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A researcher examines sorghum panicles at a field trial site in Uganda.

Credit: Marion Aluoch/CIMMYT

CGIAR project on

Accelerated varietal improvement and seed systems in Africa

Annual Technical Report 2024

Author: CGIAR Science Group Project on Accelerated varietal improvement and seed systems in Africa

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The Artificial Intelligence (AI) software ChatGPT was used to support the editing of parts of this report, specifically to improve clarity, grammar, and style. ChatGPT was not used to generate the content of the report. All edits made with AI assistance were reviewed and validated by the authors to ensure accuracy, coherence, and alignment with the original intent.

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CGIAR Technical Reporting 2024

CGIAR Technical Reporting has been developed in alignment with CGIAR's Technical Reporting Arrangement. This annual report ("Type 1" Report) constitutes part of the broader CGIAR Technical Report. Each CGIAR Research Initiative/Impact Platform/Science Group Project (SGP) submits an annual "Type 1" Report, which provides assurance on progress towards end of Initiative/Impact Platform/SGP outcomes.

As 2024 marks the final year of this CGIAR Portfolio and the 2022-24 business cycle, this Type 1 Report takes a dual approach to its analysis and reporting. Alongside highlighting key achievements for 2024, the report also provides a cumulative overview of the 2022-24 business cycle, where relevant. This perspective captures the evolution of efforts over the three-year period. By presenting both annual and multi-year insights, the report underscores the cumulative impact of CGIAR's work and sets the stage for the transition to the 2025-30 Portfolio.

The 2024 CGIAR Technical Report comprises:

- **Type 1 Initiative, Impact Platform, and SGP Reports:** These annual reports present progress towards end of Initiative/Impact Platform/SGP outcomes and provide quality-assured results accessible via the CGIAR Results Dashboard.
- **Type 3 CGIAR Portfolio Practice Change Report:** This report provides insights into CGIAR's progress in Performance Management and Project Coordination.
- **Portfolio Narrative:** Drawing on the Type 1 and Type 3 reports, as well as data from the CGIAR Results Dashboard, the Portfolio Narrative synthesizes insights to provide an overall view of Portfolio coherence. It highlights synergies, partnerships, country and regional engagement, and collective progress.
- **Type 2 CGIAR Contributions to Impact in Agrifood Systems: evidence and learnings from 2022 to 2024:** This report offers a high-level summary of CGIAR's contributions to its impact targets and Science Group outcomes, aligned with the Sustainable Development Goals (SDGs), for the three-year business cycle.

The Portfolio Narrative informs the 2024 CGIAR Annual Report – a comprehensive summary of the organization's collective achievements, impacts, and strategic outlook.

Elements of the Type 2 report are integrated into the CGIAR Flagship Report, released in April 2025 at CGIAR Science Week. The Flagship Report synthesizes CGIAR research in an accessible format designed specifically to provide policy- and decision-makers at national, regional, and global levels with the evidence they require to formulate, develop, and negotiate evidence-based policies and investments.

The diagram below illustrates these relationships.

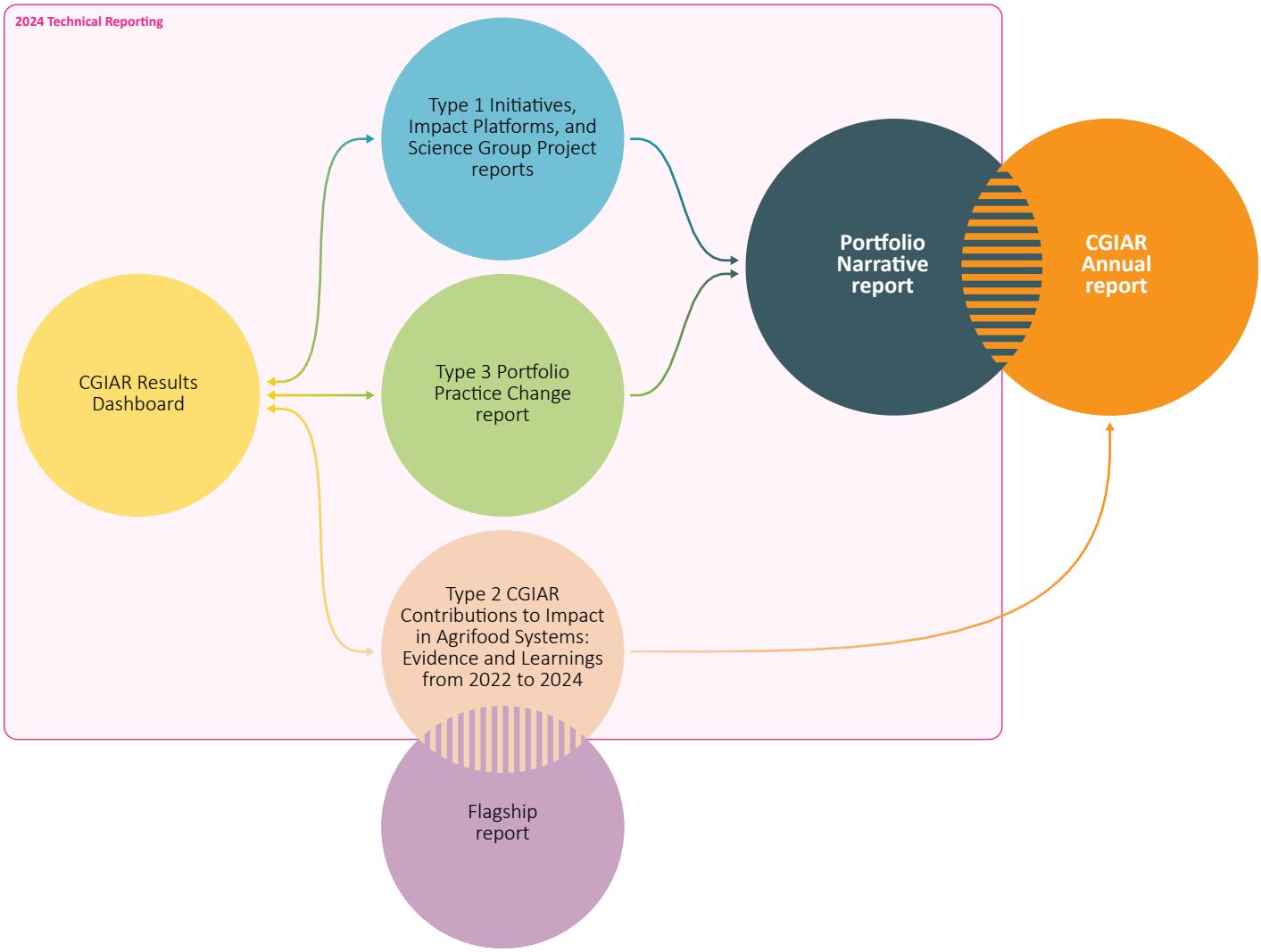


Figure 1. CGIAR's 2024 Technical Reporting components and their integration with other CGIAR reporting products.

Section 1: **Fact sheet, executive summary and budget**

Science Group Project name	Accelerated varietal improvement and seed delivery of legumes and dryland cereals in Africa
SGP name	AVISA
Science Group Project Lead	Harish Gandh (harish.gandhi@cgiar.org)
Science Group Project Co-lead	Mark Nas (t.nas@cgiar.org)
Science Group	Genetic Innovation
Start – end date	01 May 2023 – 31 December 2024
Geographic scope	**Regions** East and Southern Africa · West and Central Africa **Countries** Burkina Faso · Cameroon · Chad · Ethiopia · Ghana · Kenya · Malawi · Mali · Mozambique · Niger · Nigeria · Senegal · South Sudan · Tanzania · Togo · Uganda · Zambia · Zimbabwe
Website link	https://www.cimmyt.org/projects/avisa/

EXECUTIVE SUMMARY

This report summarizes the key achievements of the CGIAR Project on AVISA (Accelerated varietal improvement and seed delivery of legumes and dryland cereals in Africa).

The project had six end of Project outcomes (EOPOs) with six corresponding Work Packages (WPs). The six EOPOs were:

1. Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties.
2. CGIAR-national agricultural research system-small-and medium-sized enterprise (CGIAR-NARES-SME) networks use market segments, product profiles and pipeline investment cases to orient variety development and deployment towards those that provide larger scale benefits across the five Impact Areas.
3. Regional networks enhance on-farm performance trials for AVISA crops and cultivars targeting geographies.
4. Women, men, youth and disadvantaged socio-economic groups access affordable, market-demanded and produce- preferred, high yielding, resilient seed varieties.
5. CGIAR and national agricultural research and extension systems (NARES) crop improvement teams make data-driven decisions.
6. Regional collaborative crop improvement networks for dryland crops.

The corresponding WPs are:

1. Co-create impact through applied social science research that guides prioritization of public and private investments;
2. prioritize resource investments and provide benchmarks for CGIAR collaborative breeding programs;
3. expand on-farm testing networks and scale-up the pre-release trials;
4. iv) strengthen currently successful impact pathways and validate innovative approaches to seed production and delivery of recently released varieties;
5. co-develop and implement modern data management principles, governance, and strategy;
6. establish sustainable regional collaborative crop improvement networks with responsibility-based sharing of resources.

EOPO1 focused on a new design philosophy and a pilot-ready Modular Impact Accelerator. A collaborative effort involving over 380 NARS and CGIAR scientists resulted in a new impact acceleration framework, published as "Pathways to resilient dryland food systems in Africa" (2024). This framework guides systems change through three domains, ten strategies, and an Impact Accelerator. The Modular Impact Accelerator for Dryland Seed-Grain Ecosystems was developed to operationalize this framework. This customizable design addresses five critical bottlenecks: seed replacement, SME seed production, logistics, consumer engagement, and market access. Anchored in regional variety branding, a franchise conversion approach, and a coordinating orchestrator model will be piloted in 2025 to assess its replicability, cost-effectiveness, and scalability.

Significant progress was made in crop improvement across multiple countries and institutions under EOPO2. Key achievements included:

- Finalization of 28 market segment/target product profiles (MS/TPP) for six crops (sorghum, pearl millet, groundnut, finger millet, pigeon pea and chickpea), eight MS/TPP for common bean in Eastern and Southern Africa and cowpea in Western and Central Africa. Steady progress on the development of breeding material through shared breeding pipelines in Africa dryland crops.
- Extensive evaluation of breeding lines of sorghum, pearl millet, groundnut, finger millet, pigeon pea and chickpea for identifying founder germplasm. Progress towards defining heterotic patterns and identifying founder lines for the pearl millet hybrid breeding program. Implementation of genomic selection approach in common bean.
- Extensive use of genomic tools for Quality Assurance and Quality Controls (QAQC) of parents and new F1s (Foundation 1), validation and utilization of trait markers, fingerprinting with mid-density panel, development of new reference genomes and shared leadership for trait discovery – via "Trait Champions".
- Standardized protocols for 17 biotic stresses guided disease screening in seven countries for 1,400 entries.
- Breeding infrastructure upgrades and training activities enhanced research capabilities across the partner network.

Under EOPO3, regional networks facilitated on-farm performance trials for AVISA crops, enabling targeted cultivar deployment. Successful trials were conducted in Ethiopia, Ghana, Mali, Senegal, and other countries for all the crops we worked with. Varieties were released in several countries of Eastern and Southern Africa, and Western and Central Africa – Mali, Tanzania, Uganda, and others, and promising lines and hybrids were identified for further development and release in advanced stage trials.

In EOPO4, seed system interventions, implemented through partnerships with NARS, CGIAR, and non-NARS partners like the Syngenta Foundation on Sustainable Agriculture (SFSA), reached over 5.9 million smallholder farmers with improved seed and production bundles, exceeding the 2024 target. Innovative seed delivery models were implemented to strengthen local seed systems and accelerate access to new varieties.

EOPO5 focused on addressing data management and breeding challenges by establishing a Data and Informatics Core Committee (DICC) for standardized data handling and Breeding Informatics Groups (BIGs) to streamline breeding informatics. Pipeline development workshops optimized breeding strategies, and the adoption of Breeding Data Management Systems (BMS) and Genotype Investigator for Genome-Wide Analysis (GIGWA) facilitated data sharing. Development of analytical tools and analysis support for F1 QA/QC and parental purity verification, diversity analysis using mid-density panel, and breeding trials enhanced breeding precision. Digital tools and 11 training workshops for 290 researchers on biometrics, trial design, and genomic selection supported NARS breeding programs. These initiatives strengthened breeding capacity, ensured knowledge transfer, initiated heterotic group-based hybrid breeding, and fostered long-term agricultural impact in Africa.

Finally, under EOPO6, the Africa Dryland Crops Improvement Network (ADCIN) and its governing structure were formed and enhanced the capacity of its members through awards for students, visiting scientists, group trainings, and infrastructure improvements. This will help accelerate genetic gain and build human capacity in breeding, biometrics and seed systems. ADCIN Steering Committees were formed for each of two regions, in Eastern and Southern Africa, in Western and Central Africa); they developed bylaws to guide their operations and agreed on a draft membership agreement for ADCIN members to ensure effective collaboration and resource leveraging. These combined efforts across all end of the Project outcomes and WPs contribute to long-term impacts by generating validated impact pathways, effective breeding strategies and operations, rigorous assessment of varieties, data-driven breeding decisions, and on-ground effects on millions of farmers by adopting improved varieties. The formation of ADCIN and the establishment of a NARES-led governance structure, along with their shared commitment to leveraging each other's strengths, bodes well for achieving real impact in the dryland areas of sub-Saharan Africa where these crops are grown.

	2023	**2024**
APPROVED BUDGET	$8.00M	**$12.00M**

This is the Gates Foundation (GF)-funded portion of the budget. However, this report covers overall progress across other funding sources, including United States Agency for International Development (USAID) and Accelerated Breeding.

Section 2: **Progress towards End of Initiative outcomes**

Science Group Project-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.

CHALLENGE STATEMENT

- Millions of smallholder producers in sub-Saharan Africa grow local varieties of dryland crops for subsistence. Significant opportunities exist to improve the climate change resilience and well-being of these farmers by supporting their production of stress-tolerant, dual-purpose, improved cultivars, along with appropriate agronomy that enables achievement of reliable or surplus production. Thus, there is a great need to improve system-level capacity to develop and ensure access to farmer-preferred cultivars and associated technologies.
- The AVISA-Transition project will apply modern agricultural science to reduce poverty and food and nutrition insecurity. We hypothesize that translating genetic gains from advanced agricultural science into equitable and sustained livelihood benefits to farmers—especially resource-poor and hard-to-reach farmers—will require modern crop breeding programs and innovative seed systems.
- The project aims to contribute to strengthening and building the sustainability of networks and coalitions that address components of its broader Theory of Change (ToC). The project's overarching ToC posits that rapid development and access to quality seed of improved varieties and associated technologies contribute to livelihood resilience and improvement, which involve interrelated strategies to manage risks (such as crop failure and nutrition insecurity), assets (such as soil health and livestock), and well-being (such as education, nutrition, and health).

RESEARCH QUESTIONS

What is the genetic gain of crop improvement programs?

SPHERE OF **CONTROL**

Work Packages

Work Package 1

Co-create impact through applied social science research that guides prioritization of public and private investments (Socioeconomics and gender integration).

Work Package 2

Prioritize resource investments and provide benchmarks for OneCGIAR collaborative breeding programs (Trait discovery and early testing).

Work Package 3

Expand on-farm testing networks and scale-up the pre-release trials (Late testing and variety release).

Work Package 4

Strengthen currently successful impact pathways and validate innovative approaches to seed production and delivery of recently released varieties (Seed systems).

Work Package 5

Co-develop and implement modern data management principles, governance, and strategy (Data and bioinformatics for decision support).

Work Package 6

Establish sustainable regional collaborative crop improvement networks with responsibility-based sharing of resources (Inclusive regional crop improvement networks).

SPHERE OF **INFLUENCE**

End-of-Project Outcomes

End-of-Project Outcome 1

Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties.

End-of-Project Outcome 2

One CGIAR- NARES- SME networks use market segments, product profiles and pipeline investment cases to orient variety development and deployment towards those that provide larger scale benefits across the 5 impact areas.

End-of-Project Outcome 3

Regional networks enhance on-farm performance trials for AVISA crops and cultivar targeting to geographies.

End-of-Project Outcome 4

Women, men, youth and disadvantaged socio-economic groups access affordable, market-demanded and producer preferred, high yielding, resilient variety seed.

End-of-Project Outcome 5

CGIAR and NARES Crop Improvement teams taking data driven decisions.

End-of-Project Outcome 6

National and private seed company breeding programs accelerate the development of varieties that provide larger scale benefits across the 5 Impact Area.

Action Area Outcomes

Genetic Innovation

1 **1** · CGIAR partners develop and scale innovations that contribute to the empowerment of women and other social groups in food, land, and water systems.

4 **2** · National and private seed company breeding programs accelerate the development of varieties that provide larger scale benefits across the 5 Impact Areas.

1 **3** · CGIAR-NARES-SME networks use market segments, target product profiles to orient variety development and deployment towards those that provide larger scale benefits across the 5 Impact Areas.

SPHERE OF **INTEREST**

Impact Areas

Nutrition, Health & Food Security

1 End hunger for all and enable affordable health diets for the 3 billion people who do not currently have access to safe and nutritious food.

Poverty Reduction, Livelihoods & Jobs

1 2 Lift at least 500 million people living in rural areas above the extreme poverty line of US $1.90 per day (2011 PPP).

Gender equality, Youth & Social Inclusion

3 Close the gender gap in rights to economic resources on, access to ownership of, and control over land and natural resources, for more than 500 million women who work in food, land, and water systems.

Climate Adaptation & Mitigation

3 Equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems.

Researchers assess pod development in pigeon pea during a field visit in Zambia to monitor improved lines.

Credit: Zambia

Summary of progress against the theory of change

EOPO 1: Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties

Making dryland crop innovations work for farmers

In Africa's drylands there are many improved crop varieties – thanks to years of work by CGIAR and national programs. But adoption of these varieties remains low. One reason is that efforts to get them into farmers' hands have often been fragmented and uncoordinated. Meanwhile, the seed market has considerable potential. It was valued at **USD 1.9 billion in 2019** and is projected to reach **USD 3 billion by 2025**. Most of this is driven by maize. Yet crops like **millet, sorghum, and groundnut** – which together make up **67 million metric tons of annual production** – are still underserved. If better varieties were more widely used, and farmers applied the right seed rates, these crops could unlock a **USD 1 billion seed market.** Even reaching **half of that potential** would be worth hundreds of millions of dollars.

Realizing this potential requires solving some long-standing challenges:

- New varieties often do not match the practical needs of farmers.
- Seed and grain markets are not well linked, even though grain demand drives seed demand.
- There's a lack of good data to guide scaling efforts.
- As a result, businesses that could grow the seed and grain economy do not get the investment they need.

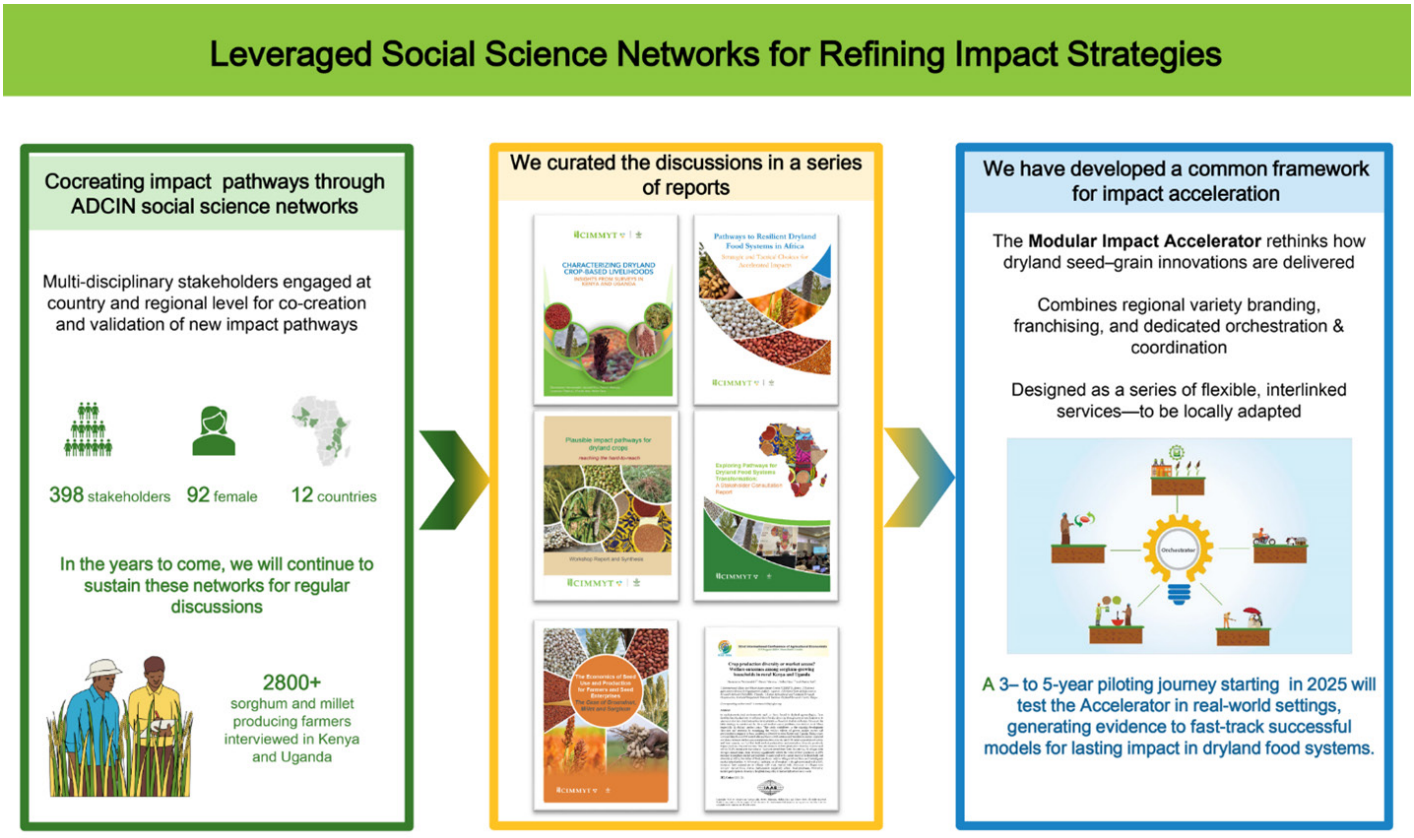
To move forward, what is needed is not just better seeds, but better coordination across the whole system – from breeding and marketing to grain processing and farmer support. Such joined-up approaches can help farmers benefit more fully from innovation. That kind of thinking is now needed to unlock the full value of dryland crops.

1. **A common framework for accelerating impact**

Between 2022 and 2024, more than 380 scientists from national research programs and CGIAR, along with other partners, took part in a series of consultations to understand why it has been difficult to scale up dryland crop innovations. Together, we identified key challenges and co-developed a shared framework to help overcome them.

This framework gives national and regional programs a common way to work toward impact. It lays out ten practical strategies – focused on better data systems, breeding that responds to farmer needs, and stronger markets and institutions. The full approach is described in our report, Pathways to Resilient Dryland Food Systems in Africa: Strategic and Tactical Choices for Accelerated Impacts.

FIGURE 1: THE VALIDATION PROCESS FOR NEW IMPACT PATHWAYS



2. **A new way to scale what works**

To bring the impact framework to life, we co-developed the **Modular Impact Accelerator for Dryland Seed–Grain Systems**, working closely with national research partners. This approach rethinks how innovations reach farmers – by making them easier to access, more valuable to markets, and better coordinated across the system.

The Accelerator is built around three simple but powerful ideas:

- **Regional variety branding** – Giving improved varieties clear, recognizable identities makes them easier to promote and builds demand among both farmers and consumers. Think of it as creating "household names" for seeds.
- **Franchise-style delivery** – Rather than starting from scratch, we work through existing agribusiness networks, bundling services in a way that is scalable and consistent across different areas.
- **A central coordination role** – To avoid duplication and keep everyone working together, a dedicated team helps align efforts, adjust plans based on feedback, and stay rooted in local realities.

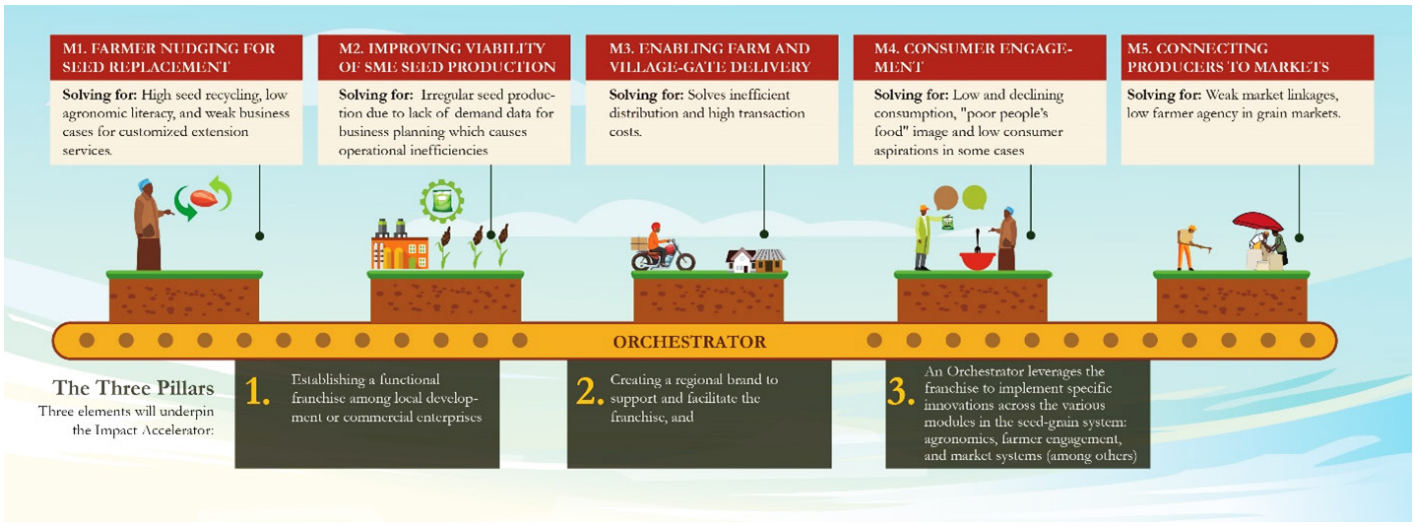
3. **How the Accelerator will work: Local services, modular design**

At its core, the Accelerator is a flexible set of local agribusiness services – called modules – that can be combined based on what a particular place needs. These services might include:

- Farmer advisory services that promote seed replacement as smart agronomy and as a way to grow seed markets.
- Business development support for SME seed producers, including cost and risk tools.
- Last-mile delivery solutions like shared logistics services.
- Campaigns to build consumer demand for dryland grains and pulses.
- Structured market access, for example through contracts that reward quality.

Each module can stand alone or work as part of a larger package. This flexibility makes the Accelerator easy to scale and adapt to different places – helping dryland innovations move faster and further than ever before.

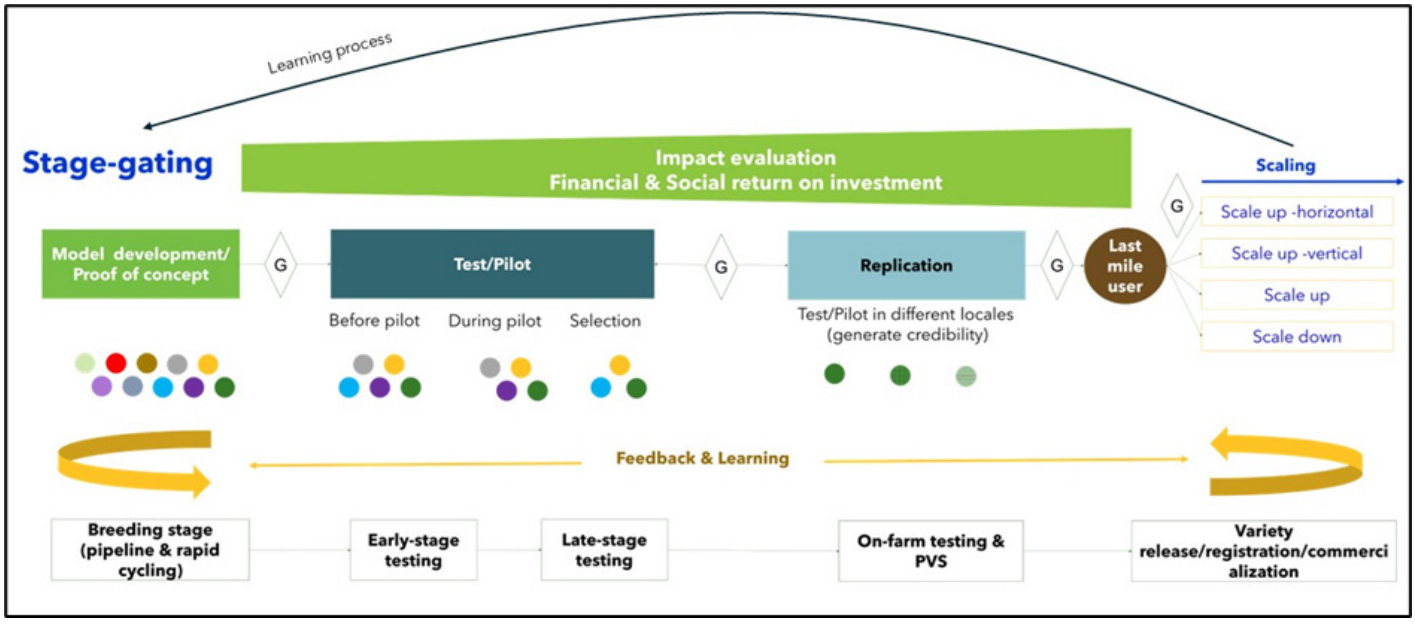
Figure 2. The proposed Modular Impact Accelerator for dryland food systems



4. **Testing what works – then scaling it**

Over the next 3-5 years, the focus will be on identifying what works best in scaling dryland innovations – and expanding it. This will be done through pilot learning sites, beginning in Ghana and Kenya, where different parts of the Accelerator model will be tested and adapted to local contexts. Some sites will focus on specific services or modules, while others will trial the full model. Each site will follow a structured learning process, supported by digital tools, to track outcomes and guide improvements. This approach offers, for the first time, a practical and standardized way to evaluate and scale agribusiness and service delivery innovations under real-world conditions – not just in theory, but on the ground.

Figure 3. The proposed data gathering and stage-gating system for testing and fast-tracking proven impact-enabling models (showing a parallel variety of development stages at the bottom)



EOPO 2: CGIAR-NARES-SME networks use market segments, product profiles and pipeline investment cases to orient variety development and deployment towards those that provide larger scale benefits across the five Impact Areas

The crop improvement network achieved substantial progress in 2023-2024. CIMMYT initiated MS/TPP development in 2023, leading to network-wide finalization for all crops in 2024, including regional market segments/target product profiles (MS/TPPs) for six dryland crops. This facilitated shared breeding pipelines across 28 market segments. Information on prioritized MS/TPP, and our breeding scheme is available on the Breeding Portal and GloMiP platforms. IITA prioritized cowpea traits via national/regional MS/TPPs and Product Design Teams (PDTs), focusing on essential and threshold traits. CIAT targeted eight bean market segments in East Africa, emphasizing traits like fast cooking and high iron/zinc. Extensive breeding advanced populations for key crops, with an annual review assessing progress.

Significant progress was made on the breeding of six crops led by CIMMYT. Shared Population Development Centers (PDC), which are the locations and scientists who co-implement a pipeline, made breeding crosses for respective breeding pipelines. The CIMMYT PDC in Kenya also implemented rapid generation advancement protocols. Over 300 pearl millet hybrids were tested in Western and Central Africa using factorial designs to understand heterotic patterns. Quality assurance and Quality control (QA/QC) of 18,348 parental/F1 samples across 12 ADCIN partners (NARES contributing 71 percent) revealed operation issues in developing groundnut (3-52 percent true-F1) and finger millet F1s (0-15 percent true-F1), prompting mitigation plans including technician training. A dashboard for monitoring QC results is being developed. During 2024, for sorghum and groundnut, 2,775 entries were genotyped, with validated markers for crucial traits in sorghum (striga, stay-green, fertility restoration) and groundnut (late leaf spot, high oleic acid). In addition, 1,974 genotypes were fingerprinted using a mid-density panel, and nine African sorghum and one finger millet reference genomes were developed for pan-genome research.

Nineteen CGIAR-NARES Trait Teams (Eastern and Southern Africa: 12 teams for six crops; Western and Central Africa: 7 teams for three crops), each led by a "Trait Champion" scientist, were established to lead regional trait discovery and validation. Harmonized protocols for 17 biotic stresses across six crops guided regional screening for 10 diseases in seven countries, involving ~1,400 lines and ~1,900 pearl millet F1s, including a special Striga donor trial. Infrastructure upgrades at ADCIN partner sites, and robust training for farmers, extension officers, and researchers bolstered the network. CIAT modernized its bean program with BRIO (offers rapid and long-term gains in breeding, and is based on accurate genomic breeding values, rapid cycles, index selection, and optimized mating designs.), and IITA enhanced cowpea breeding with high-throughput phenotyping. New varieties were tested and released, and strategic partnerships for germplasm development were initiated.

EOPO 3: Regional networks enhance on-farm performance trials for AVISA crops and cultivar targeting to geographies

Regional networks have significantly enhanced on-farm performance trials for AVISA crops, facilitating the targeting of cultivars to specific geographies. Collaborative efforts across Ethiopia, Ghana, Kenya, Mali, Nigeria, Senegal, CIAT, and IITA have rigorously tested and improved crops including chickpea, sorghum, groundnut, millet, and bean.

A total of 122 agronomic trials were conducted across Eastern and Southern Africa, focusing on sorghum, groundnut, pearl millet, pigeon pea, finger millet, and chickpea. These trials predominantly involved late-stage evaluations. Over 226 agronomic trials were conducted in Western and Central Africa for sorghum, groundnut, and pearl millet, encompassing Preliminary Yield Trials (PYT), Advanced Yield Trials (AYT), National Variety Trials (NVT), and Regional Variety Trials (RVT).

In 2024, advancement meetings were initiated in Burkina Faso, Mali, and Nigeria for sorghum, pearl millet and groundnut, and additional ones are scheduled in Mali and Nigeria for 2025, involving all Product Development Team members and relevant stakeholders, to rigorously assess product performance against the respective Target Product Profiles (TPPs). We will add additional countries from Eastern and Southern Africa, and Western and Central Africa during 2025. This evaluation considers disease resistance, agronomic performance, and seed availability in addition to yield metrics.

Ninety-five on-farm trials were conducted at 4,418 farmer sites across eight countries in Eastern and Southern Africa using the TRICOT approach. In Western and Central Africa, on farm TRICOT trials were conducted at nearly 3,500 farmer sites. These on-farm trials were conducted for sorghum, finger millet, pearl millet, groundnut, cowpea, beans and pigeon pea. Challenges identified include delays in data submission, funding availability for harvesting and evaluation, limited field visits, training needs for various release committee members, and losses due to drought, floods, and cattle grazing.

EOPO 4: Women, men, youth and disadvantaged socio-economic groups access affordable, market-demanded and producer-preferred, high yielding, resilient seed varieties

Seed system interventions implemented through strategic partners with NARES from 18 countries, CGIAR (CIAT, IITA) and four non-NARES partners (CBCC: Centre for Behaviour Change and Communication, myAgro, NML: New Markets Lab and SFSA: Syngenta Foundation for Sustainable Agriculture) enhanced access to quality seed and production bundles to an estimated 5,931,674 smallholder farmers across Eastern and Southern Africa, and Western and Central Africa – 1.5 times more than the 2024 target of 3,837,836 farmers. Of these, about 1 million farmers (estimated 998,562) were reached through large scale variety promotional activities, including field days, TRICOT trials, small seed packs and seed fairs. A total of 24,808 tonnes of quality seed of improved sorghum varieties, pearl millet, finger millet, groundnut, chickpea and pigeon pea were produced in 2024. We estimated that this seed will be planted on at least 1,013,335 hectares of land, benefiting 5,066,674 smallholder farmers across 18 countries. To support seed production and dissemination, over 1,000 personnel from private seed companies and other decentralized seed producers were trained in seed production, seed business skills, seed dealership, variety licensing and seed quality control and assurances. Seed delivery was achieved through innovative models that strengthened local seed systems and accelerated access to new and improved varieties. These models included Adopted Villages in Nigeria and Ghana, Youth and Women Quality Centres in Kenya and Tanzania, the Community-Managed Seed System Model in Tanzania, the Aggregator-Led Model in Ghana, and the Input Layaway Model in Senegal, among others .

EOPO 5: CGIAR and NARES crop improvement teams make data-driven decisions

The Africa Dryland Crops Improvement Network (ADCIN) addressed multiple challenges in data management and breeding by establishing the Data and Informatics Core Committee (DICC) to create a standardized data management policy and ensure uniform data handling across breeding programs. This network-level policy document has been provided to the ADCIN Steering Committee for their review and approval to be adopted by all the network members.

To improve breeding efficiency, during annual breeding reviews in 2024, we extensively discussed and planned for sparse testing strategies, further optimizing breeding schemes based on quantitative genetics principles. The adoption of Breeding Data Management Systems (BMS) and Genotype Investigator for Genome-Wide Analysis (GIGWA) facilitated better data sharing; we further supported the deployment of F1 QA/QC and parental purity verification by developing and deploying analytical workflows for quick analyses of genotyping data from Intertek. As described in EPO2, mid-density marker panels were used to genotype parental lines. Data analytics supported this further by enabling accurate diversity analysis and formation of diversity groups in crops like sorghum and pearl millet. We supported several breeding efforts of ADCIN by designing performance and plant health screening trials, uploading germplasm to breeding management systems, and analyzing the regional trials data sets for identifying founder parental lines and promising varieties. Our most critical achievement of 2024 was the migration of CIMMYT's breeding program from BMS to Enterprise Breeding System (EBS) for breeding program and data management.

We provided digital tools such as moisture meters, barcode scanners, and tablets to support NARES breeding programs for efficient field data collection. During 2023, the overall breeding teams of ADCIN were grouped into three Breeding Informatics Groups (BIGs) – A, B, & C, categorizing experts into leadership, field execution, and data analytics teams, respectively. During 2024, we further executed this strategy. For example, we organized the training and workshops as per the members of groups A, B, and C. This allowed us to tailor our training to the target group. We conducted 11 training workshops on biometrics, trial design, and genomic selection and engaged 290 researchers. These initiatives have strengthened ADCIN's breeding capacity, ensuring sustainable knowledge transfer, heterotic group-based hybrid breeding initiation, and long-term agricultural impact across Africa.

EOPO 6: National and private seed company breeding programs accelerate the development of varieties that provide larger scale benefits across the five Impact Areas

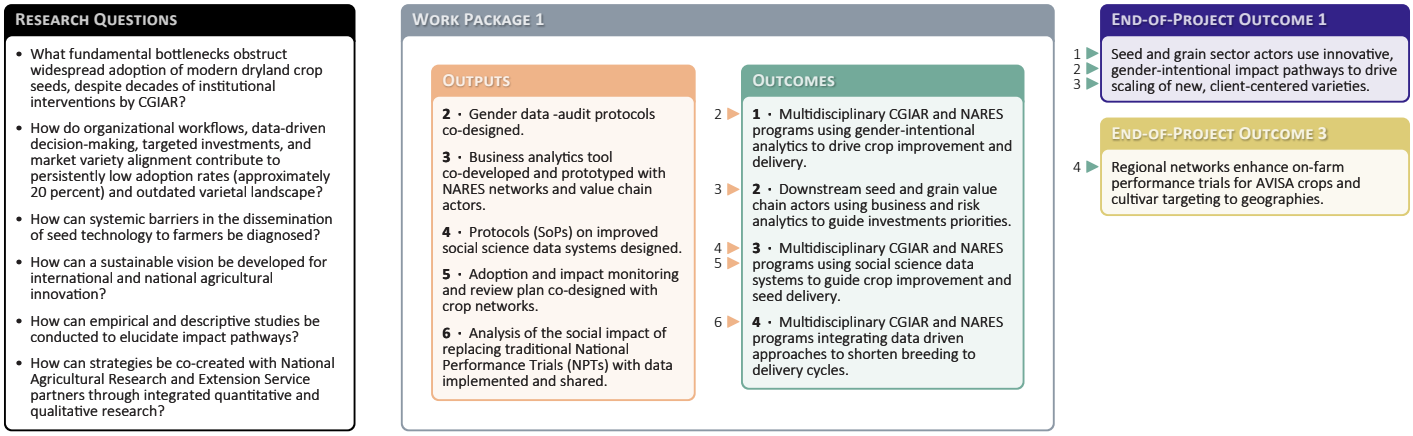
ADCIN and the formation of its governance structure, which was reported as the key result of PO6 last year, continue to strengthen its governance by executing the terms of reference of the steering committees. ADCIN steering committees developed bylaws to guide their operations, including duration of appointments as steering committee members. The bylaws guide the steering committee members to fulfill their responsibilities to ADCIN. The draft of the network membership agreement is also ready, guiding network members on the standard way of working, following harmonized protocols and avoiding duplication of work. The network agreement will guide the network on sharing germplasm, data and valuable information and emphasize agreed ways of working as a team to leverage resources.

ADCIN aims to accelerate genetic gain through improving the human and infrastructure capacity of the network members. In 2024, the ADCIN steering committee took a major initiative to improve the capacity of the network members by providing awards in four categories: students, visiting scientists, group training, and infrastructure. National institutes are now equipped with equipment for sample collection and storage before shipment for genotyping; some of the institutes installed irrigation facilities, which will enable them to produce two generations per year; and others invested to establish or improve disease screening facilities. ADCIN realized the importance of building human capacity for better succession, and therefore, its steering committee provided an award for short-term training and long-term (MSc and PhD) studies.

Participants engage in practical field exercise during ADCIN's capacity building training in Senegal, aimed at strengthening breeding skills and knowledge sharing across the Sahel region.

Credit: Senegal

WP1: Co-create impact through applied social science research that guides prioritization of public and private investments (Socioeconomics and gender integration)



Work Package 1 progress against the theory of change

PO1 was built on the recognition that scaling dryland cereals and legumes requires more than just new varieties – it requires smarter systems, better data, and market-aligned approaches. Through direct engagement with nearly 400 scientists and stakeholders from over 10 countries, the team developed a strategic roadmap to address the bottlenecks that have historically limited impact in these crop systems.

This roadmap is structured around three pillars:

- **Better data systems:** A major finding was that many research systems lack the tools and infrastructure to monitor variety adoption in a timely and consistent way. Adoption data is typically collected through stand-alone surveys, making it difficult to track changes over time or inform real-time decision-making. To address this, we propose a standardized protocol for use in building robust, interoperable adoption monitoring systems.
- **Smarter breeding strategies:** The teams discussed the need to reorient breeding programs toward varieties that reflect both farmer realities and market opportunities. The approach emphasizes systems-driven breeding, with a strong focus on linking varietal profiles to prevailing farming conditions and end-user preferences. There is now an emerging consensus on undertaking upstream breeding steps under conditions that more accurately replicate on-farm realities.
- **Emphasis on market and institutional innovations:** Evidence shows that most seed systems targeting smallholders remain unprofitable due to thin markets, weak demand signals, and limited integration with other parts of the value chain (grains, multiple crops, and inputs), thereby weakening private sector incentives. Findings from Economics of Seed Use and Production revealed that successful scaling requires integrated systems – where informal channels are complemented by local SMEs and public-private partnerships. These models are better suited to serving informal or underserved markets while still ensuring quality and access.

Output 1.2.1 – Business analytics and market risk assessments:

Analyses focused on identifying where and why seed and grain markets fail to scale. We mapped key profitability constraints and demonstrated the need for integrated seed-grain strategies. It highlighted the importance of region-specific planning that considers climate risks and consumer preferences, as seen in the cowpea studies in West Africa. We now plan to develop an end-user analytics toolkit to promote high-quality decision-making and improve the profitability of seed-grain (multi-crop and multi-service) operations.

Output 1.3.1 and output 1.3.2 – Social science data systems:

Data fragmentation emerged as a major challenge to evidence-based scaling. Fieldwork in Kenya and Uganda found limited use of panel data, weak data-sharing protocols, and non-standardized collection tools. The team developed and harmonized a blueprint for fast-tracking data collection, identifying and validating high-impact models, and enabling systemic change.

In Uganda, a CIAT-led study compared WhatsApp-based digital advisory services with traditional extension. Results showed that 70-84 percent of digital users retained key messages, compared to 40-51 percent using conventional methods. Moreover, 29 percent of WhatsApp users shared information beyond their village, compared to just 2.6 percent of those using traditional models – highlighting the power of digital platforms in amplifying impact.

This work laid a good foundation for designing investment-ready strategies to scale dryland cereals and legumes. Moving into 2025, the focus will shift from strategy design to implementation. Priorities include:

1. **Translating strategic frameworks into scalable impact accelerator and other policy** ideas tailored to the needs of specific seed and grain markets.
2. **Strengthening data systems** within NARES to enable better tracking of variety adoption and use in the service of improved and faster decision-making (e.g. which varieties or agribusiness approaches to prioritize for investments, in which markets).
3. **Deepening partnerships and policy engagement** to support coordinated implementation and accelerate impact on the ground.

The following are the key knowledge products from 2023-2024:

FIGURE 4. SUMMARY OF KNOWLEDGE PRODUCTS DEVELOPED THROUGH WORK PACKAGE 1

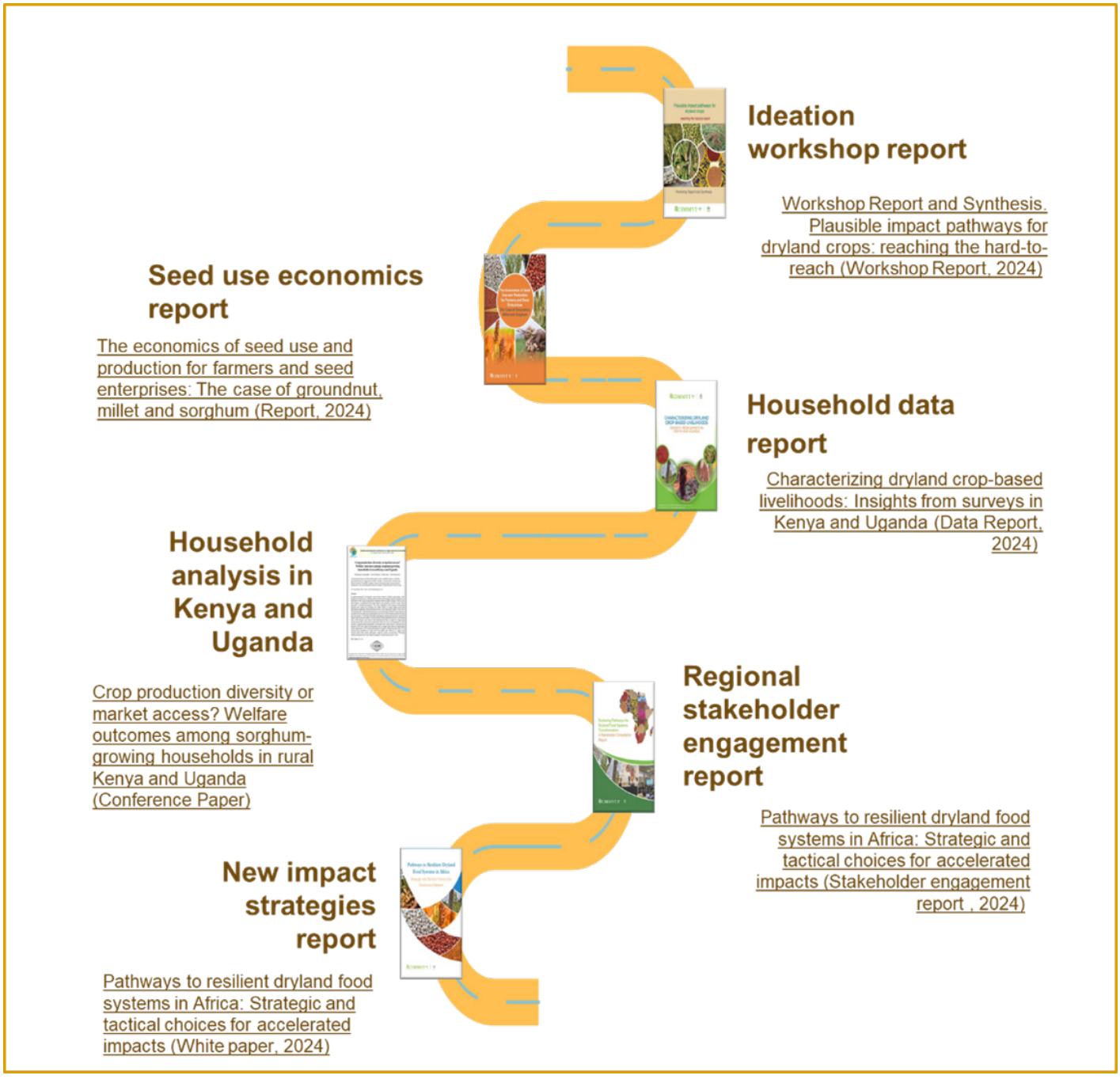


Table 1: Key outputs and outcomes for EOPO1 (2023-2024)

OUTCOME	OUTCOME DESCRIPTION	PRIMARY EOPO	SECONDARY EOPO	OUTPUTS DELIVERED	OUTCOMES REALISED
EOPO1: Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties	1.1. Multidisciplinary CGIAR and NARES programs using gender-intentional analytics to drive crop improvement and delivery	EOPO1: Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties	EOPO4: Women, men, youth and disadvantaged socio-economic groups access affordable, market-demanded, producer-preferred, high-yielding, and resilient seed varieties	• Country and regional conventions • Workshop report and synthesis. Plausible impact pathways for dryland crops: reaching the hard-to-reach • Exploring pathways for dryland food systems transformation: a stakeholder consultation report	Gender-intentional analytics integrated into impact pathways, ensuring inclusive scaling strategies. Findings published in Pathways to Resilient Dryland Food Systems in Africa inform decision-making on gender-responsive breeding and seed delivery.
1.2.1 Business analytics tool co-developed and prototyped with NARES networks and value chain actors	1.2. Downstream seed and grain value chain actors using business and risk analytics to guide investments priorities	EOPO1: Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties	EOPO5: CGIAR and NARES Crop Improvement teams make data-driven decisions	• The economics of seed use and production for farmers and seed enterprises: The case of groundnut, millet and sorghum	Seed business report published describing the current status of the economics of seed use and seed production for farmers and seed producers (covering groundnut, millet, and sorghum). Profitability analyses underscore the need for hybrid formal-informal seed models, supporting seed SMEs.
1.3.1. Protocols (SoPs) on improved social science data systems designed	1.3. Multidisciplinary CGIAR and NARES programs use social science data systems to guide crop improvement and seed delivery	EOPO1: Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties	EOPO5: CGIAR and NARES Crop Improvement teams make data-driven decisions	• Pathways to resilient dryland food systems in Africa: Strategic and tactical choices for accelerated impacts • Country and regional conventions highlight data streaming concept • Workshop report and synthesis. Plausible impact pathways for dryland crops: reaching the hard-to-reach • Exploring pathways for dryland food systems transformation: a stakeholder consultation report	The socio-economics team developed and validated new strategic approaches to scaling dryland cereal and legume varieties across over 10 sub-Saharan African countries through collaboration with 398 NARES and key stakeholders. This effort produced impact pathways published in Pathways to Resilient Dryland Food Systems in Africa, focusing on three strategic domains: 1) process and organizational strategies – addressing weak data infrastructure through standardized, real-time data collection for informed decision-making and more rigorous scaling analytics; 2)technological and genetic approaches – prioritizing low-input, climate-resilient varieties suited to farmers' constraints by implementing dual breeding programs that empower farmers at local levels but also serving broad regional market segments; 3) social, market, and institutional interventions – emphasizing institutional innovations and merging formal and informal seed systems to accelerate varietal turnover and improve market access.
1.3.2 Adoption and impact monitoring, and review plan co-designed with crop networks	1.3. Multidisciplinary CGIAR and NARES programs use social science data systems to guide crop improvement and seed delivery	EOPO1: Seed and grain sector actors use innovative, gender-intentional impact pathways to drive scaling of new, client-centered varieties	EOPO5: CGIAR and NARES Crop Improvement teams make data-driven decisions	• Characterizing dryland crop-based livelihoods: Insights from surveys in Kenya and Uganda • Country and regional conventions highlight data streaming concept • Workshop report and synthesis. Plausible impact pathways for dryland crops: reaching the hard-to-reach • Exploring pathways for dryland food systems transformation: a stakeholder consultation report	The impact accelerator will provide a platform for standardizing data collection across the seed-grain value chains. AVISA partners now have standardized data collection protocols. Digital twinning and data streaming concepts are being tested for real-time decision-making. Dryland crop adoption barriers are better understood, informing targeted interventions. The 2023-2024 household surveys in Kenya and Uganda provide critical baseline data.
1.4.1 Analysis of the social impact of replacing traditional National Performance Trials (NPTs) with data implemented and shared	1.4 Multidisciplinary CGIAR and NARES programs integrate data-driven approaches to shorten breeding-to-delivery cycles	EOPO1: CGIAR and NARES Crop Improvement teams make data-driven decisions	EOPO4: Women, men, youth and disadvantaged socio-economic groups access affordable, market-demanded, producer-preferred, high-yielding, and resilient seed varieties	**On-going (to report in 2025)**	

Farmers, women's groups, and seed entrepreneurs in Nigeria receive training under the Farm and Community-Managed Seed System (FCMSS), gaining access to quality sorghum seed and improved production techniques.

Credit: Muhammad Ahmad Yahaya/IAR

WP2: Prioritize resource investments and provide benchmarks for CGIAR collaborative breeding programs (traits prioritization, trait discovery, population development and early testing)

Research Questions

- What are the most impactful traits for addressing key biotic and abiotic stresses across target geographies?
- How can stakeholder preferences be effectively integrated into trait prioritization? How do we scale up the market intelligence activities done in Tanzania's sorghum to other countries and crops?
- What is the economic and ecological value of prioritizing certain traits over others in breeding programs?
- What are the genetic loci or pathways controlling high-priority traits? Is it feasible to map these loci and identify metabolic pathways for engineering/editing?
- How can modern genomic tools improve the efficiency of identifying novel alleles or gene variants for prioritized traits?
- What environmental and management interactions influence the expression of prioritized traits? What traits (plant architecture and metabolic) are suitable for dual-species breeding (relay or intercrop)? Is dual-species genomics more effective than traditional genomics?
- Can selfing generations be accelerated in dryland crops through optimizing speed breeding or rapid generation advance?
- How can genomic selection methods be optimized for early testing in diverse populations, diverse environments, and management practices?
- What are the best strategies for transitioning to rapid cycle genomic selection in the next one to two years to maximize genetic gain?
- What are the final founders for each breeding pipeline, and how are/were they used in existing populations? What strategies need to be implemented so that the first cohorts for genomic selection are ready in a year (early 2026)?
- How do early testing protocols impact the predictability of performance in later stages of the breeding pipeline?
- How can we effectively transition to sparse testing in terms of logistics and appropriateness of genetic material?
- How can we integrate machine learning, deep learning, and high-throughput phenomics in our breeding and testing pipelines?

Work Package 2

Outputs

7 · Novel variation made available to network partners for traits of interest with limited variability.

8 · Infrastructure for rapid recycling improved at population development centers.

9 · Fit-for-purpose, crop-wise genomic resources, processes, methods, and tools are available for marker-assisted breeding.

10 · High-throughput phenotyping methods and infrastructure developed for screening of prioritized traits.

11 · High-throughput phenotyping methods and infrastructure developed for screening of prioritized traits.

12 · Standard operating procedures for high throughput phenotyping methodology operationalization at network partner locations (artificial and hot spot) for screening of priority traits.

13 · Infrastructure for rapid recycling improved at population development centers.

14 · Strategic early discovery and germplasm development institutions engaged / identified.

15 · Breeding schema optimized for high priority breeding pipelines to deliver high rate of genetic gains.

16 · Optimized breeding schema implemented for high priority breeding pipelines to deliver high rate of genetic gains.

17 · Regional breeding pipeline lead and relevant staff at the Population Development Center (PDC) trained on Rapid Cycle Genomic Selection (RCGS).

18 · Use of molecular makers in population improvement at population development centers.

19 · Improved breeding materials or early-stage material available for the network.

20 · Target Population of Environment (TPE) information/data generated to optimize regional trialing network.

21 · High-quality testing data generated for early-stage material for recycling parents.

22 · High-quality testing data generated for late-stage material for product advancement.

23 · Capacity development training on good performance trial practices.

24 · Annual and seasonal advancement meetings conducted in country and at network level to identify country specific and regional products.

25 · Infrastructure for trialing improved at key network sites.

Outcomes

7 9 10 12 → **5** · One CGIAR-NARES-SME networks adopting phenotyping and genomics platforms for improving trait performance.

14 → **6** · CGIAR Institutes develops partnership with advanced Research Institutes to access germplasm.

15 16 17 18 19 → **7** · Population development Center of CGIAR-NARES using modern population improvement approaches.

20 21 22 23 24 → **8** · Regional trialing networks developed with national partners to generate reliable performance data for early- and late-stage trials.

8 13 25 6 → **9** · National partners modernizing their breeding infrastructure including for rapid recycling of

End-of-Project Outcome 2

5 6 7 8 9 → One CGIAR - NARES - SME networks use market segments, product profiles and pipeline investment cases to orient variety development and deployment towards those that provide larger scale benefits across the 5 impact areas.

Work Package 2 progress against the theory of change

The crop improvement network has significantly enhanced overall breeding work and capabilities across CGIAR and NARES. In 2023, at CIMMYT, we successfully developed MS/TPP through a consultative approach with NARES and country PDTs. During 2024, the network successfully finalized and adopted MSs and TPPs for all crops, establishing regional MS and TPPs for key dryland crops. This collaborative approach resulted in the development of shared breeding pipelines that support 28 major MSs, enabling partners to co-own and co-manage breeding pipelines, initiate crosses, and develop populations and lines. Information about 28 prioritized MS, TPP and breeding schemes for respective breeding pipelines have been uploaded to CGIAR-wide shared platforms – the Breeding Portal and GloMiP. IITA focused on developing and implementing cowpea varieties targeting CGIAR's five Impact Areas. Market segments and TPPs were identified at national and regional levels, and PDTs were established to refine and prioritize traits. Essential traits and minimum threshold traits were listed and considered in each breeding program. CIAT identified eight major MSs across Ethiopia, Tanzania, and Uganda for various bean types. These segments include large and medium-sized red mottled and red bush beans, medium-sized yellow bush beans, large and medium-sized sugar bush beans, small red bush beans, small white bush beans, large and medium-sized purple/*kablanketi* beans, and large and medium-sized sugar climbing beans. The prioritized traits for improvement include fast cooking, high iron and zinc content, yield under various conditions, and disease resistance.

During 2024, breeding activities were extensive and productive across most of the shared breeding pipelines, with significant efforts focused on creating and advancing populations for key crops such as sorghum, pearl millet, groundnut, finger millet, pigeon pea and chickpea. In addition, each crop network and region team made significant progress in conducting trials to identify founder lines (see Table 2). At the end of 2024, we conducted an annual review of the progress made by each partner towards their assigned responsibilities. CIMMYT and NARES partners made numerous crosses and advanced populations were maintained at partner locations or population development centers (PDCs). In sorghum, rapid generation advancement nurseries were initiated in Kenya; this will be later scaled up at other sorghum PDCs in the region. In pearl millet, as a continuation of work initiated in 2023, factorial mating designs were employed to develop hybrids for understanding heterotic patterns among genetically distinct groups. More than 300 hybrids were tested in Western and Central Africa. These activities are expected to yield the necessary lines for the current breeding cycle, underscoring the network's dedication to developing resilient and high-yielding crop varieties. During our annual review we also identified critical gaps and challenges in implementing the shared breeding pipeline approach.

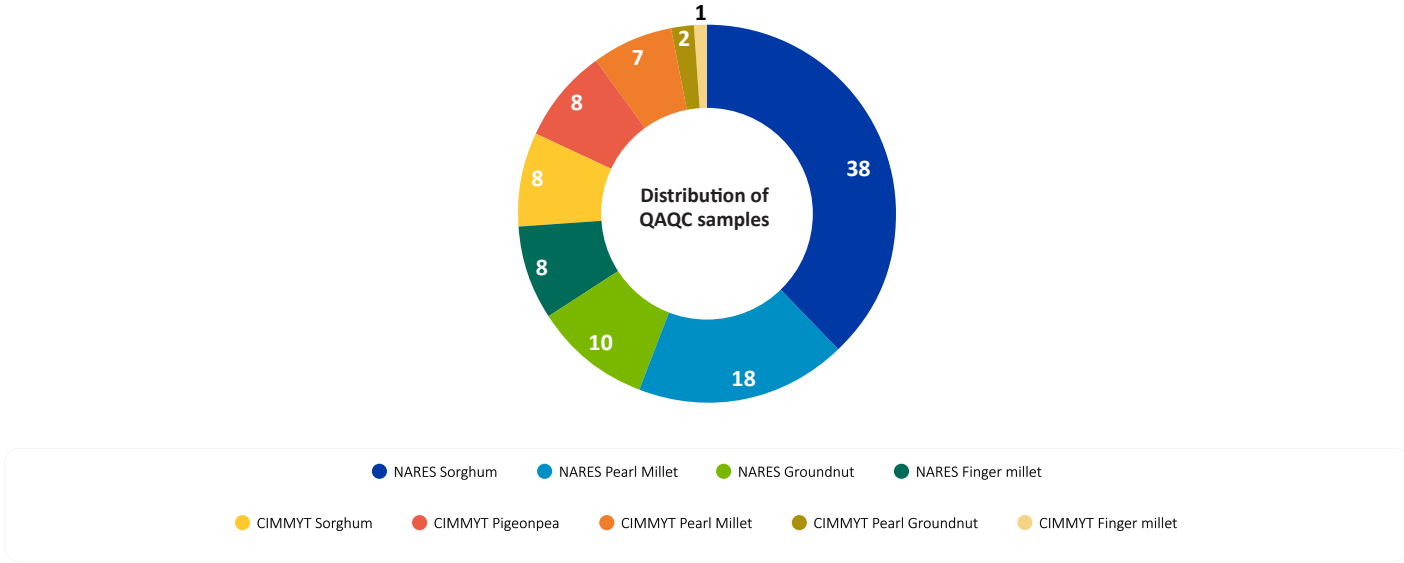
Table 2. Evaluated regional trials and OPVs

CROP	REGION*	SEGMENT NAME	GLOMIP SEGMENT ID	TOTAL FOUNDER CANDIDATES TESTED	NUMBER OF LOCATIONS
Sorghum	ESA	EWS	MS00665, MS00666	238	50
	ESA	ERS	MS00661, MS00662	116	50
	ESA	MMS	MS00667, MS00920	24	50
	WCA	SD-WSL, MS-WSL	MS00673, MS00400	115	29
	WCA	MD-RSL	MS00681	57	9
	WCA	SD-WSH, MS-WSH	MS00674, MS00675	56	18
Finger Millet	ESA	LBFM	MS00655, MS00657	28	50
	ESA	EBFM	MS00652, MS00653	53	50
Pearl Millet	ESA	GPM	MS00648, MS00650	61	17
	ESA	HPM	MS00925	8	7
	WCA	SDO	MS00641	40	12
	WCA	MDO	MS00643	46	12
	WCA	MD-HYB	MS00644, MS00642	20	10
Groundnut	ESA	MD	MS00388, MS00389, MS00393, MS00394	74	6
	ESA	SD	MS00393, MS00394, MS00395, MS00397	46	6
	WCA	MD	MS00631	21	17
	WCA	SD	MS00630	46	20
Pigeon Pea	ESA	SD	MS00454	15	4
	ESA	MD	MS00694, MS00695	49	4

* Eastern and Southern Africa (ESA); Western and Central Africa (WCA).

The routine parental and F1 quality assurance and quality control (QAQC) implementation was widely implemented across CGIAR and NARES partners, integrating crucial marker applications to aid breeding decisions. During 2024, we sampled 18,348 parental and F1 samples for five crops across 12 ADCIN partners (CIMMYT – 29 percent samples and NARES – 71 percent samples) in Eastern and Southern Africa, and Western and Central Africa. F1 QAQC results revealed significant breeding operation challenges in developing reliable F1s for the crops, groundnut (3 to 52 percent true-F1 plants) and finger millet (0 to 15 percent true-F1 plants), which led ADCIN breeders of these crops to develop plans to mitigate risks (e.g. training of technicians and adding redundancy) to achieve the necessary population size (Ne) in stage 1 trials. Insights from QC results were shared with participating partners to purify parents, advance true-F1s, and further improve success rates, exemplified by significant enhancements in sorghum crossing the success rate by a regional pipeline breeder in Uganda. We are developing a dashboard to monitor parental and F1-QC results by crop and PDC regularly, allowing us to improve continuously.

Figure 5. Distribution of QAQC samples collected by CIMMYT and NARES partners for five crops



We continued to apply genomics tools to understand genetic diversity among the collected germplasm, conduct trait discovery, and deploy markers for selecting genotypes with desired traits. In 2024, we genotyped 1,974 samples using a mid-density genotyping platform at Intertek. In 2024, through collaboration with advanced research institutes, we validated the trait-linked markers for several loci of sorghum and groundnut. These loci were for important product profile traits such as sorghum Striga, stray green, fertility restoration, groundnut late leaf spot, and high oleic acid. We fingerprinted 2,775 genotypes with these validated trait markers to establish locus-specific allelic frequencies for each trait, aiding us in developing breeding strategies. The team also supported backcrossing efforts for the network's sorghum stay-green and Striga traits at NARES partners by genotyping backcross material with trait markers and initiated new backcrossing projects for groundnut at CIMMYT, Kenya for Eastern and Southern Africa. Apart from these genomics efforts, we developed nine reference genomes for African sorghum and one for African finger millet genotypes. We will use these reference genomes to develop pan genomes, which will aid in marker-assisted breeding approaches.

A community of CGIAR-NARES Trait Champions was established to lead regional trait discovery and marker validation. Trait Champions is a novel approach to shared leadership for coordinating the development of trait development strategies in the network, and planning the development of mapping populations, phenotyping, and genotyping for key traits. Each Trait Champion is supported by a multidisciplinary CGIAR-NARES team, including geneticists, data analysts, plant pathologists, and breeders. There are 19 trait teams: 12 in Eastern and Southern Africa for six crops and seven in Western and Central Africa for three crops. During 2025, we will be training the Trait Champions on various leadership and technical aspects of leading trait discovery and deployment projects.

At the end of 2023, a team of network pathologists gathered to harmonize protocols for 17 biotic stresses for six crops and agreed on ADCIN plant health screening sites across Eastern and Southern Africa and Western and Central Africa for several diseases, insect pests, and Striga. In 2024, pathology screening was widely implemented regionally for 10 different crop diseases in seven countries (one in Eastern and Southern Africa and six in Western and Central Africa), with several disease screening sites. Across network sites, we screened about 1,400 lines for four crops and about 1,900 F1s for the pearl millet Open-Pollinated Variety (OPV) pipeline.

We screened various crops for diseases such as pearl millet downy mildew, groundnut Rosette and leaf spots, sorghum and pearl millet Striga, sorghum anthracnose, and finger millet blast. This included a special trial for Striga to identify the most promising donors across the region from ~60 known tolerant entries. This regional approach has strengthened crop health and resilience, allowing us to leverage the facilities and experts available in ADCIN.

Infrastructure upgrades across ADCIN partner sites significantly enhanced research capabilities, including improvements to seed production sites, germplasm cold stores, irrigation systems, screening facilities, and greenhouse infrastructure. At the Kenya Agricultural and Livestock Research Organization (KALRO)-CIMMYT Kiboko site, we established an irrigation system, a new office, and seed processing areas through Crops to End Hunger (CtEH) funding. Several NARES partners improved their infrastructure due to funding from CtEH, and the AVISA project channeled through sub-awards and ADCIN Steering Committee infrastructure awards. Training activities have been robust, with numerous field days and training sessions conducted to build capacity among farmers, extension officers, and researchers. These efforts have bolstered the regional crop improvement network by fostering knowledge transfer and enhancing research capabilities.

At CIAT, we modernized our common bean breeding program with enhanced market-oriented efforts and adopted the BRIO (offers rapid and long-term gains in breeding, and is based on accurate genomic breeding values, rapid cycles, index selection, and optimized mating designs) breeding approach. At IITA, we developed effective improvement plans for cowpea traits through strong partnerships and collaborations, adopting high-throughput phenotyping methods and enhancing screening infrastructure. New crop varieties have been tested and released, with several varieties submitted for pre-release testing and evaluation. Strategic partnerships for early discovery and germplasm development have been initiated, with breeding schemas for priority pipelines discussed in collaboration with various initiatives. Strong collaborations are laying the groundwork for adopting and disseminating developed varieties, demonstrating a robust approach to improving crop resilience and productivity through targeted breeding, crop health activities, and variety releases across diverse regions.

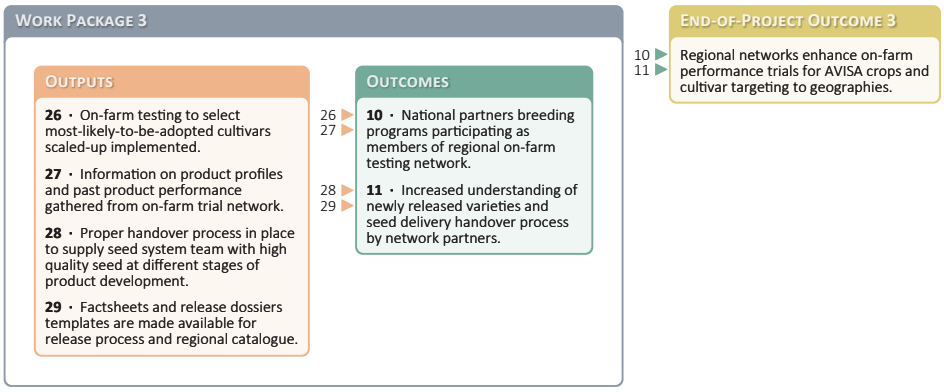
These combined efforts highlight the collaborative and innovative approach of the crop improvement network across multiple regions.

Researchers and farmers take part in a Participatory Varietal Selection (PVS) exercise led by the pearl millet team in the Sahel zone of Chad. Credit: Chad

WP3: Expand on-farm testing networks and scale-up pre-release trials (late testing and variety release)

Research Questions

- What are the most effective strategies for scaling on-farm trials to capture diverse agroecological conditions? Are all crops implementing TRICOTS or are there more suitable designs for late-stage materials?
- How do on-farm trial outcomes compare to controlled experimental results in predicting variety performance? Is there a correlation between on-farm environments and station experiments?
- What are the barriers to farmer participation in on-farm testing, and how can they be mitigated? How do we involve product design teams in decisions for product deployment?
- What elements of product advancement processes and stage-gate processes can be implemented?
- How can machine learning and data analytics optimize trial network design for better decision-making?
- What metrics can best measure the effectiveness and scalability of pre-release trials?
- How do socioeconomic factors influence the adoption of new varieties released through scaled-up testing networks?



Work Package 3 progress against the theory of change

Regional networks have significantly enhanced on-farm performance trials for AVISA crops, facilitating the targeting of cultivars to specific geographies. Through collaborative efforts across Ethiopia, Ghana, Kenya, Mali, Nigeria, Senegal, CIAT, and IITA, various crops such as chickpea, sorghum, groundnut, millet, and beans have been rigorously tested and improved.

A total of 122 agronomic trials were conducted across Eastern and Southern Africa, focusing on six crops: sorghum, groundnut, pearl millet, pigeon pea, finger millet, and chickpea. These trials predominantly involved late-stage evaluations, which are critical for advancing candidate varieties to deployment or registration phases. Over 226 agronomic trials were conducted in Western and Central Africa for three major crops: sorghum, groundnut, and pearl millet. These trials encompassed various stages of evaluation, including Preliminary Yield Trials (PYT), Advanced Yield Trials (AYT), National Variety Trials (NVT), and Regional Variety Trials (RVT). These trials are essential for advancing candidate varieties to subsequent development phases.

We also scheduled advancement meetings in several countries, including Mali and Nigeria, involving all PDT members and relevant stakeholders. During these meetings, we will rigorously assess product performance against the respective TPPs. This evaluation process is designed to identify and promote superior varieties that meet market demands. In addition to yield metrics, other critical factors such as disease resistance, agronomic performance, and seed availability are considered. These attributes collectively contribute to identifying high-impact, commercially viable varieties that can drive significant agricultural advancements in the region.

On-farm and TRICOT trials were conducted across eight countries in Eastern and Southern Africa in 95 on-farm trials and 4,418 TRICOT sites. Significant progress has been made, and challenges encountered in our recent efforts.

In Western and Central Africa, the number of TRICOT trials grew significantly, with nearly 3,500 sites conducted across various crops, including sorghum, beans, groundnuts, cowpeas, finger millet, and pearl millet. These trials have yielded promising results, with high farmer interest and positive feedback. Despite this success, several challenges have been identified, including delays in data submission, funding availability for harvesting and evaluation, limited field visits, and training needs for variety release committee members. Additionally, trials have faced losses due to drought, floods, and cattle grazing, underscoring the need for improved mobility to trial sites and standardized protocols for data collection. Below are some examples of various activities conducted at NARES in various countries for late stage, on-farm, variety release and production of seeds for hand-off:

- In Ethiopia, the Ethiopian Institute of Agricultural Research (EIAR) conducted preliminary TRICOT trials in 2023 using 10 superior chickpea varieties with 38 farmers in two districts. In 2024, proper TRICOT trials were conducted with 15 superior varieties and advanced lines targeted for release. These trials took place in the Oomiya region across six districts, the Amhara region in three districts, and the Southern Nations, Nationalities and Peoples (SNNP) region in two districts, involving a total of 200 farmers. Additionally, 25 demonstrations were conducted in major chickpea growing areas.
- In Mali, the Institute of Rural Economy (IER) achieved significant results with sorghum, groundnut, and millet. For sorghum, the line IER-SV-021-EPDU-59 recorded the best grain yield of 2026.1 kg/ha, and producers preferred three hybrids. The institute produced 98 kg of nucleus and breeder seed and registered three early-maturity varieties in the national catalogue. In groundnut, four short-duration and two medium-duration best-performing varieties were identified, with four medium-duration varieties released in 2024. DUS (Distinct, Uniformity and Stability) tests for three medium- and two short-duration varieties were conducted in four locations. For pearl millet, the first draft of a manual for seed multiplication was developed, and basic seeds were produced from several OPV varieties and a new hybrid, Cz MH22 001.
- In Ghana, the Council for Scientific and Industrial Research – Savanna Agricultural Research Institute (CSIR-SARI) identified four OPVs in millet, established three partnerships, and used six varieties for 33 TRICOTS. These OPVs will be presented to the National Variety Release and Registration Committee in 2025. Partnerships with ANTIKA (local seed company), Integrated Water and Agricultural Development Ghana Ltd., and an individual entrepreneur led to the production of 126.8 kg of breeder seed. Late-stage testing for groundnut was implemented, with on-farm testing conducted with 284 participants.
- In the case of the common bean, four varieties were released by two NARES partners in Eastern and Southern Africa, TARIBEAN6 and TARIBEAN7, which were released by the Tanzania Agricultural Research Institute (TARI) in Tanzania, and NABE12CR and NABE14R, which were released by National Agricultural Research Organization in Uganda.
- In Nigeria, the Lake Chad Research Institute (LCRI) made significant progress in pearl millet breeding and trialing across the Sahelian and Sudanian regions. Yield trials for OPVs and hybrids were conducted in multiple locations, and training on downy mildew inoculum development was provided. A breeding collaboration with CIMMYT resulted in the co-development of Medium Duration-Open Pollinated Variety Sudan. Three pearl millet lines met all trialing requirements and were selected for release, with on-farm trials conducted in six locations. Additionally, three new hybrids suited for well-endowed environments were identified, and seed multiplication will take place in the 2024/2025 dry season.
- In Kenya, Kenya Agricultural and Livestock Research Organization tested elite varieties of finger millet, sorghum, pigeon pea, and pearl millet from across Eastern and Southern Africa along with Kenya-preferred varieties at various locations. On-farm performance trials comprising new lines were tested against market varieties in TRICOT trials across selected counties to identify varieties suited for different regions.

WP4: Strengthen currently successful impact pathways and validate innovative approaches to seed production and delivery of recently released varieties (seed systems)

Research Questions

- What innovative ways exist to achieve increased demand-driven, gender-equitable, timely access to quality seed and other inputs by small-scale producers?
- How does the capacity development of seed producers contribute to increased supply of high-quality seed of improved varieties?
- How do public-private partnerships drive access to quality early-generation seed by seed producers?
- Do market segmentation and intelligence approaches, methods, and tools facilitate better targeting and prioritization of investments in seed systems development?

Work Package 4

Outputs

30 · Seed producer and grain aggregator linkages established and strengthened.

31 · Large-scale promotional activities established and supported in partnership with extension and delivery systems.

32 · Grain aggregator and farmer linkages leveraged and strengthened with emphasis on women and youth farmers.

33 · Seed production and business skills of small-scale and emerging seed entrepreneurs improved to shore-up commercialization.

34 · Public, private sector and community seed enterprises capacitated to reliably supply small-scale producers with quality certified and Quality Declared Seeds (QDS) of improved market-demanded varieties.

35 · Public and private seed sector actors supported to produce and supply high quality Early Generation Seeds (EGS) of new varieties.

36 · Develop and implement a series of targeted training workshops for public institution staff on policy development and best practices for variety handover to the private sector, and produce a comprehensive policy guideline document to guide these processes.

37 · Market segmentation studies provided to seed systems actors to guide seed production and marketing strategies.

38 · Market intelligence studies provided to NARES and CGIAR partners on opportunities for future investments in breeding selected dryland crops.

39 · Effective tools for variety promotion and delivery shared with NARES, seed companies and grain actors.

Outcomes

30 31 32 ▶ **12** · Increased demand-driven, gender-equitable and timely access to quality seed and other inputs by small-scale producers.

33 34 ▶ **13** · Increased supply of high-quality seed of improved varieties that are profitable to produce and desired by the markets.

37 38 39 ▶ **14** · Improved access by seed systems actors (NARES, CGIAR, seed companies) to field-tested approaches, methods, and tools to prioritize investments in breeding and seed systems development.

35 36 ▶ **15** · Improved access to adequate quantities of high quality early generation seed (EGS) by seed producers.

End-of-Project Outcome 4

12 13 14 15 ▶ Women, men, youth and disadvantaged socio-economic groups access affordable, market-demanded and producer preferred, high yielding, resilient variety seed.

Work Package 4 progress against the theory of change

Accelerating the adoption of newly released public-domain varieties requires providing farmers with clear evidence that these varieties outperform older or local ones. Reliable, firsthand information enables them to make informed decisions about performance at both local and broader scales. To support this, large-scale promotional activities were implemented in collaboration with extension services and seed delivery systems, enhancing awareness among farmers and other stakeholders across Eastern and Southern Africa and Western and Central Africa. These efforts included seed fairs, demonstration plots, farmer field days, small seed pack distribution, and Tricot trials, collectively reaching 998,562 farmers across 18 countries.

As awareness and demand for new and improved varieties increased, seed production across various classes was expanded to ensure better access for both farmers and the industry. This demand-driven production was achieved through collaboration with 18 NARES partners and six non-NARS partners – including International Institute of Tropical Agriculture (IITA), CIAT, MyAgro, Syngenta Foundation for Sustainable Agriculture, New Markets Lab, and Center for Behavior Change Communication – who implement targeted initiatives along the seed value chain, from early generation seed (EGS) production to downstream distribution. In 2024, NARES partners produced 207 metric tons (MT) of breeder seed and 19,591 MT of foundation seed, ensuring the availability of subsequent seed classes for the next season. Additionally, 24,818 MT of certified seed was produced, reaching 5,066,674 farmers. This seed has the potential to generate 905,995 MT of grain, valued at USD 483.11 million (see Table 3).

Table 3. Seed production for 2024 (metric ton), area covered (ha), farmers reached, grain produced (MT), and grain value (USD, millions)

Crop	Breeder seed (metric ton)	Foundation seed (metric ton)	Certified seed/QDS (metric ton)	Estimated area under the crop (ha)*	Estimated number of farmers reached*	Estimated grain to be produced (metric ton)*	Estimated total value of grain produced (US$ M)*
Sorghum	15.1	8272.2	6129	766,125	3,830,625	719,391	334.52
Pearl millet	1.8	15.6	30.2	5,034	25,172	3,358	1.83
Finger millet	1.8	9.3	30.3	6,059	30,295	4,041	2.20
Groundnut	42.7	10,493.8	4,689	46,800	234,000	43,243	57.00
Common bean	107.4	420	10,595	105,948	529,738	83,593	67.13
Cowpea	32.4	360.3	3,320	83,004	415,021	51,878	20.08
Pigeon pea	3.9	3.9	7	228	1,142	247	0.11
Chickpea	2.2	16.8	16	136	682	244	0.25
Total	**207.4**	**19,591.9**	**24,817**	**1,013,335**	**5,066,674**	**905,995**	**483.11**

*Values were estimated using the average seed rate for a crop, the average farm holding size, the average yield (by crop and country) and the average price of grain by crop.

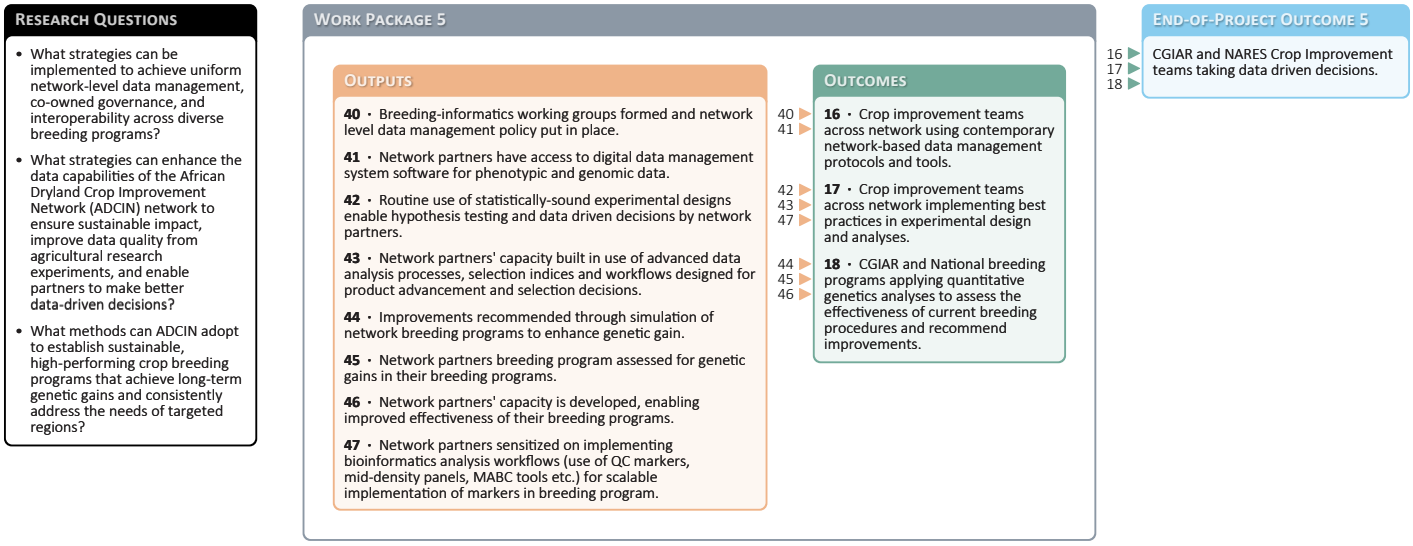
The key seed delivery models implemented in 2024 prioritized demand-driven, supply-responsive, and community-based approaches to enhance seed demand, uptake, and repeat sales. In Nigeria, for example, community-based organizations (CBOs) were registered with regulatory agencies to gain accreditation as seed producers and traders, strengthening local seed production and distribution networks. A similar model, the Farmer Hub, a one-stop-shop approach, has been expanding, with 40 hubs now in operation across Nigeria. These hubs not only improve farmers' access to new seed varieties but also provide complementary technologies such as fertilizers and mechanization. Additionally, they function as aggregation platforms, enabling farmers to supply grain to off-takers. More broadly, collaboration between seed producers, farmers, and aggregators has been instrumental in strengthening demand-led seed systems by linking grain trade with seed demand. These partnerships provided farmers with reliable markets while ensuring aggregators benefited from a stable supply chain and improved grain quality control. Strengthening these relationships involved targeted training, formal agreements, and access to market information to align quality standards, pricing, and delivery mechanisms. During the reporting period, grain aggregation was facilitated through Youth and Women Quality Centres, Farmers' Hubs, Community Agribusiness Partnership Platform, and the aggregator seed delivery model, resulting in at least 241 tons of grain traded through these partnerships.

To enhance seed quality, production, and participation in the seed sector, CIMMYT's seed systems team, in collaboration with partners, organized training workshops and learning forums focused on seed production best practices, certification, and quality control. These capacity-strengthening initiatives were delivered through at least 15 NARES programs, reaching nearly 1,000 trainees, including representatives from seed companies, cooperatives, research institutions, and rural development agencies. Participants received both theoretical and practical training on seed laws, production strategies, quality assurance, storage techniques, and seed health, among other key areas. In parallel, efforts were made to streamline on-farm trials through TRICOT to identify the most promising varieties for commercialization, particularly where multiple varieties within the same market segment had been released but remained underutilized. As part of these efforts, in collaboration with the 1000Farms team, training sessions were conducted for seed systems teams on trial design, entry selection, and data analysis, benefiting nearly 200 trainees in the NARES. On the ground, strengthening the skills of field agents and increasing farmer awareness of on-farm testing using TRICOT remain key priorities, alongside early planning to ensure effective trial implementation. As these initiatives scale up, partners will require refresher courses on ClimMob to enhance their ability to analyze trial data for informed decision-making while also addressing challenges related to implementation costs and participant engagement.

Accelerating varietal turnover requires a deep understanding of market needs and preferences. In collaboration with the market intelligence team, market insights were gathered and shared with stakeholders, focusing on groundnut, sorghum, and common bean. These efforts engaged at least 228 representatives from seed companies, traders, processors, breeders, and NARES, helping to define market segments linked to both food and animal feed traits. Engagement in PDT meetings further provided an opportunity to assess traits valued by different stakeholders and identify gaps in current trait evaluations. For instance, in pigeon pea, existing TPPs emphasize farmer and consumer priorities such as ease of shelling and cooking time. However, other potential uses – such as canned vegetable pigeon pea for consumption – require further exploration. In response, Egerton University is currently testing three new vegetable-type pigeon pea varieties in Kenya's national performance variety trials. These varieties exhibit key attributes, including high yield, frequent podding and green pod harvesting, large fresh seeds, and early maturity. Meanwhile, in Tanzania, the CGIAR Research Initiative on Market Intelligence is assessing processor and consumer needs for peanut butter made from single varieties. Insights from this work will guide investments in seed systems to ensure the availability of varieties suited to this specific market demand.

On the policy front, efforts to enhance the adoption of improved varieties and strengthen partnerships with the private sector, with the support of New Markets Lab (NLM), focused on capacity building for commercializing public varieties, via licensing. These initiatives aim to streamline early generation seed production and generate royalties for reinvestment in research. Training workshops attended by close to 170 participants in Tanzania, Ghana and Nigeria, led to the development of licensing roadmaps outlining short- and long-term goals, as well as synthesis reports assessing the licensing environment, identifying gaps and challenges, and recommending improvements to variety handover processes. Additionally, NML identified AVISA varieties for regional registration to expand market access, with 15 varieties targeted for registration under COMESA, 15 under SADC, and 10 under ECOWAS . A policy brief is being drafted to guide CGIAR Centers on registering CGIAR varieties in regional seed catalogues. NML has also updated annotated guidebooks on regulatory aspects of variety registration and dissemination in Tanzania and Nigeria to support public institutions. Furthermore, it has drafted Procedural Guidelines under Nigeria's Plant Variety Protection Regulations, which, once validated in the second quarter of 2025, will facilitate the implementation of the PVP regulatory framework.

WP5: Co-develop and implement modern data management principles, governance, and strategy (data and bioinformatics for decision support)



Work Package 5 progress against the theory of change

The formalization of Breeding Informatics Working Groups (BIGs) and the ADCIN Data and Informatics Core Committee (DICC) marked a significant milestone in 2024. These groups streamlined research efforts, ensuring targeted capacity-building workshops and training sessions. The DICC has been instrumental in guiding data management strategies, leading to the approval of the ADCIN Research Data Management Policy, which is currently under review by the ADCIN Steering Committee.

To enhance data-driven breeding, ADCIN partners gained access to institutional and centralized Breeding Data Management Systems (BMS). In 2024, 209 breeding studies (trials and nurseries) were hosted on BMS, with 101 new studies initiated. As a leader in modern breeding informatics, ADCIN has begun migrating to the Enterprise Breeding System (EBS), with a dedicated EBS server deployed and 14 multi-location trials (MLTs) already generated in the new system.

Efforts to improve statistically sound experimental designs led to two regional biometrics and quantitative genetics workshops in Eastern and Southern Africa and Western and Central Africa, optimizing breeding strategies for key crops such as chickpea, pigeon pea, groundnut, sorghum, pearl millet, and finger millet. Participating researchers refined selection methods, crossing designs, and experimental strategies based on quantitative genetic principles.

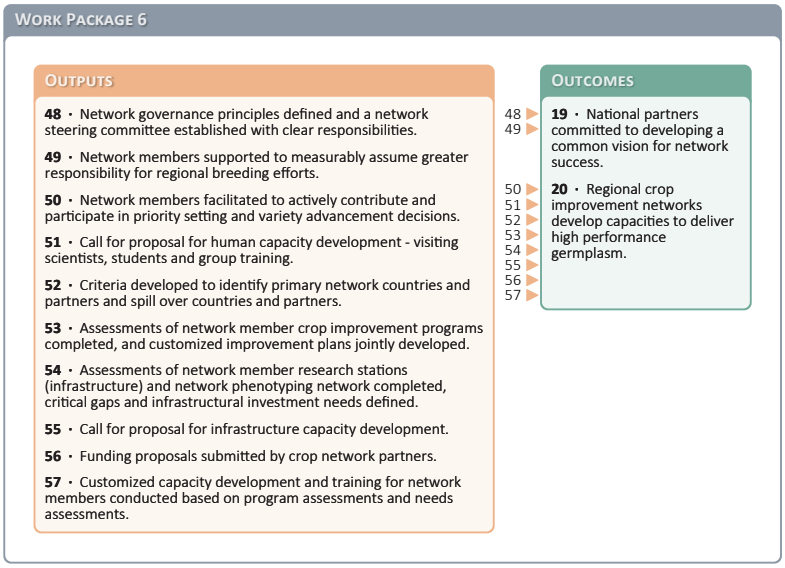
The Breeding Informatics Team analyzed 205 trial datasets across five crops, eight countries, and nine institutes, publishing results on the Trial Information System Dashboard for enhanced accessibility.

A total of 11 training workshops, including three virtual sessions, were conducted, engaging 290 ADCIN researchers. These sessions strengthened data management, biometrics, and genomic selection skills while implementing a Train-the-Trainer model, ensuring sustainable knowledge transfer across breeding programs in Africa. Through these advancements, ADCIN continues to drive efficient, data-driven breeding improvements for climate-resilient crops.

WP6: Establish sustainable regional collaborative crop improvement networks with responsibility-based sharing of resources (inclusive regional crop improvement networks)

Research Questions

- How can more strategic networks be built to better reach ADCIN's vision and mission?
- What is the strength of our Institute's partnerships and interorganizational relationships in the research of dryland crops?
- How has our network changed and impacted the livelihood of African smallholder farmers?
- How can ADCIN leverage and share resources to improve our institutes and community?
- How can the network help members to improve their capacity and lead to a win-win situation in conducting modernized research?



Work Package 6 progress against the theory of change

The year 2024 was pivotal, as the ADCIN Steering Committee awarded 1 million USD for developing the human and infrastructure capacity of the network for Eastern and Southern Africa and Western and Central Africa. This may be the first time a NARES-led crop-improvement network steering committee was formed and decided on priority areas for their institution. This required a significant investment of time and energy from all the steering committee to develop the call for proposal, develop and notify award selection criteria, and rigorous and fair selection of awardees from more than 90 applications amounting to approximately 12 million USD. Later, these awards were distributed by CIMMYT on behalf of the ADCIN steering committee to the selected awardees in the categories of students, visiting scientists, group training, and infrastructure. In human capacity, a total of seven students were awarded for PhD and MSc (42.9 percent male, 57.1 percent female), 15 visiting scientists (73.3 percent male, 26.7 percent female), and four group trainings were awarded in biometrics and seed systems with a total of 197 participants. A total of six proposals were funded for infrastructure to accelerate genetic gain by improving irrigation facilities, purchasing genotyping equipment and building disease screening facilities for drylands crops. For example, a downy mildew screening facility was set up in Burkina Faso (see photo), and genotyping equipment was bought in Ghana (see photo). Therefore, the ADCIN award will enhance partners to deliver products with good nutritional value, resistance to pests and high yields.

Apart from developing the capacity of ADCIN members, in 2024, we further strengthened the governance of ADCIN. During this period, we finalized the by-laws to guide the operation of the ADCIN steering committee and guide the steering committee to fulfil responsibilities committed to the network. In October 2024, the joint meeting of the Eastern and Southern Africa and Western and Central Africa ADCIN steering committee was organized in Addis Ababa, Ethiopia. During this joint session, one of the agenda items was to finalize the network agreement, which will be signed off with partner institutes' leaders to guide the network members on ways-of-working in ADCIN, germplasm, data and information sharing and use of standard templates, systems, and processes to leverage resources. The network agreement, prepared in English and French, is in the final stage and will be sent to each member institution in 2025 to obtain their formal approval to be part of ADCIN.

Genotyping equipment in Ghana.

Downy mildew screening facilities in Burkina Faso.

Work Package progress rating summary

WORK PACKAGE	PROGRESS RATING & RATIONALE

1

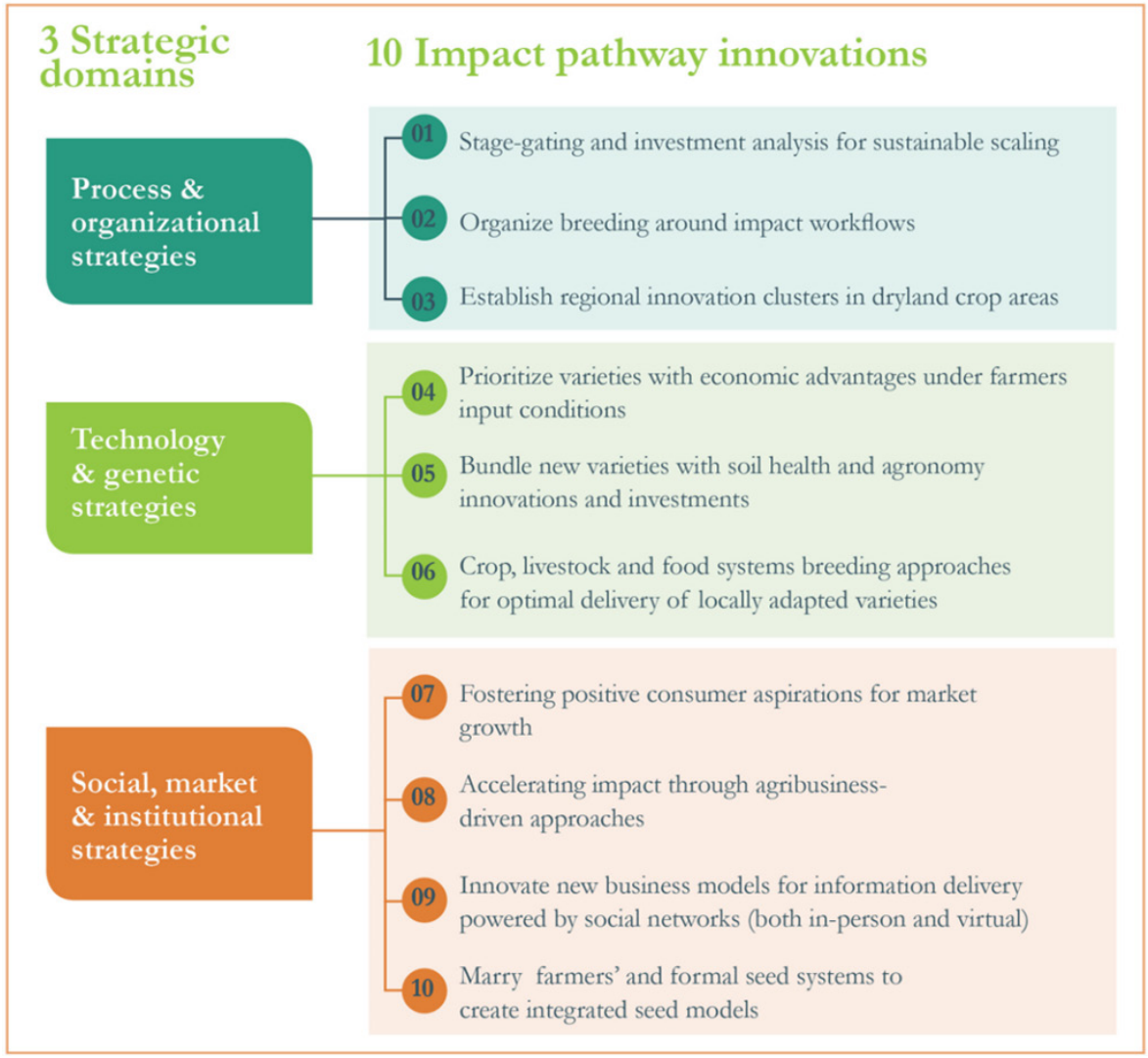
On track

PO1 was designed to develop new, practical approaches for accelerating the impact of dryland crops – particularly in regions where traditional models of variety delivery and scaling have underperformed. Over the past 2+ years, the team worked closely with partners to develop a set of common approaches, methods, and insights that inform strategic investments in breeding pipelines, data systems, and scaling models. These have now been integrated into an investment-ready platform: the Modular Impact Accelerator. This flexible, country-adaptable framework offers a roadmap for governments, donors, and private partners to achieve better development outcomes from dryland crop investments.

Key deliverables include (see Figure 6):

- A practical framework for designing and scaling impact.
- Real-time data and decision-support framework (using principles of stage-gating) to improve adoption tracking and adaptive management.
- Market and profitability analyses to guide investments in smallholder-focused, low-margin seed systems.

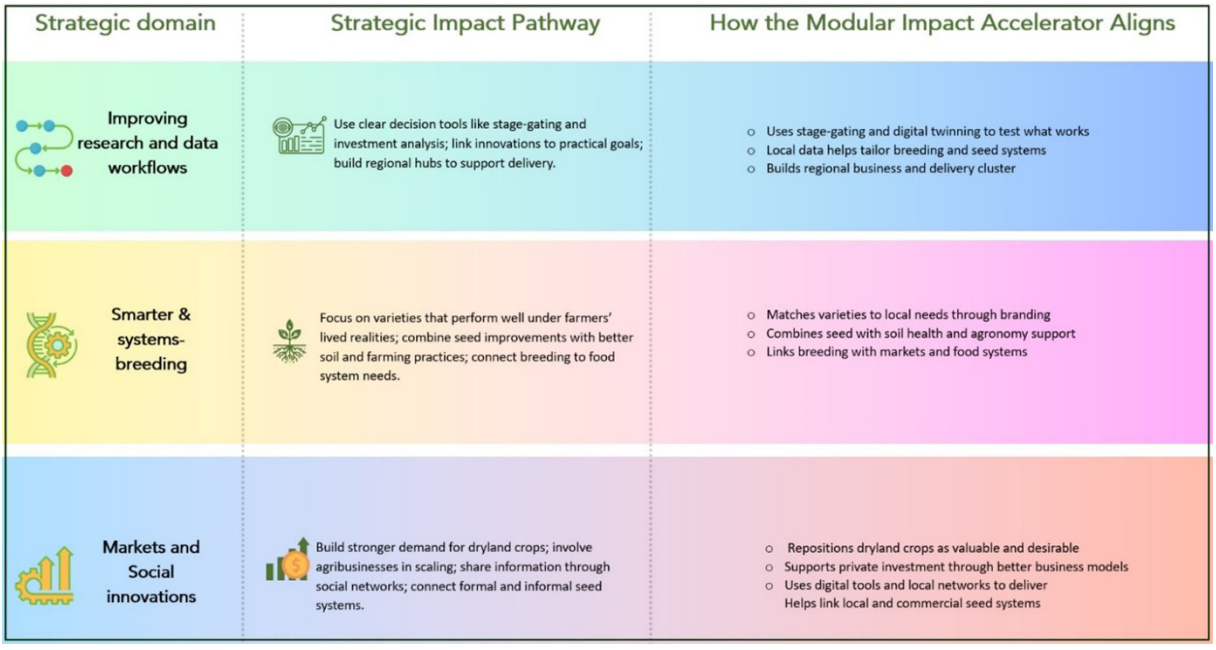
FIGURE 6. STRATEGIC DOMAINS AND IMPACT PATHWAY INNOVATIONS



WORK PACKAGE	PROGRESS RATING & RATIONALE

We plan to continue refining and mainstreaming these strategies with ADCIN networks and beyond. We have now delivered a complete, ready-to-implement package that supports smarter, higher-impact investments in dryland food systems. These outputs directly impacted Work Packages 2, 3 and 4, showing the connections with other POs focused on genetic innovation, market intelligence, and systems transformation. In 2025 and beyond, the priority is shifting to translating these frameworks into practical investments that drive breeding, scaling, and seed market innovations for enhanced impact. Figure 7 shows how the impact accelerator aligns with the broader strategic approaches above as discussed in the stakeholder processes.

FIGURE 7. ALIGNMENT BETWEEN STRATEGIC DOMAINS, IMPACT PATHWAYS AND MODULAR IMPACT ACCELERATOR



2

On track

PO2 activities across various countries have made notable advancements, as part of regional shared breeding and testing pipelines, pathology and genetics networks. Key activities included conducting field trials, genotyping, and enhancing infrastructure for crops such as sorghum, millet, groundnut, chickpea, and pigeon pea. Significant achievements were made in defining market segments, identifying high-yielding and disease-resistant varieties, and performing extensive trials. Infrastructure improvements, such as seed storage and irrigation systems were also emphasized. Despite facing challenges like drought and pest attacks, the programs are generally on track, with most objectives being met. The research aims to enhance crop resilience, yield, and quality, ultimately benefiting farmers and advancing agricultural practices. Overall, the progress indicates a positive trajectory towards achieving beyond the 2024 targets, with substantial contributions to improving dryland productivity and sustainability.

3

On track

PO3 activities are on track, highlighted by the progress from partner institutes in Burkina Faso, Cameroon, Chad, Ethiopia, Ghana, Kenya, Mali, Mozambique, Nigeria, Senegal, Tanzania, Togo, Zambia, and Zimbabwe, which are conducting trials and seed multiplication for sorghum, pearl millet, finger millet, groundnut, chickpea, and pigeon pea. These efforts aim to identify superior genotypes, develop new varieties, and improve seed production to enhance food security and dryland productivity. Challenges such as drought, bird damage in sorghum, and floods are addressed through adaptive measures like offseason multiplication and participatory variety selection. Collaborative efforts with local farmers and organizations are emphasized, with significant progress in registering new varieties, producing breeder seeds, and conducting on-farm trials and demonstrations. The overarching goal is to support improvement of crop yields in the dryland farming systems.

WORK PACKAGE	PROGRESS RATING & RATIONALE
4	On track Seed systems remained on track and, in some cases, exceeded the set targets of the four broad outcomes, largely due to strategic partnerships that strengthened both supply and demand for quality seed. By leveraging these collaborations, the initiative was able to expand market linkages, enhance farmer engagement, and improve the functionality of seed systems through strengthened public-private-producer partnerships. Partnerships with the Vision for Adapted Crops and Soils project provided seed producers of finger millet, pearl millet, and pigeon pea with access to EGS from AVISA projects, while also amplifying ongoing promotional efforts to reach more farmers. Collaboration with the 1000Farms and CGIAR's Market Intelligence Initiative played a critical role in collecting and analyzing farmer feedback, ensuring that the varieties prioritized for seed production aligned with market demand and farmer preferences. Working with the Accelerate Varietal Turnover Project on sorghum, common bean, and groundnut significantly boosted seed production volumes, allowing the initiative to exceed its targets, particularly for these crops. Working closely with the Seed Equal Initiative enabled us to track seed production, quality seed use and varietal turnover. Beyond increasing production, this partnership reinforced trader- and aggregator-led models that facilitated direct seed sourcing from the project, making seed systems more efficient and market-responsive.
5	On track All activities are on track. By strengthening data-driven decision-making, capacity building, and genomic resource development, ADCIN ensures that breeding programs generate high-quality, actionable data, aligning with the goal of accelerating genetic gains. This structured approach adheres to the theory of change by fostering institutional capacity, optimizing breeding pipelines, and ensuring scalable, long-term impact on network breeding approach.
6	On track 2024 was a significant year for ADCIN. The year started with a review of the submitted proposals for ADCIN awards. The whole process was done with members of the steering committee for both Eastern and Southern Africa and Western and Central Africa, and the process was completed in April 2024 when the selected candidates were identified. CIMMYT distributed the allocated budgets to the selected human and infrastructure capacity building candidates. During implementation, the only challenge faced was a delay in the signing of the contract by both parties. However, the whole exercise is still on track. The ADCIN Steering Committee has also developed a network agreement, which indicates how partners will collaborate and share germplasm and information, including data. The finalized network agreement has already been translated into French and is now in the process of being sent to the institutional directors for signature.

Definitions

On track

- Progress largely aligns with Plan of Results and Budget and Work Package theory of change.
- Can include small deviations/issues/delays/risks that do not jeopardize success of Work Package.

Delayed

- Progress slightly falls behind Plan of Results and Budget and Work Package theory of change in key areas.
- Deviations/issues/delays/risks could jeopardize success of Work Package if not managed appropriately.

Off track

- Progress clearly falls behind Plan of Results and Budget and Work Package theory of change in most/all areas.
- Deviations/issues/delays/risks do jeopardize success of Work Package.

Section 4: **Quantitative overview of key results**

This section provides an overview of results reported and contributed to, by the CGIAR Initiative on Accelerated varietal improvement and seed systems in Africa from 2022 to 2024. These results align with the CGIAR Results Framework and Accelerated varietal improvement and seed systems in Africa's theory of change. Further information on these results is available through the CGIAR Results Dashboard.

The data used to create the graphics in this section were sourced from the CGIAR Results Dashboard on 04 April 2025. These results are accurate as of this date and may differ from information in previous Technical Reports. Such differences may be due to data updates throughout the reporting year, revisions to previously reported results, or updates to the theory of change.

Overview of results per category

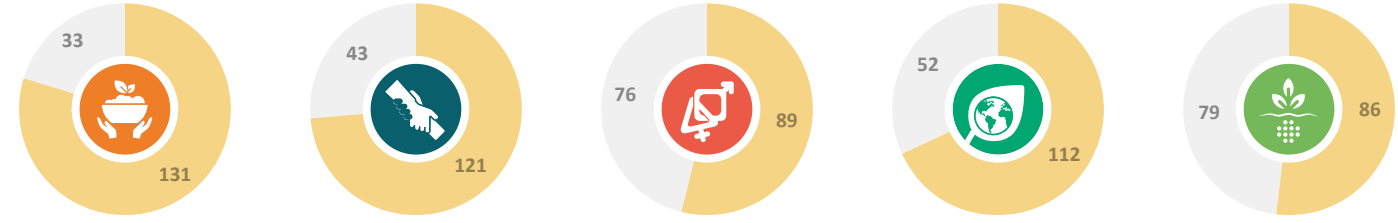
Outputs

- Other outputs 109
- Capacity sharing for development 21
- Knowledge products 14
- Innovation development 6

Outcomes

- Other outcomes 11
- Innovation use 4

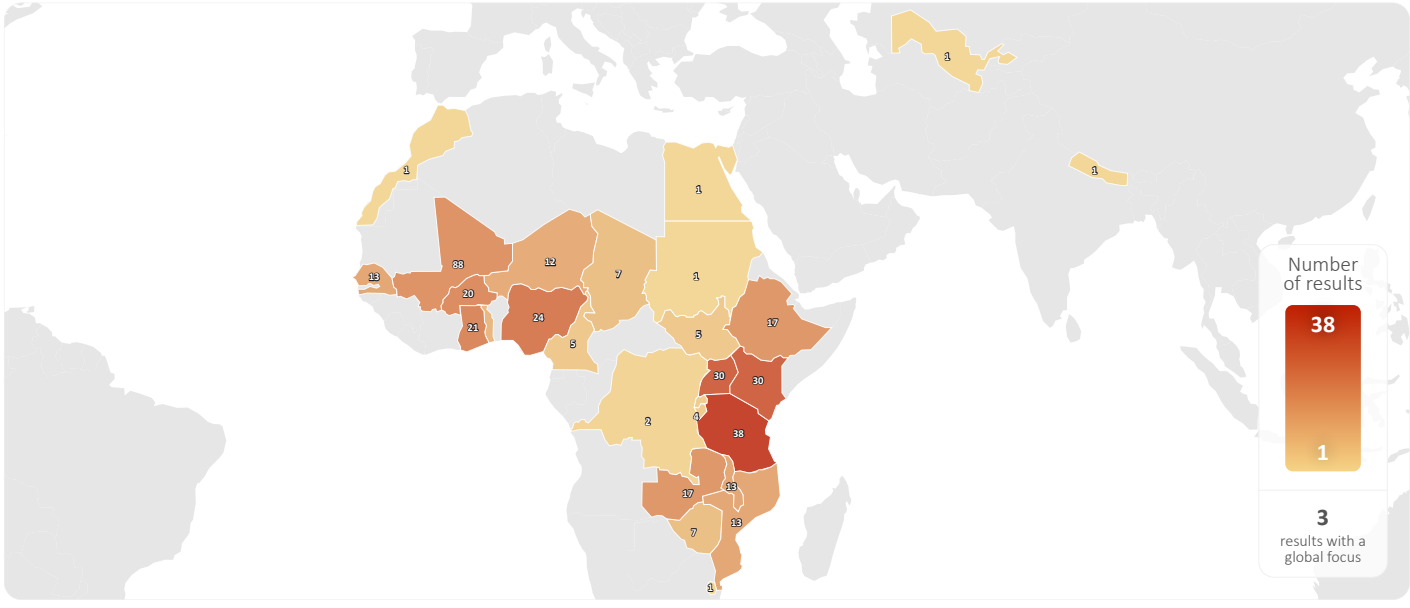
Number of results by Impact Area contribution



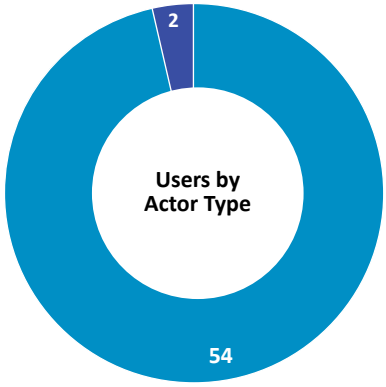
Nutrition, health and food security	Poverty reduction, livelihoods and Jobs	Gender equality, youth and social inclusion	Climate adaptation and mitigation	Environmental health and biodiversity
608	608	608	608	608

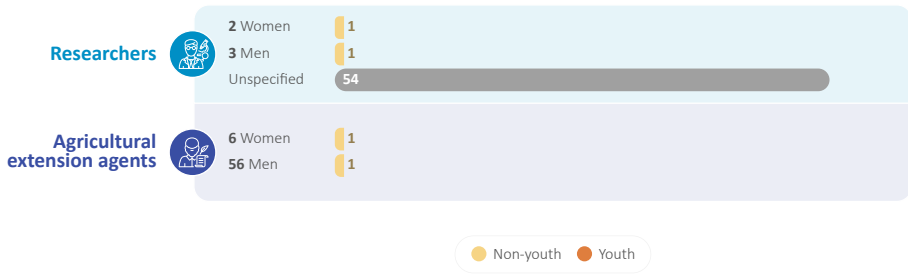
- **2 = Principal:** Contributing to one or more aspects of the Impact Area is the principal objective of the result. The Impact Area is fundamental to the design of the activity leading to the result; the activity would not have been undertaken without this objective.
- **1 = Significant:** The result directly contributes to one or more aspects of the Impact Area. However, contributing to the Impact Area is not the principal objective of the result.
- **0 = Not targeted:** The result has been screened against the Impact Area, but it has not been found to directly contribute to any aspect of the Impact Area as it is outlined in the CGIAR 2030 Research and Innovation strategy.
- **Not applicable:** Pertains to 2022 reported results when only information on Gender and Climate impact area tagging was available.

Geographic focus of results

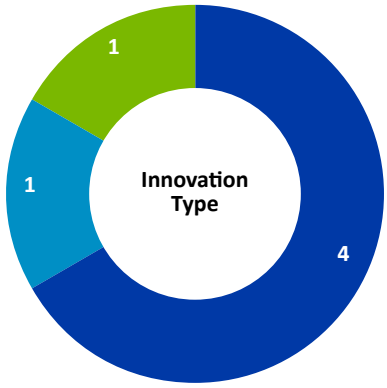


Innovations users by actor type





Innovations by typology



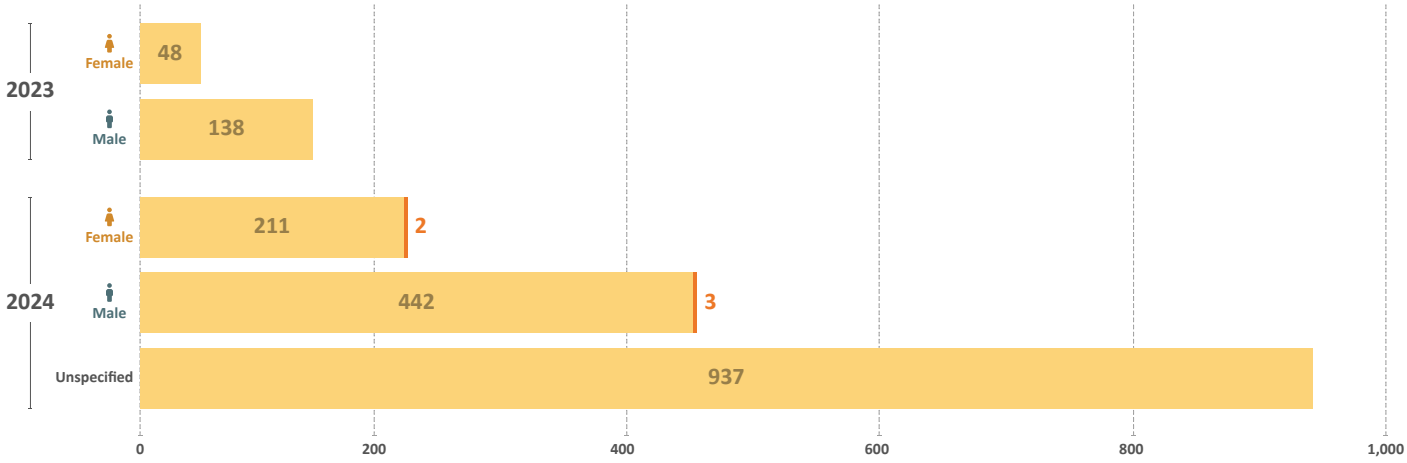
TECHNOLOGICAL INNOVATION
Innovations of technical/material nature, including varieties/breeds, crop and livestock management practices, machines, processing technologies, big data, and information systems.

POLICY/ORGANIZATIONAL/INSTITUTIONAL INNOVATION
Innovations that create enabling conditions, including policy, legal and regulatory frameworks; business models; finance mechanisms; partnership models; public/private delivery strategies.

CAPACITY DEVELOPMENT INNOVATION
Innovations that strengthen capacity, including farmer, extension or investor decision-support services; accelerator/ incubator programs; manuals, training programs and curricula; online courses.

OTHER INNOVATION
Unknown or the type does not work for the innovation.

Number of individuals trained by the initiative

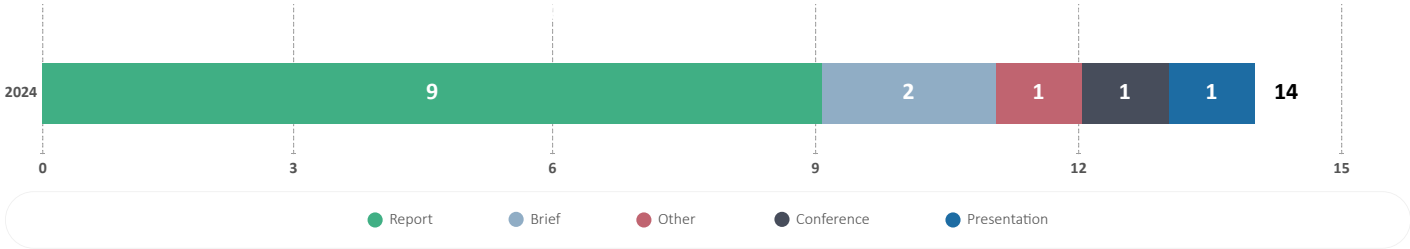


Long-term trainees: Long-term training refers to training that goes for three or more months.
Short-term trainees: Short-term training refers to training that goes for less than three months.

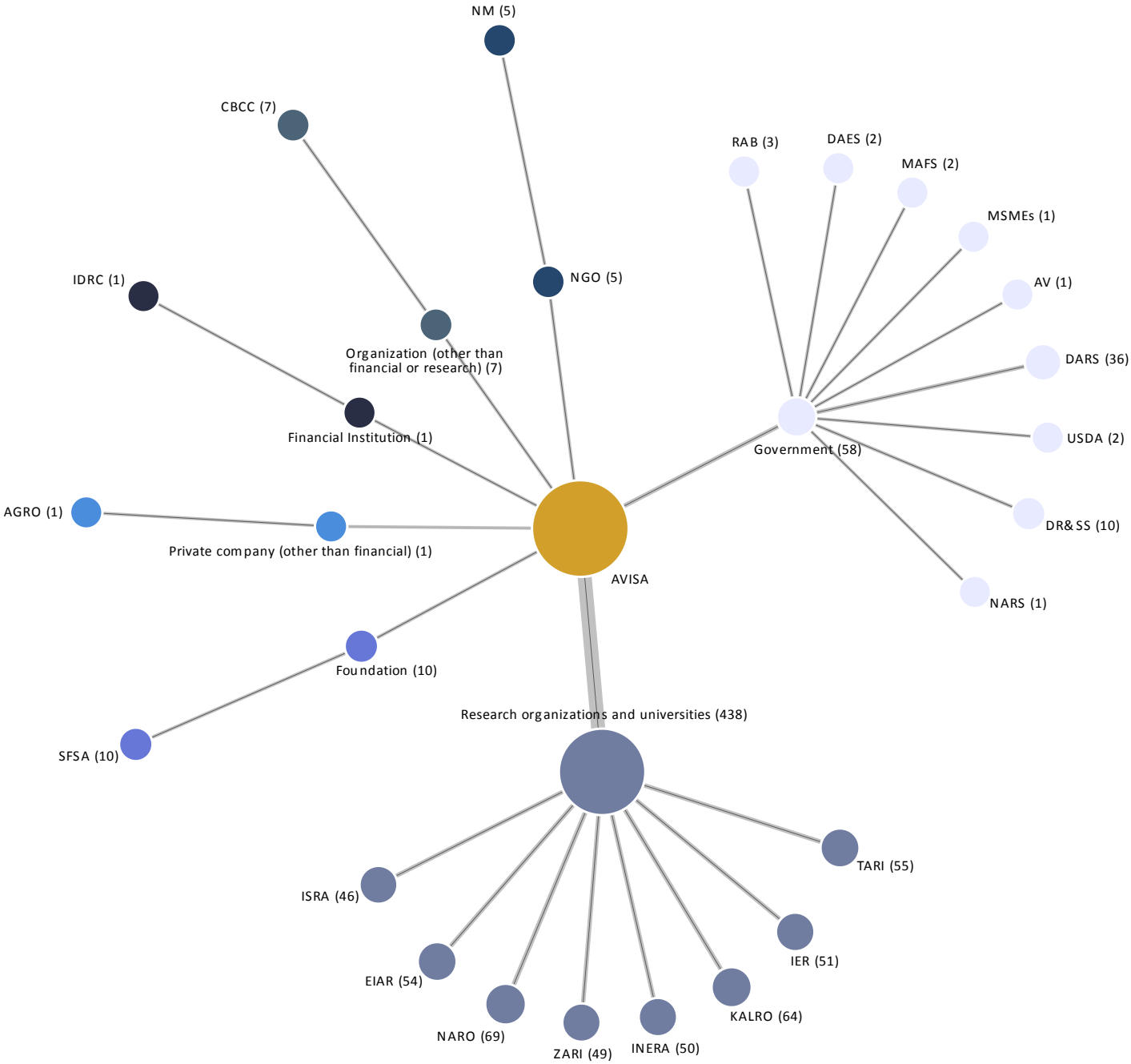
Number of innovations and their readiness levels

		Pipeline overview # of innovations
9	**Proven Innovation** The innovation is validated for its ability to achieve a specific impact under uncontrolled conditions	0
8	**Uncontrolled Testing** The innovation is being tested for its ability to achieve a specific impact under uncontrolled conditions	0
7	**Prototype** The innovation is validated for its ability to achieve a specific impact under semi-controlled conditions	2
6	**Semi-Controlled Testing** The innovation is being tested for its ability to achieve a specific impact under semi-controlled conditions	0
5	**Model/Early Prototype** The innovation is validated for its ability to achieve a specific impact under fully-controlled conditions	1
4	**Controlled Testing** The innovation is being tested for its ability to achieve a specific impact under fully-controlled conditions	1
3	**Proof of Concept** The innovation's key concepts have been validated for their ability to achieve a specific impact	1
2	**Formulation** The innovation's key concepts are being formulated or designed	0
1	**Basic Research** The innovation's basic principles are being researched for their ability to achieve a specific impact	1
0	**Idea** The innovation is at idea stage	0

Knowledge products by typology



Accelerated varietal improvement and seed systems in Africa's external partners



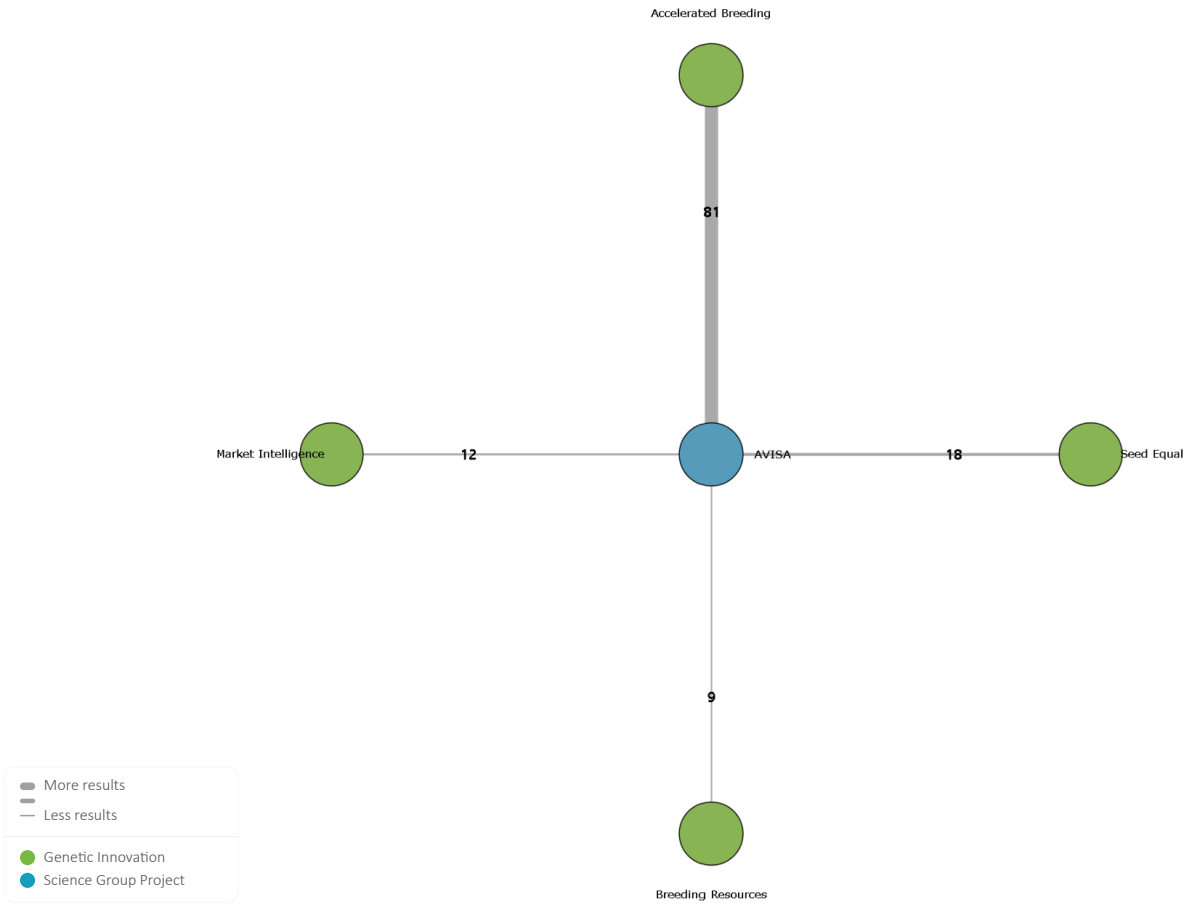
This diagram maps the external partners of AVISA, organized by partner type. The numbers in brackets represent the number of results each partner has contributed to, reflecting the scale and diversity of collaborations. To allow for a clearer view, a maximum threshold of eight partners was applied for each typology. The list of partner acronyms is available here.

Partnerships and Accelerated varietal improvement and seed systems in Africa's impact pathways

AVISA had a total of 28 partners, including CIMMYT as the lead. There were two other CGIAR partners (IITA, and the Alliance of Bioversity International and CIAT), 21 national programs from Eastern and Southern Africa, and Western and Central Africa, and four non-governmental organizations (CBCC, SFSA, NML and MyAgro).

Section 6: **CGIAR Portfolio linkages**

Accelerated varietal improvement and seed systems in Africa's internal network of collaborations



This diagram presents the internal collaborations of AVISA with other Genetic Innovation Initiatives. Connections are sized according to the number of shared reported results. Thicker lines represent stronger collaborative links based on a higher number of shared results.

Portfolio linkages and Accelerated varietal improvement and seed systems in Africa's impact pathways

AVISA was aligned to several CGIAR Initiatives within the Genetic Innovation Science Group. For example, EOPO1 was aligned to the Market Intelligence Initiative while EOPO2, EOPO3, and EOPO6 were mapped to the Accelerated Breeding Initiative. EOPO4 was linked to the SeedEqual Initiative. Finally, EOPO5 was aligned to the Breeding Resources Initiative. Going forward into the next business cycle, it is envisioned that AVISA will be aligned to several Areas of Work within the Breeding for Tomorrow (B4T) Science Program.

Section 7: **Key result story**

Community-managed seed systems: Expanding access to quality seeds for smallholder farmers in Tanzania

Visit to the Chamwiilee Agro-Live QDS group producing QDS of groundnut variety Naliendele 2016 at Bahi district, Dodoma region.

Primary Impact Area

Other relevant Impact Areas targeted

Contributing Initiative

Accelerated varietal improvement and seed systems in Africa

Contributing Centers

CIMMYT · Alliance of Bioversity International and CIAT

Contributing external partners

Bill and Melinda Gates Foundation · Tanzania Agricultural Research Institute (TARI)

Geographic scope

Countries: Tanzania

Millions of smallholder farmers in Tanzania grow common beans and groundnuts for food security, income generation, and diet diversification. However, despite the availability of improved varieties capable of yielding up to 2 tons per hectare, farm-level productivity remains low – approximately 0.9 t/ha for groundnuts and 1.4 t/ha for beans. Limited access to quality seed, disease pressure, erratic rainfall, and weak market linkages hinder productivity. To address these challenges, targeted interventions are necessary to provide affordable, high-quality seeds that enable farmers to fully utilize the genetic potential of improved varieties.

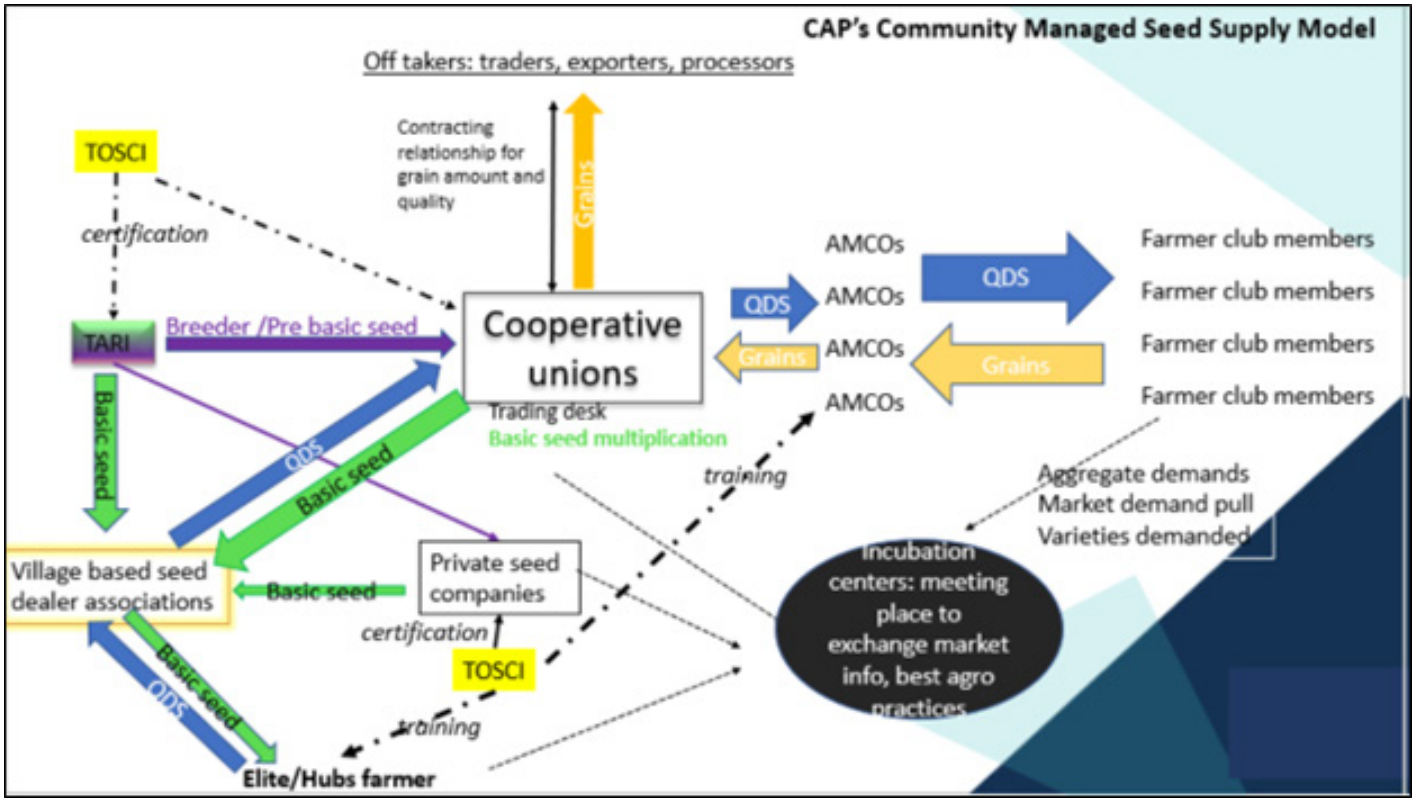
During recent years, our efforts in Tanzania focused on ensuring farmers could access high-quality, farmer-preferred crop varieties and associated technologies through innovative public-private partnership (PPP) models. A key initiative is the Community-Managed Seed Supply Model (CMSSM), implemented by the Syngenta Foundation for Sustainable Agriculture (SFSA) in partnership with Community Agribusiness Partners (CAP), a local non-governmental organization. This model enhances seed access while strengthening agricultural livelihoods.

Funded by the Bill and Melinda Gates Foundation, the initiative was led by CIMMYT, in collaboration with the Alliance of Bioversity International and CIAT, the Tanzania Agricultural Research Institute (TARI), and private sector actors.

The CMSSM was designed to support a community-based seed production system centered on Quality Declared Seed (QDS) production. The process follows a structured approach:

1. **Seed sourcing:** Farmer cooperative unions obtain early generation seed (EGS) (breeder or pre-basic seeds) from TARI, which is then used to produce large quantities of basic or foundation seed.
2. **QDS production:** Seed producers trained by Hub Farmers , use the basic seeds to produce QDS. Alternative seed sourcing options exist, with hub farmers also obtaining basic seeds from TARI or private seed companies.
3. **Seed distribution:** The QDS is supplied to Agricultural Marketing Cooperative Societies (AMCOS), linking them with farmers for grain production.
4. **Quality assurance:** The Tanzania Official Seed Certification Institute (TOSCI) trains hub farmers and cooperative representatives, ensuring quality through inspections and certification.

Community Managed Seed Supply Model (CMSSM)



Key highlights of this model include:

- Seed production at the community level, ensuring timely access to affordable, high-quality seed for farmers at the last mile.
- The incorporation of feedback loops, enabling farmers to share insights with product design teams, including breeders, on the performance of specific varieties.
- Creation of seed and grain business opportunities for cooperative unions and village-based seed producers, fostering long-term sustainability.

Some of the model's key achievements in 2024 include:

- **42,225 farmers** gained access to affordable, high-quality seed – up from **28,175** in the previous year. Women comprised **49 percent** of these farmers, primarily engaged in groundnut and bean production in Iringa, Ruvuma, and Songwe regions.
- The number of Hub Farmers (QDS producers) rose to **181**, up from **161** the previous year.
- **40 MT of QDS** of the **Selian 13 bean** variety and **20 MT of QDS** of the **Naliendele 2016** groundnut variety were produced by **143 smallholder QDS farmers, 39 percent** of whom were women.

- Farmers received seed production training from TOSCI to maintain high-quality standards.
- Cooperative unions in Iringa, Songwe, and Ruvuma produced **8.3 MT of basic groundnut seed** and **2.3 MT for beans**, ensuring a continuous seed supply.
- At the end of the pilot phase, the total seed value exceeded **USD 88,627**, with the produced seed covering **7,359 hectares** for beans and groundnuts, directly benefiting **9,088 smallholder farmers** who have an average of **2-3 acres** each, with an estimated grain production of **7,723 MT**, indirectly impacting over **36,353 farmers**.

Voices from the field

Key partners and farmers expressed their enthusiasm for the CMSSM:

- "The cooperative unions play a central role in enabling the model by sourcing basic seeds for QDS farmers and distributing the QDS seed to AMCOS in the villages. Furthermore, the unions serve as the primary contact for larger traders purchasing members' output and have committed to producing basic seed to ensure an adequate supply for QDS farmers." **Shija Mihambo, Senior Agribusiness Manager, CAP.**
- "This initiative will give farmers in remote areas access to affordable, quality seeds." **Mon Mwampamba, SORECU Manager.**
- "The project supported me with 100 kg of basic seed of Selian 13 that I planted and harvested 800 kg of clean seeds. With this seed, I am confident I can increase my family's income during the upcoming season." **Suzana Sankwa, Hub Farmer and Member of Mbildhilo AMCOS LTD.**
- "On behalf of all AMCOS members, I appreciate the project's support that has helped us access quality seeds of groundnuts. We are planning to multiply more seeds during the upcoming season so that farmers around us can also access seeds on time and at affordable prices." **Ally Andrew, Vice Chairman, Njerenje Scheme AMCOS LTD, Songwe region**.

Pigeon pea farmer Festus Muthoka and breeder Rael Karimi during a field day in Kenya, showcasing improved pigeon pea varieties.
Credit: Marion Aluoch/CIMMYT

CGIAR

A farmer in Tanzania beams with joy as she displays a freshly harvested bundle of groundnuts.

Credit: Tanzania