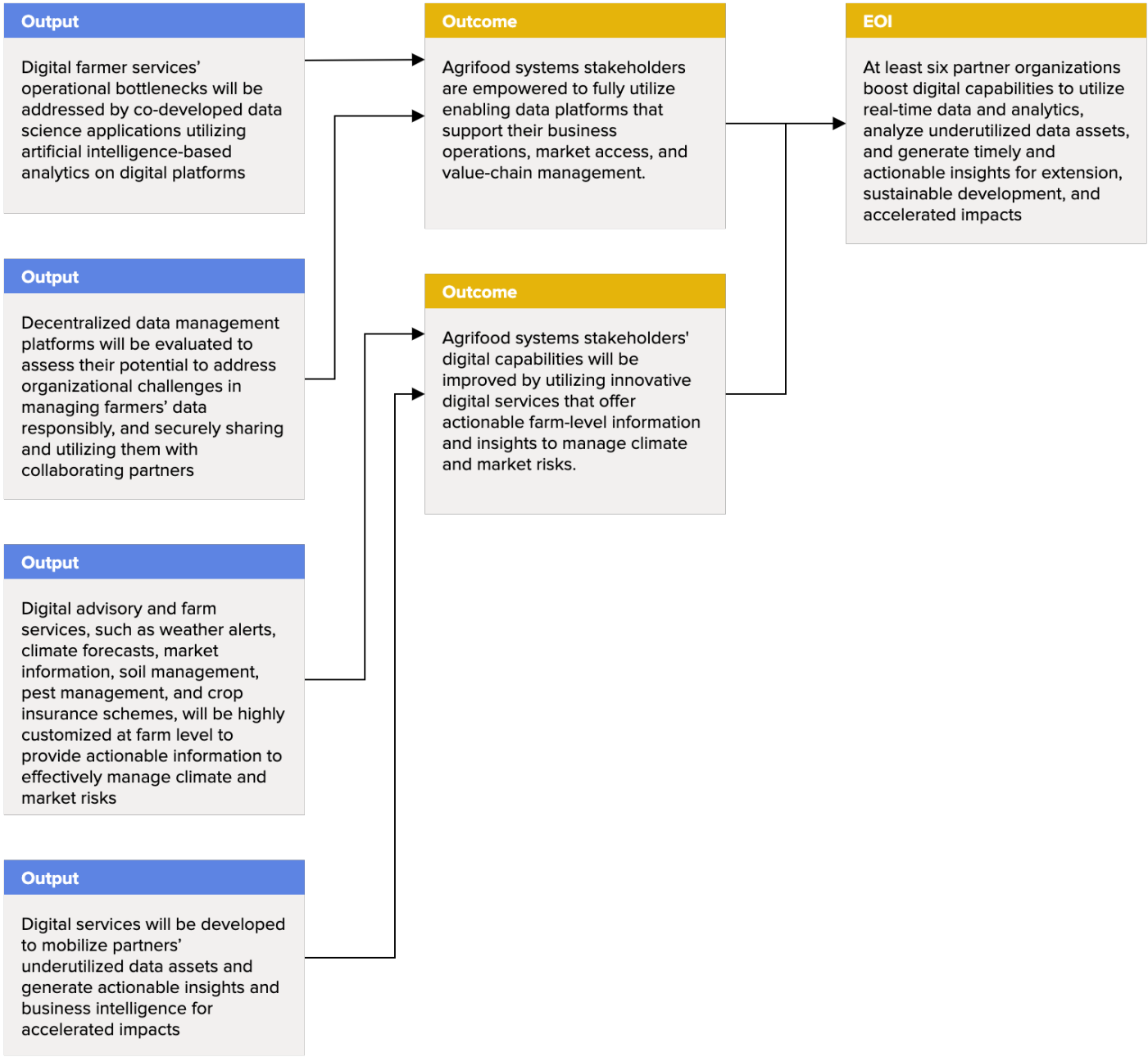
hands-on educational tool, features a comprehensive set of sensors, lysimeters, and an automated weather station to provide real-time agroclimatic data. In 2024, the Initiative aims to scale the digital plot to other geographies, bolstering the digital agriculture skills of students, field technicians, and farmers.



Students at the Centro Universitario de Oriente in Guatemala test internet-connected sensors measuring soil moisture. Credit: Daniel Jimenez (Alliance of Bioversity International and CIAT)

WP5: Platforms and services

On track



Work Package 5 progress against the theory of change

Work Package 5 addresses the challenge of limited capabilities by aiming for two interconnected outcomes, the adoption of “enabling data platforms” and “innovative digital services”. Throughout 2023, the Initiative supported a variety of innovations, knowledge products, and capacity-sharing initiatives, focusing on these objectives in India and Indonesia.

In India, ILRI, in partnership with the World Bank, The Agri Collaboratory, and the Competitiveness Institute, developed a prototype for a new [agriculture sector-wide data platform](#), AgDX. This platform is designed to evaluate digital agriculture readiness at the sub-national level. Additionally, ILRI collaborated with the

India Meteorological Department to pilot a weather advisory service based on a large language model, aimed at providing more precise and actionable advisories.

In collaboration with Bayer, IRRI has integrated its [site-specific nutrition management](#) tool into the FarmRise application, extending its reach to over 12,000 rice farmers in Uttar Pradesh and Odisha, India. The Initiative has also assisted IRRI in [reanalyzing its agronomic trial data using AI](#), which has improved yield estimations. In Indonesia, IRRI launched Layanan Konsultasi Padi, a new digital advisory service for rice farmers. Additionally, IRRI has organized a number of capacity building activities in India, such as the

[International Certificate Course in Digital Agriculture](#) with Sri Sri University, attended by 95 participants; a workshop on [Leveraging the Role of Computer Vision in Agriculture Applications](#) with Delhi Technological University, for 36 participants; and a [Climate Smart](#)

[Agriculture in South Asia](#) program, focusing on digital agriculture applications, with the South Asian Association for Regional Cooperation (SAARC) Agriculture Centre, benefiting 28 participants.



A rice farmer in Indonesia uses the Rice Crop Manager mobile app to receive automatically generated management guidelines.
Credit: Benedict Jardinero (IRRI)

WORK PACKAGE	PROGRESS RATING & RATIONALE
1	<div><div></div><div>Progress rating The success of ICTforAg in 2023, along with associated activities such as the Learning Network, Co-LAB, Data Hub, and the Inspire Challenge, has significantly contributed to achieving the Work Package outcomes. As a result, we have already met the objectives outlined for the End of Initiative outcomes associated with Work Package 1.</div></div>
2	<div><div></div><div>Progress rating The Multi-dimensional Digital Inclusiveness Index was successfully developed as scheduled in 2023. Human-Centered Design approaches were applied to the Initiative’s innovations and the Initiative expanded these practices to partner institutions. The planned outcomes of Work Package 2 are largely achieved, aligning with its associated End of Initiative outcomes.</div></div>
3	<div><div></div><div>Progress rating The development of digital twin systems at the river basin level, which incorporates real-time data and system modeling, is advancing according to plan. Key beneficiaries are being actively engaged in the development process. The majority of the outcomes associated with Work Package 3 are achieved, aligning with its associated End of Initiative outcomes.</div></div>
4	<div><div></div><div>Progress rating All activities related to real-time monitoring of food systems are advancing as scheduled, leveraging the Initiative’s expertise in decision-support systems and their application for broader impact. The outcomes associated with Work Package 4 have been successfully achieved, in line with its associated End of Initiative outcomes.</div></div>
5	<div><div></div><div>Progress rating All activities on enabling platforms and services are progressing as planned, contributing to significant achievements with our partners in both the public and private sectors. The objectives associated with Work Package 5, as outlined in the End of Initiative outcomes, have been successfully met.</div></div>

Definitions

<div><div></div><div>On track</div></div> <div><div>✔ Annual progress largely aligns with Plan of Results and Budget and Work Package theory of change.</div><div>✔ Can include small deviations/issues/ delays/risks that do not jeopardize success of Work Package.</div></div>	<div><div></div><div>Delayed</div></div> <div><div>⚠ Annual progress slightly falls behind Plan of Results and Budget and Work Package theory of change in key areas.</div><div>⚠ Deviations/issues/delays/risks could jeopardize success of Work Package if not managed appropriately.</div></div>	<div><div></div><div>Off track</div></div> <div><div>✖ Annual progress clearly falls behind Plan of Results and Budget and Work Package theory of change in most/all areas.</div><div>✖ Deviations/issues/delays/risks do jeopardize success of Work Package.</div></div>
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Section 4: Key results

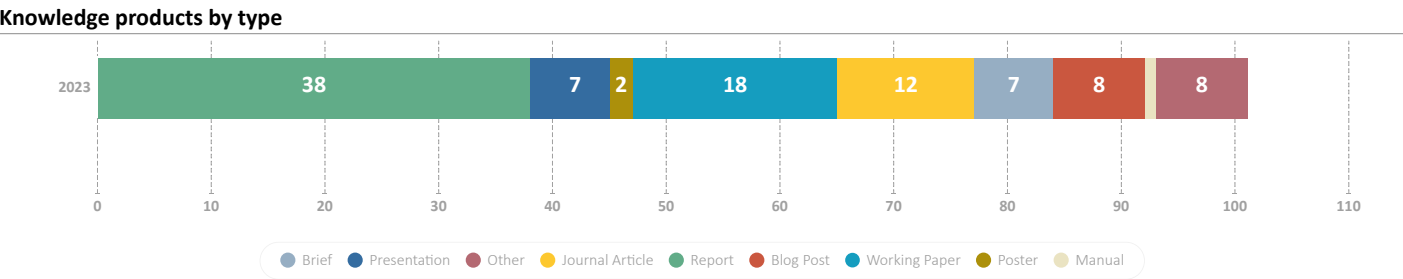
This section provides an overview of results reported by the CGIAR Research Initiative on Digital Innovation in 2023. These results align with the CGIAR Results Framework and Digital Innovation’s theory of change. Source: *Data extracted from the [CGIAR Results Dashboard](#) on 29 March 2024.*

OVERVIEW OF REPORTED RESULTS

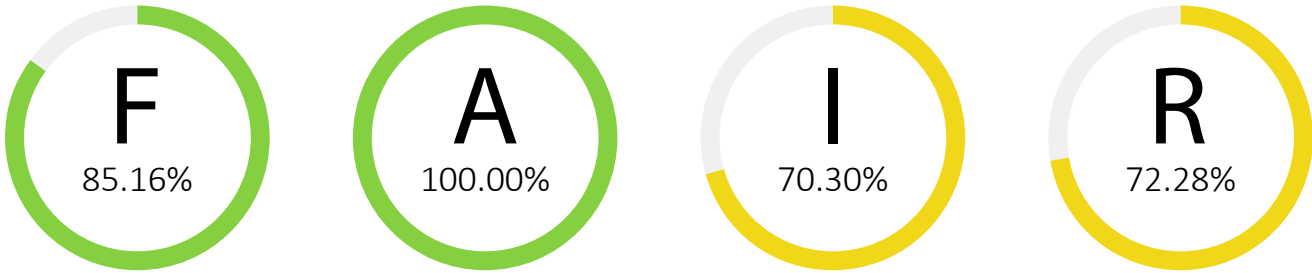


Digital Innovation produced 101 knowledge products, 43 innovation development results, 18 capacity sharing for development results, and 36 other outputs. It also produced four policy change results, four innovation use results, and one other outcome in 2023.

NUMBER OF KNOWLEDGE PRODUCTS BY TYPE AND THEIR FAIR SCORES



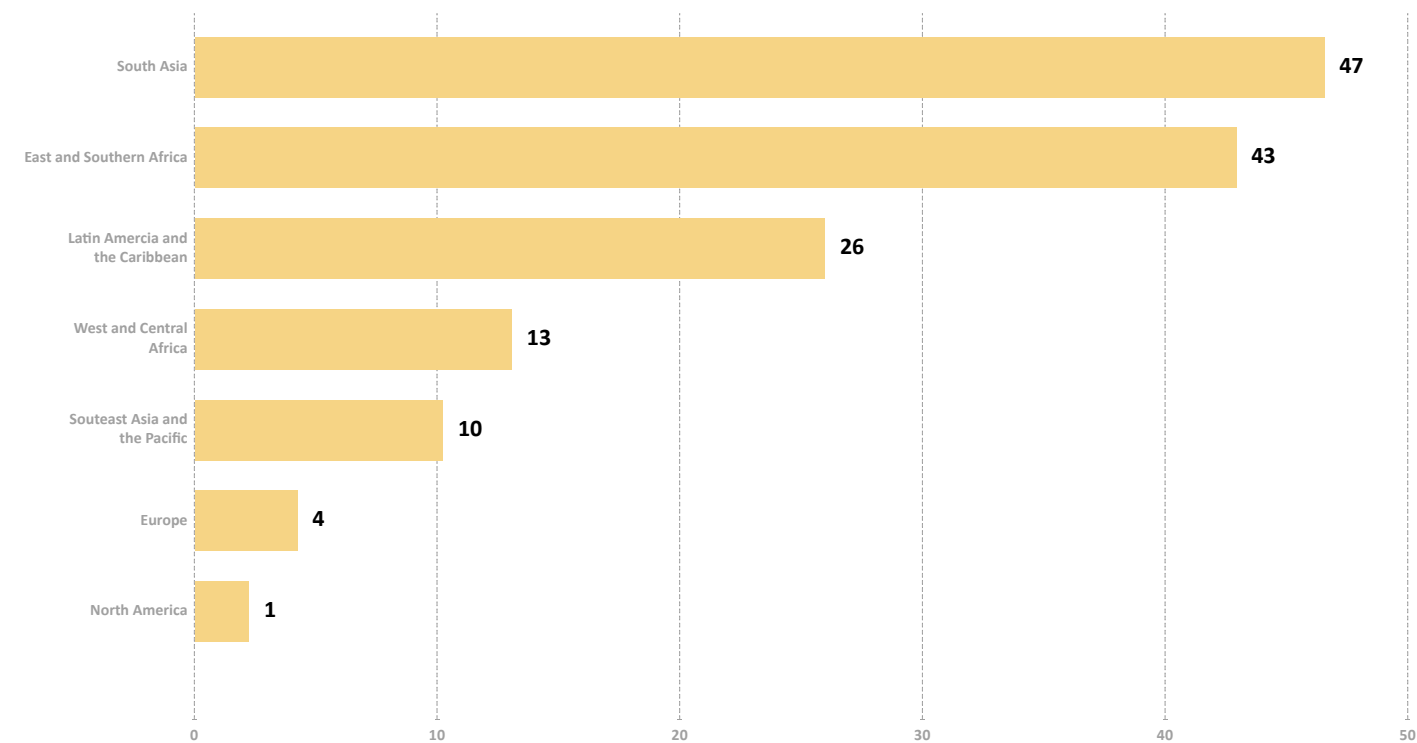
Findable, Accessible, Interoperable and Reusable (FAIR) scores



FAIR scores refer to a set of principles that support the reusability of digital assets. FAIR (findability, accessibility, interoperability, and reusability) scores are calculated based on the presence or absence of metadata in the CGSpace repository. [CGIAR Open and FAIR Data Assets Policy](#)

The majority of knowledge products produced, such as reports, working papers, and journal articles were open-access and relatively easy to search – with 85 percent findable.

GEOGRAPHIC DISTRIBUTION OF RESULTS BY REGION



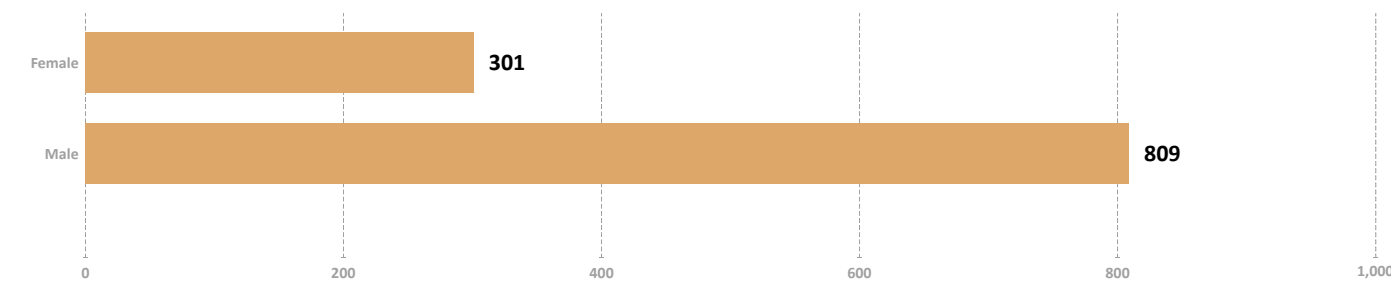
Most of the research activities implemented and outputs produced by Digital Innovation focused on South Asia, East and Southern Africa, and Latin America in 2023, as planned. It is anticipated that results from other regions such as Southeast Asia will increase through joint implementation and sharing of resources in bilateral projects.

CONTRIBUTIONS TO THE UN SUSTAINABLE DEVELOPMENT GOALS



Out of 17 SDGs, Digital Innovation contributed to 16 SDGs geared mostly to Goals 2 (zero hunger), 1 (no poverty), 5 (gender equality), 13 (climate action), and 15 (life on land) in 2023.

NUMBER OF PEOPLE TRAINED BY DIGITAL INNOVATION



Short-term trainees had increased from 77 in 2022 to 1,110 in 2023. The majority of the trainees were from national agricultural research systems (NARS), national research organizations and universities, and private companies.

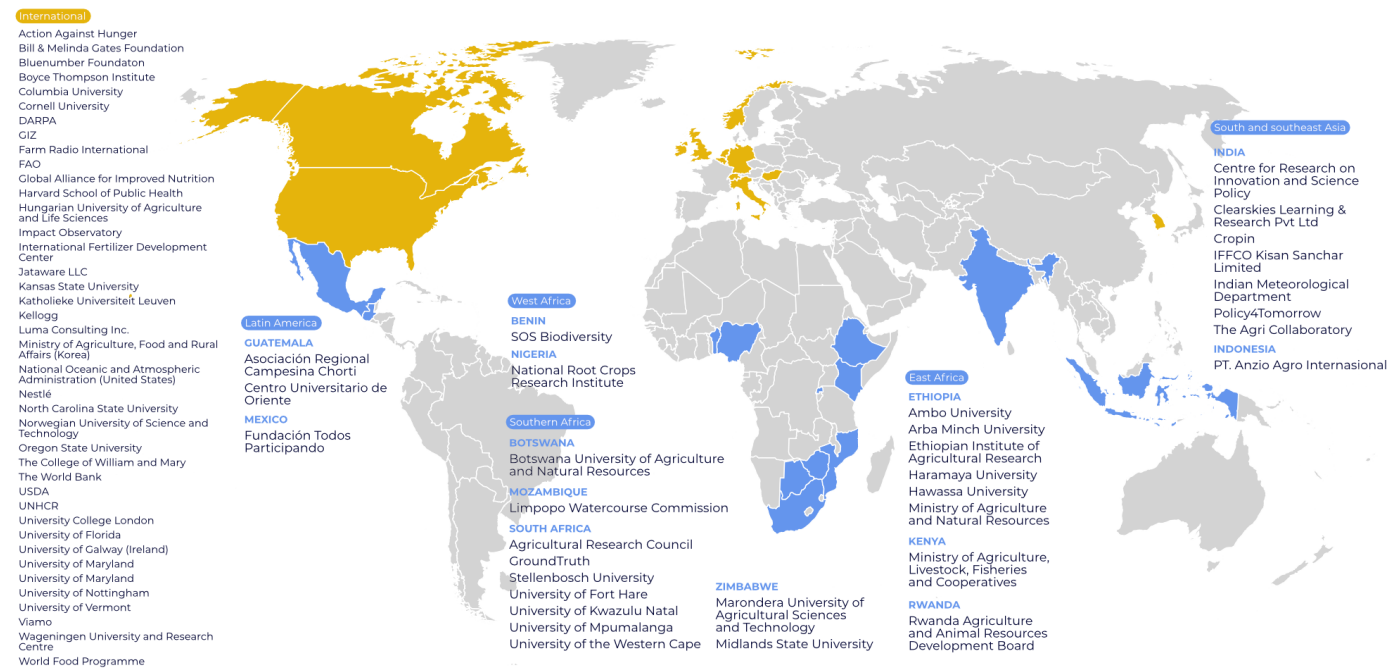
NUMBER OF INNOVATIONS BY READINESS LEVEL



Digital Innovation reported 43 innovations in 2023, of which 8 have increased their level of readiness, while 2 were already at the “proven” stage. Most innovation users were research organizations and universities, governments, other organizations, and private companies.

Section 5: Partnerships

MAP OF PARTNERS



Colors represent the number of different partners which collaborated on results achieved in a specific country. One result can impact different countries and therefore the same partner can be associated with more than one country. Source: Data extracted from the [Results Dashboard](#) on 29 March 2024.

Partnerships and Digital Innovation’s impact pathways

Digital Innovation has established partnerships with 85 external organizations whose expertise and missions are in line with its theory of change. These partners were selected based on their potential to contribute to the Initiative’s outcomes and their alignment with our values and expertise.

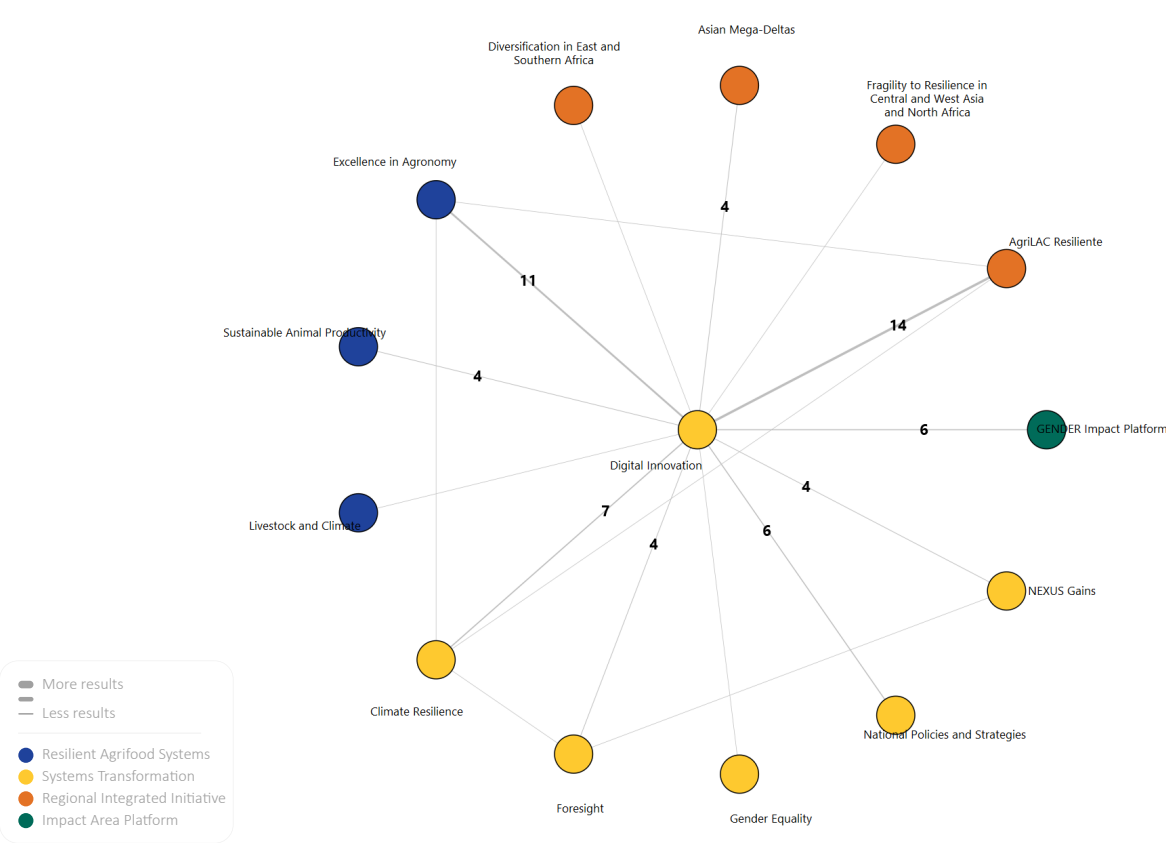
Our primary demand partners were identified through comprehensive stakeholder consultations. These include NARES such as the Kenya National Irrigation Authority, *Institut Sénégalais de Recherche Agricole*, and the Indian Council of Agricultural Research; natural resource management authorities such as the Limpopo Watercourse Commission; academic institutions like Sri Sri University and Centro Universitario de Oriente; non-governmental organizations (NGO)s including Farm Radio International; and multilateral organizations such as the World Bank and UNICEF. We collaborate with these entities to enhance their technical capabilities

in developing digital innovations that enable real-time monitoring of agrifood systems and facilitate informed decision-making, while also building on their prior collaborations with CGIAR.

Additionally, many of our demand partners, particularly in the private sector, double as innovation and scaling partners. For example, we collaborate with GroundTruth in South Africa for their contributions on enhanced water monitoring innovations and expanded citizen science programs through AI-powered mobile apps. In selecting private sector partners, we focus on those with complementary technical skills and the potential to contribute to global public goods. For instance, our partnership with Bluenumber aims to pilot a decentralized data management system, enabling Mexican farmers to monitor their data usage and offering Bluenumber a new application for their technology in the agrifood systems of the global South.

Section 6: CGIAR Portfolio linkages

DIGITAL INNOVATION’S INTERNAL PORTFOLIO NETWORK



Connections are sized by the number of reported results. Collaborations where only one result was reported with a linkage between two Initiatives are excluded.

Portfolio linkages and Digital Innovation’s impact pathways

Digital Innovation had strong portfolio linkages across several Initiatives in 2023 of which some examples are provided below.

The CGIAR Research Initiatives on:

- AgriLAC Resiliente through joint research activities such as the digital agricultural plot and digital agriculture diploma course at the Centro Universitario de Oriente in Guatemala and the ICTforAg satellite event in Latin America.
- Excellence in Agronomy on collaborative training workshops on human-centered design as well as digital inclusions.
- Climate Resilience on the “Remote-sensing based Information and Insurance for Crops in emerging Economies” across Africa and in-situ farm monitoring in Guatemala.
- Sustainable Animal Productivity through the Africa-Asia Dairy Genetic Gains (AADGG) dairy app to support smallholder buffalo farmers in Nepal.
- Ukama Ustawi (Diversification in East and Southern Africa), Foresight, and NEXUS Gains on the development of a

digital twin for water resources management in Limpopo river basin in Southern Africa and digital tools to map the river morphology to monitor changes due to river flow management.

National Policies and Strategies on digital data use cases for better decision-making and performance management as well as a virtual food policy coach – a customized AI chatbot for food policy research.

We also worked with the CGIAR Gender Impact Platform on national consultative workshops on digital innovation and inclusion and gender inequalities in labor-market outcomes using mobile phone data.

Additionally, we have developed a strategic partnership with CGIAR’s Digital & Data group. This collaboration allows us to leverage the expertise and resources of both to drive digital innovation in research and digital transformation across the entire CGIAR system, based on the [recommendations](#) made by the CGIAR Independent Advisory and Evaluation Service (IAES).



Farmers testing the usability of a mobile app.
Credit: Mariette McCampbell (Wageningen University)

Section 7: Adaptive management

RECOMMENDATION	SUPPORTING RATIONALE
Document evidence for the End of Initiative outcomes.	All Work Packages are advancing towards achieving the End of Initiative outcomes by December 2024. However, there are some gaps in evidence materials. To ensure comprehensive reporting, it is essential to gather the necessary concrete evidence as mandated by the Performance and Results Management System (PRMS).
Strategic engagement with partners for outcomes and impacts beyond the end of the Initiative.	As the Initiative enters its final year, partners are inquiring about the Initiative’s future beyond the current phase. To guarantee the effective delivery of innovations leading to desired outcomes and impacts, the Initiative team will actively engage with partners to explore opportunities for continued partnerships within the context of the upcoming CGIAR Portfolio, starting in 2025.
Revise the plan for developing the Digital Inclusivity Toolbox as a comprehensive toolkit.	As the development of the Multi-dimensional Digital Inclusiveness Index (MDII) has gained momentum, we are reconsidering the initial plan to create the Digital Inclusivity Toolbox as a primary output. Rather than developing a new toolkit, it will be more strategic to concentrate on refining and testing MDII with partners and documenting them throughout 2024.
Position the Initiative as the global lead of digital innovations in agrifood systems at the ICTforAg 2024 and the CGIAR Science Week events.	Following the success of ICTforAg 2023, the Initiative will further engage with the global digital innovation community in the global South at ICTforAg 2024. Additionally, the Initiative aims to facilitate the participation of key partners in the upcoming CGIAR Science Week. This will provide an opportunity to engage with a global audience and showcase co-designed innovations. To maintain this momentum within the community, resources permitting, the Initiative will plan to appoint a dedicated community manager.
Provide clear roadmaps for Initiative-developed innovations, specifically digital twin systems, to be fully deployed, operationalized, and maintained.	To promote the uptake of innovations developed by the Initiative at partner institutions and their broader scaling, it is crucial to create detailed roadmaps for deploying and operationalizing these innovations. The Initiative team will collaborate with the product management team of the Digital & Data group to develop strategies that can transform these innovations into impactful products.

Section 8: Key result story

AI to unlock the citizen science revolution

Digital Innovation empowers over 1,000 river community members in Southern Africa collecting verifiable water quality data for policy impact.



Citizen scientists use miniSASS to collect water quality data.
Credit: Nicholas Pattinson (GroundTruth)

Local communities in Southern Africa are monitoring the health of their freshwater sources, using the miniSASS method to identify small creatures living in streams and rivers. Their data fills an urgent need to track the impacts of pollution, overuse, or climate change, but how can decision-makers trust citizen science? A smartphone app developed by the CGIAR Research Initiative on Digital Innovation makes it easier to automatically verify the data collected – a solution that elevates citizen science for global impact on environmental sustainability.

The Limpopo river basin sustains life and livelihoods across four countries in Southern Africa (Botswana, Mozambique, South Africa and Zimbabwe), governed by the Limpopo Watercourse Commission (LIMCOM). Decision-makers need better data to prevent harm to this vital resource from pollution, overuse, and climate risks, but national budgets for water monitoring are scarce.

Scientists at IWMI and GroundTruth have pioneered the mini stream assessment scoring system (miniSASS), a simple and inexpensive method to monitor water quality. It involves going to a stream or river, and capturing and identifying small animals called macroinvertebrates in the water. Different groups of macroinvertebrates are sensitive to different water quality issues. MiniSASS uses those differences to assign a score for water quality and river health based on the community of creatures present.

With miniSASS, local communities can become citizen scientists. One such group, the Enviro-Champs, has spread from one township to become a technologically innovative group of around 1,000 volunteers in KwaZulu Natal with the support of multiple partners, including GroundTruth and the Duzi-Umngeni Conservation Trust (DUCT), the South African Presidential Employment Stimulus and the Social Employment Fund.

A report by UN Water recognizes the “global potential” of miniSASS to monitor the progress of SDGs relating to the health of water systems. Yet the report notes that “acceptance of citizen-derived data for official SDG reporting is rare”.

To build confidence and take miniSASS to the next level, a partnership was formed between GroundTruth, Digital Innovation, the UNICEF, and North-West University (NWU). This has resulted in an AI-powered smartphone app which trains users, helps to

accurately identify macroinvertebrates, and reports data to an online system.

“CGIAR has given us a miniSASS product that auto-verifies its own data, creating a path for citizen scientists to submit data that are actionable in policy and management”, said Nicholas Pattinson, environmental research scientist at GroundTruth. “This is well-timed now that that national governments are looking to incorporate citizen science within management and policy. CGIAR involvement has taken the potential of miniSASS to the forefront for biomonitoring of the SDGs.”

Groundtruth and Digital Innovation used a database of 13,000 photos collected on field trips during late 2022 to train a machine learning algorithm to recognize macroinvertebrates. Then, the solution was built into a smartphone app alongside training materials and an interactive map.

With the miniSASS app, users navigate the map to the survey site, document its features and take photos of macroinvertebrates using their smartphone camera. The app then uses a digital, interactive visual identification key to calculate the miniSASS score while the machine learning algorithm does the same, and it then uploads all the measurements, photos, and other data to miniSASS.org.

Combining the miniSASS score calculated by citizen scientists, the AI-calculated score and the geo-tagged photos uploaded to the cloud, the miniSASS app creates citizen scientist data that are automatically verified and immediately available to decision-makers.

UNICEF has adopted miniSASS to engage young people in citizen science through its YOMA learning platform, with over 600 people enrolled in the online miniSASS course. “This collaboration will empower youth in environmental stewardship while building their 21st century skills for the green economy”, said Michael Scheibenreif, UNICEF Impact Youth Market (YOMA) Lead.

For the next step, more communities and decision-makers at the national and international levels are being engaged to develop water quality monitoring systems using citizen science. One such effort is an ongoing Digital Innovation project with LIMCOM to build a digital twin, a full digital representation of the Limpopo river basin integrating multiple layers of real-time data, modeling and analysis to create a powerful dashboard for natural resource managers.

Primary Impact Area



Other relevant Impact Areas targeted



Contributing Initiative

Digital Innovation

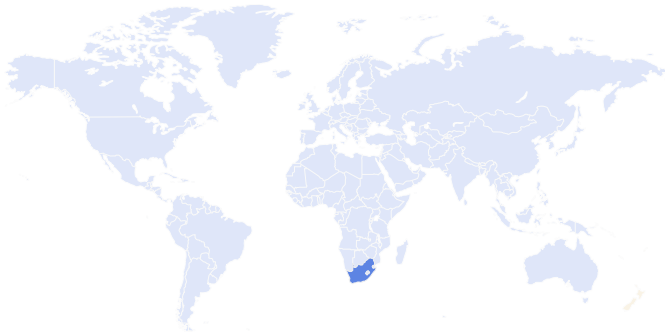
Contributing Centers

IWMI · IFPRI

Contributing external partners

GroundTruth · UNICEF

Geographic scope



Country: Southern Africa



Front cover photo

Women farmers in Nepal using a mobile phone to access agricultural information services.
Credit: Chris de Bode

Back cover photo

Citizen scientists participating in the Enviro-Champs program in South Africa take a group photo before checking the health of a river using miniSASS.
Credit: Nicholas Pattinson (GroundTruth)



INITIATIVE ON
Digital Innovation