CGIAR

INITIATIVE ON
Mixed Farming Systems

Socio-technical innovations in mixed farming systems involve substantial community engagement. In Rangpur, Bangladesh, farmers involved in the CGIAR Research Initiative on Mixed Farming Systems communally collect and store rice straw after harvesting and threshing to remove the grain. The farmer groups were formed when short-duration summer (aman) rice was introduced, which supplied rice straw livestock feed earlier in the season, when there is high feed scarcity.

Credit: Abdul Haque, IRRI

CGIAR Research Initiative on
Mixed Farming Systems

Annual Technical Report 2024

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Disclaimers

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Boundaries used in the maps do not imply the expression of any opinion whatsoever on the part of CGIAR concerning the legal status of any country, territory, city, or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Borders are approximate and cover some areas for which there may not yet be full agreement.

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.

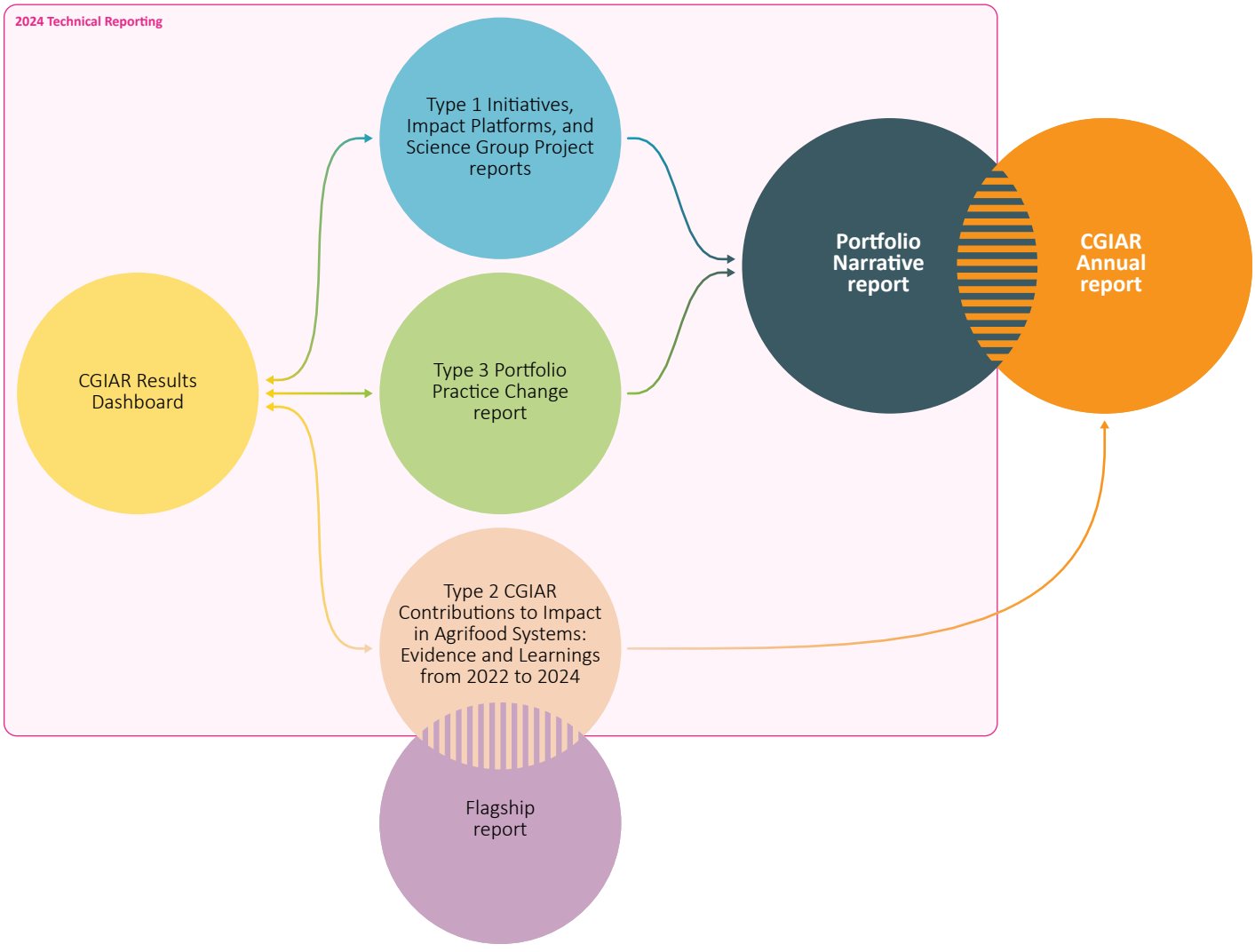

Figure 1. CGIAR's 2024 Technical Reporting components and their integration with other CGIAR reporting products.

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

Initiative name	Sustainable Intensification of Mixed Farming Systems
Initiative short name	Mixed Farming Systems
Initiative Lead	Mateete Bekunda- m.bekunda@cgiar.org
Initiative Co-lead	Santiago Lopez- s.l.ridaura@cgiar.org
Science Group	Resilient Agrifood Systems
Start – end date	01 April 2022 – 31 December 2024
Geographic scope	**Countries** Bangladesh · Ethiopia · Ghana · Lao People's Democratic Republic · Malawi · Nepal
OECD DAC Climate marker adaptation score[1]	**Score 1: Significant** The activity contributes in a significant way to any of the three CGIAR climate-related strategy objectives — namely, climate mitigation, climate adaptation and climate policy, even though it is not the principal focus of the activity.
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OECD DAC Gender equity marker score[2]	**Score 1A: Gender accommodative/aware** Gender equality is an objective, but not the main one. The Initiative/project includes at least two explicit gender specific outputs and (adequate) funding and resources are available. Data and indicators are disaggregated by gender and analyzed to explain potential gender variations and inequalities.
Website link	https://www.cgiar.org/initiative/19-sustainable-intensification-of-mixed-farming-systems/

[1] The Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) markers refer to the OECD DAC Rio Markers for Climate and the gender equality policy marker. For climate adaptation and mitigation, scores are: 0 = Not targeted; 1 = Significant; and 2 = Principal.
[2] The CGIAR Gender Impact Platform has adapted the OECD gender marker, splitting the 1 score into 1A and 1B. For gender equality, scores are: 0 = Not targeted; 1A = Gender accommodative/aware; 1B = Gender responsive; and 2 = Principal.
These scores are derived from Initiative proposals, and refer to the score given to the Initiative overall based on their proposal.

EXECUTIVE SUMMARY

The CGIAR Research Initiative on Mixed Farming Systems (MFS) sought to mitigate challenges of the MFS complex socioecological systems experiencing multiple environmental, biological, and socioeconomic shocks and stresses through sustainable intensification research to identify context-specific pathways toward resilient, scalable innovations that preserve natural capital and offer equitable benefits for all. A systems approach requiring a holistic view on MFS was prioritized, considering interactions between components or subsystems and allowing focused efforts that strategically integrate multiple interventions at different scales. The research was implemented initially in six countries (Bangladesh, Ethiopia, Ghana, Laos, Malawi, Nepal) targeting seven mixed farming system types, and India came on board during the third year of the Initiative. The results reported in the PRMS reflect a combined contribution from different Work Packages (WPs) and countries and are further described in Section 3.

WP1 generated 65 knowledge products for monitoring how MFS evolve amidst global environmental and socioeconomic changes, using methods and tools developed in WP2. The products identified key entry points and priority zones for effective co-design of sociotechnical innovation bundles of technologies (under WP3), which were then scaled out in the frame of WP4.

WP2 generated 102 products with systems analysis methods and tools (M&Ts) to support the process of co-designing, targeting, and scaling sustainable intensification innovations for different types of MFS. These M&Ts allowed other WPs to characterize the diversity of MFS, holistically assess their performance through multiple criteria, explore different management scenarios for specific MFS, and identify and quantify main trade-offs and synergies. In close collaboration with local partners, the application of these M&Ts was the basis to ensure a systemic approach to co-design more sustainable MFS.

WP3 developed 232 knowledge products over the three-year period covering crops, livestock, natural resource innovations, and accelerators (with 15%, 29%, and 56% of these products developed respectively in 2022, 2023, and 2024). Five bundled sustainable intensification innovations were co-designed and implemented at the farm scale to address interconnected system challenges in MFS-operating countries, and they all improved MFS performance. Different WPs' output innovations contributed to the bundled innovations.

WP4 developed a methodological guide for packaging and bundling innovations (socio-technical innovation bundles), developed capacity, and backstopped this process for researchers. Through this approach, 56 innovations were profiled over the three years; about 61 percent of these were technical and the remainder focused on policy and capacity development. Approximately 60 percent of these innovations made a significant contribution to one or more of CGIAR's Impact Areas, while 52 percent had a scaling readiness score of 5 or higher. Regarding scaling use, 8 innovations—with a total of 1,706 users (40 percent women)—were packaged in 4 countries.

WP5 partnered with WP4 on developing capacity in systems approaches for the co-design, implementation, evaluation, and scaling of socio-technical innovation bundles. The capacity needs of 120 MFS researchers were assessed and a generic capacity needs framework was consequently developed for an inventory of capacity needs of relevant stakeholders. This framework was country-contextualized and focused on the skills, knowledge, and tools required by different types of actors for the co-design process. To facilitate access to knowledge on systems analysis and design, a prototype of a Virtual Institute for Systems Analysis (VISA) was developed. On this platform, an international community of practice will exchange system science knowledge and experiences and allow continuous critical reflection on processes and outcomes from systems approaches. Steps were undertaken to roll out VISA in CGIAR's Sustainable Farming Program and Capacity Sharing Accelerator of the CGIAR Portfolio 2025–2030.

To measure the progress of the End-of-Initiative outcomes (EOIOs), the team conducting the Initiative's monitoring, evaluation, learning, and impact assessment (MELIA) completed three baseline studies in Malawi, Ghana, and Ethiopia in 2023, using the Sustainable Intensification Assessment Framework (SIAF). Additionally, an impact assessment plan was designed in collaboration with the CGIAR Standing Panel on Impact Assessment (SPIA) to measure the impacts and projected benefits as stipulated in the Initiative's TOC. Stakeholder consultations were implemented in some of the Work Packages. The results of these actions indicate some significant progress toward achieving the EOIOs.

Backstopped by systems approaches' method and tools (WP2) and with a strong emphasis on capacity building and sharing (WP5), the systemic and interdisciplinary nature of the MFS Initiative allowed CGIAR and partner institutions to identify entry points for the sustainable intensification of MFS (WP1), to co-develop locally adapted options for the diversity of farming systems (WP3), and to identify the main innovation bundles and the properties of an enabling environment for their scaling (WP4). This integrated approach of acknowledging the complexity of MFS and developing partnerships for sustainable intensification innovations at different scales is promising to tackle the complex challenges facing small-scale farm households in the Global South.

	2022	2023	**2024**
PROPOSAL BUDGET	$11.46M	$14.47M	**$14.06M**
APPROVED BUDGET [1]	$7.80M	$9.02M [2]	**$8.29M** [2]

[1] The approved budget amounts correspond to the figures available for public access through the Financing Plan dashboard.
[2] These amounts include carry-over and commitments.

Part of their morning routine, three bulls are seen basking against the tranquil and picturesque landscapes of Houayno Village in Phonxay District, Luang Prabang Province, Laos.
Credit: Alie Peter Galeon, Alliance Bioversity-CIAT

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

Initiative-level theory of change diagram

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

CHALLENGE STATEMENT

- Mixed farming systems (MFS) occur in nearly all agroecological zones globally, with an enormous variety of climatic and soil conditions, and livelihood patterns. In the developing world, MFS supply around 75 percent of milk, 60 percent of meat, and 41–86 percent of cereals consumed. Livestock provides draft power and manure, while crop residues provide livestock feed. Livestock is sold to compensate for low crop yields in unfavorable years, while multi-cropping allows farmers to diversify risk from single crop production. Sustainable intensification (SI) of MFS involves integrating crops and livestock to maximize the potential to maintain ecosystem function and health, enhance biodiversity, and increase capability to absorb shocks to the natural resource base.
- Several biophysical challenges affect MFS, including high population growth, urbanization, water scarcity, soil degradation, climate change, evolving food consumption patterns, and food price volatility. Inequalities in resource access lead to conflicts and migration. Social inequalities produce unfavorable outcomes—primarily for women, youth, and marginalized actors—and obstruct progress toward the Sustainable Development Goals. Farmers' local experience and knowledge enable them to adapt to many challenges. However, the increasing speed at which many changes are happening exceeds their capacity.
- Research on these challenges has applied different approaches but most are uncoordinated and commodity based. SI of the MFS approach will offer integrated systems research to identify context-specific pathways toward resilient, scalable MFS innovations that preserve natural capital, offer equitable benefits for all, and attract young people into profitable agribusinesses. It will be a unified, multidisciplinary program that will identify, validate, and transfer a suite of plausible integrated technologies and knowledge to farmers, offering them much greater ability to make decisions that launch them on pathways out of poverty and food and nutrition insecurity, while also allowing them to protect the natural resources essential for sustainable farming.

SPHERE OF **CONTROL**

Work Packages

Work Package 1

Status, trends, and future dynamics of MFS.

Work Package 2

Building methods and tools (M&T) for SI of MFS.

Work Package 3

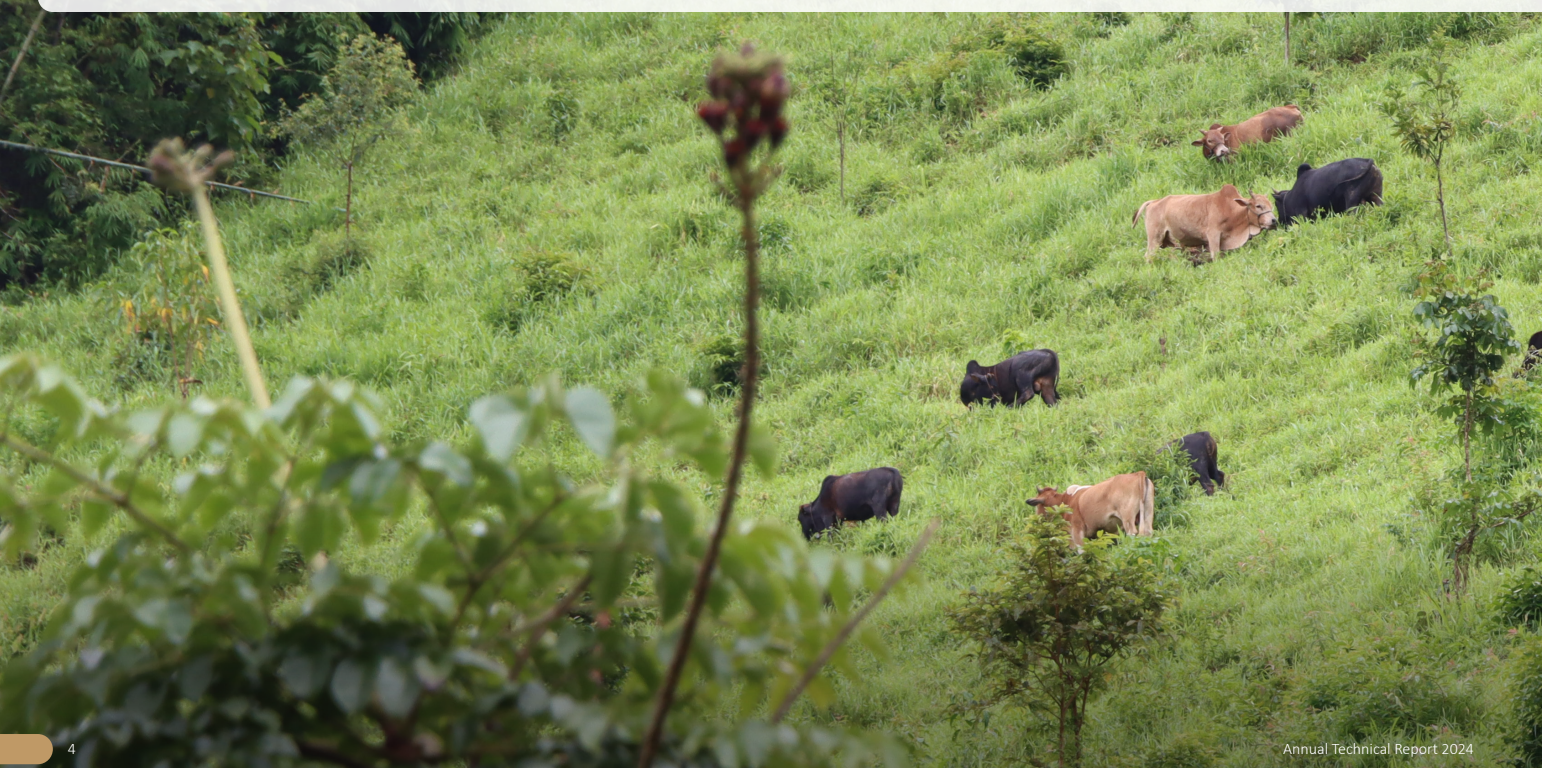
Participatory co-design of MFS with evidence-based, validated SI innovation packages.

Work Package 4

Advancing and supporting scaling of innovations.

Work Package 5

Capacity building for MFS design and analyses.



SPHERE OF **INFLUENCE**

End-of-Initiative Outcomes

End-of-Initiative Outcome 1

Key strategic actors are transitioning research priorities, policies, and strategic financial investments towards Sustainable Intensification of Mixed Farming Systems.

End-of-Initiative Outcome 2

Innovation, demand, and scaling partners are jointly using a systems approach.

End-of-Initiative Outcome 3

Partners and farmers are developing, implementing, and validating Sustainable Intensification options.

End-of-Initiative Outcome 4

Mixed Farming Systems actors adopting, adapting, and scaling socio-technical, gender-transformative innovation packages.

End-of-Initiative Outcome 5

Partners and CGIAR scientists aware of Mixed Farming Systems thinking and gender-transformative approaches, mainstreamed through a global virtual institute and regional scaling hubs.

Action Area Outcomes

Resilient Agrifood Systems

1 3 **1** · Smallholder farmers use resource- efficient and climate- smart technologies and practices to enhance their livelihoods, environmental health and biodiversity.

2 3 **2** · Research and scaling organizations enhance their capabilities to develop and disseminate RAFS-related innovations.

3 **3** · Smallholder farmers implement new practices that mitigate risks associated with extreme climate change and environmental conditions and achieve more resilient livelihoods. ST

4 **4** · Women and youth are empowered to be more active in decision making in food, land and water systems. ST GI

3 5 **5** · National and local governments utilize enhanced capacity (skills, systems and culture) to assess and apply research evidence and data in policy making process. ST

SPHERE OF **INTEREST**

Impact Areas

Nutrition, Health & Food Security

- 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

- 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

- 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.
- Offer rewardable opportunities to 267 million young people who are not in employment, education, or training.

Environmental Health & Biodiversity

- Stay within planetary and regional environmental boundaries: consumptive water use in food production of less than 2500 km3 per year (with a focus on the most stressed basins), zero net deforestation, nitrogen application of 90 Tg per year (with redistribution towards low-input farming systems) and increased use efficiency, and phosphorus application of 10 Tg per year.

Farmers in Sobchie Village in Phonxay District, Luang Prabang Province integrate trees to improve pasture management and boost livestock production.

Fertilizer application for Mbili Mbili, Malawi.
Credit: Michael Kinyua

Summary of progress against the theory of change

The MFS Initiative aimed to provide equitable, gender-transformative pathways for improving the livelihoods of farmers in seven prio ritized mixed farming systems in Africa and Asia. The small-scale farming systems dominant in these regions are complex not only because of the multiple interacting components but also because the whole system is geared toward multifunctionality, where income generation, food security, climate and market risk management, preservation of traditions and cultural values, and many other objectives drive the livelihood of families and the way they manage their complex agricultural systems. The research approach of the MFS Initiative therefore aimed to integrate both biophysical and socioeconomic metrics to gain understanding of outcomes at the whole-farm or farming system level, relying on high-quality research from all the different components of MFS.

The Initiative's research activities were conducted in six countries: Bangladesh, Ethiopia, Ghana, Laos PDR, Malawi, and Nepal. The results reported in the PRMS reflect a combined contribution from these countries. They are presented by Work Package, but the implementation of research activities was interconnected across packages, as indicated in the Initiative's TOC and results framework. From 2022 to 2024, the Initiative planned and executed research activities leading to 581 results. Of these results, 567 were research outputs produced across the five Work Packages and 14 were research outcomes of the Initiative. Approximately 61 percent of the outputs produced were knowledge products, 15 percent involved innovation development, 14 percent focused on capacity sharing for development, and 7 percent represented other outputs. Nine of the Initiative's outcomes focused on innovation use, two on capacity change, two on other outcomes, and one on policy change. These research outputs and outcomes aimed to contribute to the five measurable End-of-Initiative outcomes by 2025.

During this three-year reporting period, the Initiative established collaborations with 29 Initiatives, impact platforms, and science group projects and 16 CGIAR Centers contributed to producing the results. The Initiative also established 242 formal and informal partnerships among national and international research institutions, development agencies, donor agencies, and regional state unions. This supported our assumption that if these partners understood the benefits that sustainable intensification innovations generated by MFS toward CGIAR's five Impact Areas, it would trigger genuine interest in supporting an integrated systems approach in the co-development and implementation of sustainable intensification options for MFS at scale.

To measure progress toward the EOIOs and five Impact Areas, the MELIA team completed three baseline studies in Malawi, Ghana, and Ethiopia in 2023. A questionnaire was developed based on the indicators in the results framework of the Initiative, which are closely related to the SIAF framework. Additionally, an impact assessment plan was designed in collaboration with the SPIA to measure the impacts and projected benefits as stipulated in the Initiative's TOC. Stakeholder consultations were also implemented by some of the Initiative's Work Packages.

The results below indicate some significant progress toward the End-of-Initiative outcomes. The MELIA team developed a survey tool to track and quantify progress toward the EOIOs made in 2024.

Mbili Mbili configuration, integrating maize and legumes.
Credit: Michael Kinyua

Progress against End of Initiative Outcomes

This infographic provides a concise summary of the Initiative's progress toward achieving its Theory of Change End-of-Initiative outcomes for the 2022-2024 period. By drawing on reported results, it offers a comprehensive synthesis of progress made against the established outcome targets, highlighting the Initiative's overall impact and key achievements at the conclusion of this three-year cycle.

EOIO 1

Key strategic actors are transitioning research priorities, policies, and strategic financial investments toward sustainable intensification of mixed farming systems.

EOIO 2

Innovation, demand, and scaling partners are jointly using a systems approach.

EOIO 3

Partners and farmers are developing, implementing, and validating sustainable intensification options.

EOIO 4

Mixed farming systems actors adopting, adapting, and scaling socio-technical, gender-transformative innovation packages.

EOIO 5

Partners and CGIAR scientists aware of mixed farming systems thinking and gender-transformative approaches are mainstreamed through a global virtual institute and regional scaling hubs.

The Initiative exceeded its EOIO 1 target of 11 organizations as 43 national organizations and 5 international organizations transitioned their research priorities to MFS. In addition, 5 policymakers transitioned their national policies toward MFS. Unfortunately, no donor participated in the survey. The MFS Initiative influenced research priorities by shifting focus toward integrating crop and livestock management practices to enhance system sustainability and resource efficiency. The results indicate that about 71 percent of the respondents, mostly national partners, were transitioning their research priorities, policies, and strategic financial investments toward sustainable mixed farming systems after their interaction with the Initiative team.

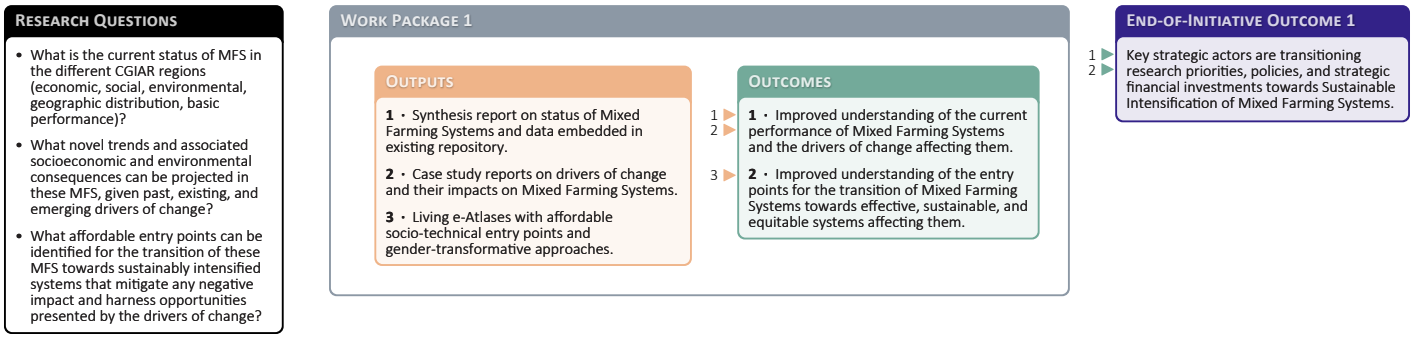
Against a target of 50 percent of innovation, demand, and scaling partners to collaboratively use a systems approach over the three years of the Initiative, the Initiative achieved an overall success rate of 59 percent across 6 countries. Approximately 66 percent of the Initiative's innovation and scaling partners were familiar with the M&Ts used to define MFS and its diversity. Furthermore, 59 percent of them utilized M&Ts to characterize MFS. The institutions involved included national agricultural research and extension systems (NARES), farmer organizations, local non-governmental organizations (NGOs), the Food and Agriculture Organization of the United Nations (FAO), the United States Agency for International Development (USAID), Wageningen University & Research (WUR), and the Australian Agency for International Development (AUSAID).

Against a target of 12 partners and farmers developing, implementing, and validating sustainable intensification options, 13 partner organizations (non-CGIAR = 12, CGIAR = 1) co-designed and co-developed innovations with farmers through focus group discussions. About 72 percent of respondents indicated that their institutions had established protocols to implement and sequence MFS in their extension systems. Concerning the farmers, the MFS Initiative aimed for a total of 50,000 direct beneficiary farmers using MFS innovations in the six countries between 2022 and 2024. The Initiative directly benefited 17,094 farmers (34.2 percent of the target). Most of the farmers who directly used MFS innovations on their farms were in Bangladesh and Ethiopia.

Aiming to scale MFS innovations among 710,000 beneficiaries across the 6 Initiative target countries between 2022 and 2024, the Initiative achieved a cumulative 604,900 beneficiaries (85.2 percent). Malawi, Ethiopia, Nepal, and Bangladesh were the countries where MFS innovations were mostly scaled out to beneficiaries, farmers, and value chain actors. About 78 percent of the respondents in the survey had an enabling environment that supported the scaling of socio-technical innovation packages. Among the challenges they are facing are limited resources to fund technology adoption and unstable market prices of commodities.

Aiming for 50 percent of its partners and CGIAR scientists to be made aware of mixed farming systems thinking and gender-transformative approaches during its three years of operation, the Initiative achieved 50 percent, as planned (non-CGIAR partners = 27, CGIAR partners = 3). About 50 percent of respondents participated in MFS training delivered by the Initiative and WUR, with most of the participants rating the training as very useful.

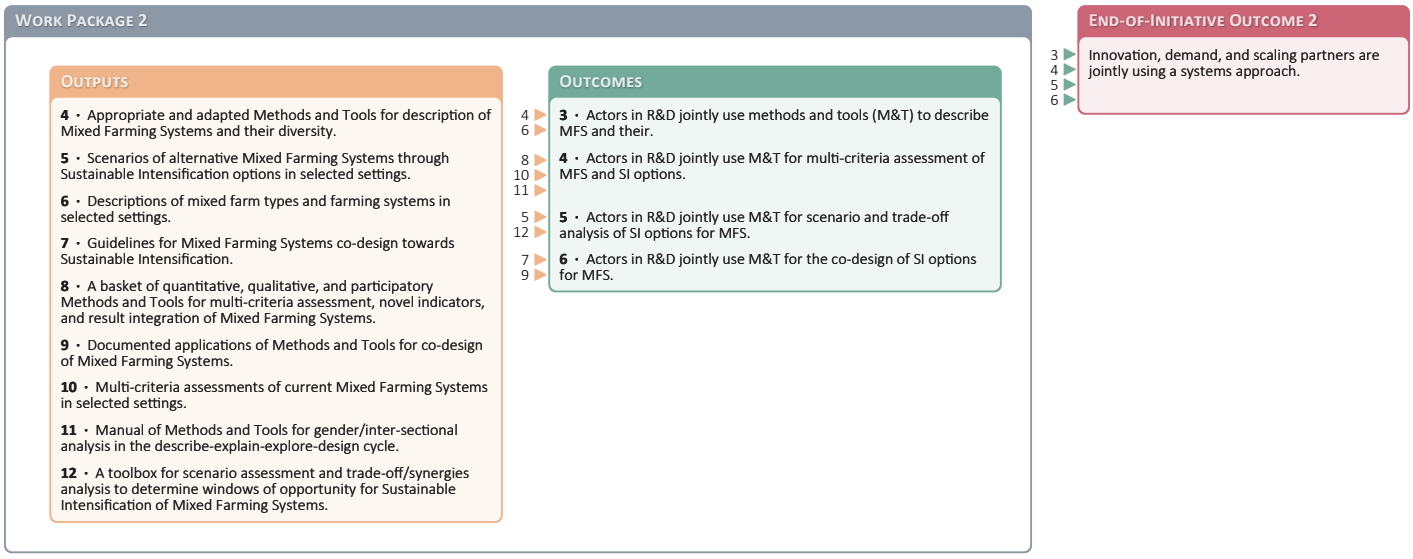
WP1: Status, trends, and future dynamics of MFS



Work Package 1 progress against the theory of change

The WP1 research questions were exhaustively expounded through different tools and methods identified in WP2. Knowledge of the status of MFS increased through systematic reviews and context analysis in the focal countries and globally. Key datasets on crop yields, parcel boundaries, and household surveys were archived in open-source repositories. These knowledge products will be key in monitoring how the MFS evolves amidst global environmental change. The status was analyzed considering differentiated gender roles across the different MFS; for example, a global study documented the differences in women's and men's access and preferences for technologies and the gendered impacts of technologies on income and labor. Case study reports focused on the drivers of climate, land degradation, land use, crop yields, pests, and diseases. These case studies applied advanced tools and algorithms to identify drivers of change in the targeted MFS, e.g. remote sensing, unmanned aerial vehicles, systems dynamic models, and machine learning. Affordable entry points and spatial recommendation domains were developed and presented as e-atlases for the maize-cowpea intercropping system in Ghana, cereal-forage legume mixed cropping in Ethiopia, and Conservation Agriculture in Malawi. Other generic living e-atlases were produced for mapping the suitability of user-defined bundles of technologies. Also, the results of the pasture expansion study in Laos are accessible as an eAtlas. These knowledge products will guide extension and development agencies to increase adoption rates and reduce the risk of failure of different bundles of technologies promoted with various scaling models. Key results in 2024 included development of a framework for guiding system thinking within the complex mixed farming system of the Ethiopian highlands. High-resolution remote sensing data revealed the rapid expansion of pastures in Northern Lao PDR from 1993 to 2023. A framework approach was developed for the identification and prioritization of context-specific climate-smart agricultural (CSA) practices in Ethiopia. The cascading impacts of capacity sharing on the use of drones have transformed natural resource monitoring and management in Ghana. EOIO revealed that 5 international and 48 national partners and 5 key policymakers began transitioning their research priorities, policies, and strategic financial investments toward sustainable MFS after interacting with the Initiative team. However, major donors need to be targeted to enhance this transition with more investment.

WP2: Building methods and tools for sustainable intensification of MFS



Work Package 2 progress against the theory of change

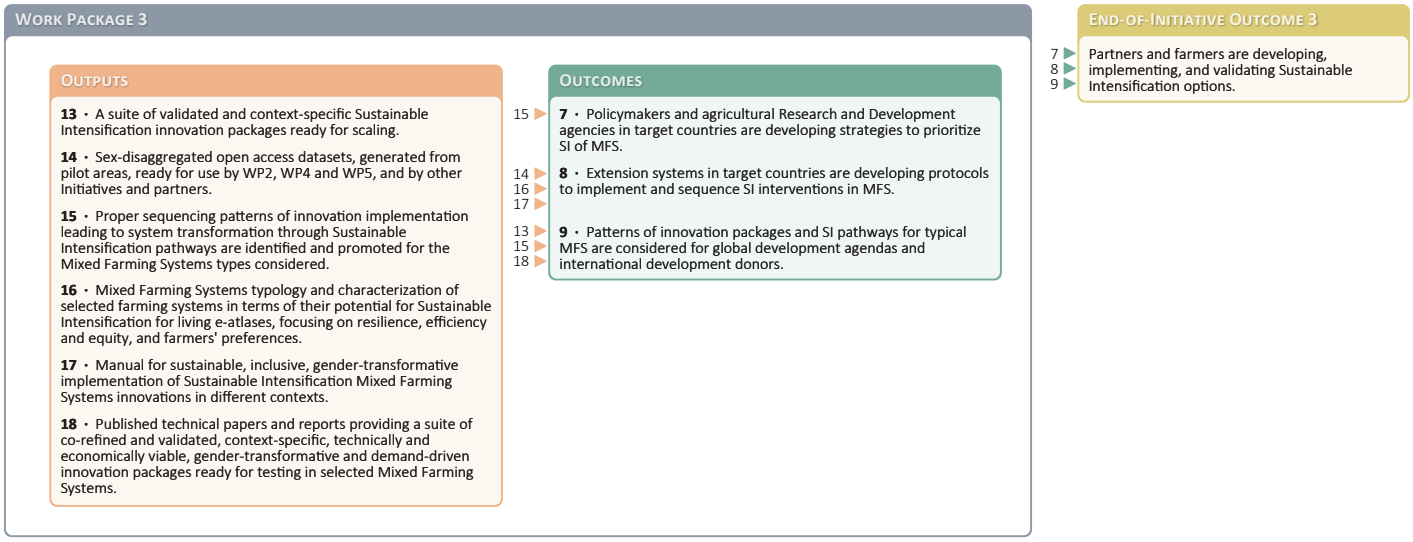
WP2 aimed to catalyze the use of research methods and tools (M&Ts) for the systemic understanding of mixed farming systems and contexts. The Work Package outcomes related to increasing the use of such M&Ts by third-party actors for system description, for multi-criteria and trade-off analysis, and for co-design. Targeting 12 actors to be using these M&Ts by the end of the Initiative, the WP achieved 48 use cases.

During the 2022–2024 period, 102 outputs were generated. These were aligned to the Work Package outcomes: i) describe the diversity of MFS, ii) holistically assess their performance through multiple criteria, iii) explore different scenarios and identify main trade-offs and synergies, and iv) contribute to the co-design of more sustainable MFS. Of the 102 outputs, 44 were cross-CGIAR-Center products, 44 were done in collaboration with other CGIAR Initiatives, and 50 products were co-authored with partners, notably NARES and International Advanced Research Institutions (IAIRS). This highly collaborative approach demonstrated the capacity-sharing and culture-building intentions of the Initiative to mainstream systems analysis work.

Statistically robust methods for segmenting MFS through typologies were implemented in all six countries of the Initiative (Ghana, Ethiopia, Malawi, Nepal, Bangladesh, and Laos) and used for better targeting of sustainable intensification innovations. The assessment of current and alternative MFS was conducted through multiple criteria, which allowed an assessment of the performance of different types of MFS (e.g. in India) and of the opportunities, challenges, and main trade-offs associated with their sustainable intensification (e.g. irrigation in the mid-hills of Nepal, different cropping systems in Malawi, improved agro-silvo-pastoral systems in northern Laos).

Systems analyses have mainly been applied at the farm household level, where they provide insights into how best to sustainably intensify specific mixed farming systems. Some efforts have been conducted at the landscape level, which aimed to advance system restoration through diversity and socio-technical innovation bundles. And some of the M&Ts have a regional or cross-regional scope and provide the basis for further development of social and technical innovations for improved sustainability of MFS in the Global South.

WP3: Participatory co-design of MFS with evidence-based, validated sustainable intensification innovation packages

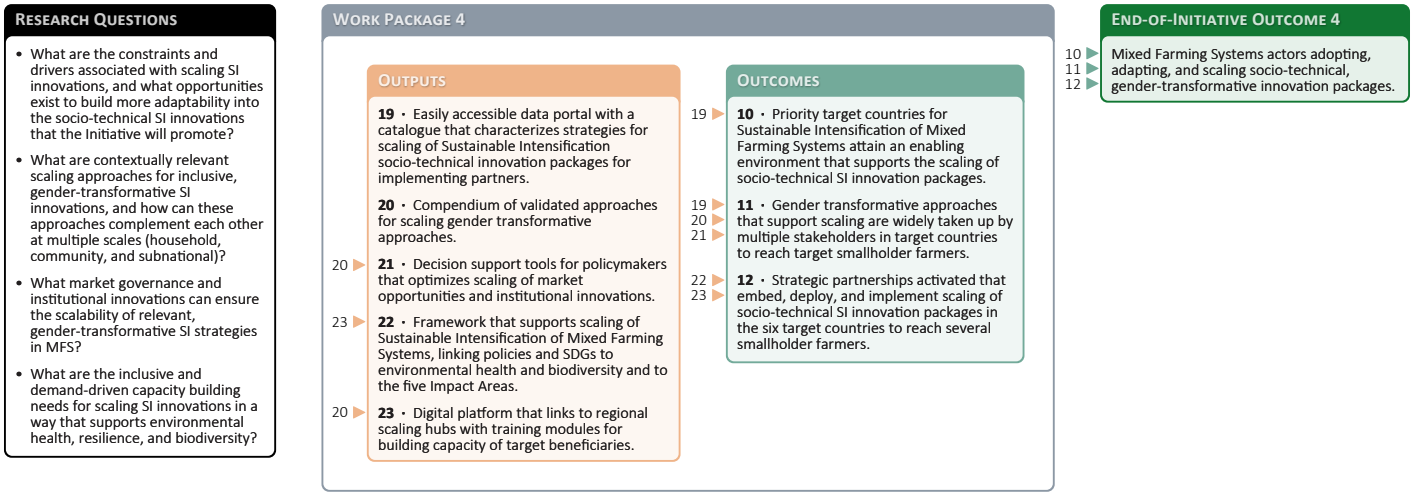


Work Package 3 progress against the theory of change

WP3 generated 131 outputs in 2024, with 70 percent of them being knowledge products related to crops, livestock, natural resource innovations, and accelerators and 18 percent of them being innovations. The number of outputs produced in 2024 increased over the numbers produced in 2022 and 2023. Over the three years of the Initiative's operations, a cumulative total of 232 outputs were produced in the Initiative's 6 countries, 15 percent in 2022, 29 percent in 2023, and 56 percent in 2024. Bundled innovations for sustainable intensification were co-designed and implemented at the farm scale to address interconnected system challenges in MFS-operating systems in the countries considered.

A system readiness methodology was developed and implemented in selected countries to guide the bundling of innovations to generate sustainable intensification. In Ethiopia, the integration of home garden intensification with livestock feed innovations and improved feeding practices helped to address key challenges, including feed shortages, limited access to nutritious food, soil nutrient depletion, and low-income generation opportunities. Integrating legume food-feed crops into the mixed farming system in Ghana offered multiple agronomic and economic benefits while enhancing farmers' resilience to climate change. This approach enhanced soil fertility through biological nitrogen fixation, and enhanced livestock feed availability, and helped to diversify income, thereby strengthening the sustainability and adaptability of farming systems in the face of climatic variability. The Mbili Mbili intercropping system, promoted in Malawi as a strategy to diversify and intensify crops, demonstrated returns up to 37 percent higher than conventional intercropping practices. This technology has been widely adopted in maize-growing regions across East and Southern Africa, enhancing the productivity and sustainability of farming systems there. The incorporation of rice and maize in Bangladesh led to greater diversification and intensification of mixed farming systems and greater resource use efficiency. This approach doubled system productivity compared to traditional practices, while contributing to food security and providing feed resources for livestock and aquaculture. In Nepal, the co-evaluation of irrigation water lifting and application technologies from various water sources enhanced year-round agricultural productivity. These innovations allowed farmers to irrigate their fields efficiently and facilitated the cultivation of vegetables and high-value crops while improving water resource management. In Laos, the rapid expansion of cassava and cattle markets- driven by government policies and incentives to promote commercial agriculture, improve farmer linkages to markets, and meet growing international demand- is driving the conversion of mixed farming systems. While this conversion provides income and economic opportunities for farming communities, it also has negative impacts on ecosystem services, including soil fertility, erosion control, grazing access, and watershed protection. To mitigate environmental and agroecosystem degradation, efforts have focused on strengthening farmers' technical and innovation capacities, co-designing supportive policies and regulations, and promoting resource management. All of the solutions to date have been characterized by relevant complementary innovations, such as small-scale mechanization, strengthened farmer organizations, and improved approaches to market access, that can promote sustainable intensification in these fragile systems.

WP4: Advancing and supporting the scaling of innovations



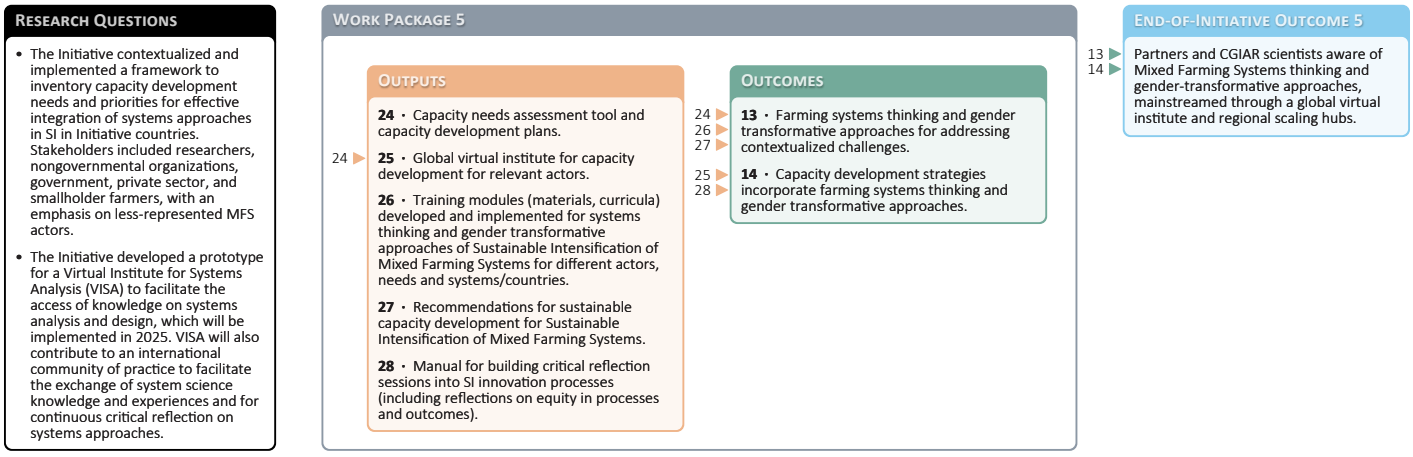
Work Package 4 progress against the theory of change

MFS scaling efforts are guided by the CGIAR Innovation Packaging and Scaling Readiness framework. Given that bundling innovations and paying attention to gender transformative considerations are critical for achieving the goals of the Initiative, WPs 2, 3, 4, and 5 developed a methodological guide that teams adapted to design, profile, and develop scaling strategies for innovations. Thus guided, the team developed profiles of 56 innovations (12 in 2022, 19 in 2023, and 25 in 2024), with 61 percent of these being technical innovations and the remainder focused on policy and capacity development. Approximately 60 per cent of these innovations made a significant contribution to one or more of CGIAR's Impact Areas and 52 percent had a scaling rea diness score of 5 or higher. Regarding scaling use, 8 innovation packages — with a total of 1,706 users (40 percent women) — were used in 4 countries. Most of the innovations, however, had low scaling readiness and moderate scalability due to key constraints in the enabling environment. One key focus area was the commercialization of forage seed businesses in the mixed farming systems of the Ethiopian highlands. In Nepal, four packaged innovations aimed at improving agricultural productivity and sustainability by enhancing water use efficiency through micro-irrigation practices, introducing high-value fruit trees to diversify household income and nutrition in mid-hill smallholder farming systems, promoting improved Napier fodder for mixed farming systems, and establishing an inclusive multi-stakeholder knowledge sharing platform for farmers and relevant stakeholders. In Malawi, the innovation packaging effort centered on Mbili Mbili and doubled-up legume for crop diversification and resilience, while in Ghana the focus was on optimizing fertilizer timing, utilizing cowpea as a living mulch, and implementing leaf stripping to intensify smallholder maize-livestock systems.

We used the SIAF framework to inform decision-making on MFS intensification in the different countries and developed a prototype digital platform for building the capacity of beneficiaries in the different countries.

The WP assumptions held. For instance, in all the focus countries, participatory engagement with relevant actors progressed well, as exhibited during Innovation Packages and Scaling Readiness workshops and subsequent engagements. From 2022 to 2024, we collaborated with 113 scaling partners in the 6 target countries — Bangladesh, Ethiopia, Ghana, Lao PDR, Malawi, and Nepal.

WP5: Capacity building for MFS design and analysis



Work Package 5 progress against the theory of change

Work Package 5 aimed to build capacity for MFS analysis and co-design. It thereby focused on developing capacity in systems approaches for the co-design, implementation, evaluation, and scaling of socio-technical innovation bundles.

The capacity needs of 120 researchers of sustainable intensification and mixed farming systems were assessed in a rapid virtual survey. With these first insights, a generic capacity needs framework was developed to make an inventory of the capacity needs of relevant stakeholders, including national researchers; NGO, government, private-sector actors; and smallholder farmers, with an emphasis on the more under-represented groups. This framework was contextualized for each country targeted by the Initiative and focused on the skills, knowledge, and tools required by different types of actors for the co-design process (Output 5.1). Furthermore, a methodology was developed for assessing the current capacities and skills of the various stakeholders.

In this process, concrete plans (e.g. for Malawi [A, B, C], Bangladesh, Nepal, Laos) were developed to inform how capacity would be strengthened. This involved identifying the individuals or organizations to target; planning interventions, initiatives, and activities; and formulating expected or desired outcomes. A monitoring and evaluation framework was established, including mechanisms to evaluate learning throughout the implementation cycle so as to adapt activities as necessary and allowing continuous critical reflection on processes and outcomes from systems approaches.

Various training modules for capacity development on systems analysis were developed and implemented in the Initiative's countries (e.g., Ethiopia, Ghana), contributing to Output 5.3. Activities involved surveys and included discussions with actors and organizations. Outputs included establishing a baseline regarding the capacity of targeted actors and prioritizing their capacity development needs. In conjunction with the MELIA team, the Initiative continuously monitored its capacity development work.

To identify problems and sustainable and inclusive solutions, access to knowledge on systems analysis and design is needed. For this, a prototype of a Virtual Institute for Systems Analysis (VISA) was developed. VISA contributes to an international community of practice by facilitating the exchange of system science knowledge and experiences and continuous critical reflection on the processes and outcomes of systems approaches. An online structure and the attributes of its different components were developed (Output 5.2). Steps were undertaken to have VISA rolled out in 2025 and taken forward by CGIAR's Sustainable Farming Science Program and Capacity Sharing Accelerator.

Work Package progress rating summary

WORK PACKAGE	PROGRESS RATING & RATIONALE
1	On track All Research questions were elaborated upon, resulting in 65 knowledge products, 17 other outputs, 4 capacity sharing results, 2 innovations developed, and 1 other outcome. Co-production of these results with partners and some targeted training and dissemination resulted in good progress toward outcomes, as documented in the EOIO.
2	On track More than 100 M&Ts and their applications in the 6 target countries were documented. The participation of partners and Centres showed that systems analysis allows interdisciplinary and inter-institutional efforts for the sustainable intensification of mixed farming systems in a great diversity of agroecological and socioeconomic contexts.
3	Delayed The team progressed quite well on community and stakeholder engagement as well as on piloting and testing technical solutions. Bundling and packaging of innovations discussed but could only be piloted at a larger scale in the rice based and cattle systems. More time would allow the team to better explore the sequences of bundled innovations implementation and generate the scientific validation evidence for that.
4	Delayed The team lacked a gender expert for most of the reporting period, which constrained integration of gender transformative dimensions. The hiring of a gender expert provided partial support, only in three out of six countries. Addressing some of the scaling bottlenecks also required more time beyond the three-year cycle of the Initiative. We believe that these will be adequately addressed in the next investment cycle .
5	On track Important advances in Outputs 1 and 2 were made in the respective target countries.

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 Mixed Farming Systems from 2022 to 2024. These results align with the CGIAR Results Framework and Mixed Farming Systems'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 7 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.

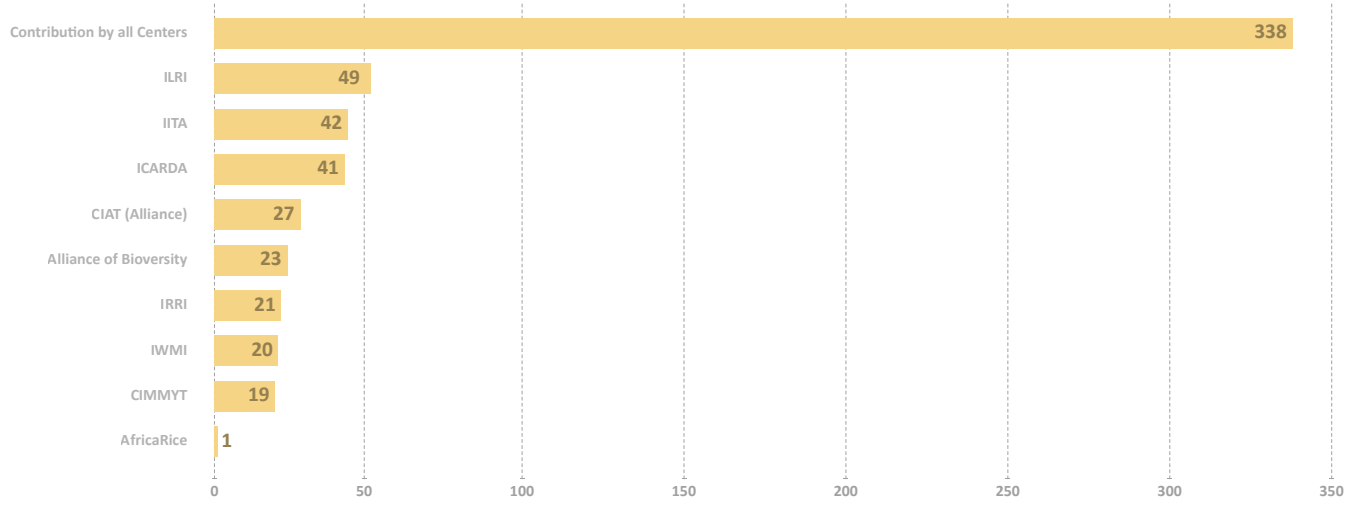
The Initiative's research activities conducted in six countries (Bangladesh, Ethiopia, Ghana, Lao PDR, Malawi, and Nepal) yielded 581 results reported in the Performance and Results Management System (PRMS) of the CGIAR (see graphs below). Approximately 61 percent of the outputs produced were knowledge products, 15 percent focused on innovation development, 14 percent emphasized capacity sharing for development, and 7 percent represented other outputs. Of the Initiative's outcomes, 9 involved innovation use, 2 capacity change, 2 other outcomes, and 1 policy change.

Overview of reported results by category

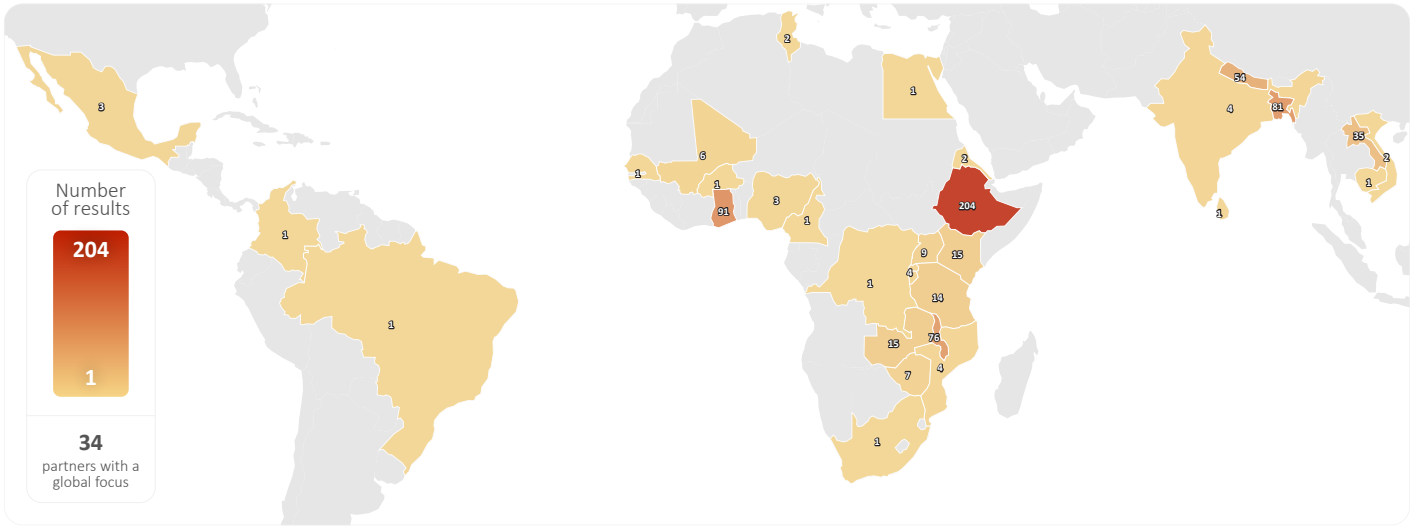
Outputs

Outcomes

Primary Centers contributing to results

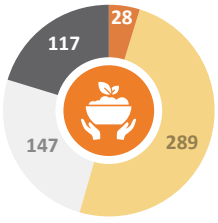


Geographic areas of emphasis



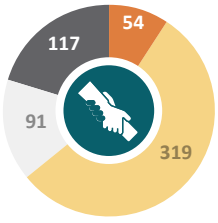
These data provide an overview of the reported results from 2022 to 2024. One result can impact multiple countries and can therefore be represented multiple times. Based on the locations of the CGIAR Centers, the characterization of contributions indicates a slightly higher output contribution from Africa than from Asia. Coordinated efforts were made to create a more balanced Portfolio for Asia, which helped increase outputs from Nepal and Laos PDR.

Contribution of results to CGIAR Impact Areas



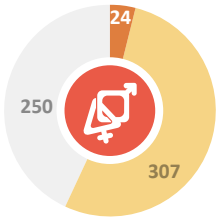
Nutrition, health and food security

581



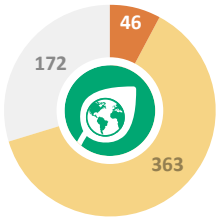
Poverty reduction, livelihoods and Jobs

581



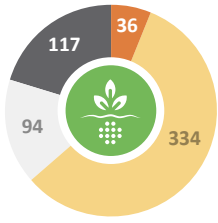
Gender equality, youth and social inclusion

581



Climate adaptation and mitigation

581



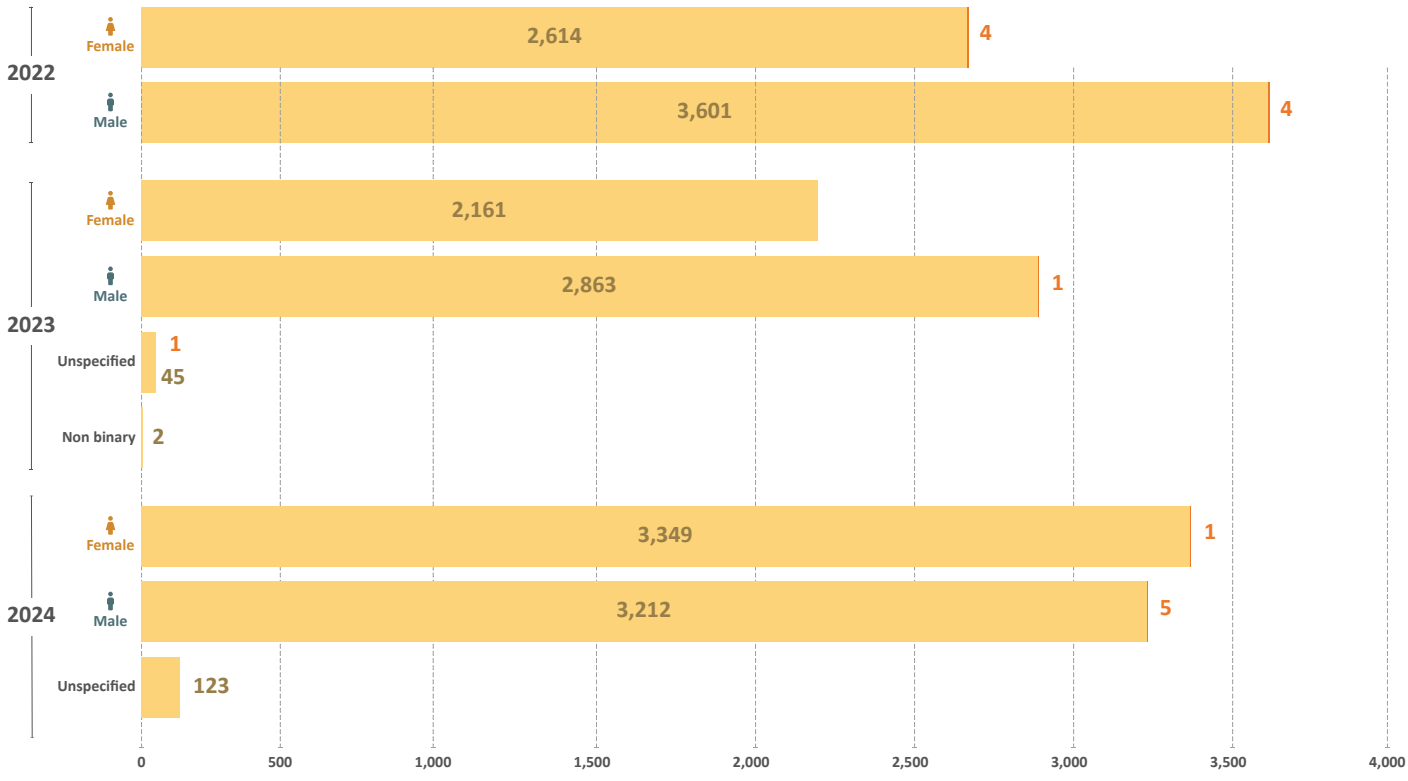
Environmental health and biodiversity

581

- **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.

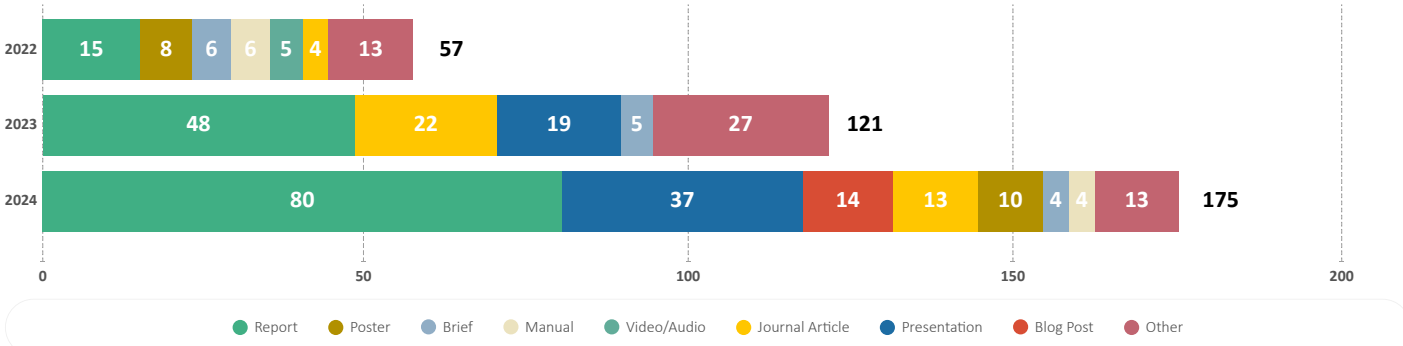
Most of the Initiative's results are tagged to all five Impact Areas.

Number of individuals trained by the initiative



There was a slight increase in the number of short-term trainees during 2024 compared to 2022 and 2023. The number of women trainees was slightly higher than men in 2024. This is an important improvement in women's representation compared to the past two years. The numbers of long-term trainees dropped from 8 in 2022 to just 2 in 2023 and picked up again to 6 in 2024.

Knowledge products by category



The number of knowledge products increased significantly during 2024, compared to 2023 and 2022, the latter of which was the first year of implementing activities. It is anticipated that, with time, journal articles will form the core foundational product from which most of the other knowledge products are derived, such as blogs, technical briefs, and videos. We also expect a spillover of knowledge products into the Portfolio 2025-2030 period.

46-year-old Chansone harvests a wad of forages from their farm's experimental plots in Houayno Village, Luang Prabang..
Credit: Alie Peter Galeon, Alliance Bioversity-CIAT

Farmer, extension officer and researchers standing on Mbili Mbili plot in Malawi.
Credit: Michael Kinyua

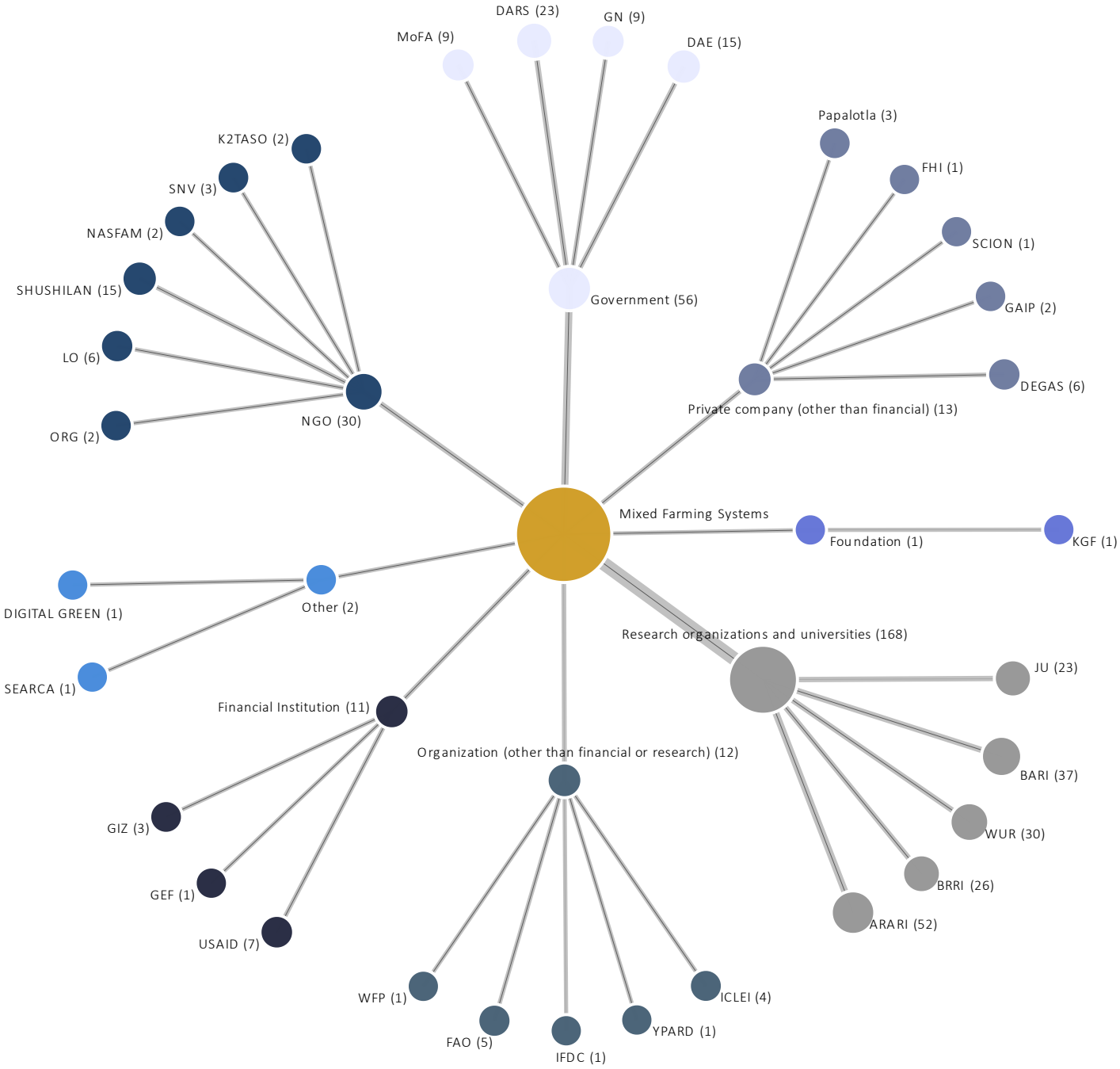
Partnerships and Mixed Farming Systems' impact pathways

The network graph shows that national partners of the MFS Initiative played critical roles and represented about 58 percent of its partnership engagement. The distribution appears related to the presence of CGIAR Centers that readily engage each other. Universities, NARS and government institutions dominated the national partnerships. These partnerships continued to fill the research and scaling staffing that CGIAR Centers requires to implement their TOCs. The external partner engagement highlights a key gap in the low (6 percent) involvement of the private sector in the work conducted. This was expected to grow as products from WP1 and WP2 as well as the socio-technical innovation bundles developed in WP3 increased in number and variety to attract the variable interests of this group.

Partnerships and Mixed Farming Systems' impact pathways. This Initiative's work packages were interlinked through a partnership matrix that operated at different levels depending on the context. For example, WP5 used the knowledge gaps identified by other WPs to develop the capacity of key strategic actors and guide their investments in building capacity in MFS. WP4 had significant NARES involvement linked to WP2 and WP3 and operated within the sphere of scaling. WP3 prioritized, fine-tuned, and validated socio-technical innovation packages for WP4, while WP4 co-designed gender-transformative approaches with the prioritized innovation packages for scaling partners to implement and take beyond the sphere of control into the sphere of influence. WP1 identified entry points for equitable applications of sustainable intensification innovations by identifying emerging opportunities for mitigating negative impacts of change.

Engaging policymakers was critical since their decisions impact both the sphere of influence and the sphere of control. The Initiative continued to facilitate smallholder farmer access to, and scaling of, improved innovations and services through public-private partnerships. This empowers the farmers to implement new practices in MFS not only to achieve greater productivity and more resilient livelihoods but also to develop sufficient local capacity in systems science research.

Network of external partners by type



The diagram maps the external partners of the Mixed Farming Systems Initiative, 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 six partners was applied for each typology. The list of partner acronyms is available here.

Section 6: **CGIAR Portfolio linkages**

The diagram presents the internal collaborations of MFS initiative with other CGIAR Initiatives, Impact Area Platforms. Connections are sized according to the number of shared reported results, highlighting the depth of collaboration across the CGIAR Portfolio. A results threshold filter is applied (set to a minimum of four results) to focus the view on the most significant collaborations. Thicker lines represent stronger collaborative links based on a higher number of shared results.

Portfolio linkages and Mixed Farming Systems's impact pathways

The systemic and interdisciplinary nature of MFS helped to build strong linkages with other CGIAR Initiatives and Platforms, with which MFS co-generated 21 outputs. The most important thematic linkages were built with Sustainable Animal Productivity, Excellence in Agronomy, Livestock and Climate, and Nature Positive Solutions. Also, 80 products were co-generated with the Regional Integrated Initiatives, notably Diversification in East and Southern Africa (Ukama Ustawi), Transforming Agrifood Systems in South Asia, and Asian Mega-Deltas. Because systems analysis conducted at different scales is at the center of the MFS Initiative, an interdisciplinary approach is required to assess and generate innovations for smallholder mixed farming systems. Inputs from several Initiatives that implement component research were therefore needed by MFS. And where the MFS Initiative sites were co-located with other CGIAR Initiatives, staff resources were shared.Internal collaboration network of Mixed Farming Systems Initiative.

Goats shed under the banana plants ta home stead in Kasungu District, Malawi
Credit: Amina Homann

Section 7: **Key result story**

Cropping boosts food and feed security through crop-livestock integration for 5,000 households in Northern Bangladesh

Bangladeshi farmer Dilip Chandra holds rice straws of a short-duration rice variety, BRRI dhan75. The long-duration aman variety in the background is still green. Short-duration rice straw feeds Chandra's cattle earlier in the season and long-duration rice straw later.

Credit: Bappy Kumar, IRRI

Primary Impact Area

Other relevant Impact Areas targeted

Contributing Initiative

Mixed Farming Systems

Contributing Center

International Rice Research Institute

Contributing external partners

Bangladesh Rice Research Institute (BRRI) · Bangladesh Livestock Research Institute (BLRI)

Geographic scope

Regions: South Asia

Countries: Bangladesh

Growing short-duration rice (BRRI dhan75) enables early harvests and extends the availability of rice grain and straw by 30–40 days. This provides farmers with food and feed early in the season and enables them to grow fodder or high-value crops in crop cycles while diversified winter (rabi) crops like maize and pulses provide supplementary livestock feed. These practices improve food and feed availability during the lean period, boosting food security, farm income, livestock productivity, and milk production, the latter by 30–40 percent. This innovation benefited 5,000 farmers through increased crop diversification and crop-livestock interaction.

In northern Bangladesh, *aman* (summer or wet season rice)-fallow-boro (dry season rice) is the dominant cropping pattern, covering over 50 percent of the land. Several non-rice (winter) crops such as maize, mustard, potato, carrots, and fodder can be grown between the two rice crops; their optimal planting time is early November. However, this is only feasible if *aman* rice is harvested before early November. Typically, farmers grow long-duration (130–150 days) *aman* rice varieties, which are harvested after late November, leading to a fallow period or delayed planting of winter crops and reduced yields. Additionally, in October-November, farmers face a critical shortage of livestock feed and fodder due to limited crop straw reserves and late-harvests of *aman* rice, resulting in poor livestock health and low milk production.

An impactful solution is replacing long-duration *aman* rice varieties with short-duration alternatives while utilizing the fallow period for fodder and high-value winter crops. This approach allows farmers to harvest rice earlier, which provides them with food (grain) in the lean period and ensures that feed (straw) is available when livestock feed scarcity peaks, and also enables the timely planting of winter crops.

From 2022 to 2024, the International Rice Research Institute (IRRI), under the auspices of the CGIAR Initiative on the Sustainable Intensification of Mixed Farming Systems, co-designed and co-tested innovation bundles of short-duration *aman* rice varieties in northern Bangladesh. Among these, BRRI dhan75 emerged as the best-performing variety, yielding an average of 5–6 tons per ha of grain and 8–10 tons per ha of fresh green straw. The short-duration *aman* rice growers harvested their rice crop from mid-October to early-November, securing straw for their livestock during the critical feed scarcity period. Some farmers grew green fodder crops such as alfalfa and berseem while others benefitted from livestock grazing the fields after the rice harvest. Moreover, early planted winter crops produced higher forage yields, complementing straw from rice.

Comparing the new *aman* rice (short-duration)-winter crop-*boro* rice cropping system with the traditional *aman* rice (long-duration)-fallow-*boro* rice system, researchers observed a 30–60-percent increase in rice equivalent yield (Figure). By the end of 2024, the project had supported over 5,000 smallholder Bangladeshi farmers with a bundle of services including seeds, training, extension services, mechanization, and market linkages to enhance the intensification and diversification of their rice-based cropping systems.

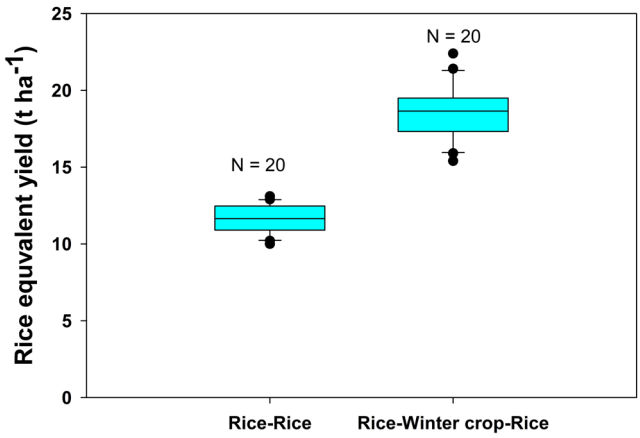
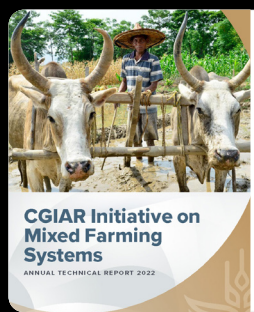


Figure: Rice equivalent yield of rice-winter crop-rice (intensified and diversified systems) compared to rice-fallow-rice (most dominant practice) systems in northern Bangladesh. Crop cut and farmer surveys were done with 20 farmers (N=20).

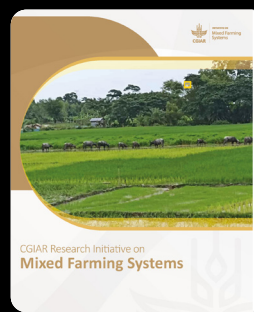
Severe fodder shortages occur in our area during October-November because late-maturing aman rice varieties restrict access to early straw. In 2024, support from the CGIAR Mixed Farming Systems Initiative enabled me to cultivate BRRI dhan75 rice on 50 decimals, which yielded 1,300 kg (1,200 bundles) of green straw with excellent grain yield (1,200 kg). This boosted the milk production of my five cattle by 40 percent; I sold 300 straw bundles to neighbors for a total of USD 15, to neighbors, alleviating their fodder scarcity that season. Additionally, the early rice harvest ensured my family's food security in the lean period, the increased productivity of my livestock improved my family's nutrition, and my farm income increased by 15 percent.

Dilip Chandra, a farmer from Gardharmapal village, Nilphamari District, northern Bangladesh



2022 key result story

Seven CGIAR Initiatives collaborate to develop a common framework for multi-scale systems analysis and target context-specific interventions and investments



2023 key result story

Empowering women and youth

CGIAR

INITIATIVE ON
Mixed Farming Systems

A woman farmer from Rangpur, Bangladesh is threshing her harvested rice, having received short duration Aman rice seeds and training from the Mixed Farming Systems Initiative, she efficiently separates grains from straw.

Credit: Abdul Haque, IRRI