CGIAR

INITIATIVE ON
Transforming Agrifood Systems in South Asia

Transforming Agrifood Systems in South Asia

ANNUAL TECHNICAL REPORT 2022

CGIAR Technical Reporting 2022

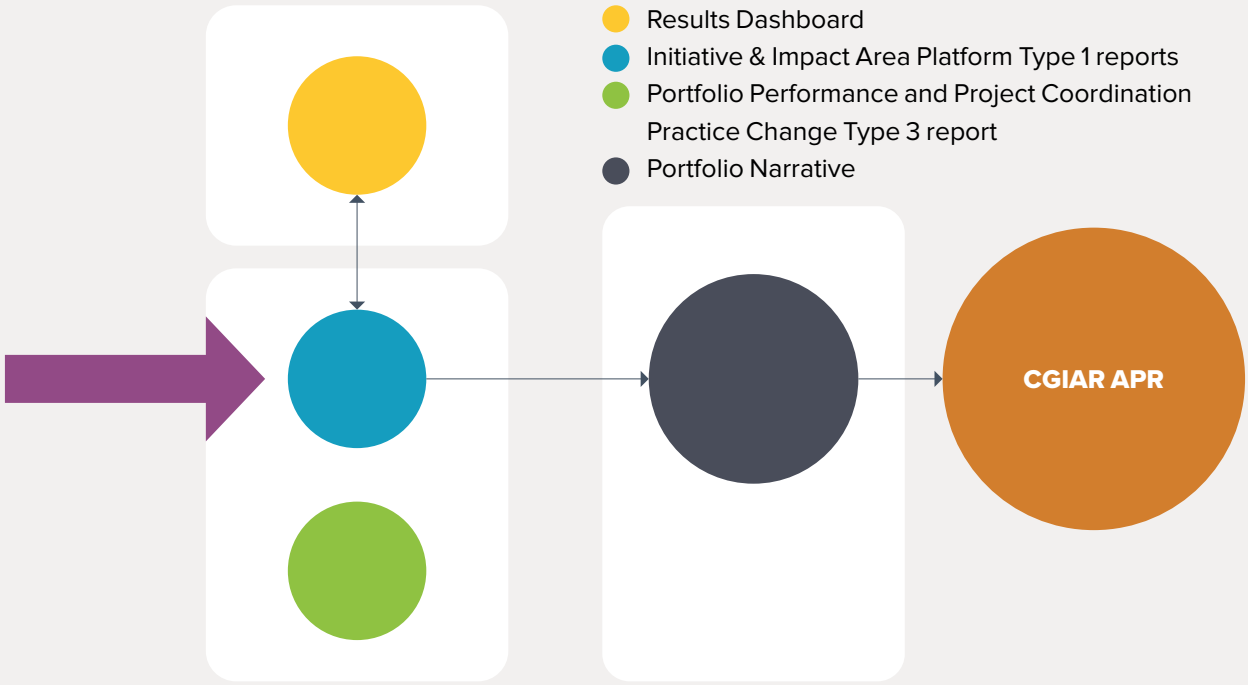
CGIAR Technical Reporting has been developed in alignment with the CGIAR Technical Reporting Arrangement.

This Initiative report is a Type 1 report and constitutes part of the broader CGIAR Technical Report. Each CGIAR Initiative submits an annual Type 1 report, which provides assurance on Initiative-level progress towards End of Initiative outcomes.

The CGIAR Technical Report comprises:

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

The CGIAR Technical Report constitutes a key component of the CGIAR Annual Performance Report (APR).



US$	2022	2023	2024
Proposal Budget from initial submission	US$11,382,678	US$14,103,143	US$14,514,179
Approved 2022 Budget	US$4,242,914		

2022 Disbursement Target based on Approved FinPlan

Section 1 Fact sheet

Initiative name	Transforming Agrifood Systems in South Asia
Initiative short name	TAFSSA
Action Area	Resilient Agrifood Systems
Geographic scope	**Regions targeted in the proposal:** South Asia **Countries targeted in the proposal:** Bangladesh; India; Nepal; Pakistan **Regions with results reported in 2022:** South Asia **Countries with results reported in 2022:** Bangladesh; India; Nepal; Pakistan
Start date	Jan. 1, 2022
End date	Dec. 31, 2024
Initiative Lead	Timothy J. Krupnik – t.krupnik@cgiar.org
Initiative Deputy	Purnima Menon – p.menon@cgiar.org
Measurable three-year End of Initiative outcomes (EOI-Os)	**EOI-O 1:** Governments and other actors take decisions to reduce the environmental footprint of food systems from damaging to nature positive. TAFSSA's partners engage with networks reaching at least 500 stakeholders and decision-makers to inform at least two policies/programs and/or market interventions aiding in agrifood systems transformation.
	EOI-O 2: Data-informed actions supporting agrifood systems are implemented in at least four of TAFSSA's learning locations.
	EOI-O 3: Farmers implement improved farming practices and/or diversify production systems on at least 0.71 million ha
	EOI-O 4: Innovations in entrepreneurial rural service provision markets and public and private extension systems accelerate the uptake of improved farm management practices and production diversification by at least 0.58 million farmers, including 0.20 million women.
	EOI-O 5: Business models supporting farm product aggregation, better pricing for farmers at the farmgate, and/or shortened value chains benefit at least 95,000 farmers (22,500 of whom will be women).
	EOI-O 6: At least two food product supply chains are targeted to reduce food waste and/or financial losses for food distributers, processors, and/or retailers.
	EOI-O 7: At least five local governments engage in efforts to reshape rural food environments to support access to affordable healthy and nutritious food.
	EOI-O 8: At least two nutrition behavior-change programs operated provide evidence-based guidance to consumers on sustainable healthy diets, reaching 0.48 million people (all women).

	EOI-O 9: Gender- and equity-focused nutrition approaches are included in at least two large programs focused on agrifood systems linkages and/or social protection programs.
	EOI-O 10: Farmers implement improved farming practices and/or diversify production averting GHG emissions of 8.12 million t CO2e..
OECD DAC Climate marker adaptation score*	**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*	**Score 1B:** Gender-responsive: On top of the minimum requirements for 1A, the Initiative/project includes at least one explicit gender equality outcome, and the Initiative/project team has resident gender expertise or capacity. The Initiative/project includes gender equality indicators and monitors the participation of and differential benefits for diverse men and women.
Website link	https://www.cgiar.org/initiative/20-transforming-agrifood-systems-in-south-asia-tafssa/

*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.
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.

Rabeya, a farmer in Dinajpur, Bangladesh transplants rice as part of participatory action research and social-agronomic experiments examining the consequences of crop diversification on nutrition, income generation, and climate change adaption and environmental goals.
Photo credit: Abdul Momin

Section 2 Initiative progress on science and towards End of Initiative outcomes

Dr. N A Siddiqui of the Bangladesh Institute of Research and Training on Applied Nutrition leads a discussion with farmers on agriculture, nutrition, and environmental stewardship as part of TAFSSA trials in Dinajpur, Bangladesh'
Photo credit: Abdul Momin

Overall summary of progress against the theory of change

Home to one-quarter of humanity — one-fifth of whom are youth — South Asia has the world's largest concentration of poverty and malnutrition. The region's agrifood systems face formidable poverty reduction, social equity, climate change, and environmental challenges in providing an adequate and affordable supply of the diverse foods required for sustainable healthy diets. The CGIAR Regional Integrated Initiative Transforming Agrifood Systems in South Asia (TAFSSA) responds directly to these challenges.

TAFSSA delivers a coordinated program of research and engagement across the food production to consumption continuum to support equitable access to sustainable healthy diets, improve farmers' livelihoods and resilience, and conserve land, air, and groundwater resources. TAFSSA's progress in 2022 is summarized below, with key outputs available here.

Progress in applied research for development

Taking a regional and nationally based approach, TAFSSA's research is systems-based and grounded in the principle that transforming agrifood systems requires trans-disciplinary collaborations. TAFSSA generates global, regional, and nationally relevant public goods that advance more sustainable agrifood systems.

Vegetables on sale in a market surveyed by TAFSSA researchers in Photo credit: Rangpur, Bangladesh.

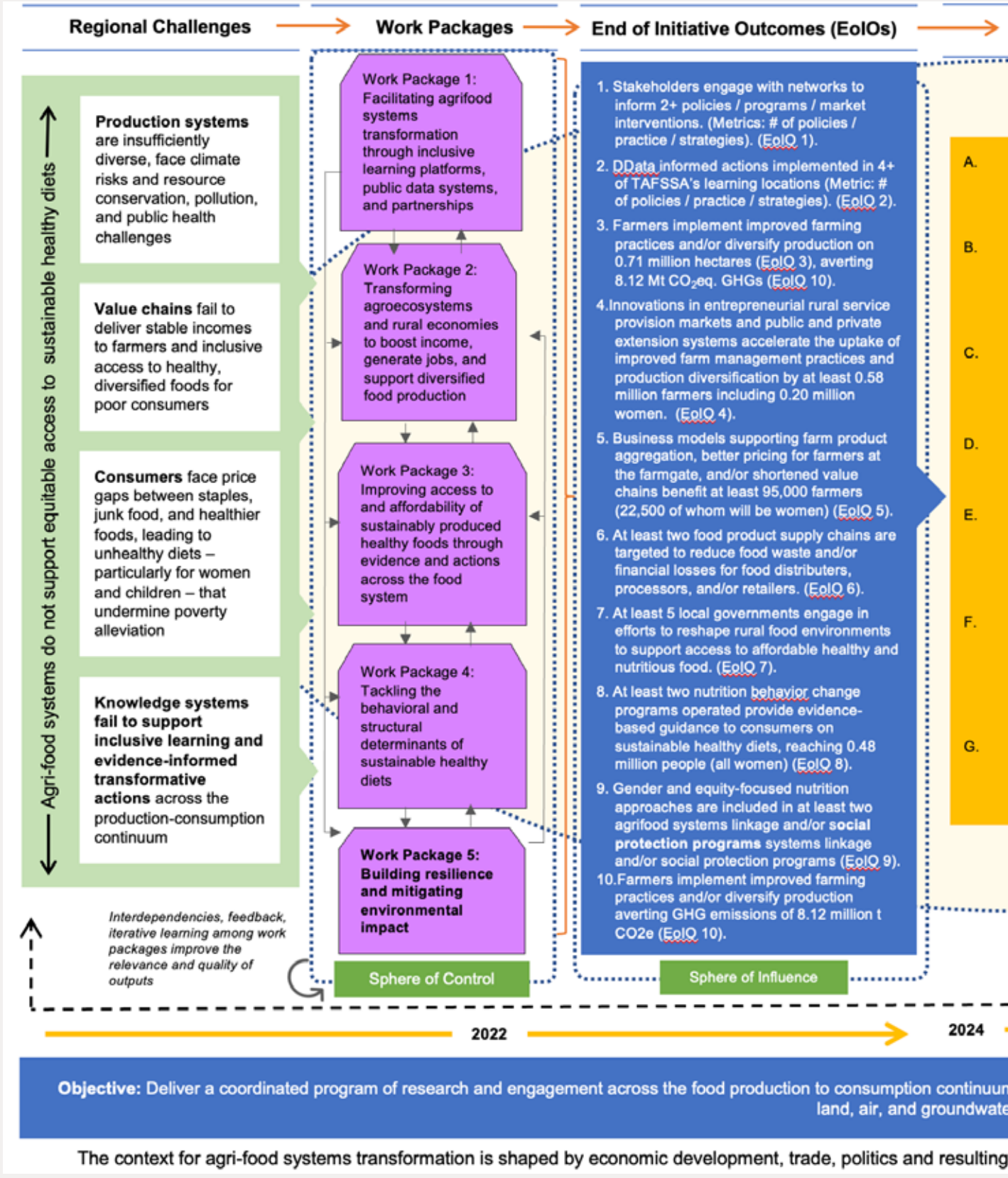
Major scientific highlights from 2022 include:

- Co-design, with public and private stakeholders, of an integrated and multidisciplinary agrifood systems assessment providing evidence on opportunities and barriers to agrifood systems transformation.
- Partnering with new national research and extension institutes in Bangladesh, development of nutrition-sensitive agricultural research including participatory social-agronomic experimental design and management by 700 farmers.
- Building on data generated from farmer-led social-agronomic experiments, TAFSSA's hydrological modelers are studying the implications of current and future climates on groundwater sustainability under different cropping systems.
- Responding to research gaps linking agricultural zoning planning to nutrition, TAFSSA developed preliminary regional-scale maps of spatial patterns in the production of nutrients and vitamins for sustainable, healthy diets.
- Linking farmers to markets, TAFSSA developed and expanded research-based business models supporting Small Farmer, Large Field groups diversifying production.
- Responding to demand to better characterize opportunities to improve nutrition for the poor, a scoping review of behavior change communication research to reduce unhealthy food consumption in South Asia was initiated .
- Addressing links between climate and water management, TAFSSA generated high-profile publications in journals including Science and Nature.
- Overcoming natural resources management data gaps, TAFSSA partnered with the Government of Nepal to release a new digital groundwater sustainability monitoring tool.
- To inform policy, historical studies of agrifood systems in Nepal and India were released by TAFSSA .
- In a cross-CGIAR Initiative partnership with research institutes in Bangladesh, TAFSSA completed research on climate stresses for livestock, with data incorporated into a climate information service tool, widely used by extension services.
- TAFSSA documented its work through 74 peer-reviewed research notes and protocols, and extension publications generated by TAFSSA.

TAFSSA's efforts integrate eight CGIAR Centers. Nearly 75% of TAFSSA's team of 80-plus scientists are of South Asian descent and/or are long-term regional residents. The Initiative collaborates with over 160 partners in activities aligned with the Initiative's theory of change, testing multiple pathways to impact towards End of Initiative outcomes (EOI-Os).

Initiative-level theory of change diagram

This is a simple, 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.



EOI — End of Initiative outcome

AA — Action Area

IA — Impact Area

SDG — Sustainable Development Goal

Nutrition, Health, and Food Security

Poverty Reduction, Livelihoods, and Jobs

Gender Equality, Youth, and Social Inclusion

Climate Adaptation and Mitigation

Environmental Health and Biodiversity

Teams from CGIAR's three Action Areas — System Transformation, Resilient Agrifood Systems and Genetic Innovation — worked to develop an improved set of Action Area outcomes in October 2022. Since this was near the end of the reporting cycle for 2022, it was decided not to update the theories of change based on these new Action Area outcomes.

The exception to this is Genetic Innovation — for this Action Area, as the new outcomes had already been widely discussed among the relevant Initiatives, and with its advisory group of funders and other stakeholders, the decision was made to update their outcomes in time for the 2022 reporting cycle.

Progress by End of Initiative outcome[1]

EOI-O 1 **Partners co-develop knowledge systems and engage with networks reaching 1,000 stakeholders and decision-makers to inform at least two policies/programs/ market interventions supporting agrifood systems transformation.**	In 2022, TAFSSA completed a multi-stakeholder engagement strategy and used its convening power to bring together 160 regional, national and sub-national partners in Bangladesh, India, Nepal and Pakistan to affect discourse, practice and policy shaping. Two major regional conferences (Delivering for Nutrition and Affordability of Nutritious Diets) brought together over 1,000 trans-disciplinary experts to share research and chart actions and plans to overcome challenges to resilient food systems, such as the shock caused by the COVID-19 pandemic, and sustainable healthy diets.
EOI-O 2 **Data-informed actions supporting agrifood systems are implemented in at least four of TAFSSA's learning locations.**	TAFSSA is supporting partners and stakeholders to take data-informed actions transforming agrifood systems in South Asia by: first, completing a new data assessment identifying gaps and charting actions to improve dietary data; and second, co-designing, with partners, new and innovative approach to rapid integrated agrifood systems assessment piloted in five locations across South Asia. This assessment provides diagnostic data to identify opportunities to diversify agrifood systems, deliver healthy diets, and improve environmental sustainability. Finally, TAFSSA generated empirical insights on dietary challenges in India from public datasets.
EOI-O 3 **Farmers implement improved farming practices and/or diversify production systems on at least 0.71 million hectares.**	Throughout 2022, TAFSSA led research in Bangladesh on climate services. Engaging with complementary Initiatives and national research and extension partners, 7,078 field-level extension agents working with farmers gained access to real-time, high-resolution climate adaptation and farm advisories for crops and aquaculture, and in a new innovation in Bangladesh, for livestock. Research on crop diversification in Bangladesh and India informed extension and supported policy efforts, encouraging a shift from rice toward less water-consumptive and more profitable crops. Farmers intensified their crop management practices and diversified production on more than 35,930 ha in TAFSSA's focus countries. Analysis and documentation of the GHG mitigation benefits of these efforts is ongoing; research built on new and existing datasets was also documented in over 70 publications.

1 TAFSSA's EOI-Os were adjusted in Quarter Two of 2022 to better reflect available budgets relative to the proposed aspirational budget

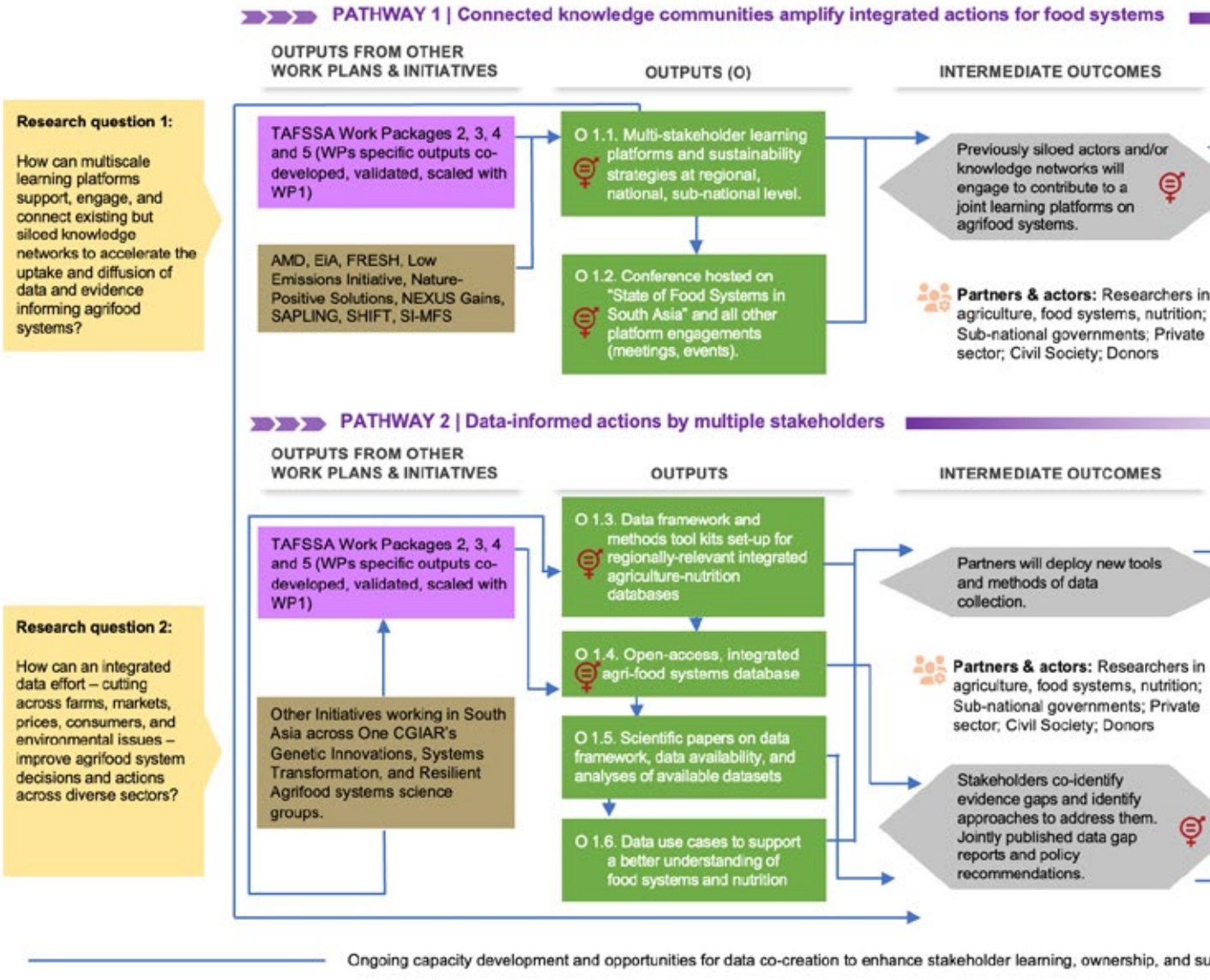
EOI-O 4 **Innovations in entrepreneurial rural service provision markets and public and private extension systems accelerate the uptake of improved farm management practices and production diversification by at least 0.58 million farmers, including 0.20 million women.**	Leveraging public and private sector partnerships to facilitate increased farm machinery services access among smallholder farmers, TAFSSA helped complete 112 farmer, machinery owner, mechanic, and machinery retailed business service linkage events, involving 23 partners across South Asia. TAFSSA also raised capacity of 722 businesses. Together with complementary non-pooled projects, national research, farm machinery, and private finance partners, TAFSSA generated insights supporting four public–private partnerships, influencing more than 0.71 million farmers (19% women) to improve management practices and diversity production. Farmers and business also generated or received US$2.41 million of income or finance, respectively. Data supporting these outcomes was documented in research on mechanization for land leveling, and in wheat and rice-maize cropping systems.
EOI-O 5 **Business models supporting farm product aggregation, better pricing for farmers at the farmgate, and/or shortened value chains benefit at least 95,000 farmers (22,500 of whom will be women).**	TAFSSA intervened in value chains to improve farmers' profits and reduce costs for consumers purchasing more nutritious foods in 2022. In Odisha and Bihar in India, TAFSSA empowered women and mobilized 15,000 farmers in Small Farmer, Large Field groups cultivating potato, rice, wheat, maize, chickpea, mustard, vegetables, and millet more profitably. In Bangladesh, action research with 49 farmer groups, processors, and traders of pulses, vegetables, and oil seeds piloted business models involving 1,168 farmers. TAFSSA also leveraged partnerships with market development projects and 12 seed and post-harvest milling companies. In total, 695 tons of premium quality and biofortified rice seed were sold to farmers which — through business models co-developed by TAFSSA — resulted in cultivation by 115,892 farmers in Bangladesh.
EOI-O 6 **At least two food product supply chains are targeted to reduce food waste and/or financial losses for food distributers, processors, and/or retailers.**	Addressing food waste and financial losses, TAFSSA launched research in India and Bangladesh developing value stream maps of key vegetable, fish, and cereal food supply chains. Collaborating with other Initiatives, TAFSSA is exploring innovations in block-chain technology to reduce food loss in India and Bangladesh. The Initiative also commenced research calculating food and financial losses from vegetable, fish, and cereal supply chains.

EOI-O 7 **At least five local governments engage in efforts to reshape rural food environments to support access to affordable healthy and nutritious food.**	Partnering to collect first-of-a-kind data on food environments and markets, TAFSSA is engaging district-level governments in Nalanda in Bihar (India), and in Chapainawabganj, Rajshahi, Rangpur, and Dinajpur (Bangladesh). In 2022, 246 rural markets and 2,843 food retailers were surveyed in food market censuses to characterize food environments. Stakeholders were engaged to validate preliminary foodshed travel-time surface maps for processed and unprocessed foods in Nalanda. Maps will support district-level planning of cultivation, collection, processing, and marketing of more sustainably produced nutritious foods.
EOI-O 8 **At least two nutrition behavior-change programs operated provide evidence-based guidance to consumers on sustainable healthy diets, reaching 0.48 million people (all women).**	In 2022, TAFSSA launched research on dietary intakes, sources of foods, and linkages between consumers, markets, and food production through an integrated agrifood systems assessment. Data will generate "plate-to-farm" analyses tracing food from consumers through value chains. Working with the Drivers of Food Choice program, TAFSSA is assembling a methods toolkit to improve understanding of healthy and unhealthy food purchase decisions. TAFSSA also engaged the USAID-backed Suaahara project in Nepal, the International Centre for Diarrhoeal Disease Research (iccdr,b) in Bangladesh, the National Institute of Nutrition (India) and Aga Khan University (Pakistan) on a scoping review on nutrition behavior change communication.
EOI-O 9 **Gender- and equity-focused nutrition approaches are included in at least two large programs focused on agrifood systems linkages and/or social protection programs.**	During 2022, TAFSSA built on the Agriculture, Nutrition, and Gender Linkages (ANGeL) project to co-develop, together with national research partners in Bangladesh, innovative approaches to nutrition-sensitive programming in social-agronomic experimentation. New intra-household data collection methods were piloted to strengthen gender and equity insights from the Initiative's integrated agrifood systems assessment. A regional convening on the affordability of nutritious diets helped connect more than 200 stakeholders to reshaping efforts on improving diets. TAFSSA also initiated research on social safety nets and diets.
EOI-O 10 **Farmers implement improved farming practices and/or diversify production systems on at least 0.71 million ha (from EOI-O 3), averting GHG emissions of 8.12 million tCO2e.**	Research published in 2022 on carbon sequestration, energy-efficient rice-wheat crop production, and the ways in which adapted conservation agriculture practices can lower yield-scaled greenhouse gas emissions addressed opportunities to mitigate agricultural greenhouse gasses in South Asia.

A vegetable market surveyed by TAFSSA scientists in Nalanda, Bihar

Section 3 Work Package-specific progress

Work Package 1:
Facilitating agrifood systems transformation through inclusive learning platforms, public data systems, and partnerships

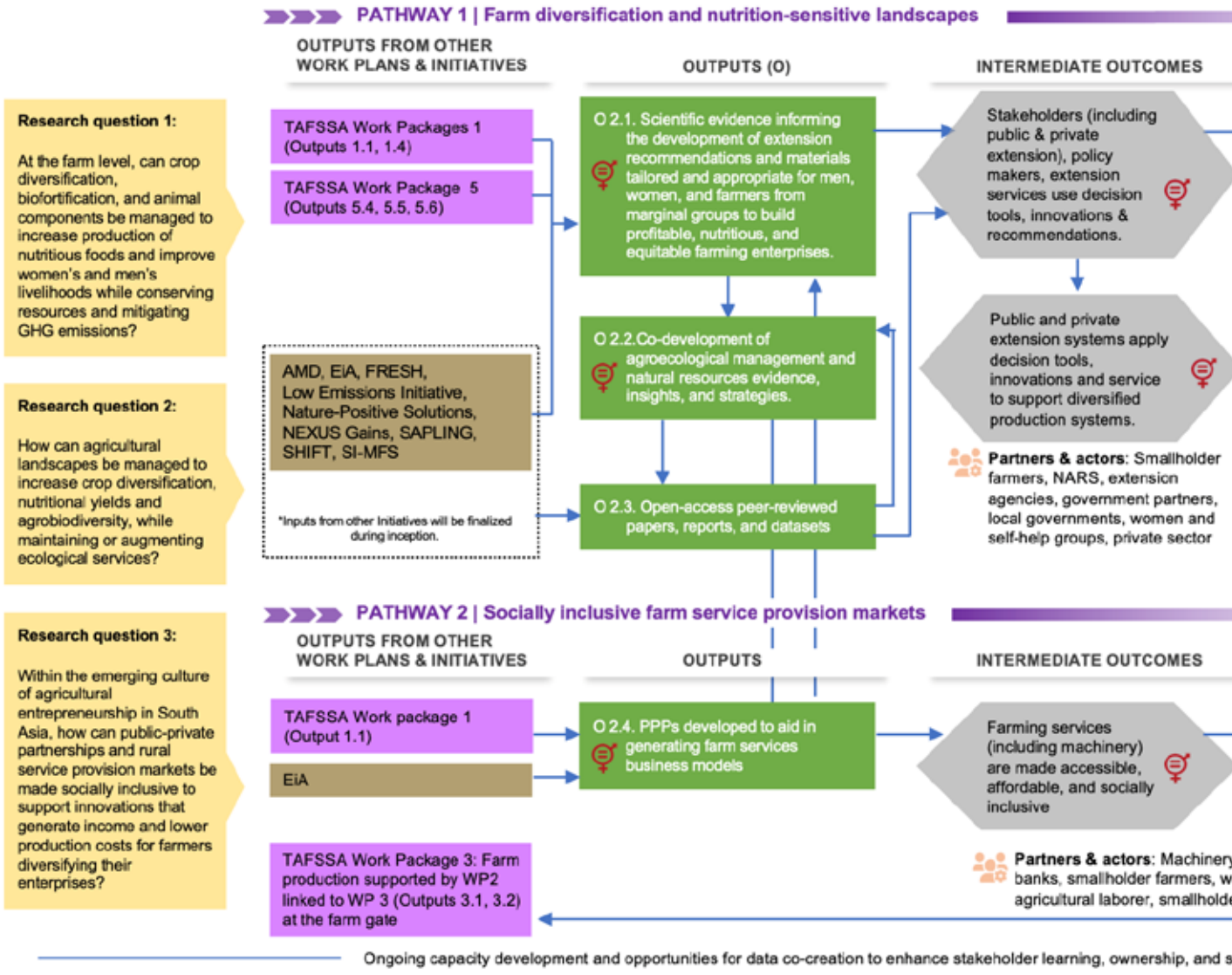


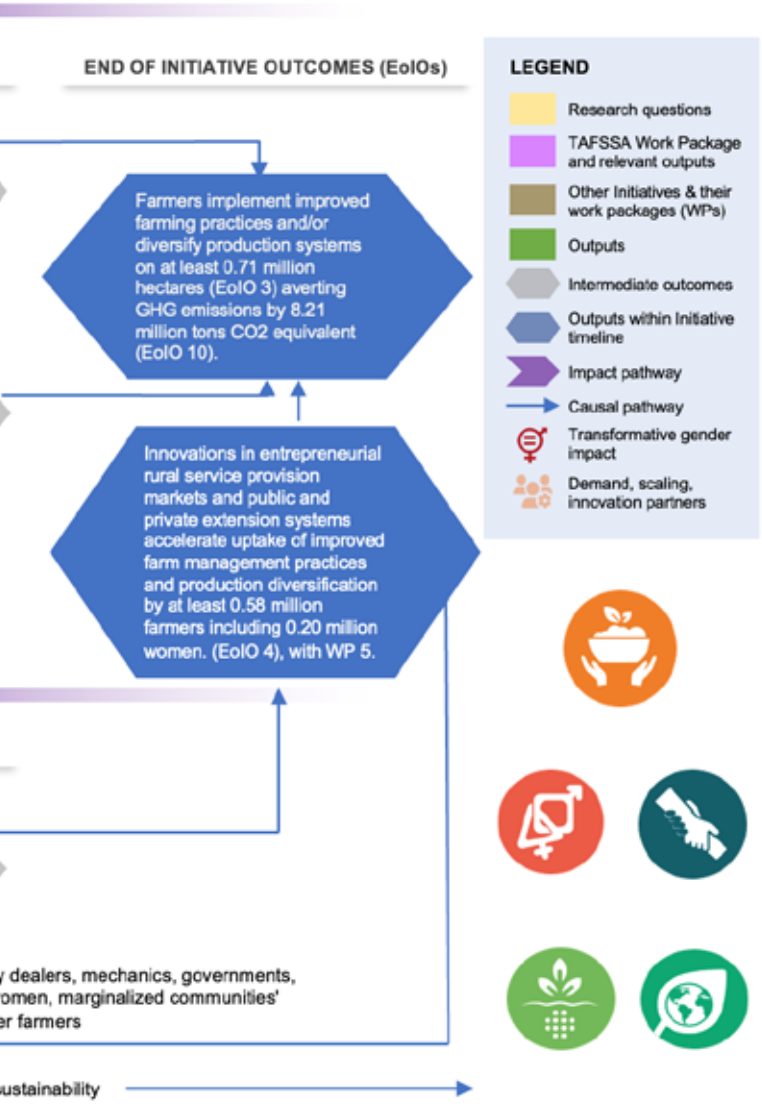
Work Package 1 progress against the theory of change

TAFSSA's Work Package (WP) 1 is cross-cutting. It engages existing but currently siloed knowledge networks to accelerate evidence use toward more sustainable and equitable agrifood systems. WP1's first impact pathway connects knowledge communities to amplify integrated food system actions. Building on TAFSSA's multi-stakeholder engagement strategy, WP1 engaged with 160 partners across Bangladesh, India, Nepal, and Pakistan . Engagements kick-started research toward a more vibrant constituency for evidence-based decision-making. WP1 also co-organized two inter-disciplinary conferences (Delivering for Nutrition and Affordability of Nutritious Diets), engaging over 1,000 stakeholders.

WP1's second impact pathway supports data-informed actions by multiple stakeholders. Consultations with researchers, policymakers, and agrifood system actors were held to co-design comprehensive, gender-sensitive, district-level agrifood systems assessments and survey instruments. Instruments are contextually adapted from the High Level Panel of Experts (HLPE) on Food Security and Nutrition Food Systems Framework. Surveys utilize a farm-to-plate approach, including modules on intra-household consumption, production, value chains and markets, climate change adaptation, and natural resources. New tools developed by TAFSSA were used to collect data on diets and gendered and age group specific choices, actions, and aspirations from women, men, boys, and girls, underway in five districts in Bangladesh, India and Nepal, with plans for Pakistan in 2023.

Work Package 2:
Transforming agroecosystems and rural economies to boost income, generate jobs, and support diversified food production





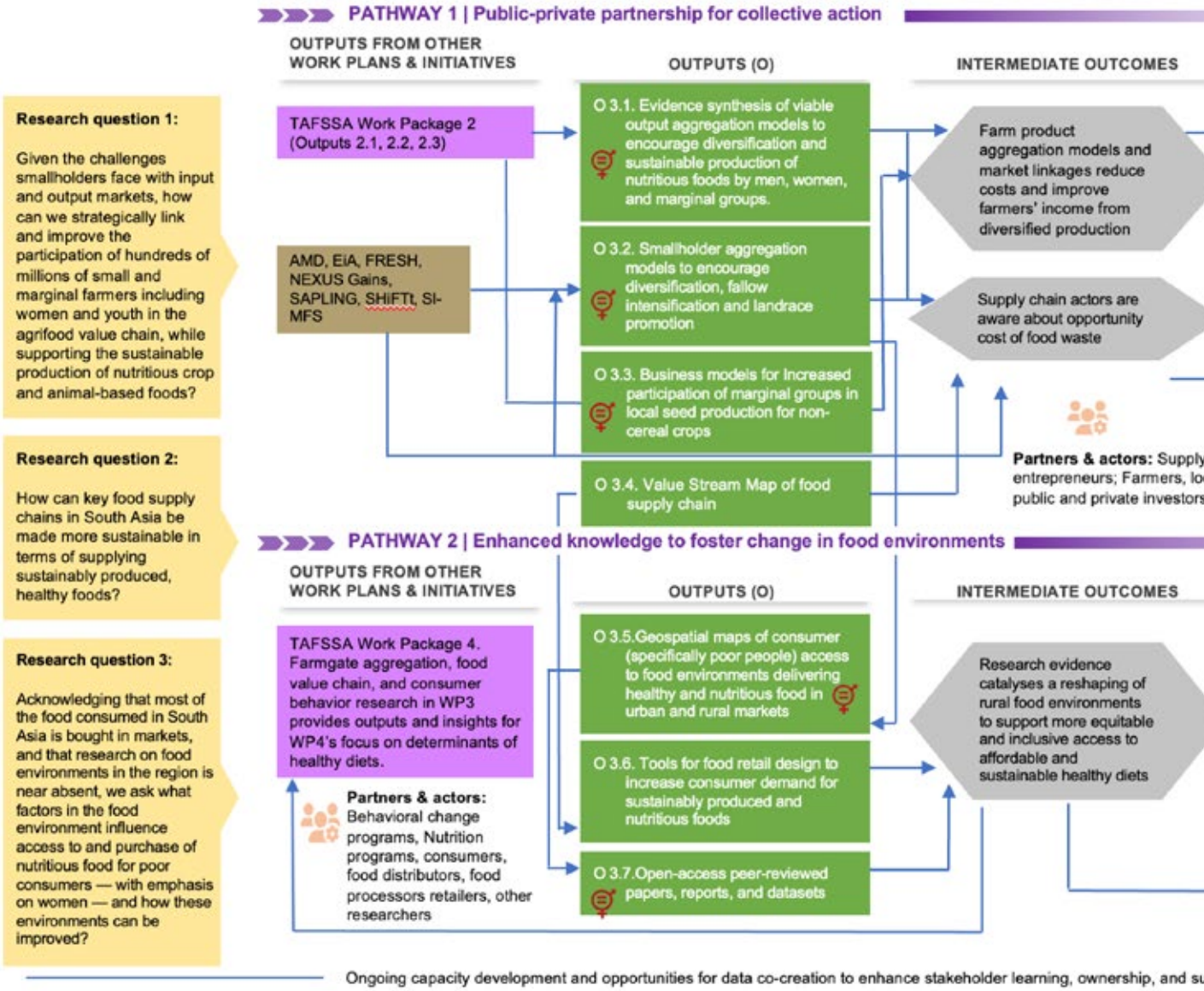
Work Package 2 progress against the theory of change

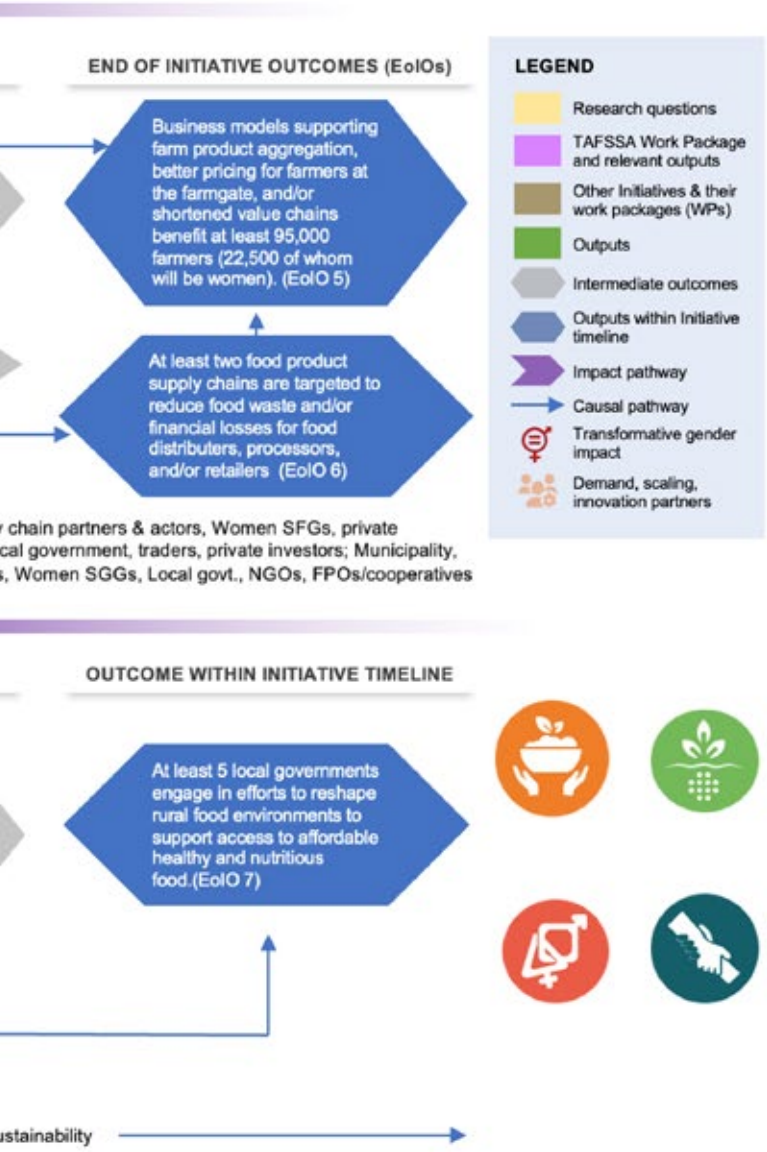
Focused on hotspots of poverty, malnutrition, and environmental degradation, WP2 generated 20 innovations in 2022, with 6 utilized by stakeholders. WP2's first impact pathway develops socially inclusive options improving the production of diverse, profitable, and nutritious foods. TAFSSA collaborated with the Indian Council of Agricultural Research (ICAR), the Bangladesh Agricultural Research Institute (BARI), the Bangladesh Wheat and Maize Research Institute (BWMRI), and the Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN) in 2022, to establish 20 living laboratories in which farmers are actively involved in designing research and managing experiments. A total of 700 households (including husbands and wives) designed diverse cropping systems evaluated in farmer-managed experiments that integrate innovations in nutrition and market training. Experiments will continue into 2024, completing at least two crop rotations, with data utilized by BIRTAN and the Department of Agricultural Extension (DAE) to inform agricultural policy and extension design.

Research is generating data to model the consequences of changing cropping patterns on groundwater sustainability under current and future climates. TAFSSA also addressed landscape-level agrobiodiversity management and developed preliminary regional-scale maps that will depict patterns in nutrient and vitamin production from cropping systems.

The Initiative supported four public–private partnerships generating innovations in rural entrepreneurship as part of WP2's second impact pathway on socially inclusive farm service provision markets. Research and development collaborations with the Cereal Systems Initiative in South Asia (CSISA), BARI, and seven farm machinery and three finance companies contributed to 50,839 farmers (16% women) on 26,188 ha diversifying their farms and/or intensifying their land preparation, crop establishment, irrigation, and harvesting practices using efficiency-enhancing farm machineries. Additionally, out-scaling of extension information supported by TAFSSA contributed to farmers' innovation use on 9,742 ha. WP2 research was documented in 27 peer-reviewed papers, 6 research notes and technical publications, and several extension materials.

Work Package 3:
Improving access to and affordability of sustainably produced healthy foods through evidence and actions across the food system



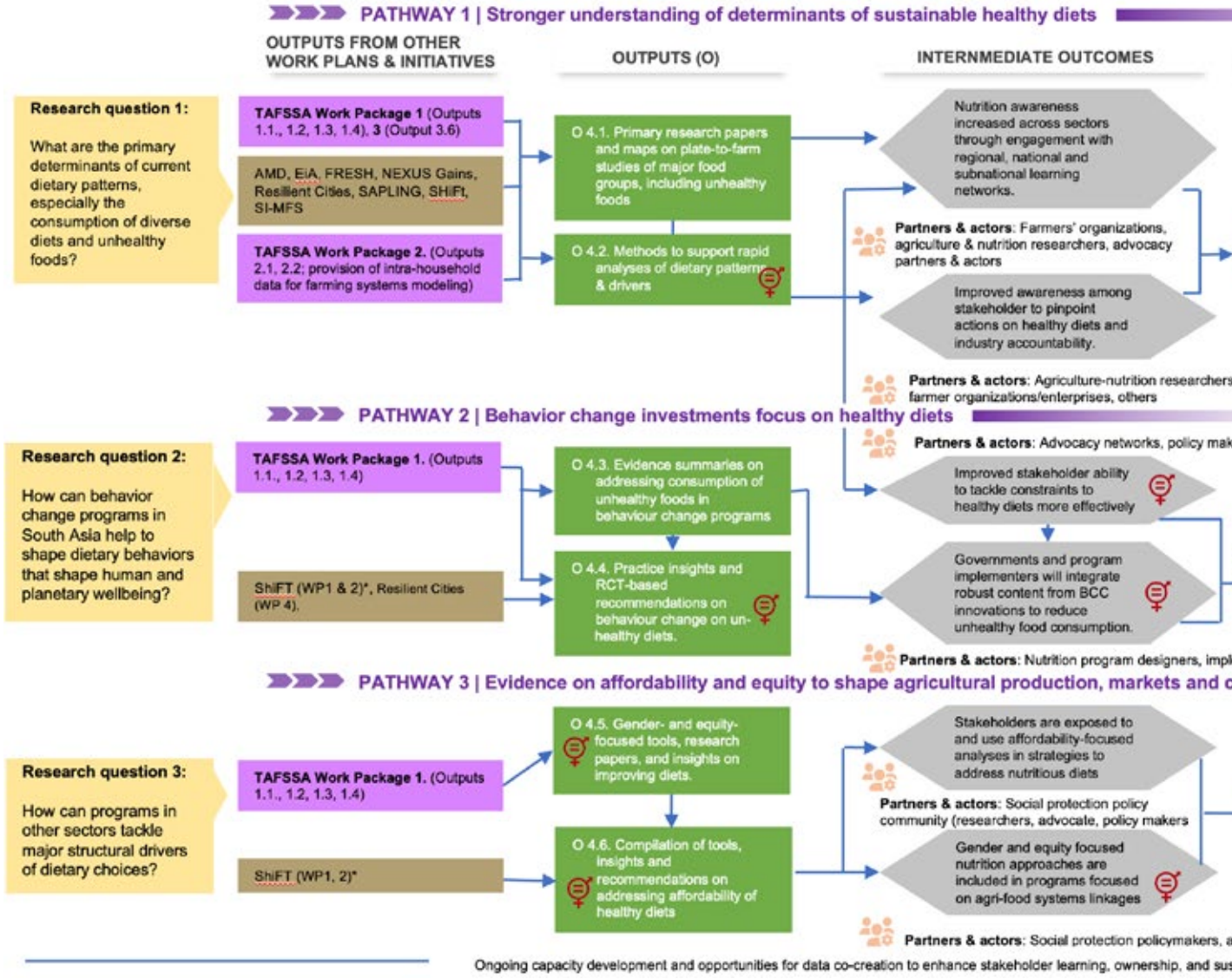


Work Package 3 progress against the theory of change

Docking with WP2 at the farm gate, WP3 improves access to, and the affordability of, sustainably produced nutritious foods. Its first impact pathway focuses on public–private partnerships for collective action. TAFSSA contributed to finalizing research published in 2022 and kick-started Small Farmer, Large Field (SFLF) business models in Bihar, Assam, and Odisha in India. In total, 15,000 farmers have joined SFLF groups with approximately 30% women's membership. Farmers are now equipped with better access to farm inputs and machinery services, aiding in production diversification, with 200% average profit increases.

Ongoing research in WP3's second impact pathway fosters food environment change by addressing diverse farm product marketing issues, with emphasis on more sustainably grown legumes, oilseeds, vegetables, fish, and premium quality and biofortified rice (PQBR) varieties. TAFSSA partnered with CSISA in 2022, facilitating the sale of 695 tons of PQBR seed by 12 companies in Bangladesh. A total of 105,462 male and 10,430 female farmers subsequently grew PQBR on 23,178 ha; these approaches will be further scaled in 2023–2024. Collaborating with district governments in India and Bangladesh, TAFSSA also initiated value chain mapping research for these foods, including comprehensive market surveys of 2,843 food retailers in 246 markets, which — for the first time in South Asia — provide data on linkages between production and consumption in Bihar (India) and Chapainawabganj, Rajshahi, Rangpur, and Dinajpur (Bangladesh). Partners also validated preliminary foodshed travel-time maps for processed and unprocessed foods in Nalanda (Bihar, India). Maps support local governments to identify options improving cultivation, collection, processing, and marketing. Collaboration with CGIAR's Digital Initiative is also under way exploring block-chain technologies to limit food waste.

Work Package 4:
Tackling the behavioral and structural determinants of sustainable healthy diets



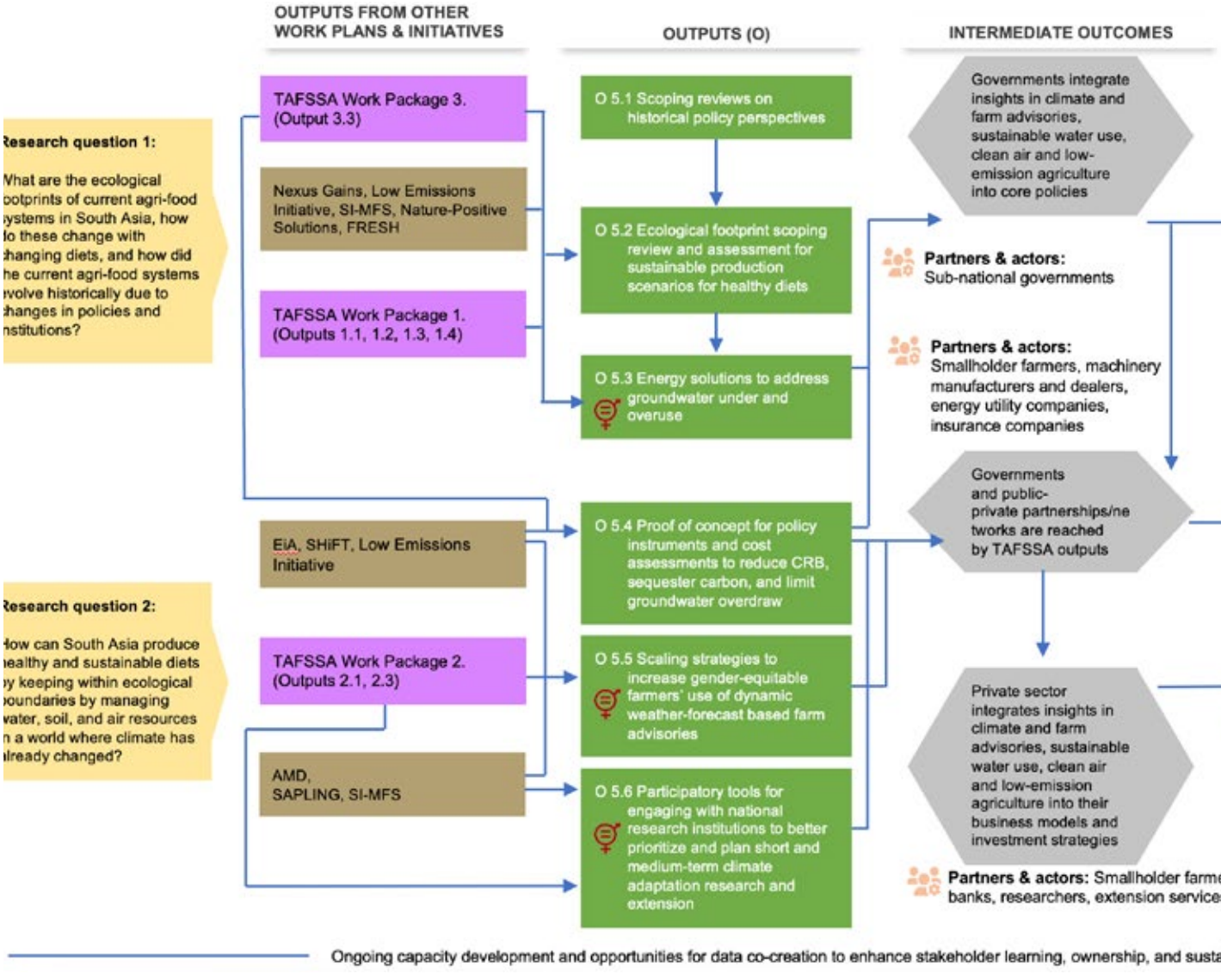
Work Package 4 progress against the theory of change

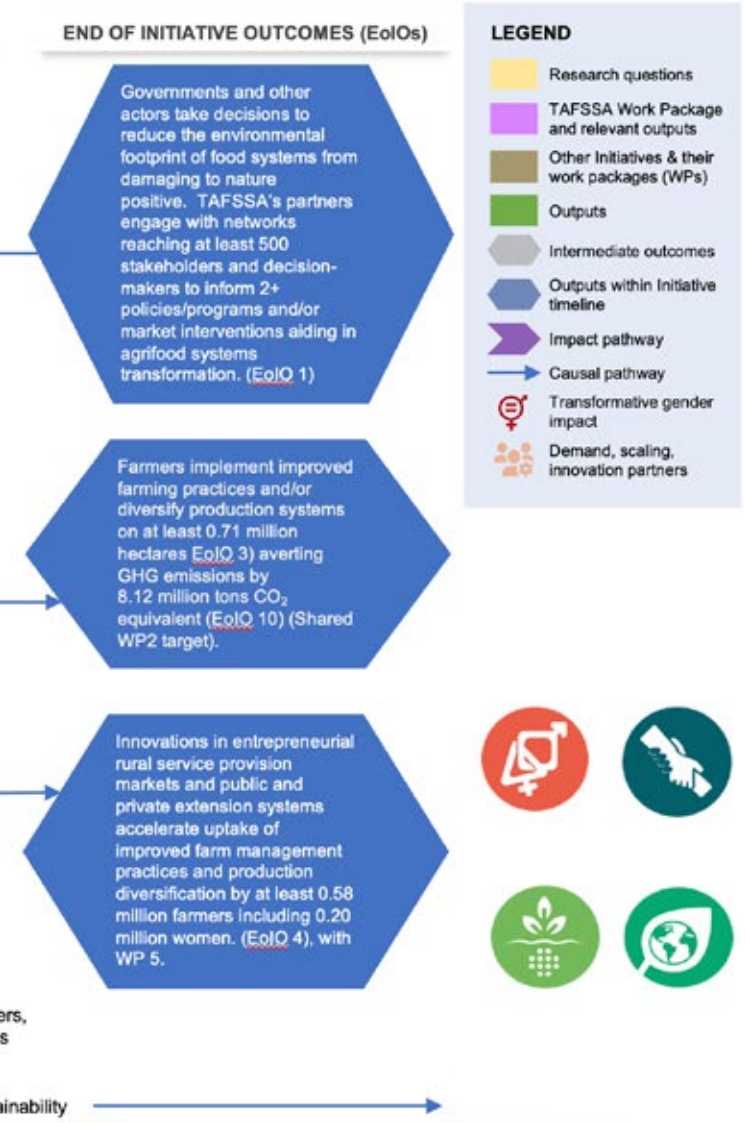
In its first impact pathway, WP4 improves understanding of the gendered determinants of dietary patterns. TAFSSA generated new research on gaps in dietary data in South Asia, and is using innovative new tools capturing dietary intake data in collaboration with the global Intake program. TAFSSA also engaged the Drivers of Food Choice program and fostered collaborations with South Asian partners toward a methods toolkit on dietary drivers.

Together with partners from iccdr,b in Bangladesh, the National Institute of Nutrition in India, Aga Khan University in Pakistan, and the USAID-supported Suaahara/Helen Keller International in Nepal, TAFSSA initiated a global review of behavior change communication programs focusing on consumption of unhealthy foods that affect human and planetary well-being. Preliminary findings highlight the paucity of studies, policies, and program actions addressing unhealthy foods. These findings will inform critical policy actions as part of WP4's second impact pathway that affects behavioral change investments.

In WP4's last impact pathway, TAFSSA supports cross-sectoral programs to tackle structural gender, social equity, and affordability constraints to nutritious diets. TAFSSA co-developed a preliminary conceptual framework elucidating the social equity dimensions of intra-household food consumption decisions. Surveys in Bangladesh, India, and Nepal are measuring intra-household division of food system tasks considering gender, age, and power dynamics. The consolidation of evidence on affordability of nutritious diets included TAFSSA convening a regional workshop discussing pathways to close affordability gaps.

Work Package 5:
Building resilience and mitigating environmental impact





Work Package 5 progress against the theory of change

As its primary impact pathway, WP5 generates evidence for decision-making toward inclusive, climate-resilient, and low-carbon agrifood systems. Social inclusion is integral in research to improve equitable access to groundwater resources and to adapt to climate change. Research detailing the historical evolution and environmental consequences of food systems in Nepal and in Odisha, India was published in 2022. TAFSSA conducted trainings on systematic literature review, and published a review of environmental footprint assessments informing WP research plans for 2023 and 2024. WP5's efforts addressed policies affecting groundwater over- and under-use and climate change through peer-reviewed publications, including in Science and *Nature*, and by engaging 25 stakeholders in a workshop co-convened by the Infrastructure Development Company Limited IDCOL, Solar EPC Development Ltd, and the Low Emissions Initiative, with the Solar Irrigation for Agricultural Resilience (SoLAR). Collaborating with CSISA and Nepal's Groundwater Resources Development Board (GWRDB), TAFSSA helped generate a conceptual framework and new digital groundwater monitoring system, with both being used by USAID/Nepal to support socially equitable irrigation investments.

Climate adaptation research geared up during 2022. Collaboration with the Asian Mega-Deltas Initiative and the Bangladesh Livestock Research Institute (BLRI) generated a systematic literature review on climate stress thresholds for livestock, which is currently being written up. Data were used to enhance Agvisely, a farm-level climate-services adaptation tool co-developed by CGIAR, DAE, and the Bangladesh Meteorological Department (BMD). DAE's use of Agvisely resulted in 597,920 farmers (23% women) applying weather-forecast driven to better manage nine crops, and two fish and prawn species each, and livestock species, respectively. TAFSSA's climate adaptation research was also documented in peer-reviewed papers on climate services, climate and crop disease linkages, and on climate-adaptive rice-planting strategies.

Work Package progress rating

WORK PACKAGE	TRAFFIC LIGHT / RATIONALE	
1		• 2022 progress largely aligns with Plan of Results and Budget and the WP theory of change, with few activities delayed. • Funding shortfalls have limited the number of districts in which agrifood system assessments have been deployed.
2		• 2022 progress largely aligns with TAFSSA's Plan of Results and Budget and the WP theory of change. • TAFSSA's fund allocation was lower than its aspirational budget in 2022. This has limited the number of living laboratories the Initiative has been able to initiate. Research is therefore yet to commence in rice-fallow cropping sequences in India and Bangladesh. • Funding shortfalls have also limited TAFSSA's deployment of choice experiments on farmers' preferences for biofortified varieties and diverse cropping systems.
3		• No major challenges were observed in the theory of change or identified in the Plan of Results and Budget, although WP2 and WP3 linkages must be increased. Price transmission studies are being considered to enhance WP congruence. • Funding shortfalls, however, suggest that the WP3 End of Initiative outcome commitment to engage with 10 local governments will be reduced to 4.
4		• All outputs are on track or only slightly delayed. • Only minor editorial changes have been made to WP4's theory of change.
5		• 2022 progress largely aligns with Plan of Results and Budget, with WP theory of change assumptions largely holding. • Slight changes to rationalize the theory of change have been by collapsing four original research questions into two primary ones, both still aligned with the same impact pathways.

KEY		
On track		• Annual 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 jeopardise success of Work Package
Delayed		• Annual progress slightly falls behind Plan of Results and Budget and Work Package theory of change in key areas • Deviations/issues/delays/risks could jeopardise success of Work Package if not managed appropriately
Off track		• Annual progress clearly falls behind Plan of Results and Budget and Work Package theory of change in most/all areas • Deviations/issues/delays/risks do jeopardise success of Work Package

Woman chopping vegetables to prepare meal for her family in Nalanda, India.
Photo credit: Shawn Sebastian

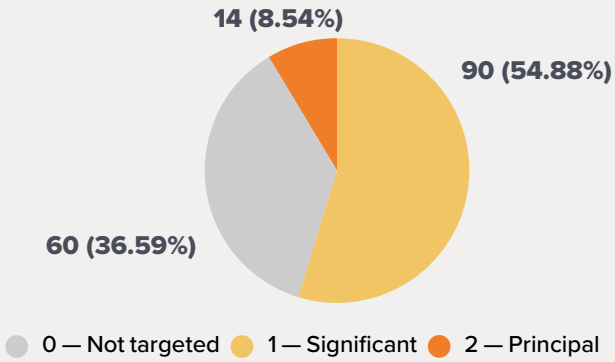
Section 4 Initiative key results

This section provides an overview of 2022 results reported by TAFSSA. These results align with the CGIAR Results Framework and TAFSSA's theory of change. Further information on these results is available through the CGIAR Results Dashboard.

Overview

Innovation users

Results by climate change tag

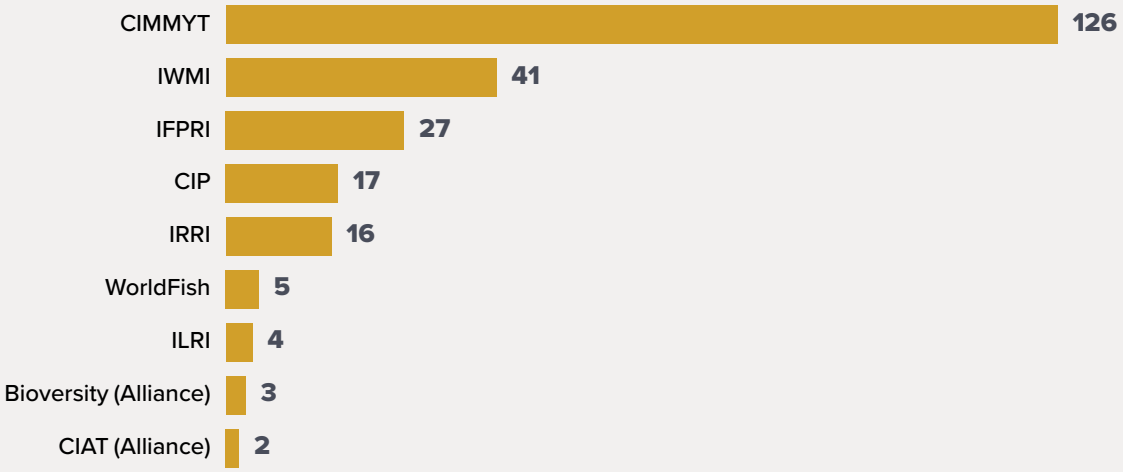


0 = Not targeted: The activity does not target climate mitigation, adaptation, and climate policy goals of the CGIAR as put forward in its strategy.

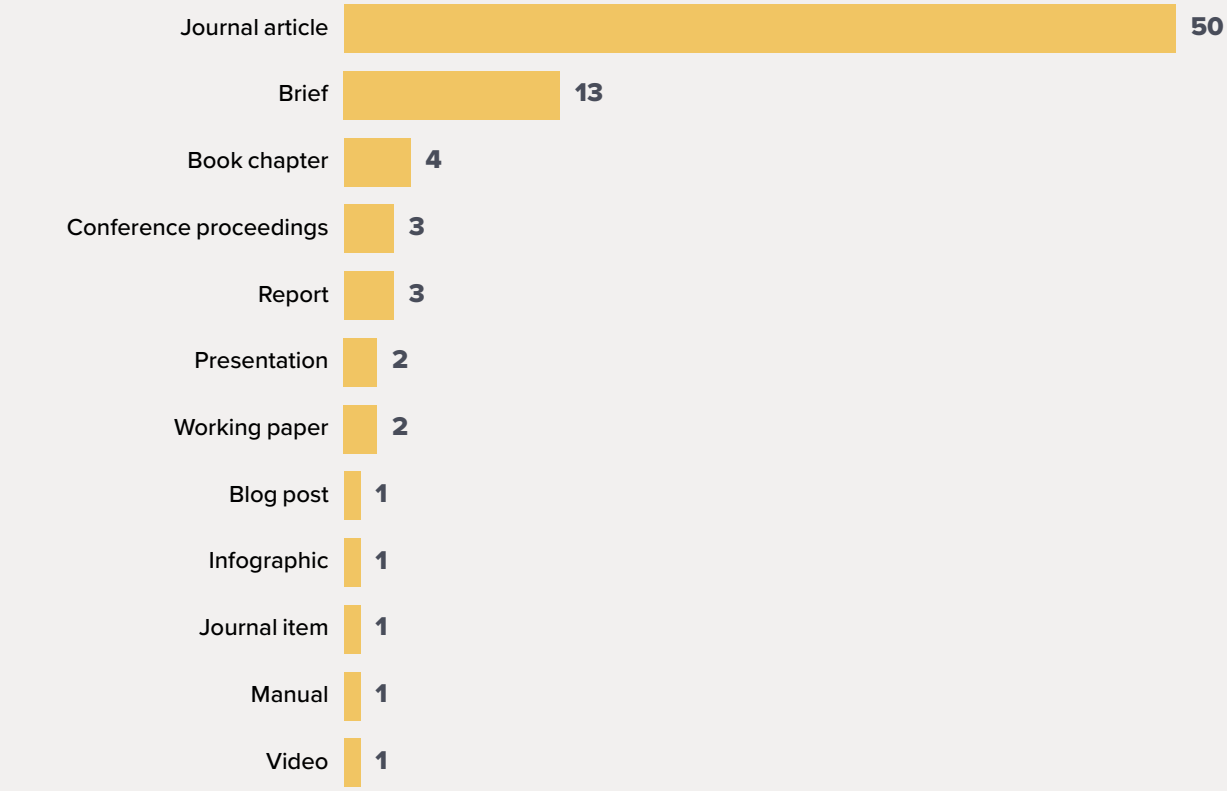
1 = Significant: The activity contributes in significant ways to either one of the three CGIAR climate-related strategy objectives — namely, climate mitigation, climate adaptation, and climate policy, even though it is not the principal focus of the activity.

2 = Principal: The activity is principally about meeting either one of the three CGIAR climate-related strategy objectives — namely, climate mitigation, climate adaptation, and climate policy, and would not have been undertaken without these objectives.

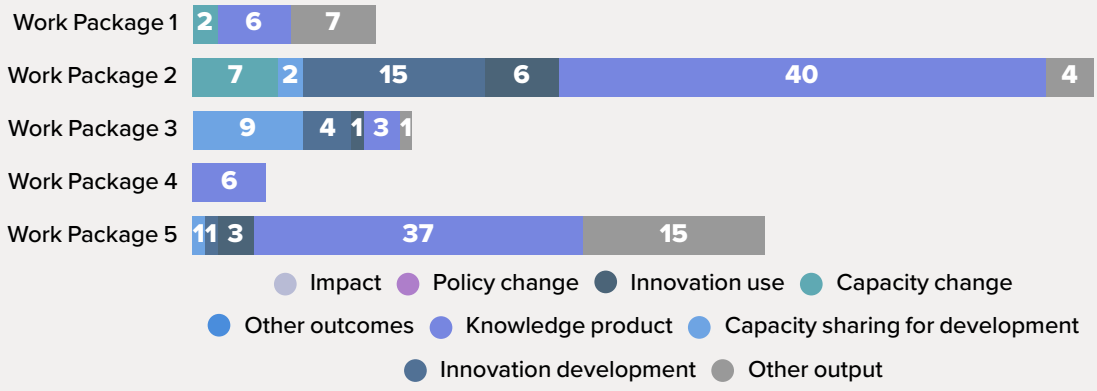
Contributing CGIAR Centers



Knowledge products by category



Results by Work Package

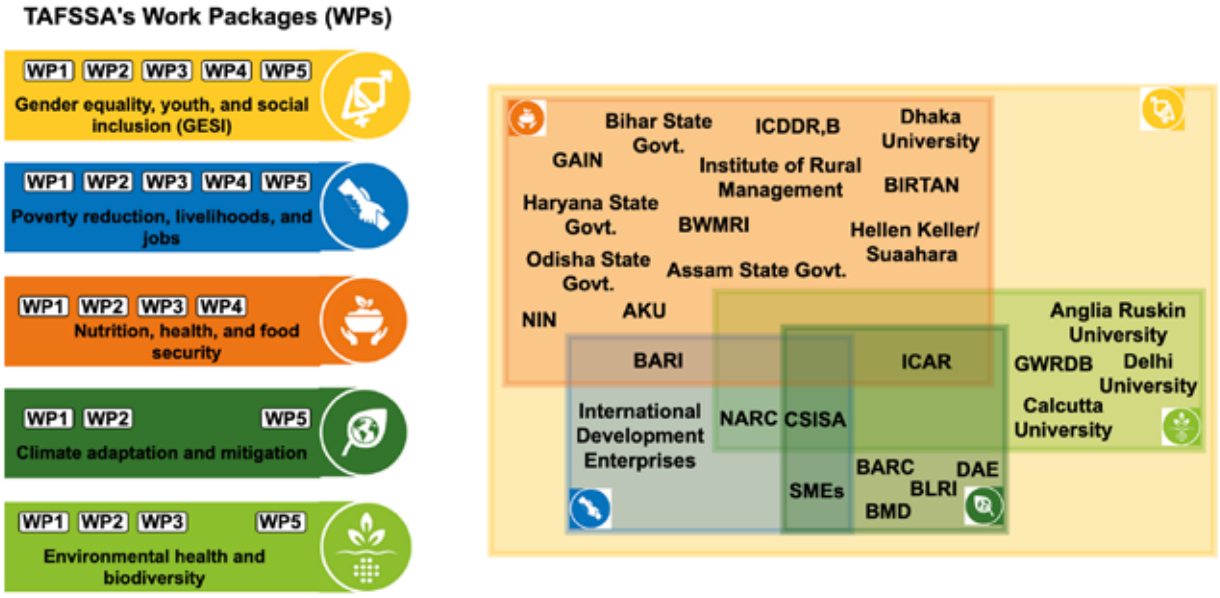


Innovations by readiness level

		Pipeline overview Number of innovations
9	PROVEN INNOVATION – The innovation is validated for its ability to achieve a specific impact under uncontrolled conditions	8
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	1
5	MODEL/EARLY PROTOTYPE – The innovation is validated for its ability to achieve a specific impact under fully-controlled conditions	0
4	CONTROLLED TESTING – The innovation is being tested for its ability to achieve a specific impact under fully-controlled conditions	4
3	PROOF OF CONCEPT – The innovation's key concepts have been validated for their ability to achieve a specific impact	3
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	1

Farmers threshing high-quality biofortified rice in Bihar, India

Section 5 Impact pathway integration – External partners



Left: *Relationship between CGIAR's action areas with TAFSSA Work Packages.* ***Top Middle:*** *Relationships between CGIAR action areas and govt. and non govt. partners with boxes showing action area overlaps with different partners TAFSSA is currently collaborating with.* ***Top Right:*** *Interconnecting Relationship between CGIAR action areas. Note that the size of the boxes does not necessarily represent the size, scope, or intensity of collaborations or work; rather, the boxes show overlapping areas of collaboration considering the range of partners, CGIAR action areas, and TAFSSA. Abbreviations for partners can be found in the report text, exempting 'SMEs', which stands for private sector 'Small and Medium Scale Enterprises'. TAFSSA maintains intensive collaboration with a large number of SMEs across South Asia.*

Partnerships and TAFSSA's impact pathways

TAFSSA engaged 25 demand, 105 innovation, and 30 scaling partners supporting the Initiative's impact pathways across CGIAR's five Impact Areas in 2022.

Nutrition, Health, and Food Security: TAFSSA convened multi-stakeholder platforms in Bangladesh, India, and Nepal linking food production, markets, diets, and health. Key governmental partners in India included National Institute of Nutrition, state governments (Haryana, Bihar, Odisha, and Assam), ICAR, and the Institute of Rural Management. In Bangladesh, BARI, BWMRI, and BIRTAN contributed. Major international non-governmental organizations (NGOs) and university partners included GAIN, iccdr,b, and Dhaka University (Bangladesh), Suaahara/Helen Keller International (Nepal) and Aga Khan University (Pakistan). Separately, TAFSSA also coordinated collaboration among these partners and the Drivers of Food Choice program to refine a toolkit on dietary choice determinants.

Poverty Reduction, Livelihoods, and Jobs: Private sector partnerships form a key impact pathway in TAFSSA. TAFSSA leveraged complementary projects including CSISA to engage 722 small- and medium-scale farm input, services, and output businesses in Bangladesh and Nepal. Research was supported by BARI and the Nepal Agricultural Research Council (NARC). The NGO International Development Enterprises contributed to 17 of TAFSSA's outputs in this impact area.

Gender Equality, Youth, and Social Inclusion (GESI): TAFSSA engages all of its partners to address GESI. TAFSSA's innovation partners addressed social inclusivity through data and evidence generation. Small- and medium-scale enterprises were targeted with actions boosting

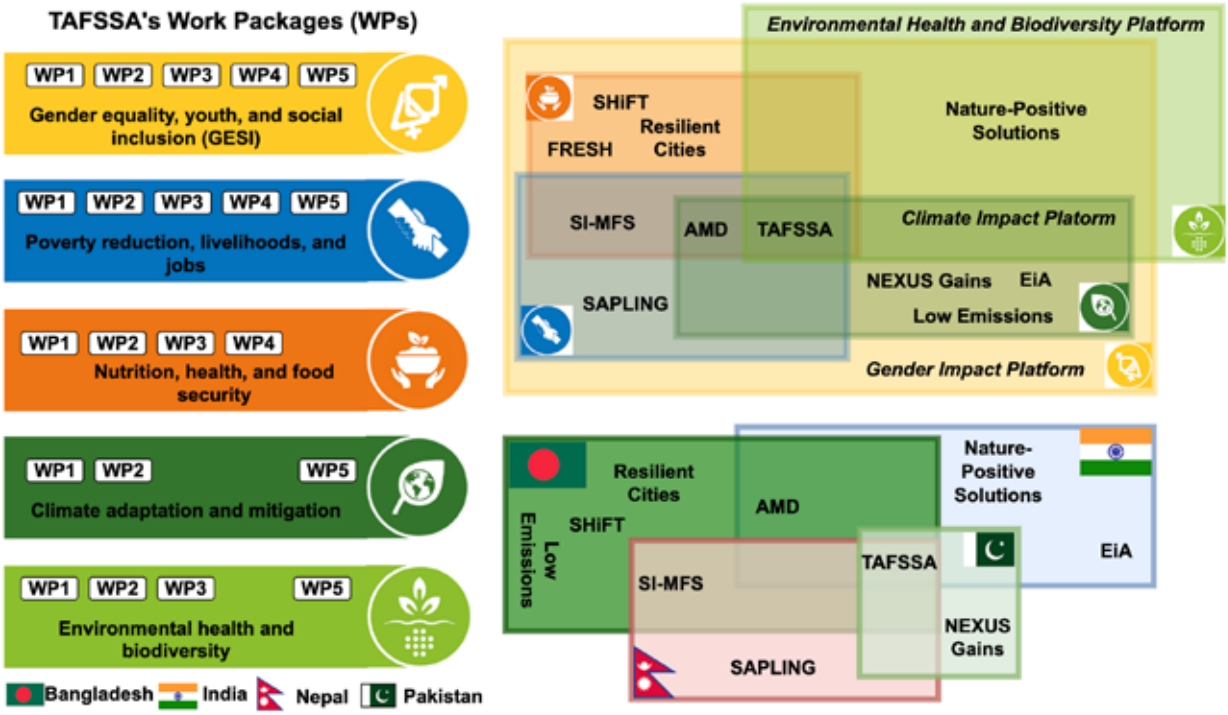
A farmer proudly displaying potato grown without tillage as part of TAFSSA's agronomic experiments in Nalanda, Bihar

women employee's agency and to increase access to farm machinery services among marginalized groups in Nepal.

Climate Adaptation and Mitigation: Mitigation research involved ICAR and institutes under the Bangladesh Agricultural Research Council, in India and Bangladesh, respectively. In 2022, TAFSSA collaborated with BLRI as a new climate adaptation research partner generating weather-forecast driven advisories for livestock scaled through BMD and DAE.

Environmental Health and Biodiversity: Partnerships with Anglia Ruskin University (UK) and ICAR focused on food waste analysis. Groundwater research in Bangladesh involved 25 partners; in Nepal, TAFSSA collaborated with Cornell University, CSISA, NARC, GWRDB, and USAID. Research on the evolution of food systems in India involved Delhi University. Studies on landscape pollination services were launched with the University of Calcutta.

Section 6 Impact pathway integration – CGIAR portfolio linkages



Left: *Relationship between CGIAR's action areas with TAFSSA's Work Packages.* ***Top Right:*** *Relationships between CGIAR action areas and initiatives currently collaborating with TAFSSA. Overlapping boxes show relationships between collaborating Initiatives and the CGIAR Impact Areas.* ***Bottom Right:*** *Relationship between CGIAR Initiatives TAFSSA is collaborating with and countries TAFSSA is working in. For all graphics, please note that box size does not necessarily indicate size, scope, or intensity of work; rather, boxes show overlapping areas of collaboration considering CGIAR Impact Areas and Countries.*

Portfolio linkages and TAFSSA's impact pathways

TAFSSA currently collaborates with ten of CGIAR's Initiatives and with aligned non-pooled projects developing knowledge products, capacity-sharing, and innovation use across CGIAR's Impact Areas. Key highlights are detailed below.

Nutrition, Health, and Food Security: TAFSSA is part of a community of practice on retail food environments, together with SHIFT, FRESH, and the Resilient Cities Initiatives, established in 2022. TAFSSA also coordinates collaboration among these Initiatives and the global Drivers of Food Choice program.

Poverty Reduction, Livelihoods, and Jobs: Research with the Mixed Farming Systems Initiative is under way through survey co-design. In 2022, TAFSSA also collaborated with the Sustainable Animal Productivity Initiative, and leveraged linkages to non-pooled projects, largely under CSISA, to scale out research insights in WP2 and WP3.

Gender Equality, Youth, and Social Inclusion (GESI): Research on gender dynamics in TAFSSA is linked to the GENDER Platform and contribute to TAFSSA's WP1 and WP4 impact pathways to reshape local food systems and large-scale nutrition programs and policies. Linkages to CSISA enable scaling of business models in Bangladesh and Nepal, increasing access to farm machinery

Md. Sazzad Ali _ Mst Anjuara Begum

services by women and members of marginalized social castes and ethnicities.

Climate Adaptation and Mitigation: TAFSSA collaboration with the Asian Mega-Deltas Initiative improved and scaled out climate advisories in Bangladesh. TAFSSA is co-developing a Climate Adaptation Prioritization Tool (CAPTain) with Excellence in Agronomy, and co-facilitated participatory design workshops in Bangladesh, India, and Nepal in 2022. Links to the NEXUS Gains Initiative amplify adaptation research through shared data generation, modeling, and partnerships.

Environmental Health and Biodiversity: Both TAFSSA and the Low Emissions Initiative partner with the SoLAR project. TAFSSA collaborates with the Nature-Positive Solutions Initiative's pollination services on diverse food production.

Beyond research, TAFSSA works closely with CGIAR's South Asia Regional Director to boost cross-initiative collaboration and boost engagements between CGIAR and national partners.

Section 7 Adaptive management

RECOMMENDATION	SUPPORTING RATIONALE
Sharpen pathways to impact for nutrition behavior change interventions by choosing two to three specific programs targeting nutrition behaviors in focus countries (relevant to WP4).	Progress along the pathway to impact for nutrition behavior change programs will incorporate new practices/recommendations on reducing consumption of unhealthy foods. This requires the TAFSSA team to identify focus programs in at least two countries in 2023 to target the findings of the behavior change reviews.
Identify focus countries where programs/ policies can integrate findings of gender and affordability research (relevant to WP4).	Progress along the pathway to impact for gender/social safety net programs will incorporate recommendations addressing gender equity or actions to address affordability of nutritious diets. The TAFSSA team is accordingly focusing efforts in India and Bangladesh only.
Identify new work package leadership team members (relevant to WP2 and WP5).	With the departure of two senior Work Package co-leads (Aditi Mukherji, who shifted roles from WP5 lead to CGIAR's Director for the Climate Adaptation and Mitigation Impact Area Platform, and ML Jat, who shifted from WP2 co-lead to ICRISAT), TAFSSA's Senior Leadership team identified new leads for these roles. For WP2, Mahesh Gathala (CIMMYT) has taken on the co-leader role. Tek Sapkota (CIMMYT) and Shreya Chakraborty (IWMI) have taken on co-leadership for WP5, liaising with Aditi Mukherji as needed for strategic guidance.
Reduce Initiative projected benefits because of funding shortfalls .	As a result of funding shortfalls relative to TAFSSA's aspirational budget, the Initiative has reduced End of Initiative outcome targets. TAFSSA's aspirational 2022–2024 budget was US$11,382,678 and US$14,103,143, although funding in Year 1 and Year 2 has been more than 60% below this figure. This is unfortunate as TAFSSA has already established an outstanding track-record of research output (with 74 knowledge products, including 40+ peer-reviewed publications building on prior CGIAR research) and development impact. The latter has included 112 training/linkage events with 23 partners, and 2,524 people trained. Capacities were also raised in 722 agribusinesses in 2022. Considering innovation use, TAFSSA contributed to 0.71 million farmers (24% women) on 35,900 ha using CGIAR's outputs to improve farm and marketing practices. TAFSSA has a very high rate of advanced research innovation development and use. Given our work in high poverty burden areas, TAFSSA also contributed approximately 70% to the number of people globally benefiting from Regional Research Initiatives in 2022. Budget shortfalls nonetheless suggest that TAFSSA's original targets will be challenging to meet, and to better manage expectations and focus on core innovations leading to substantial impact, TAFSSA has reduced targets.

Section 8 Key result story

Abdul Motaleb, a farmer in Rangpur, Bangladesh pumps groundwater to the surface to irrigate his vegetable crops. Photo credit: Abdul Momin

The 'Bengal water machine' offers a regional and context-appropriate design for groundwater management by policymakers and millions of farmers in Bangladesh

Restrictive mandatory groundwater use permit requirements are being implemented across Bangladesh. Based on previous CGIAR studies on the groundwater–energy nexus, ongoing research under TAFSSA (1–3), and emerging literature on the concept of the 'Bengal water machine' (4), a TAFSSA policy perspective offers recommendations for reform (5). The analysis highlights the need for regionally appropriate and hydrologically specific groundwater and energy policies, rather than umbrella curbs on irrigation that negatively affect farmers. This concept could substantially benefit tens of millions of groundwater users in Bangladesh and has gained significant international attention (4).

With a population of 168 million people in a land area of 148,000 km2, 7% of which is covered by water, Bangladesh is among the world's most densely populated countries. Crop production in Bangladesh is intensive. Farmers not only cultivate crops during the rainy monsoon season; they also produce a second or even third crop during the dry winter and early summer seasons. The secrets to their success are groundwater irrigation and supportive energy policies. Research now shows that, when carefully managed, irrigation can not only aid water conservation efforts, but can also enhance flood control and food security. Nonetheless, restrictive mandatory groundwater

use permits are currently being implemented across Bangladesh, although they may not always be appropriate. TAFSSA's research suggests the need for revision of restrictive policies to address context-specific options in geographically specific areas of groundwater over- and under-use, depending on aquifer recharge conditions.

Prior to and shortly after independence, Bangladesh faced severe food scarcity. In 1971, the country gained independence, with policymakers realizing that a key strategy to provide enough food was to establish two to three crops each year. However, with only one rainy season, this required irrigation, and the active support of government through policies that relaxed barriers to the import and instillation of inexpensive irrigation pumps.

Thus, the Bengal groundwater machine was born, with farmers installing tube wells and using water from aquifers that are largely recharged on an annual basis by the monsoon and Bangladesh's plentiful rivers. However, this is not a perfect system. The government was mindful of differing groundwater recharge rates and drafted policies accordingly, restricting pumping in areas where recharge was less significant, and allowing it in areas where groundwater was abundant. Yet, as time has progressed, misinformation has spread and even areas that have significant recharge capacity have fallen into restriction.

Based on previous CGIAR research on the groundwater–energy nexus in Bangladesh, a high-profile publication in *Science* and *Nature* on the concept of the Bengal water machine and the relationship between water management and climate change adaptation (3, 5), new recommendations for irrigation technologies and aquifer- and cropping pattern-specific policy design are being proposed. TAFSSA has been an active source of evidence in 2022 on alternatives to restrictive umbrella policies (1, 2). This concept and proposed policy direction, with its potential benefits for both policymakers and groundwater users in Bangladesh, has achieved wide visibility and outreach, with TAFSSA researchers featured in a range of international media in 2022.

"We promote sustainable and nutritious diets within ecological boundaries, where groundwater serves as an essential ecological boundary. The region's natural endowments, such as high rainfall and favorable geology, make it possible to intensively grow food within these boundaries. TAFSSA provides evidence informing the transition from dirty to clean energy."

Aditi Mukherji, Director, Climate Adaptation and Mitigation Impact Area Platform and 2022 TAFSSA Work Package Lead

Bangladesh's 'water machine' relies on abundant monsoon rainfall and rivers for aquifer recharge, as well as pumping by farmers to extract water and mediate flooding risks during the rainy season. Most irrigation pumps used by farmers are powered by diesel, however, and are reliant on fuel

imports with associated cost discount subsidy programs. Combined with escalating energy costs in 2022, this has contributed to dwindling foreign currency reserves, not to mention greenhouse gas (GHG) emissions. TAFSSA is investing in renewable energy options to shift irrigation practices toward clean energy, while also addressing inefficiencies in diesel pumping systems, the former replacing diesel with solar irrigation pumps. As part of this transition, TAFSSA has encouraged policy shifts away from off-grid to on-grid systems, with provisions made for farmers to produce and profit from solar electricity generation for the grid when their pumps are not in operation. This integrated approach to clean energy solutions for food production not only supports sustainable irrigation practices for millions of farmers in Bangladesh but also encourages the maintenance of agrifood systems with environmental boundaries, enabling Bangladesh to achieve multiple Sustainable Development Goals.

Men processing parboiled and premium quality fortified rice grown in Dinajpur, Bangladesh

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LINKS TO IMPACT AREAS

Primary Impact Area: Environmental Health and Biodiversity

Other relevant Impact Area(s): Climate Adaptation and Mitigation

COVER PHOTO: A woman sifting millets.
Photo credit: Shawn Sebastian, 2018

KEY RESULTS STORY GEOGRAPHIC SCOPE

Region(s): South Asia
Country: Bangladesh

KEY CONTRIBUTORS

Contributing Initiative(s): Transforming Agrifood Systems in South Asia (TAFSSA)
Contributing Center(s): IWMI
Contributing external partner(s):

- Bangladesh Water Development Board
- Bangladesh Agricultural Development Corporation
- Barind Multipurpose Development Authority (BMDA)
- Bangladesh Agricultural University (BAU)
- Bangladesh Agricultural Research Council (BARC)
- Sher-e-Bangla Agricultural University (SAU)
- Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU)
- Bangladesh Rice Research Institute (BRRI)
- Bangladesh Agricultural Research Institute (BARI)
- Infrastructure Development Company Limited (IDCOL)
- Sustainable And Renewable Energy Development Authority (SREDA)
- Rural Development Academy (RDA)
- Swiss Agency for Development and Cooperation (SDC)

LINK TO CGIAR RESEARCH PROGRAMS

Climate Change, Agriculture, and Food Security (CCAFS)

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