



Fruit and Vegetables for Sustainable Healthy Diets (FRESH)

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Proposal

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A list of abbreviations and acronyms used throughout the proposal can be found [here](#).

Summary table

Initiative name	Fruit and Vegetables for Sustainable Healthy Diets (FRESH)
Primary Action Area	Systems Transformation (ST)
Geographic scope	Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries. Some of the work will be global in scope.
Budget	US\$21 million

1. General information

Fruit and Vegetables for Sustainable Healthy Diets (FRESH)

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2. Context

2.1 Challenge statement

Poor diets are a primary cause of malnutrition and the leading cause of disease worldwide^{1–3}. Improving diets, including increasing fruit and vegetable (F&V) intake, could save one in five lives annually¹. Micronutrients are essential for health; those obtained from F&Vs have a lower environmental footprint than from other foods⁴ making F&Vs essential to **healthy and sustainable diets**. Dietary trends, combined with population growth and climate change⁵, are impeding delivery of the Sustainable Development Goals (SDGs), in particular, the SDG2 goal to end hunger, achieve food security and improve nutrition.

Globally, F&V intake is far below recommended levels⁴. However, the extent and nature of the problem is poorly understood due to insufficient dietary data, especially in LMICs. Increasing F&V intake will require starting with consumers, understanding dietary patterns and addressing **desirability, accessibility, affordability, and availability** barriers through cost-effective solutions using an end-to-end approach.

Even when F&V are accessible and affordable, intake is too low⁶ highlighting the role of **desirability** in F&V intake. Context- and population-specific, cost-effective multi-channel behavioral and experiential approaches⁷ and policy changes are needed to improve F&V desirability. Cost-effectiveness may be optimized by targeting programs and policies towards those whose preferences are most malleable (e.g., young children⁸ and adolescents⁹ and/or influential (e.g., women¹⁰).

Improving **accessibility** necessitates bringing consumers and the foods they desire closer together. This can be accomplished in several ways such as increasing home production of F&Vs^{11,12} altering the physical food environment, and digitization.

More than 3 billion people cannot afford a healthy diet¹³. Often, F&V are among the least affordable foods². On the demand side, **affordability** of F&Vs can be increased with social assistance programs (SAPs) (e.g., school-feeding programs or cash-based transfers), or through providing fair wages for workers. On the supply side, increasing **availability** is essential to reducing cost of F&Vs and accommodating increased intake. The gap between F&V supply and demand is projected to remain large globally, especially in sub-Saharan Africa (SSA)¹⁴. To provide enough vegetables for healthy diets production likely needs to increase by 75% by 2050⁴ in addition to reducing postharvest losses, estimated at 30-50%. To attain this, systemwide improvements are needed such as improving farmer access to- and use of- quality seed of resilient cultivars, irrigation, safe pest management technologies and appropriate post-harvest handling (e.g., cold chains, digitization, and shorter supply chains). Lastly, institutional or socio-economic constraints on marginalized groups (such as unequal pay or zero-hours contracts) should be removed so F&V sector jobs are safe and profitable.

Poor diets are causing an overwhelming loss of DALYs and lives. Solutions for improving diet quality, in part by increasing F&V intake, are urgently needed. Climate change¹⁵ is negatively affecting F&V production⁵ and innovations will need to address these issues. Women and youth are central to sustainable changes in the F&V sector. Women are often involved in vegetable production¹⁶ and tend to decide what food is prepared and how. Youth also have an important role to play in the evolution of the F&V sector.¹⁷ Additionally, influencing their diet practices can have short- and long-term benefits. Thus, FRESH innovations along the continuum from consumption to production will also be designed to empower women and youth, and other

marginalized groups. Solutions to the intractable problem of low F&V intake will clearly need to be multifaceted and interconnected requiring the proposed end-to-end approach.

2.2 Measurable 3-year (end-of-Initiative) outcomes

FRESH will use an end-to-end approach to increase F&V intake, improve diet quality, nutrition and health while also improving livelihoods, empowering women and youth and mitigating negative environmental impacts. Together the WPs will achieve the following EoI Outcomes:

1. Key actors from government, multilateral organizations (e.g., WFP), NGOs (e.g., NI) and academia (e.g., Sokoine University) in the 4 focus countries are actively engaged in designing and testing behavioral interventions targeted to women or youth to increase F&V intake
2. At least 10,000 individuals (e.g., students, academics, government and multilateral organizations and NGO stakeholders) from across sectors access the Web-based F&V Knowledge Hub as a resource for F&V learning, research and innovations
3. 10,000 farmers (at least 5,000 of whom are women) adopt improved climate-resilient vegetable cultivars across 4 focus countries
4. 10,000 farmers (at least 5,000 of whom are women) adopt safe and sustainable vegetable production practices (e.g., use of integrated pest management (IPM) across 4 focus countries
5. Private sector partners actively engaged in co-designing and piloting innovations are ready to scale at least 4 innovations to reduce post-harvest losses and/or improve food safety
6. Key actors from government, multilateral organizations (e.g., WFP), NGOs and academia (e.g., University of Peradeniya) in 3 of the focus countries are actively engaged in designing and testing interventions to increase the accessibility and affordability of F&V especially for poor and otherwise marginalized populations
7. Key actors at national level (e.g., Agriculture, Finance or Health Ministers) prioritize F&Vs and incorporate specific actions aimed at increasing intake, production, food safety and/or equity within the F&V sector into national-level policies, laws or regulations

2.3 Learning from prior evaluations and impact assessments (IA)

FRESH responds to a donor-led big push on F&V R&D using an end-to-end approach. A global scoping review informed FRESH's development.¹² It concluded that F&Vs are largely unaffordable for poor households in LMICs and showed a neglect of F&V R&D. It recommended programs use low F&V intake as a starting point and incentivize actors along the value chain to increase intake.

FRESH also builds on prior CGIAR and WorldVeg impact evaluations and evidence reviews which have shown that F&V consumption can be increased through integrated agriculture-nutrition interventions^{7,13,14 8,15,16, 8,17} and that vegetable breeding research yields returns on investment comparable to those of CGIAR mandate crops.^{19,20} There is also evidence of widespread adoption of vegetable cultivars based on WorldVeg breeding research in East Africa^{18,19} and Asia.²⁰⁻²²

Learning from A4NH related to what agriculture can and cannot do for nutrition²³, the need to use comprehensive causal impact evaluations to assess what impact is achieved, how, and the cost-effectiveness of different approaches^{24,25} also informed FRESH. Lastly, FRESH addresses three weaknesses identified in the [Synthesis of Learning from a Decade of CGIAR Research Programs](#). First, we will use an iterative and multilayered partnership engagement approach to ensure research activities are aligned with expressed needs and will work with partners to adapt and

scale successful innovations/interventions. Second, FRESH will address the livelihood, diet and nutrition constraints and needs of women and youth through engaging with them in research and innovation, creating safe and profitable livelihood opportunities and targeting them with interventions to improve their diets. Third, it addresses CGIAR's limited experience with technology delivery and extension through partnering with other organizations with relevant experience (e.g., WorldVeg and AHR).

2.4 Priority-setting

The EAT-Lancet report⁴ and various other reports^{3,26} clearly show the need to transform global diets through reduced consumption of unhealthy foods such as sugar and red meats and increased consumption of healthy foods such as F&Vs. Such transformation is of fundamental importance to reach the UN SDGs as well as the Paris Agreement. FRESH will contribute to tackling this challenge through research on F&Vs.

FRESH uses a holistic end-to-end approach starting from F&V intake and working back to address how this can be improved through vegetable biodiversity and seed systems, production, and food environments and influencing consumer behavior. This recognizes the complexity of food systems and the need for coordinated change in many parts of the food system in order to transform diets.

Four focus countries — Benin, Tanzania, Sri Lanka and Philippines — were selected based on needs (low F&V consumption) and the potential to create impact within a 3-year period (CGIAR and WorldVeg presence, strong existing partnerships, and a clear interest of governments in food systems change and in reducing all forms of malnutrition). The end-to-end approach will be implemented in each country, but the emphasis across the system will vary by country. The balance across the system within each country will be informed by an iterative and multilayered stakeholder engagement process. The first step in the process occurred in October 2021 with virtual stakeholder consultations held for each of the four focus countries which is described in **Section 2.6** below. This process has already informed the research priorities and provided some guidance as to how and where the different Work Packages (WPs) (reflecting the various aspects of the food system) should concentrate their efforts. These consultations will continue to be an integral part of the Initiative.

Based on the criteria described above, additional countries identified for phase 2 include Burkina Faso, Ghana, Rwanda, Nepal, Cambodia, Indonesia, Samoa, Solomon Islands and Vanuatu. If there are sufficient funds, some activities will be conducted in these countries during phase 1.

F&Vs represent an enormous number of different species and production systems. FRESH will have a focus on a diverse basket of hardy and nutrient-dense F&Vs produced by smallholder farmers locally, particularly traditional leafy vegetables. On the production side, where constraints can be highly crop- and location-specific, the focus will be on vegetables in order not to dilute efforts during the first three years of the Initiative. Breeding efforts will focus on vegetables already included in the breeding portfolio of the WorldVeg (tomato, chili pepper, amaranth, African eggplant, pumpkin, bitter gourd, okra, and luffa). Within the focus countries crop selection will also be informed by dietary patterns, identified nutrient gaps and preferences to the extent possible.

Research on consumer behavior will focus initially on young children and adolescents whose health behaviors are malleable⁹ and women who can influence the diets all household members' diets especially their children's¹⁰ given their central role in food preparation. Food environment research will focus on poor and otherwise marginalized populations given their challenges with accessibility and affordability of healthy diets²⁷.

Within the selected countries, FRESH will co-locate the research of the various Work Packages in certain locations to ensure close integration of the Work Packages. These locations will be identified in consultation with local partners.

2.5 Comparative advantage

FRESH brings together expertise from the CGIAR, WorldVeg, and other organizations (UCD, WUR, USYD, IDS and AHR) across a range of fields (e.g., nutrition, agronomy, vegetable breeding, and social science). This set of partners and their complementary skills and experiences will allow us to design, test and scale end-to-end approaches to increase F&V intake using evidence-informed co-design processes with our partners. World Veg's regional centers in Benin and Tanzania and CGIAR's presence and experience in the focus countries will also facilitate the success of FRESH.

FRESH builds on some key lessons generated under A4NH and PIM. First, engaging with multisectoral partners through co-design and co-learning processes facilitates better designed programs and evaluations and increased evidence uptake and policy. Second, the focus of agriculture-nutrition programs should be to improve diets and potentially reduce micronutrient deficiencies and NCDs²³. Third, addressing issues of equity²⁸ and empowerment²⁹ are central to transforming food systems. Fourth, SAPs can be used within food systems approaches to improve diet, nutrition³⁰ and women's empowerment outcomes.³¹ We are also building on CGIAR's work on traditional and underutilized F&V, biodiversity, and market approaches to improve diets and nutrition³²⁻³⁵. The partnership with WorldVeg adds 50 years of vegetable research experience. WorldVeg's four flagship programs (genetics, production/marketing, diets and impact) align well with FRESH. WorldVeg guards the world's largest vegetable genebank with over 440 species including many traditional and underutilized species. The Center's breeding programs focus on climate-resilience, biotic resistance, nutrient content, shelf-life and consumer preferences. A consortium agreement with 61 seed companies has been highly effective for creating impact.

2.6 Participatory design process

The participatory design process involved three sets of consultations (i) [virtual stakeholder consultations in the four focus countries](#), (ii) [External Advisory Panel and Investment Advisory](#) Group consultations, and (iii) bilateral and group meetings with other CGIAR Initiatives.

(i) FRESH capitalized on existing professional networks in the focus countries to bring together stakeholders from government agencies, non-governmental organizations (NGOs) and civil society organizations (CSOs), universities, and the private sector. Two consultations were co-hosted by expected demand and scaling partners (Bureau of Plant Industry, Department of Agriculture, in the Philippines; the World Food Programme (WFP) in Sri Lanka). A total of 89 participants (15 – 28 in each country) attended these sessions which consisted of a brief overview of FRESH, two breakout sessions, and a final plenary session. The two breakout groups (self-assigned) focused on either production or consumption issues guided by a set of key questions

that were used across the four country consultations. The overall intent was to inform the development of FRESH's overall research agenda and that of the different WPs and to identify areas of collaboration with potential [innovation, demand and scaling partners](#).

Participants valued the holistic and comprehensive end-to-end approach to addressing barriers to F&V intake. They also appreciated FRESH's flexible design that can be tailored to country's specific needs and political landscape. This design flexibility extends to the proposed adaption of interventions across the WPs and making them culturally appropriate, integrating indigenous F&Vs into local value chains, shortening supply chains, and employing culturally appropriate BCC approaches – all of which will be informed by co-design processes.

Participating stakeholders identified opportunities to align FRESH's work with national priorities, for integrating activities into on-going programs and engaging with relevant groups (e.g., Arusha Food Safety Initiative). Lastly, opportunities with the private sector were also identified, primarily with vegetable seed companies.

(ii) FRESH held one meeting with an External Advisory Panel and one with an Investment Advisory Group (15 representatives from nine donor organizations). Both groups appreciated the comprehensiveness of the end-to-end approach and provided feedback to sharpen and improve some the proposed research. The IAG appreciated the alignment of the proposed FRESH Initiative outcomes with donor priorities and the proposed innovative and integrated approaches to bridge consumer demand with sustainable and safe value chains.

(iii) FRESH scientists have had informal discussions with SHiFT, which has a complementary focus on nutritious and sustainable diets. The two Initiatives also have one IDT member in common. One area of collaboration identified is around harmonizing the use of methods and metrics to assess food environments and diets in our respective focus countries which will allow for comparability across sites and contribution to the comprehensive nutrition and diet data generated within CGIAR.

FRESH and Resilient Cities share two IDT members and have also met through discussions organized by RAFS and informally to discuss how the two Initiatives can work together in urban and peri-urban spaces around increasing safe and sustainable vegetable production, understanding and improving food environments and increasing consumption of affordable, safe and sustainable healthy diets. Activities for the two Initiatives will overlap in the Philippines and Sri Lanka where we plan to develop integrated research agendas spanning rural, peri-urban and urban contexts.

Lastly, SHiFT, Resilient Cities and One Health have representatives on FRESH's External Advisory Panel and provided ideas for collaboration through that mechanism.

2.7 Projection of benefits

The projections below transparently estimate reasonable orders of magnitude for impacts which could arise as a result of the impact pathways set out in the Initiative's theories of change. Initiatives contribute to these impact pathways, along with other partners and stakeholders.

For each Impact Area, projections consider breadth (numbers reached), depth (expected intensity of effect per unit) and probability (a qualitative judgement reflecting the overall degree of certainty or uncertainty that the impact pathway will lead to the projected order of magnitude of impact).

Projections will be updated during delivery to help inform iterative, evidence-driven, dynamic management by Initiatives as they maximize their potential contribution to impact. Projected benefits are not delivery targets, as impact lies beyond CGIAR's sphere of control or influence.

The estimations below consider Benin, Tanzania, Sri Lanka and the Philippines as phase 1 countries, and Burkina Faso, Ghana, Rwanda, Nepal, Cambodia, Indonesia, Samoa, Vanuatu and Solomon Islands as phase 2 countries. The total population of these 13 countries was 589 million in 2020 (World Bank, 2021).

Impact Area	Indicator	Breadth	Depth	Probability
Nutrition, health & food security	# people meeting minimum micronutrient requirements	62.7 million people	Lifesaving: 12.5 million Transformative: 10 million Substantial: 40.1 million	High (50-80%)
Poverty reduction, livelihoods & jobs	# poor people benefiting from relevant CGIAR innovations	1.5 million households	Significant (10% permanent impact on income)	High (50-80%)
Gender equality, youth & social inclusion	# women benefiting from relevant CGIAR innovations	12 million women	Significant	Medium (30-50%)
Climate adaptation & mitigation	# people benefiting from climate-adapted innovations	375,000 households	Significant (10% permanent impact on income)	Medium (30-50%)
Environmental health & biodiversity	# ha under improved management	537,000 ha	Significant (10% permanent impact on income)	High (50-80%)
	# plant genetic accessions available and safely duplicated	1,400 new accessions of traditional African vegetables	<i>Not required for this indicator</i>	Very high certainty (>80%)

1. Nutrition, health and food security

people meeting micronutrient requirements

Challenge: Poor quality diets are a primary driver of all forms of malnutrition and the leading cause of disease worldwide. In 2017, 2 million deaths and 65 million DALYs lost were attributable to low fruit intake worldwide, ranking among the top three dietary risk factors.³⁶ Increasing intake of micronutrient-dense F&Vs can directly contribute to increasing the number of people who have micronutrient adequate diets.

Breadth: Using estimates of the cost of a healthy diet from the [SOFI report](#) as a proxy for adequate micronutrient intake and population estimates from the 13 phase one and two countries we estimate that approximately 417,901,913 people in these countries are unable to afford a healthy diet. Improving diets could save one in five lives and avert an average of 16% of DALYs. Assuming an improvement amongst 15% of the population (~62,685,287) will have improved diets if successful innovations are scaled. Applying the 20% deaths and 16% of DALYs averted we calculate the proportion of the population who would experience lifesaving and transformative changes, respectively. We assume the others will experience substantial changes.

Depth: Lifesaving: 20% (12,537,057). Transformative: 16% (10,029,646). Substantial: 64% (40,118,584)

Probability: High certainty. 50% probability of achievement given the high priority given to healthy diets and related issues like anemia and NCD prevention in our focus countries.

2. Poverty reduction, livelihoods and jobs

poor people benefiting from relevant CGIAR innovations

Challenge: F&Vs are profitable for smallholder farmers if market demand is good. Smallholder farmers will benefit from this Initiative through adopting improved vegetable cultivars and safer and more sustainable production methods.

Breadth: In Asia, the WorldVeg M&E system shows that WorldVeg material sold by seed companies was planted by 490,000 farmers in 2020³⁷. The data show a 7.4% annual growth in WorldVeg-related seed sales (2017-2020). This trend will likely be maintained over the next decade as new breeding programs are making impact leading to doubling the 10-year impact to at least 1 million farmers in Asia. In Africa, our impact through improved cultivars reach about 394,000 farmers in Tanzania alone^{18 19}. The growth in impact is likely to have a similar pace as predicted for Asia based on expressed interest in the consortium for African vegetable seed companies whose membership has increased from 8 to 23 companies (2018-2021). Based on this evidence, a conservative estimate is that at least 1.5 million smallholder vegetable farmers (1.0 million in Asia and 0.5 million in Africa) will adopt WorldVeg improved vegetable cultivars.

Depth: The adoption of improved vegetable cultivars has an incremental effect on crop yields and farm incomes. Yield gains of 6.6% and 16.9% were found for two improved tomato cultivars in Tanzania while costs did not change.¹⁸ Furthermore, Schreinemachers et al estimated a 48% increase in net household income was found for vegetable farmers in Bangladesh with adoption of improved cultivars and practices.²⁰ Thus, a 10% average income increase is realistic, while the depth of impact may be greater for farmers adopt multiple practices.

Probability: High certainty based on current M&E data

3. Gender equality, youth and social inclusion

women benefiting from relevant CGIAR innovations

Challenge: Women often assume an important role in vegetable production and processing, although this varies by crops and locations. In South Asia (SA) most tomato and chili producing farms are managed by men³⁸, but in Southeast Asia (SEA) women manage about 38% of vegetable farms¹⁸. On the consumption side, women are nutritionally vulnerable and influence food and care decisions in their households. Thus, nutrition-sensitive interventions often target women. FRESH takes a gender-sensitive approach across all WPs by explicitly considering the needs, priorities and constraints of women.

Breadth: Estimating the number of women benefitting from FRESH is challenging due to the lack of empirical studies that have reported on gendered differences in technology adoption in the F&V sector, the high variation in gender across contexts, and the fact that FRESH will work on a wide range of innovations from breeding to consumer behavior, each with its own gender dynamics. We estimate that 11,286,000 will have a transformative or greater change in micronutrient adequacy and 750,000 will have an income benefit.

Depth: There is little to no evidence that interventions in the F&V sector are gender-transformative, with the exception of home garden interventions in particular contexts such as Bangladesh^{39,40} and Burkina Faso.⁴¹ We conservatively assume that the impact of most interventions will be “significant”.

Probability: Low certainty (10-30%) given data limitations.

4. Climate adaptation and mitigation

people benefiting from climate-adapted innovations

Challenge: FRESH will address climate adaptation at the farm-level through the use of improved climate-resilient vegetable cultivars and agronomic practices that increase the resilience of vegetable-based production systems. Diversifying staple-based production systems with vegetables will also contribute to climate change resilience.⁴² Rising average temperatures increase the need for better postharvest management of vegetables such as the use of cooling and scheduling harvesting and transport when temperatures are favorable.

Breadth: We estimated above that 1.5 million smallholder vegetable farmers would benefit from improved vegetable cultivars, sometimes in combination with good practices. Many traits of improved vegetable cultivars traits are related to climate adaptation such as heat tolerance, drought resistance, flooding tolerance, short duration and shelf-life, but there are also traits that do not have a clear link to climate change adaptation. In the current breeding programs, about 1 in 4 targeted traits are climate change related. Although this does not mean that one in four cultivars are climate-smart, it could be considered as a proxy for this. We therefore estimate that 375,000 smallholder farmers will benefit from the adoption of climate-smart cultivars, often in combination with climate-smart practices.

Depth: Significant given the importance of traits such as long shelf-life and heat tolerance.

Probability: Medium (30-50%) as climate adaptation is just one of several targets for improved cultivars and good practices.

5. Environmental health and biodiversity

ha under improved management

Challenge: FRESH will conduct research on safer and more sustainable vegetable production methods, based on principles of agroecology and regenerative agriculture. Improved vegetable cultivars, more resistant to prevailing biotic and abiotic stresses, are an important component of such improved management practices. We therefore base calculations on the above rationale for the number of smallholder farmers benefitting.

Breadth: As mentioned above, we estimate that 1.0 million smallholders in Asia and 0.5 million stallholder farmers in Africa will benefit from the adoption of improved vegetable cultivars, some of which will also adopt other improved management practices. The M&E system of WorldVeg shows that the 490,000 farmers in Asia planted improved vegetable cultivars on 171,000 ha in 2020. Assuming the average size of vegetable farms will remain constant, we predict that improved cultivars will be planted on 342,000 ha in Asia by 2030. For Africa, studies show that about 84,000 ha is planted to WorldVeg tomato cultivars¹⁸ and 11,498 ha to WorldVeg amaranth cultivars.¹⁹ Using the same 7.4% growth rates, 195,000 ha will have improved vegetable cultivars by 2030, or 537,000 ha.

Depth: The adoption of improved vegetable cultivars has an incremental effect on crop yields and farm incomes. Using the same rationale as for impact on poverty, a 10% increase in productivity is realistic.

Probability: High certainty based on current M&E data.

plant genetic accessions available and safely duplicated

Challenge: World Vegetable Center holds the worlds' largest publicly available collection of vegetable genetic resources in its gene banks in Taiwan (65,157 accessions; 68% available for distribution) and Tanzania (3,000 accessions, focused on traditional African vegetables). The management of the WorldVeg gene banks follows good practices of the CGIAR Centers and the provisions of the International Treaty on Plant Genetic Resources for Food and Agriculture. The gene bank strives to make 90% of genebank accessions available for distribution by 2025 through seed production, health and quality testing and have 90% of the collection safety duplicated. Another goal is to expand the collection of traditional vegetables with 1,400 new accessions. FRESH will contribute to achieving this goal.

Breadth: 1,400 new accessions will be added to the collection, mostly of traditional vegetables.

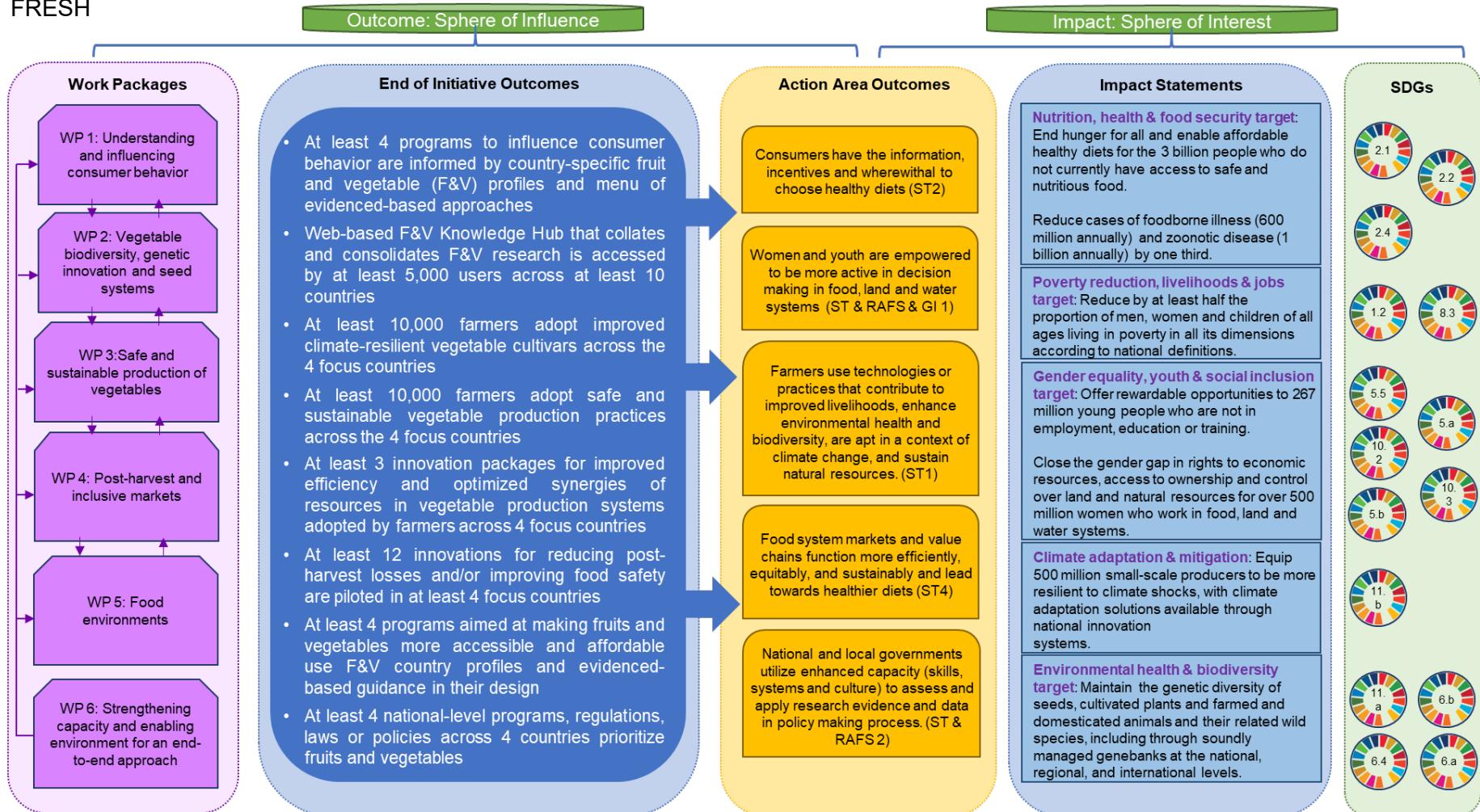
Probability: Efforts are ongoing to which FRESH will contribute. We therefore assign it a very high probability of success (>80%).

3. Research plans and associated theories of change (TOC)

3.1 Full Initiative TOC

3.1.1 Full Initiative TOC diagram

FRESH



3.1.2 Full Initiative TOC narrative

FRESH aims to design, test and scale end-to-end approaches to sustainably increase F&V intake in LMICs while also empowering women and youth and making F&V sector jobs safer, more accessible, and profitable, especially for women and youth. FRESH will start with research on consumers to understand dietary patterns and drivers of low levels of F&V intake and identify opportunities for shifting dietary behaviors (**WP1**). Simultaneously we will work with farmers and other value chain actors to understand production (**WP2 & WP3**) and post-harvest possibilities (**WP4**) for affordable, safe and sustainable produce and associated products. Food environments will also be assessed and opportunities for increasing accessibility and affordability of F&V identified (**WP5**). By approaching the problem of low F&V intake in this way, FRESH aims to create a systemwide win-win approach within the F&V sector in which consumers', farmers' and other value chain actors' diet, nutrition, health and livelihood aspirations are met, and more resilient and equitable F&V value chains are created.

FRESH will achieve these goals through its' six interconnected WPs whose activities will be based on an iterative and multilayered co-creation process. This process will bring together a wide range of stakeholders from government, multilateral organizations, NGOs, CSOs, farmers', women's and youth groups, academia, the private sector and other CGIAR Initiatives. Building on the country stakeholder meetings (**section 2.6**) we will develop a F&V Stakeholder Group and hold biannual meetings within the four focus countries. The meetings will be used to inform FRESH's overall direction and to ensure alignment with national priorities, contextual and cultural factors. From the F&V Stakeholder group, each WP will identify a subset of partners with whom to form sub-committees (which may include people external to the F&V Stakeholder Group, as relevant) to participate in each WP's co-design processes. These committees will meet regularly to identify, design and test innovations across the value chain to address **desirability, accessibility, affordability and availability** barriers to F&V intake. These subcommittees will provide updates on progress, discuss emerging evidence and constraints or opportunities in the co-design, piloting and scaling processes at the biannual F&V Stakeholder Meetings. We expect that this iterative and multi-layered co-design process will contribute to increasing stakeholder awareness of identified constraints and opportunities and give participant's voice and agency for effecting and directing change across the F&V sector.

The activities undertaken by FRESH's six interconnected WPs are expected to lead to: scaling partners integrating effective behavioral approaches for increasing F&V intake into their programs (**EoI outcome 2**), farmers' adopting improved cultivars (**EoI Outcome 3**), farmers' adopting technologies to improve production efficiency (**EoI Outcome 4**), value chain actors adopting technologies to reduce post-harvest losses and improve food safety (**EoI Outcome 5**), scaling partners designing and testing interventions to increase F&V accessibility and affordability (**EoI Outcome 6**) and scaling partners prioritizing F&Vs and ensuring specific actions to increase F&V production, processing, and intake are integrated into national policies, laws and regulations (**EoI Outcome 7**). To reduce fragmentation of F&V R&D and facilitate global learning, FRESH will create a F&V Knowledge Hub to serve as a platform for housing and sharing F&V research and innovation accessible to all (**EoI Outcome 1**). Together these outcomes are expected to contribute to a range of Action Area outcomes and in turn, achievement of goals across the five Impact Areas.

3.2 Work Package TOCs

3.2.1 Work Package 1: Understanding and influencing consumer behavior

<i>Work Package title</i>	Understanding and influencing consumer behavior
<i>Work Package main focus and prioritization</i>	People do not eat enough F&V even when they are accessible and affordable. Detailed dietary data is needed to understand the extent of the problem across different population groups in LMICs, and work is needed to design, test and scale appropriate interventions to encourage increased F&V consumption. This WP will work closely with other organizations focused on improving diets, nutrition and health outcomes including local academic partners such as Sokoine University and Wayamba University, Nutrition International, World Food Programme, and Ministries of Health. Together, we will co-design and conduct research to understand the context-specific priority opportunities and constraints, and to design, test and scale appropriate interventions to shift dietary behaviors.
<i>Work Package geographic scope (global/region/country)</i>	Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries.

The science:

F&V consumption is far below recommended levels in LMICs.⁴³⁻⁴⁷ Detailed individual-level dietary data is needed to clarify the extent of the problem, and how it varies across the life-cycle, by gender and demographic and socio-cultural factors.

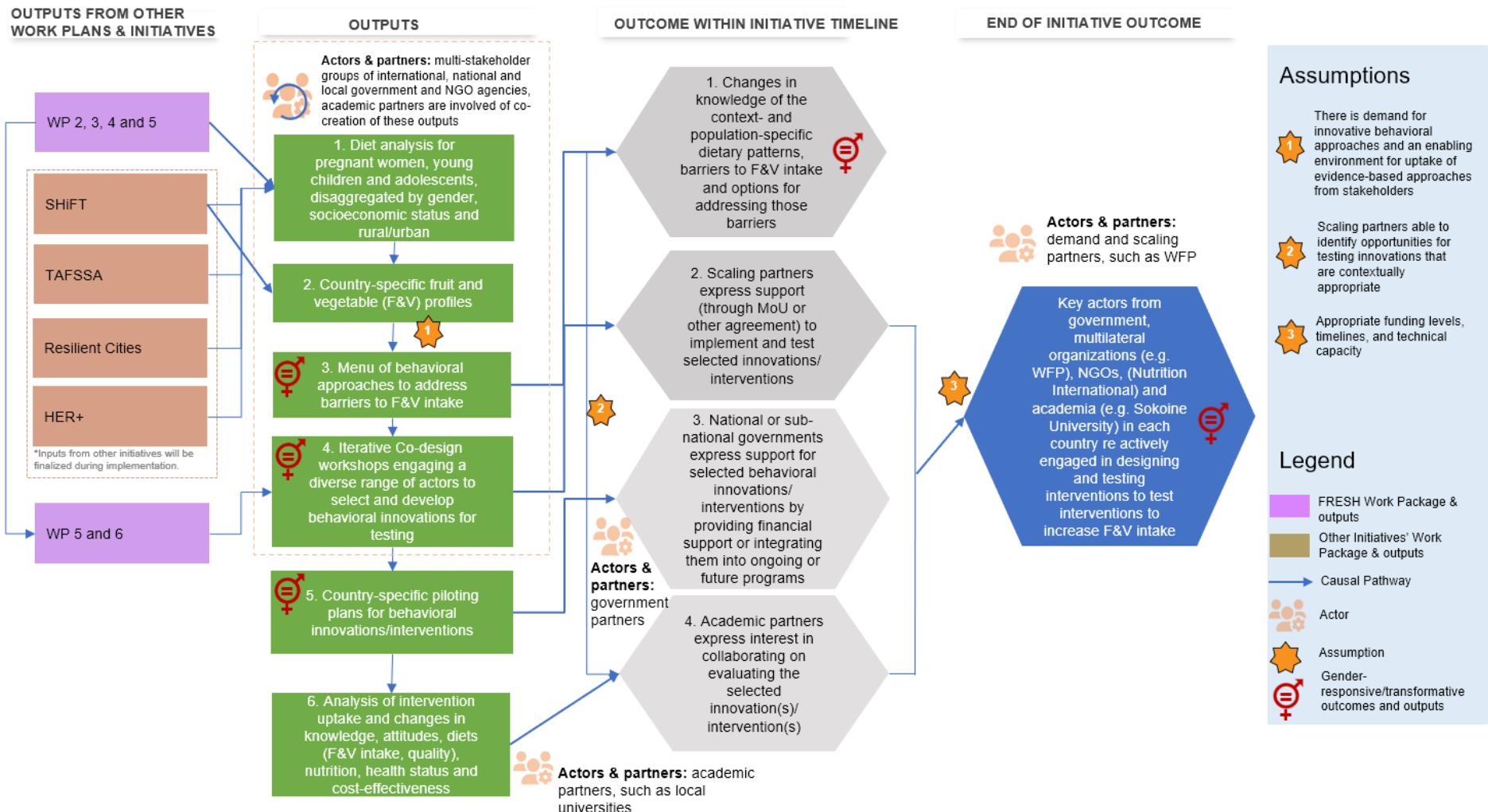
Dietary practices are difficult to change.⁴⁸ Thus, targeting interventions to key life-cycle stages important for habit formation should be prioritized. Some evidence suggests that dietary preferences are influenced in utero⁴⁹ and solidified by age three.⁸ Evidence also shows that early habits persist into adulthood.^{50,51} Adolescence has been identified as another opportune time for influencing health behaviors as adolescents gain independence and agency.⁹ Influencing women's preferences and empowering them could improve all household members' diets especially their children's¹⁰ given their central role in food preparation.

Several promising behavioral approaches warrant further testing and adaptation. For example, the mobile app FRANI (Food Recognition Assistance and Nudging Insights) provides real-time diagnostics and tailored "nudging" on dietary intake to improve adolescent girls' diets⁵² and could be adapted for groups like pregnant women. [Recipe competitions](#) can be used to highlight innovative processing and preparation approaches and increase F&V acceptability. Emerging evidence suggests that combined (as opposed to single), strategies are more effective for influencing healthy eating behaviors.⁷ National school feeding programs ([linked to WP5](#)) could be leveraged to address accessibility and desirability constraints simultaneously and test the effectiveness of peer-to-peer learning, targeted social media approaches^{53,54} or experiential learning⁷ to facilitate healthy eating habits among children and their caregivers⁵⁵⁻⁵⁷. WP1's three specific objectives will be addressed in Benin, the Philippines, Sri Lanka, and Tanzania.

Specific objectives	Research questions	Methods	Outputs	Linkages
1. Understand dietary patterns their drivers and associated health and nutrition problems	What are the dietary patterns among women, young children and adolescents; how do they vary by key characteristics?	Multidisciplinary stakeholder workshops with demand, scaling and innovation partners Literature review Secondary data analyses Repeated cross-sectional dietary assessments using multi-pass 24-h recalls with repeated measures Skin carotenoid levels using Veggie meter	Diet analysis for pregnant women, young children and adolescents, disaggregated by gender, socioeconomic status and rural/urban F&V country profiles highlighting F&V intake levels, nutrient gaps, prevalence of micronutrient deficiencies, stunting and NCDs	All WPs SHiFT TAFSSA Resilient Cities
2. Create a menu of behavioral innovation/intervention options and delivery platforms mapped to population groups and select promising approaches to test	What are the costs and benefits of the most promising interventions (to be selected with partners) in the four focus countries?	Literature review and analysis of costs and benefits of different approaches Iterative co-design workshops	Menu of options of behavioral innovation/intervention options and delivery platforms mapped to population groups Iterative co-design workshops to select target groups, contextualize new and existing evidence, select interventions/platform combinations to test and develop Country-specific piloting plans for behavioral innovations/ interventions	WP5, WP6 SHiFT TAFSSA Resilient Cities Her+
3. Assess impact of behavioral approaches (e.g., AI tools, experiential approaches)	What is the impact and cost-effectiveness of behavioral innovations on F&V intake, diet, nutrition and health outcomes and how was impact achieved?	Causal impact evaluations including knowledge, dietary, skin carotenoid, micronutrient, and anthropometric assessments designed to create long-term longitudinal cohorts Process evaluations Cost-effectiveness studies	Analysis of intervention uptake and changes in knowledge, diets and nutritional outcomes and cost-effectiveness	WP5, WP6 SHiFT TAFSSA Resilient Cities

Work Package 1: Understanding and influencing consumer behavior

OUTPUTS FROM OTHER WORK PLANS & INITIATIVES



The theory of change:

To make progress in increasing F&V intake convenience and desirability issues must be addressed. Context- and population-specific dietary patterns and their drivers need to be characterized and cost-effective behavioral approaches identified and integrated into large-scale programs and embedded into policies. Globally there is an enabling environment to support these efforts. For example, the [Healthy Diets Coalition](#) has recently formed and will emphasize three priority areas including, “*valuing food: motivating individuals, families and communities to eat healthy diets through multi-dimensional education, information, demand generation and behavior change support*”. In [preparation for the UNFSS](#), Sri Lanka, Tanzania and the Philippines highlighted the need for behavioral approaches to address their countries’ nutrition problems suggesting demand for innovative behavioral approaches and an enabling environment for uptake of evidence-based approaches (**assumption 1**).

Building on this momentum we will use a co-design process based on a 5-step process used successfully by IFPRI and WFP to improve effectiveness of nutrition-sensitive programs at WFP with multi-stakeholder groups in Benin, the Philippines, Sri Lanka and Tanzania. These groups will include representatives from **other FRESH WPs** and our External Advisory Panel and will build from the group of stakeholders who participated in the country stakeholder consultations (**Section 2.6**).

Biannual meetings (**output 4**) will serve as a platform for discussing national priorities and policies, local programs, and contextual factors along with emerging evidence related to F&V, diets, effectiveness of behavioral approaches, and assessment tools, some of which will be generated under **SHiFT, Resilient Cities TAFSSA and Her+**. The first group task will be selecting priority life-cycle groups (and sub-groups (e.g., urban/rural, SES status)) for the dietary assessments. These will be co-implemented and analyzed with our academic partners like Wayamba University in Sri Lanka (**output 1**) and will contribute to the country-specific F&V profiles (**output 2**) and menu of options (**output 3**). We expect that sharing these outputs will lead to improved understanding by participating agencies of context- and population-specific dietary patterns, barriers to F&V intake, and options for addressing those barriers (**outcome 1**). This will inform and guide scaling partners, like WFP, to identify opportunities and be willing to implement them along with rigorous impact evaluations (**outcome 2**). It will also inform and guide local government investments in the implementation and testing of behavioral approaches (**outcome 3**). Lastly, we expect our academic partners to be interested and willing to collaborate on related impact evaluations (**outcome 4**).

Based on the identified opportunities (e.g., in Sri Lanka using FRANI to nudge adolescents to improve diets with or without peer-to-peer learning), a subset of stakeholders (e.g., WFP, Ministry of Education, Foundation for Health Promotion, **FRESH WP5**) will collaborate to design pilot plans (**output 5**). If funding, timing and capacity allow (**assumption 3**), we expect partners like WFP or the Ministry of Education to co-design behavioral approaches and integrate these into their programs (e.g., national awareness campaigns or SAPs) and co-implement comprehensive impact evaluations with FRESH scientists in the four focus countries (**EoI outcome 1**). These activities, including analysis, will start in year 2 (**output 6**) and extend to phase 2 to allow sufficient time to impact diets, health, and nutrition outcomes. We will create longitudinal cohorts within the impact evaluations as funding allows to assess long-term impacts. Evaluation results will be disseminated through multiple channels to help guide future investments.

3.2.2 Work Package 2: Biodiversity, genetic innovation and seed systems

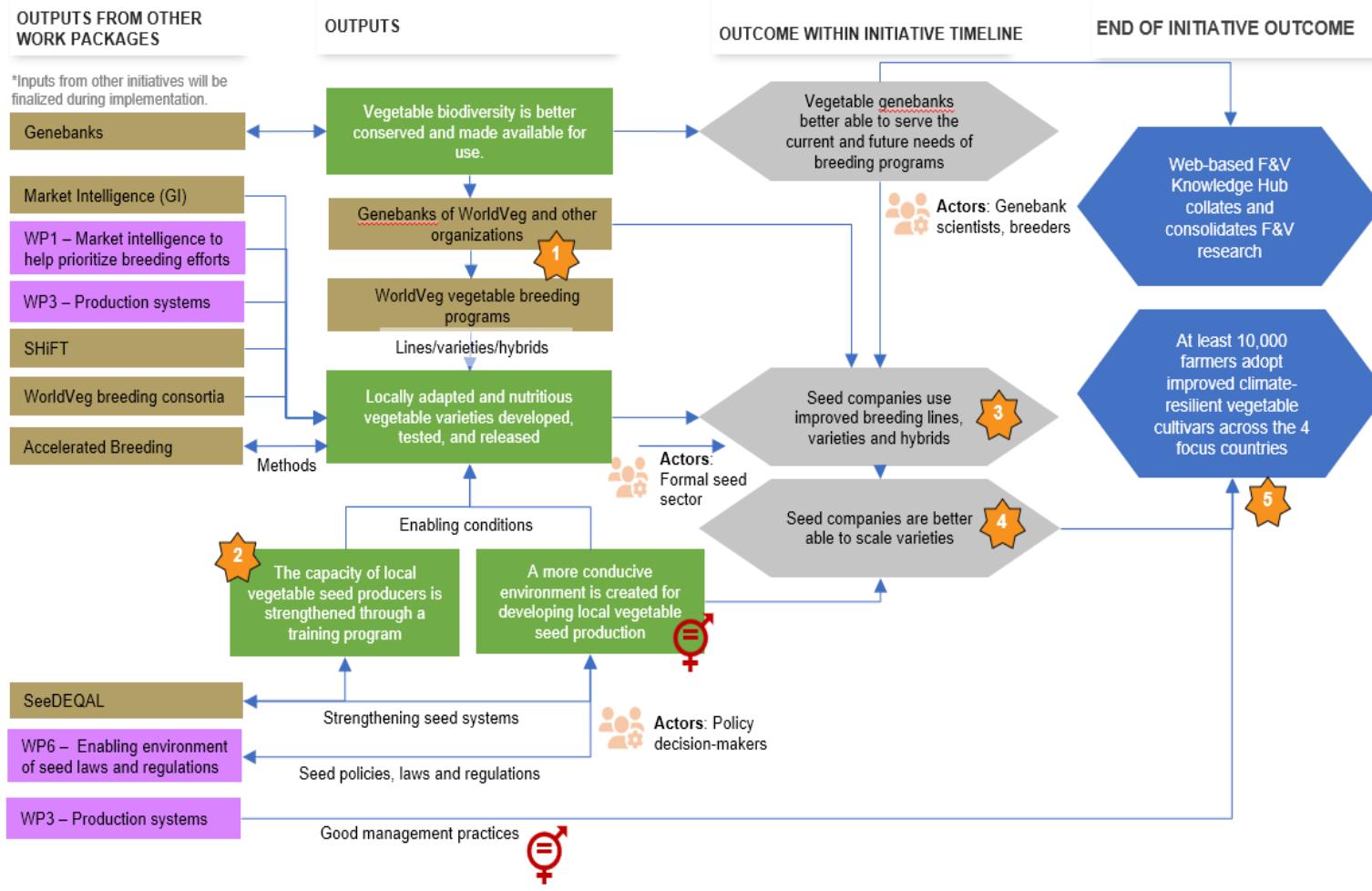
Work Package title	Biodiversity, genetic innovation and seed systems
Work Package main focus and prioritization	Low vegetable supplies, especially outside the regular growing season, is a major factor contributing to vegetables being unaffordable to consumers in LMICs. This WP aims to increase farmers' access to quality seed of improved, resilient and nutritious vegetable cultivars of a diverse range of species that align with the preferences of consumers, farmers and other value chain actors. The priorities are: (a) to better conserve and use vegetable biodiversity, particularly of traditional vegetables, as a basis for improvement and diversification; (b) to strengthen vegetable seed systems; (c) to develop locally adapted vegetable cultivars meeting local preferences; and (d) to increase farmer adoption of quality vegetable seed of well-adapted cultivars.
Work Package geographic scope (global/region/country)	Global, but with a particular focus on Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries.

The science:

Specific objectives	Research questions	Methods	Outputs	Linkages
1. Conserve and use vegetable biodiversity to source traits for new crop cultivars	What are the conservation gaps of prioritized vegetables (from WP1) that will inform germplasm rescue activities?	Biodiversity monitoring and vegetable diversity rescue Landscape genomics for germplasm characterization and identification of adaptive traits	At least 3 journal papers on vegetable biodiversity and prioritization for genetic improvement 600 germplasm accessions collected and characterized	WP1 Genebanks (GI) WorldVeg and national genebanks Nature Positive Solutions
2. Improve farmers' access to improved vegetable cultivars with good performance under local conditions	Which genetic improvements of which vegetable crops have the greatest potential to contribute to the One CGIAR Impact Areas? How do preferred traits for vegetables vary among geographies, market segments and female and male farmers?	Define product profiles and breeding pipelines based on biophysical/ socioeconomic data Strengthen the capacity of the private/public sector in cultivar evaluation and breeding Use conventional and molecular breeding methods and pilot novel breeding tools to accelerate cultivar development Tricot method to collect gender-disaggregated feedback data from farmers Seed consortia to scale cultivars	At least 10 new cultivars shared with scaling partners At least 100 people trained in vegetable cultivar evaluation and breeding At least 3 journal articles on multi-locational trials, trait prioritization and vegetable breeding methods	WP1, WP3-6 SHiFT Market Intelligence Accelerated Breeding WorldVeg breeding consortia
3. Increase farmers' adoption of improved vegetable cultivars	What seed production and delivery models can smallholder farmers including marginalized groups provide better access to seed of well	Test and scale most promising seed production models in each country Develop a capacity strengthening program for	At least 4 workshops organized on seed laws and regulations At least 1 journal paper on regional	WP4, WP6 SeEdQUAL

	<p>adapted and nutritious cultivars?</p>	<p>regional seed companies in Africa on seed production and marketing</p> <p>Policy briefs and workshops on streamlining vegetable cultivar registration and seed certification</p> <p>Study on regional seed sector and regulations</p> <p>Impact studies on seed adoption and livelihoods</p> <p>Study on the gendered differences in access to vegetable seed</p>	<p>seed sector laws and policy environment</p> <p>At least 2 journal papers on access to and adoption of improved vegetable seed including gender aspects</p>	
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Work Package 2 Biodiversity, genetic improvement and seed systems



Assumptions

- 1 Conservation and use of vegetable biodiversity provide the genetic diversity required for developing new cultivars
- 2 Seed companies are willing to include tested and locally adapted breeding lines in their breeding and variety development programs
- 3 Staff of NARS and seed companies are interested in being trained in breeding and seed production, and environmental, consumer and market studies help to develop product profiles of better adapted and consumer-accepted vegetable cultivars
- 4 Linkage of breeding programs to seed production and streamlining of seed policies strengthens seed systems
- 5 Farmers that generate more income with improved cultivars are ready to invest in quality seed to secure future harvests, thereby strengthening seed systems through continuous demand

Legend

- FRESH Work Package & outputs
- Other Initiatives' Work Package & outputs
- Causal Pathway
- Actor
- Assumption
- Gender-responsive/transformative outcomes and outputs

The theory of change:

Together with national partners (e.g., INRAB in Benin, TARI in Tanzania), we will identify biodiversity conservation gaps by analyzing genebank inventories and monitoring biodiversity in farmers' fields. This information will be used to select species and locations for germplasm rescue. Comprehensive characterization of collected and conserved germplasm enables genebanks to provide vegetable breeders in the public and private sector with valuable genetic resources to meet current and future breeding objectives.

Consumer, farmer and market requirements (obtained from **WP1, 2, 5**, "Market Intelligence") will guide vegetable breeding in FRESH. We will also study gender-specific cultivar preferences and incorporate these in product profiles. We will develop and test breeding lines and share at least 10 locally adapted and nutritious cultivars with seed companies in the focus countries to enhance the use of improved breeding lines, cultivars and hybrids. WorldVeg breeding programs are closely connected to vegetable seed companies through the [Africa Vegetable Breeding Consortium \(AVBC\)](#) and the [Asia & Pacific Seed Association \(APSA\)-WorldVeg Vegetable Breeding Consortium](#), which together have over 60 seed company members. Field demonstrations will be organized to help companies select the best material. We estimate that at least 10,000 farmers in the focus countries will purchase improved vegetable cultivars from seed companies that partner with FRESH (e.g., Landmark Agro Seeds and Onesh Agri in Sri Lanka, East-West Seed in Tanzania, Philippines and Benin).

To ensure that local seed companies are equipped to use and scale breeding lines, we will organize week-long capacity strengthening events on seed production and vegetable breeding for local seed companies and NARS. **WP2**, together with **WP6** and SeEdQUAL will identify bottlenecks to vegetable cultivar registration and seed certification and work with ministries of agriculture, seed agencies and seed associations to ease these bottlenecks.

Improved cultivars will be promoted to farmers through field demonstrations and distribution of seed samples in collaboration with seed companies. Improved cultivars will be combined with optimized production technologies from **WP3** so that farmers can see their full potential. We will study gender constraints in access to vegetable seed and address these together with partners. Links to **WP1** and **WP5** will help farmers supply produce in demand by consumers. Income generated from successful sale of harvests from improved cultivars will stimulate demand for quality seed and help to increase the supply of nutritious and affordable vegetables, also in the off-season, for better balanced diets for all.

The TOC is based on the following assumptions: (1) the available vegetable biodiversity provide enough genetic diversity for developing new cultivars with desired traits; (2) seed companies are willing to include tested and locally adapted breeding lines in their own breeding programs; (3) staff of NARS and seed companies are interested to participate in week-long training events, and environmental, consumer and market studies help to develop product profiles of adapted and consumer-accepted vegetable cultivars; (4) the regulatory environment is conducive for investment in local vegetable breeding by seed companies; and (5) farmers that generate more income with improved cultivars reinvest in quality seed to secure future harvests, thereby strengthening seed systems through continuous demand.

3.2.3 Work Package 3: Safe and sustainable production systems

Work Package title	Safe and sustainable production systems
Work Package main focus and prioritization	This Work Package focuses on enhancing the availability of vegetables through sustainable diversification and intensification under conditions of climate change. We will analyze production system constraints, and develop, test and scale options for sustainable diversification and intensification in conjunction with appropriate technologies such as regenerative agriculture practices, integrated pest management, water management, etc. with a particular focus on year-round production of diverse and safe vegetables. Strategies & networks will also be developed to make quality farm inputs and services available to smallholder farmers.
Work Package geographic scope (global/region/country)	Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries.

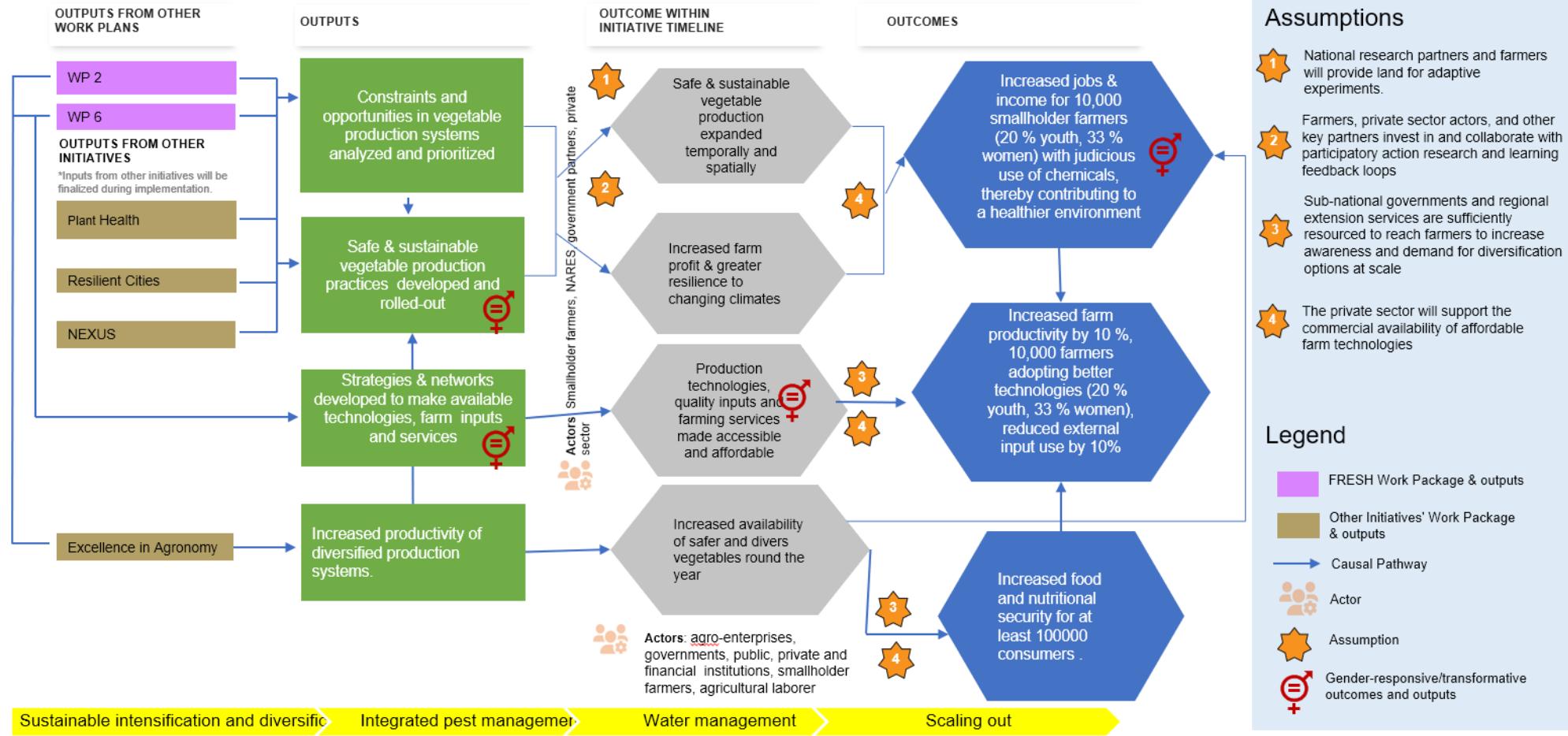
The science:

Since the global demand for vegetables continues to grow in tandem with limited availability of natural resources, future supply will be insufficient to achieve recommended levels in many countries even under optimistic socioeconomic scenarios. Hence, year-round production and supply of diverse vegetables must be enhanced in a sustainable manner. A clear understanding of production system constraints and needed interventions will help in achieving our goal in target regions.

Specific objectives	Research questions	Methods	Outputs	Linkages
1. To gain understanding of current and future challenges to - and opportunities for - safe and sustainable vegetable production	What are the key challenges and opportunities for vegetable production systems in the 4 focus countries?	Constraint mapping and analyses (Waddington et al., 2010) Resource mapping Farming system and market analysis (Martin et al., 2013)	Analysis of constraints and opportunities for vegetable production systems in the focus countries	WP-2,4 WorldVeg SAFEVEG project in Benin
2. To develop and test technological packages for enhanced resource use efficiency at scale	What technologies can enhance resource use efficiency while addressing farmers needs and constraints?	On-station and on-farm experiments in each focus country (Srinivasan et al., 2019; Srinivasan et al., 2020; Buragohain et al., 2021) Technology assessment, validation and refinement Capacity building of R&D stakeholders	4 technology packages developed in each country and rolled out.	WP-1,2,4,6 Nature Positive Solutions
3. To develop and test solutions for year-round production of vegetables	What are the technologies for year-round vegetable production? What is needed to diversify staple / commercial crop production systems using vegetables for	On-farm demonstrations (Cooreman et al., 2021; Sseguya et al., 2021) Information access and communication (Leclair and Kanyenda, 2019;	4 journal papers with results of on-farm experiments in each country	WP-2 (cultivars) Excellence in Agronomy Plant Health Resilient Cities

Specific objectives	Research questions	Methods	Outputs	Linkages
	higher productivity, increased income and enhanced food and nutritional security?	Campenhou et al., 2021)		
4. To assess sustainability matrix of production technologies using crop modeling	How does standardized assessment of sustainability parameters including productivity, resilience, resource use efficiency, soil health, and food safety for new technologies affect the efficiency and efficacy of their development process?	Experimentation Crop modeling Sustainability Matrix (Tzouramani et al., 2020; Bruma et al., 2021)	4 journal papers describing results of modeling work	WP-1,6 Excellence in agronomy

WP 3 | Safe and Sustainable Production Systems



The theory of change:

This WP focuses on strategies and a research framework for delivery of safe, diverse and abundant vegetables year-round to consumers in selected LMIC. The TOC has been built on four major research questions. Analyzing key geographic and agronomic issues, will deliver, understanding of constraints and opportunities for diversification of farming with vegetables and will inform creation of strategies for sustainable production of vegetables in target countries. This will help us in tailored technological innovations for each context. Mapping current and future resources available for vegetable production will facilitate identifying context-specific strategies for increasing farmers' access to technologies to enhance resource use efficiency. This will further assist in establishing required networks and partnerships with scaling partners while collaborating with CGIAR and IARCs to impact at least 10,000 smallholder farmers through co-created technological packages and solutions and delivery mechanisms. Partners and the Initiative team within prioritized geographies and farming systems will develop and cater research products and services which will directly feed into the output on improved efficiency and optimized synergies of resources in vegetable production systems and adoption of safe and sustainable vegetable production practices.

The intensified production systems will enhance job opportunities for women and youth. The development of networks and strategies will enhance availability of quality farm inputs and services using digital platforms. Vegetable breeders will be fed back to consider wide adaptability while releasing new cultivars, keeping in view the potential threat of climate change. For last mile delivery of technologies, agroecological based hub methodology will be used for participatory technology development.⁵⁸ Implementing a hub involves three stages: (i) establishing physical components (platforms, modules and extension areas); (ii) training extension agents, private sector and farmers; and (iii) creating, promoting and strengthening local innovation systems. Importantly, farmers public and private sector will be involved in each stage as they play a key role in technology development, adaption and scaling. Workshops and training will be conducted for public and private stakeholders on climate change effects and F&V production, adaptation and mitigation strategies. Extension functionaries will be trained on the resilient technologies and how climate change affects its production.

The standardized assessment of multiple-sustainability parameters will help in understanding the science of the process development of research products leading to safe and sustainable vegetable production. The key intervention areas will include enhanced sustainability, biodiversity and resilience, assuring food safety, reduced pesticide use, optimized water and nutrient use leading to better diets and healthier environments. **WP2** and **WP6** and Initiatives such as Resilient Cities, and Nexus Gains will also feed into the design process of this WP. The overall strategy is towards gaining a better understanding of production systems and deploying appropriate actions leading to enhance productivity of safe vegetables year-round leading to fulfilment of national demand and thereby reducing imports.

The potential impact of the interventions on regional vegetable production will be assessed against the backdrop of climate change and post COVID resilience. Variations in the secondary (temporal) data on the quantity of vegetables produced, marketed and the availability at household level will be analyzed. Mainly R&D partners and scaling partners will be involved including NARES, universities and NGOs and private sector for improved access of product and service. Experts from WorldVeg, local universities and M.Sc. and Ph.D. students will also be involved.

3.2.4 Work Package 4: Post-harvest and inclusive markets

Work Package title	Post-harvest and inclusive markets
Work Package main focus and prioritization	This WP aims to reduce postharvest losses, improve food safety, and empower women and youth in F&V value chains in LMICs. The WP will first characterize F&V value chains in each focus country to identify problems as well as entry points. It will then use a demand-led and participatory approach to design and test 12 pilot interventions to reduce postharvest losses and/or improve food safety with a particular focus on women and youth. Training materials and scaling strategies will be developed for successful innovations. The WP will work closely with value chain actors and public/private sector scaling partners to ensure that interventions are demand-led.
Work Package geographic scope (global/region/country)	Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries.

The science:

Informal markets dominate F&V value chains in LMICs and are characterized by a lack of stable business relations and communication between value chain actors, and high risk related to product losses and price fluctuations.⁵⁹ Losses and waste commonly range from 30-50%.^{56 60} Product quality and food safety are not truly valued, reducing incentives to adopt good practices. This is a major factor contributing to limited supplies and high prices to consumers. Women and youth cannot fully participate in certain value chains.⁶¹

Specific objectives	Research questions	Methods	Outputs	Linkages
1. To characterize F&V value chains in the focus countries and to identify entry points for change	<p>What are the main food safety risks; what is the extent of value chain losses and where do they occur?</p> <p>What factors impede or enable women and youth from participating in, and benefitting from, F&V value chains?</p> <p>What factors (e.g., information, technologies, organizational changes) can alter the behavior of midstream value chain actors to reduce losses and improve food safety?</p>	<p>Review of literature, policies and ongoing initiatives</p> <p>Analysis of key contaminants (chemicals, pathogens) along value chains for selected F&Vs</p> <p>Surveys of value chain actors to quantify losses</p> <p>Focus group discussions with different social strata of value chain actors</p> <p>Gaming studies and choice experiments to identify behavioral factors</p>	<p>At least 4 reports/journal articles providing a detailed description of F&V value chains in 4 focus countries</p> <p>Entry points for intervention identified and refined with stakeholders through workshops</p> <p>4 country strategies describing pathways to F&V food safety and loss reduction through inclusive approaches</p>	<p>Link to WP1 on consumer perceptions of food safety; to WP3 on farm management affecting food safety and losses; and WP5 on F&V retail</p>

<p>2. To co-create and pilot innovations for reducing losses and improving food safety along the F&V value chain, while empowering women and youth</p>	<p>What appropriate innovations (technical and institutional) can reduce losses and improve food safety along F&V value chains?</p> <p>How can these innovations be tailored to benefit and empower women and youth?</p> <p>What is the impact of these innovations?</p> <p>How to scale these innovations?</p>	<p>Co-create innovations with value chain actors, including women and youth, using a demand led participatory approach</p> <p>Pilot innovations under actual conditions</p> <p>Evaluate results; learn and adapt</p> <p>Develop training materials and scaling approach</p> <p>Assess potential for economic impact on women and youth (ex-ante)</p>	<p>At least 12 innovations (3 per country) piloted and described in technical guides</p> <p>Gender-sensitive training materials</p> <p>1,200 value chain actors trained in the innovations</p> <p>4 journal articles documenting results</p>	<p>This links to all WPs, but particularly WP1, 3 and 5</p> <p>NEXUS Gains on postharvest loss reduction</p>
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The theory of change:

This WP will work with scaling partners such as national extension systems and NGOs implementing large value chain-oriented projects (e.g., SNV, iDE, CRS) as well as the other WPs to select particular F&V value chains in the focus countries that supply nutrient-dense F&V to local informal markets. Together with local researchers from universities or NARES we will do a thorough analysis of these value chains to characterize their organization, identify food safety risks, quantify postharvest losses and analyze the role of women and youth. The results will be presented to local value chain actors (farm organizations, collectors, traders, consumer groups) and scaling partners to collectively identify entry-points for intervention. Research outputs, including journal papers, will also contribute to the global knowledge about the functioning of F&V value chains in LMICs through the Initiative's F&V Knowledge Hub.

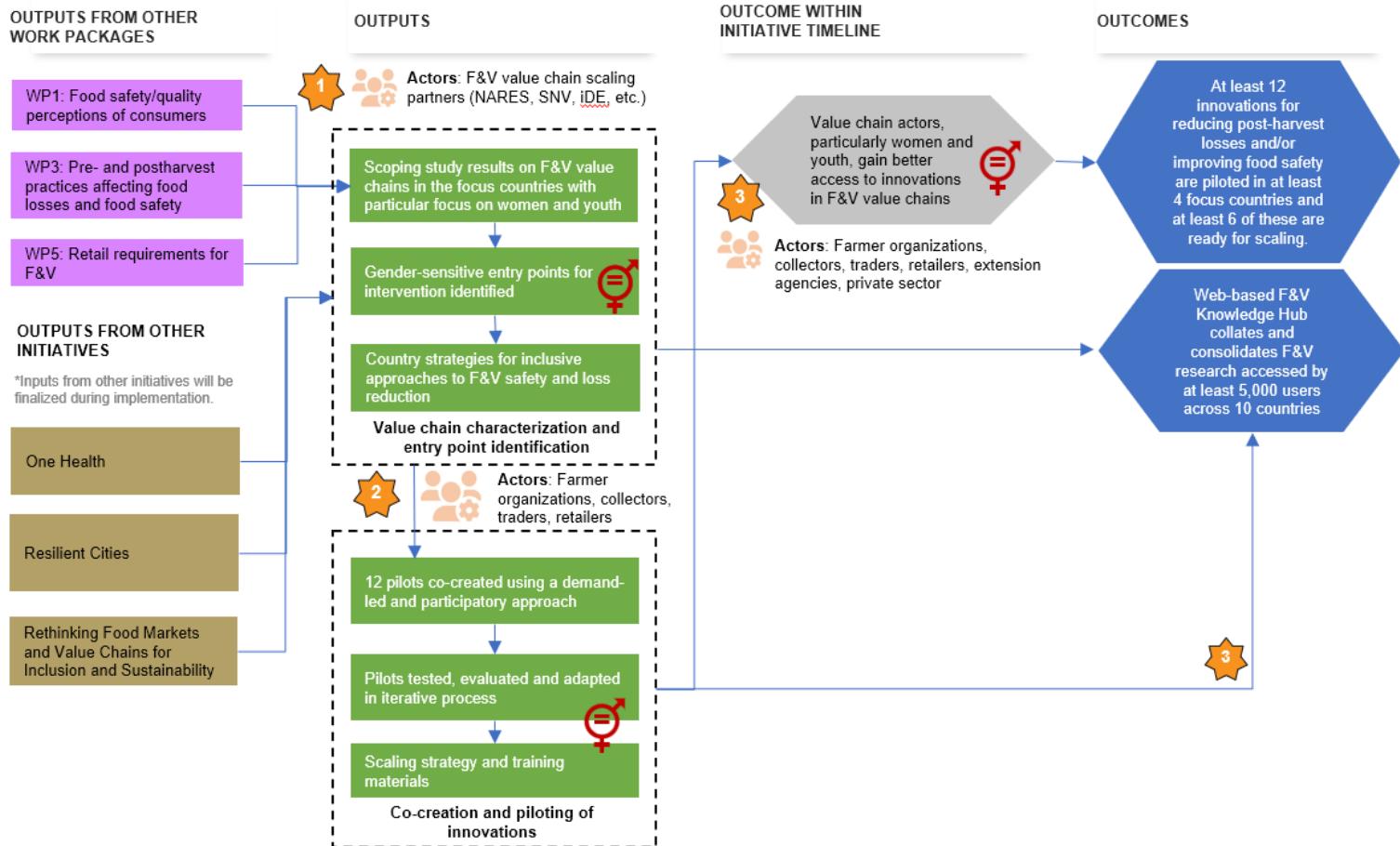
We will identify at least 12 interventions (three per focus country) — e.g., low-cost cooling, improved packing methods, novel marketing methods, rapid pesticide testing at markets, staged adoption of GAP—and use a participatory process to adapt these to local needs and conditions. Again, we will have a particular focus on women and youth to ensure it addresses their needs and constraints. The involvement of local value chain actors and scaling partners is critical at this stage to create interest and an incentive for future uptake. The piloting will be done with local researchers with technical backstopping from international partners to strengthen local research capacity in the area of F&V postharvest and food safety management.

All pilots will be tested under real-world conditions through an action-oriented research approach. Training materials will be developed and about 1,200 people will be trained in the innovations and, as a result, will gain better access to these innovations. Pilots will be evaluated and innovations will be adapted as necessary. We will particularly focus on the experience of women and youth with the innovations. At least 4 of 12 pilots should become ready for scaling by 2025. Close involvement of scaling partners throughout the process will create co-ownership of the innovations and an incentive to incorporate them into existing or future programs.

Key risks and assumptions are that scaling partners will have a strong enough interest to partner with FRESH on the development and testing of F&V value chain interventions (1). This may be a

risk as FRESH does not intend to finance the scaling process. Careful partner selection is therefore important. Another risk related to the involvement of local value chain actors such as collectors, wholesalers and market vendors who may have little time or interest to engage (2). This needs to be considered in the selection of value chains. Finally, a key risk is the uptake of the developed innovations by scaling partners and local value chain actors (3), which we tried to mitigate by involving them at every stage of the innovation process.

Work Package 4 | Postharvest and inclusive markets



3.2.5 Work Package 5: Food environments

<i>Work Package title</i>	<i>Food environments</i>
<i>Work Package main focus and prioritization</i>	WP5 focuses on how to develop or influence food environments to improve consumer access to and affordability of diverse and safe F&Vs. Drawing on key food system work on food environments ^{27,62–64} we begin with diagnostics of food environments in the focus countries, and then generate national evidence on a range of market and regulatory interventions and innovations co-designed to improve food environments that can be directly operationalized by stakeholders we will partner with. We will particularly focus on marginalized groups exposed to poor food environments and those at most risk for poor quality diets and all forms of malnutrition.
<i>Work Package geographic scope (global/region/country)</i>	Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries.

The science:

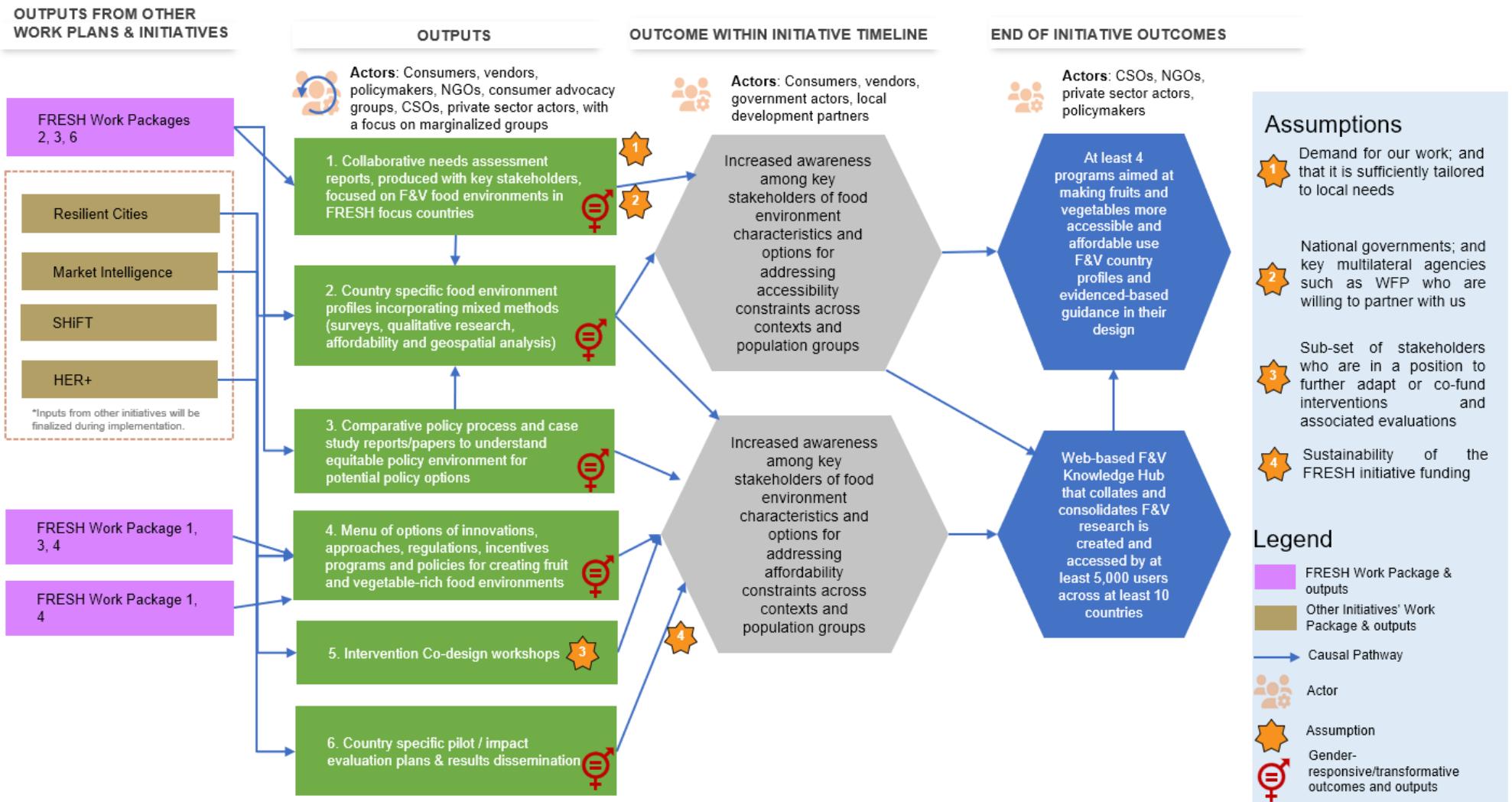
The food environment is where the production and supply end of the food system meets the consumption and food intake end, sometimes but not always through markets. Core elements of the food environment^{27,62–64} include availability and access to foods^{65–67}; vendor and product characteristics, price and affordability of foods^{68,69}; and marketing and regulation that structure the environments within which people access foods⁷⁰ that form a healthy diet, including the policy, programmatic and economic drivers of these^{71–73}. The food environment covers aspects outside of immediate consumer preferences that structure and shape food choice, both towards healthy diets and under-and over-nutrition outcomes^{74–78}.

Food environment descriptions and diagnoses are limited, and largely undertaken in high-income countries^{67,76,79–81}, though these are beginning to be done in some LMIC contexts^{63,82,83}. Interventions into food environments (again largely in high-income contexts) focus on wider questions of accessibility (including school or other institutional meals^{12,84} including local procurement^{85,86}, and bringing healthy foods such as fruits and vegetables closer to consumers^{20,85,87}; affordability (including consumer-end fruit and vegetable subsidies^{88–91}, and more general social protection⁹²); and how the wider product, retail and regulatory environment shape food environments (including labelling and advertising of foods^{92,93}, and zoning law⁹⁴). Policy choices and policy processes underpinning these areas has started to be assessed as a route to sustainable intervention^{73,95–97}. The strongest evidence favors multi-component interventions in the food environment for fruits and vegetables^{98–100}.

Our research questions and outputs are focused on 1) diagnosing and understanding F&V food environments and 2) applying and innovating new F&V focused interventions. To do so we follow a mixed methods approach including household and retail surveys^{62,67,76,79–81}; qualitative assessments of the lived experience of food environments⁶⁵; affordability studies^{88–91} geospatial analysis, policy and equity process and case study approaches^{73,94,95} and impact evaluations.

Specific objective	Research questions	Methods	Outputs	Linkages
1. Diagnosing and understanding F&V food environments	<p>What are the characteristics of food environments in relation to F&Vs?</p> <p>How do these vary by time and context and for different populations?</p> <p>What evidence exists on food environment interventions?</p> <p>What are the political economy and equity dimensions enabling and disabling such options?</p>	<p>Collaborative needs assessment workshops</p> <p>Geospatial (GIS) and retail environment assessments^{44,45, 1,7,16,19-21}</p> <p>Cost of diet/ Affordability studies³⁰⁻³³</p> <p>Qualitative assessments of food environment experiences⁵</p> <p>Policy process / political economy studies^{13,37,38, 39 49}</p>	<ul style="list-style-type: none"> ▪ Collaborative needs assessment reports per country ▪ Country Specific Food environment profiles with an equity focus ▪ Comparative policy process assessments 	WP1, WP6 SHiFT TAFSSA
2. Applying and innovating new F&V focused interventions	<p>What are the intervention and innovation options for countries and stakeholders to effectively intervene in food environments to include F&V?</p> <p>What is the impact of social assistance and other public programs on F&V accessibility and affordability? What are the costs, benefits and livelihood-environment-diet trade-offs of these innovations?</p>	<p>F&V focused adaptations of international food environment policy benchmarking (e.g., FOOD-EPI)⁵⁰</p> <p>Causal impact evaluations of healthy school meals^{26, 27}, zoning initiatives⁴⁷ and social assistance programs⁴⁸</p>	<ul style="list-style-type: none"> ▪ Country specific menu of policy and innovation options ▪ Intervention Co-design workshops ▪ Country specific pilot / impact evaluation briefs 	WP1-4,6 SHiFT TAFSSA Rethinking Food Markets

Work Package 5: PATHWAY 1 | Increasing accessibility of safe and sustainable fruits and vegetables



The theory of change:

The WP5 theory of change (TOC) is premised on the assumption that policy makers and other actors working to improve food environments in low- and middle-income countries need support in research, design and evaluation of F&V interventions. From the outset, we will work with countries, partners and affected communities to assess specific needs for this research via collaborative needs assessment workshops and associated reports (**Output 1**). This will help us test and meet **Assumption 1** that there is demand for our work; and that it is sufficiently tailored to local needs.

Given the substantial research gaps highlighted, a set of diagnoses in these contexts (via methods above), will be undertaken to produce a set of country specific food environment profiles (**Output 2**). Working with national governments; and key multilateral agencies such as WFP who are willing to partner with us (**Assumption 2**), we will use these diagnoses to design, apply and evaluate interventions at different levels (community, municipal and national) to understand *what works* in shaping fruit- and vegetable-rich food environments in different contexts. Via country specific scoping, international comparison, policy benchmarking tools and comparative policy process studies (**Output 3**) we will produce a country specific menu of policy options (**Output 4**), indicating the strength of evidence for options provided by both scientific analysis (e.g., SRs); and policy innovations adopted by comparator countries. With a sub-set of stakeholders who are in a position to further adapt or co-fund interventions and associated evaluations (**Assumption 3**) we will co-convene iterative design workshops (**Output 5**) to identify interventions and develop country specific pilots and impact evaluations (**Output 6**); and utilize the outcomes of these pilots to further catalyze work in this area including amongst other national and international stakeholders. Work here will require progressing from pilot plans developed in the first three years of the FRESH Initiative to funding cycles: **Assumption 4** notes the sustainability of the FRESH Initiative funding.

Key actors and partners for WP5 include national partnerships (e.g., in Sri Lanka, with several Ministries, Universities (Wayamba/Peradeniya) and Philippines with IIRR and key Ministry partners), to drive demand for better food environment knowledge and diagnostics. Similarly, we will work with international partners such as WFP so that we have the ability over a longer funding cycle to co-design new interventions with accessibility and desirability outcomes integrated into flagship schemes like school feeding and voucher transfers, evaluating outcomes in terms of diet, nutrition and equity. Finally, we will work with other regional and international platforms with whom we have existing links such as (e.g., in Asia, Africa and Pacific) SEARCA, AU and PSFN and, (e.g., globally) the School Meals Coalition to ensure roll out regionally and sharing of findings and approaches with international policy and research audiences. Our TOC also links to **WP1** (consumer behavior) in shaping the environments within which food choices are made; and **WP6** (policy) in working to change policy environments for sustainable change, as well as working with **WP3** (production) and **WP4** (markets) in shaping physical and economic aspects of food environments.

3.2.6 Work Package 6: Strengthening the enabling environment

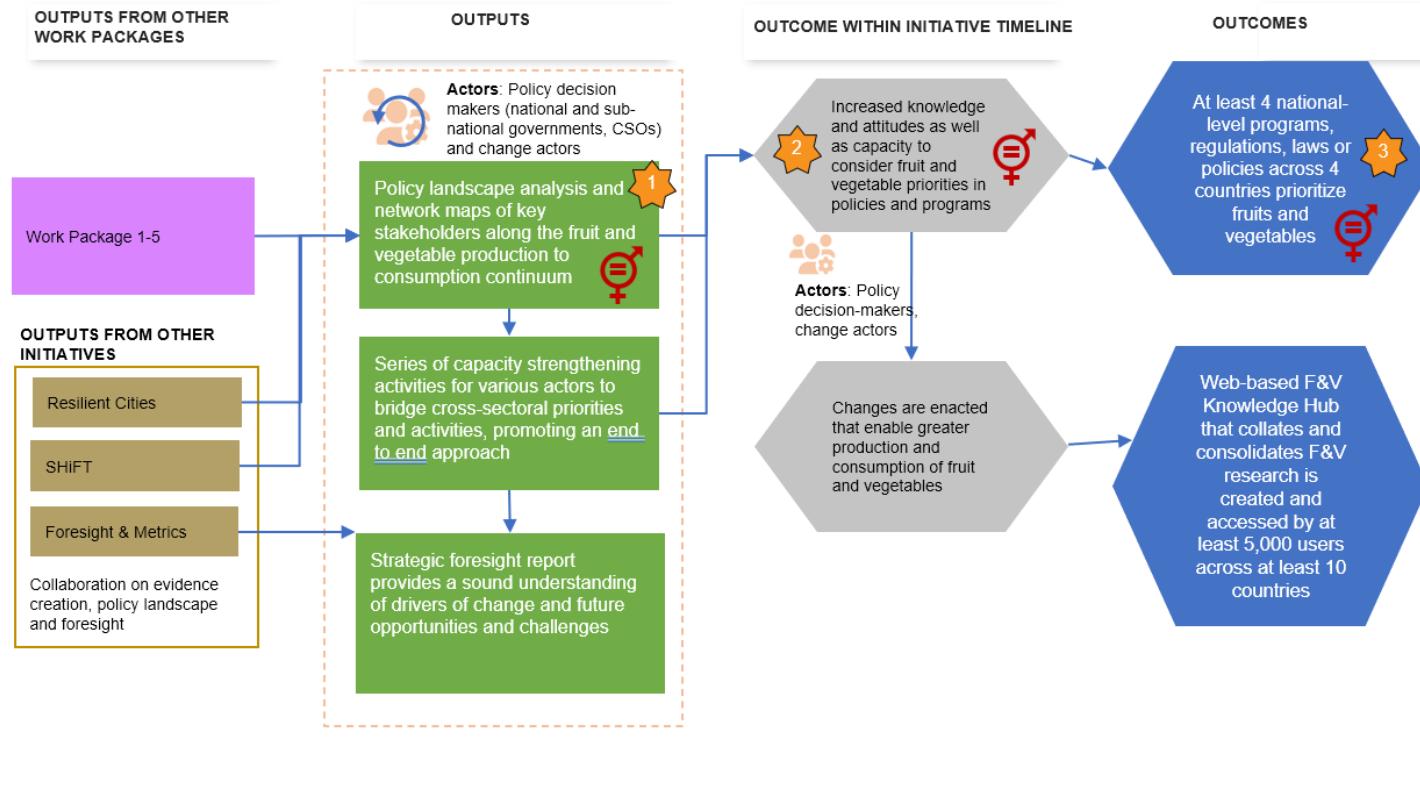
Work Package title	<i>Strengthening the enabling environment</i>
Work Package main focus and prioritization	This cross-cutting WP focuses on policy, evidence, foresight and capacity building—all aimed at strengthening the enabling environment for F&V. It will collaborate with the other Work Packages in identifying necessary changes to existing policies and the mechanisms that need to be leveraged to achieve these. Evidence for impact will play a key role in trying to influence policy change. We will review existing evidence and generate new evidence supporting the end-to-end approach. Strategic foresight will inform about future opportunities and challenges in the F&V sector. The capacity of partners to employ an end-to-end approach will be strengthened.
Work Package geographic scope (global/region/country)	Benin, Tanzania, Sri Lanka and the Philippines as phase 1 focus countries (2022-2025). Funding permitting, work will be started in phase 2 focus countries. Some of the work will be global in scope.

The science:

Specific objectives	Research questions	Methods	Outputs	Linkages
1. To raise the priority given to F&Vs in the policy agenda at global, regional and national levels	<p>What is the policy landscape regarding F&Vs across sectors (spanning production to consumption) in the focus countries, and at regional level?</p> <p>What influences policy priorities for F&Vs at national, regional and international levels, and what are leverage points and key stakeholders for increasing priority?</p> <p>What changes to existing policies and capacities are necessary to unleash the potential of F&Vs to contribute sustainable healthy diets?</p>	Policy landscape analysis through a review of policies and policy-relevant literature Key informant interviews using a priority setting framework Stakeholder “net map” analysis Strategic engagement with key change agents including capacity building events.	Policy landscape analysis and identification of priorities in four focus countries Network maps of key stakeholders in the F&V sector along the continuum from consumption to production At least 8 capacity building events with key change agents	This links to all WPs SHIFT
2. To synthesize and strengthen the evidence basis for policies, interventions and technologies in the F&V sector	<p>What is the current evidence basis for the impact of policies, interventions, and technologies in the area of F&Vs to contribute to nutritional, economic and environmental outcomes?</p> <p>What is the impact, and possibly trade-offs, of interventions in the F&V sector that employ an end-to-end approach, linking demand and supply?</p>	Systematic review and meta-analysis with a focus on LMICs, possibly divided into smaller studies Literature review to study the use of end-to-end approaches Experimental, quasi experimental or mixed methods studies	At least 1 journal article (review papers) 1 study protocol and baseline for at least 2 countries	This links to all WPs Resilient Cities
3. To provide strategic foresight	How are megatrends, new technologies and	Identify change drivers, challenges and	1 foresight report	This links to all WPs

about the future of the F&V sector in low- and middle-income countries	changing policy landscapes likely to reshape the future of F&V production, processing, marketing and consumption?	opportunities through a review of literature, interviews with key change-actors, and simulation modeling.	1 workshop to share results	Foresight & Metrics
4. To strengthen the capacity of partners to apply an end-to-end approach to comprehensively address supply and demand side issues related to F&Vs with the aim of improving diet quality and increasing incomes within planetary boundaries	What are the key enabling and impeding factors for stakeholders to apply end-to-end approach thinking in their area of work? What can influence these stakeholders to adopt an end-to-end approach?	Focus group discussions and key stakeholder interviews Process tracing to understand how activities are/aren't working Organize capacity strengthening activities for various types of actors to bridge cross-sectoral priorities and activities Develop capacity strengthening materials for promoting an end-to-end approach	1 report or paper describing how capacity strengthening activities did (or did not) align priorities/create shared vision At least 4 capacity strengthening events	This links to all WPs

Work Package 6 PATHWAY | Strengthening the Enabling Environment



The theory of change:

Food and agricultural policies, laws, regulations and organizations continue to have a strong focus on promoting the production of staple food crops and are not well-aligned with the need to promote sustainable healthy diets.¹⁰¹ Seed laws and regulations are a pertinent example of this.¹⁰² Better alignment of institutions and organizations with sustainable healthy diets is important to create a more conducive environment for interventions in the F&V area to create economic and nutritional outcomes.¹⁰³ This Work Package aims to do this at a national level in the four focus countries, while also influencing the enabling environment at regional and global levels, through a combination of four pathways: policy, evidence, foresight and capacity strengthening. This WP aims to do this at a national level in the four focus countries, while also influencing the enabling environment at regional and global levels, through a combination of four pathways: policy, evidence, foresight and capacity strengthening.

We will develop a clear understanding of the current policy landscape and the mechanisms by which policy priorities are set and can be influenced. This is based on evidence that policy changes at each point of the value chain can enable F&V consumption^{104,105}, yet current public policy relevant to F&V value chains tends to be fragmented and incoherent.^{73,106}

We will identify key change actors and a broader group of stakeholders in each focus country and engage with them in a dynamic fashion by giving them a voice in the research priority setting and discussing results and future steps. Local partners, particularly local universities, will have a key role in this. Capacity strengthening events will support this iterative process and help decision-makers, NGOs and FRESH partners to adopt an end-to-end approach by addressing supply- and demand-side aspects simultaneously.

The Work Package will also synthesize empirical studies from across the entire value chain and from around the world to inform stakeholders in the focus countries about best practices supported by scientific evidence. We will do this through evidence reviews and meta-analysis as well as new impact studies while also coordinating and supporting evidence generation across FRESH and linking with other Initiatives such as Resilient Cities. Global foresight analysis will further support evidence-based decision-making as policy advice needs to consider future opportunities and challenges based on megatrends and potentially disruptive technologies. We will collaborate with Foresight & Metrics in terms of data and methodology.

As a cross-cutting Work Package, we will work closely with all Work Packages. We will work with local universities in the focus countries to conduct policy research and impact assessment and do capacity building. The main scaling partners are public sector decision-makers who are able to influence the enabling environment and projects and programs in the F&V sector that could benefit from adopting an end-to-end approach.

Key assumptions and risks include: (1) the willingness of decision-makers to engage with FRESH and the ability of the project to navigate opposing interests that may block changes; (2) the ability to influence key decision-makers with scientific evidence; and (3) the interest and capacity of scaling partners to employ an end-to-end approach in their programming.

4. Innovation Packages and Scaling Readiness Plan

4.1 Innovation Packages and Scaling Readiness Plan

FRESH will participate in the second wave starting light track activities in Q2 of 2023. Across the WPs we expect to develop 25 innovations some of which will include adaptations (leading to several more individual adapted innovations). Five will be considered core innovations to include in scaling readiness activities. Two of these will be (1) a web-based F&V Knowledge Hub and (2) FRANI, an AI tool used to assess dietary intake and nudge adolescents towards healthier dietary choices. The other three innovations will be specified during co-design processes described earlier in the proposal. These innovations will fall under three general categories (3) technology package to improve production efficiency, (4) technology package to reduce post-harvest loss and improve food safety and (5) traditional vegetable-based school garden and procurement program. We plan to focus our scaling readiness efforts in one country. This will help facilitate learning about the impact of scaling several innovations across the production-consumption continuum. The feasibility of this will be determined by Q1 2023.

Throughout the scaling readiness process, we plan to work closely with other related CGIAR Initiatives such as Resilient Cities, SHiFT, TAFSSA, Excellence in Agronomy and SeedQual to learn from their experiences with scaling similar innovations and increase uptake and use of those created within this Initiative.

Our aim is to apply the Innovation Package and scaling readiness approach to 0-25% of the Initiative's innovation portfolio by the end of 2025.

FRESH allocated US\$100,000 to implement the Innovation Packages and Scaling Readiness Plan (2023: US\$0; 2024: US\$40,000; 2025: US\$60,000). Dedicated activities, deliverables, indicators, and line items are included in the MELIA, Management Plan and Budget Sections.

5. Impact statements

5.1 Nutrition, health and food security

Challenges and prioritization: Poor diets are a primary cause of malnutrition which affects one-third of the world population, and are the leading cause of disease worldwide.^{1–3} Improving diets, including increasing F&V intake, could save one in five lives every year.¹ Intake of F&Vs is below recommended levels globally. Supply side interventions are needed to close-supply-demand gaps and increase year-round availability and affordability of F&Vs along with improvements in the food environment. Working directly with people to shift preferences and habits is also needed as desirability is a key constraint to healthy diets. Addressing these issues and identifying cost-effective and scalable solutions will increase the number of people meeting minimum micronutrient requirements and reduce the number of people with NCDs.

Research questions

- **WP1:** What is the impact and cost-effectiveness of behavioral interventions on F&V intake, diet quality, nutrition and health outcomes and how was impact achieved?
- **WP1:** What are the characteristics of dietary patterns among key women, young children and adolescents; how do they vary by key characteristics?
- **WP3:** What is needed to diversify staple/commercial crop production systems using vegetables for higher productivity, increased income and enhanced food and nutritional security?
- **WP5:** What is the impact of SAPs and other public programs on F&V accessibility and affordability?
- **WP6:** What changes to existing policies and capacities are necessary to unleash the potential of F&Vs to contribute to sustainable healthy diets?

Components of WPs: All WPs are oriented to increasing intake of F&Vs through the use of end-to-end approaches and thus address nutrition and health objectives. **WP1** focuses on understanding dietary patterns and associated health and nutrition problems, their drivers and how to shift diets. **WP1** will work with partners to identify and scale solutions to improve diets. Likewise, **WP5** has a strong orientation to addressing health and nutrition issues through understanding and changing food environments to facilitate sustainable, healthy diets. **WP4** aims to improve food safety which will contribute directly to improving health outcomes. Similar to **WP4**, **WP3** will also address food safety through decreasing pesticide use and increasing vegetable availability and affordability through increasing production. Lastly, **WP6** will facilitate evidence uptake and use to influence policy actions to support safe, accessible and affordable F&Vs.

Measuring performance and results: Pilot studies will use dietary assessments (e.g., multi-pass 24 h recalls with repeated measures), health (e.g., prevalence of obesity, diabetes, high blood pressure) and nutrition (e.g., micronutrient deficiencies) assessments to estimate F&V and nutrient intakes and assess prevalence of diet-related health and nutrition problems and document impact of innovations on these outcomes.

Partners: Sokoine University (Tanzania), Wayamba University (Sri Lanka), other universities (all), WFP (all), government stakeholders (all)

Human resources and capacity development of Initiative team: Our team has a diverse group of scientists and specifically includes several nutritionists and food safety and policy experts and has strong internal capacity in this area. We will work with local partners to ensure local health and nutrition expertise is integrated and featured in this work.

5.2 Poverty reduction, livelihoods and jobs

Challenges and prioritization: As high-value crops, F&Vs have tremendous potential to create income and jobs for smallholder farmers and other value chain actors. F&Vs include such a very wide range of species that they can be grown in almost any location—from densely populated urban areas to remote highlands. Knowledge, inputs and markets are key to realizing the potential of F&Vs and must be addressed in a coordinated fashion. Women and youth could especially benefit from F&Vs if programs are able to address their particular constraints.

Research questions: FRESH works from the hypothesis that a holistic and well-coordinated end-to-end approach will enable smallholder farmers and other value chain actors—particularly women and youth—to realize the economic (and nutritional) potential of F&Vs. Research questions focus on creating the incentive mechanisms and technical and institutional innovations to stimulate production and trade in safe and quality F&Vs with minimal losses.

Components of Work Packages: **WP1:** consumer demand is recognized as the main driver of economic opportunities, but itself influenced by factors such as preferences and convenience as mediated by the food environment (**WP5**). **WP2:** Good quality seed is the basis of resilient and profitable production systems, but often a key constraint. **WP3:** Good production practices based on a sound understanding of agroecology are fundamental to safe and resilient production systems that enhance rather than deplete ecosystems and supply F&Vs year-round. **WP4:** Well-functioning markets that value quality and safety and are efficient in terms of minimizing product losses are fundamental to giving smallholder farmers the incentive to produce.

Measuring performance and results: Within the first-three years of the Initiative the focus will be on identifying interventions and piloting these in real-world situations. Pilots will be evaluated using mixed methods intervention designs. Income generation, livelihoods and jobs will be considered in the evaluation, particularly for interventions in the production (**WP3**) and postharvest areas (**WP4**).

Partners: Key partners include existing projects and programs supporting smallholder F&V production and value chains, which are able to scale the evidence-based solutions generated by FRESH. These include national extension services, the extension services of seed companies, as well as NGO-led programs such as development-oriented value chain programs funded by USAID, World Bank and the EU and implemented by NGOs such as iDE, SNV, CRS, ACDI/VOCA and others.

Human resources and capacity development of Initiative team: The impact on poverty reduction, livelihoods & jobs will be achieved through a coordinated approach involving all Work Packages. However, the emphasis will in **WP3** (safe and sustainable production) and WP4 (inclusive markets and postharvest) as these are most directly related to income and jobs. The expertise will include agronomists, value chain experts, postharvest specialists, crop protection specialists and gender experts. Partnerships with educational institutions in the partner countries will be sought to strengthen in-country capacity in this area.

5.3 Gender equality, youth and social inclusion

Challenges and prioritization: Poor diets, malnutrition, and poverty originate in part, from processes of social exclusion of population groups and individuals based on socio-demographic characteristics such as gender, age, and ethnicity¹⁰⁷. Inequalities are reinforced by existing food systems which limit accessibility and affordability of F&Vs for vulnerable groups². Additionally, marketing campaigns for unhealthy foods often target youth which can contribute to displacement of F&Vs in diets. A focus on empowering women within food systems is consistently reported as critical to enhance impacts on healthy diets¹⁰⁸. Mobilizing youth — as food producers and consumers, potential innovators and entrepreneurs, policy agents, and informed consumers — has been highlighted as key to food systems transformation¹⁷. Through mainstreaming a focus on gender equity, youth, and social inclusion in each of the WPs, we aim to address these issues.

Research questions:

- **WP 1:** What are the dietary patterns among women, young children and adolescents and how do they vary by gender, SES and rural/urban?
- **WP2:** How do preferred traits for vegetables vary among geographies, market segments and female and male farmers?
- **WP 4:** What factors impede or enable women and youth from participating in, and benefitting from, F&V value chains?
- **WP 5:** What are the political economy and equity dimensions enabling and disabling options for food environment interventions?

Components of Work Packages: All WPs will provide data disaggregated by gender and socioeconomic status and other relevant indicators of inequality and ensure reach and benefit of vulnerable groups in design of innovations, programs and policies. In addition, **WP1** will specifically target women and youth. **WP2**, will seek to incorporate the G+ tools developed by the CGIAR Gender and Breeding Initiative (<http://www.rtb.cgiar.org/gender-breeding-initiative/>) to ensure gender-responsive breeding in the design of new breeding products. **WP4** and **WP5** will take trade-offs related to systemic exclusion of specific marginalized groups into account to contribute to public-policy and market-led empowerment of these groups. **WP6** will ensure participation of marginalized groups as stakeholders in transformation processes, in monitoring and in capacity development.

Measuring performance and results: Where relevant and feasible, the FRESH Initiative will use the Nutrition Equity framework⁵ to understand equity issues in food systems, and the Reach-Benefit-Empower framework¹⁰⁹ and relevant indicators to understand the impact of food system interventions. Examples include proportion of vulnerable population covered by and benefitting from innovations, programs and policies.

Partners: **Innovation** -- NARES, Sokoine University (Tanzania), Wayamba University (Sri Lanka), Foundation for Health Promotion (Sri Lanka), WFP, HKI; **Demand and scaling** -- Government stakeholders, WFP.

Human resources and capacity development of Initiative team: Team members working on this Impact Area include gender and equity experts and nutritionists, economists and social scientist with gender and equity research experience which gives us good internal capacity in the area. To improve the equity of Initiative itself, we will work equitably with a wide range of stakeholders in the focus countries in the co-design process.

5.4 Climate adaptation and mitigation

Challenges and prioritization: Vegetables are sensitive to environmental extremes. Rising global temperatures is latitudinally expanding the habitats of tropical pests and pathogens, increasing vegetable crop losses^{110,111} The changing climate affects the pathosystem including those that are already difficult to control under present climatic conditions and contribute to the spread of pest and diseases to new niches and rapid emergence and spread of new pest and disease¹¹² and a reduction in pollinators.¹¹³ This increases risks and reduces profits for farmers.¹¹⁴ Agriculture production needs adaptations to mitigate climate change impacts. Unless action is taken to make agriculture resilient and productive, climate change will seriously compromise food production especially in food-insecure regions.¹¹⁵ Improved soil health and nutrient management practices can mitigate climate change effects; sustainable intensification and diversification can build system resilience to biotic, abiotic, and economic stresses.¹¹⁵

Research questions

1. **WP2:** Which genetic improvements of which vegetable crops have the greatest potential to contribute to CGIAR Impact Areas?
2. **WP3:** What are the technologies needed for year-round production?
3. **WP4:** What innovations can reduce losses and improve food safety in F&V value chains?
4. **WP6:** What are the impact, and possibly trade-offs, of interventions in the F&V sector that employ an end-to-end approach, linking demand and supply?

Components of Work Packages: **WP2** will safeguard vegetable biodiversity required for climate change adaptation and delivering more climate-resilient vegetable cultivars. **WP3** will contribute by developing and testing regenerative agricultural practices that reduce external input use and improve system performance. **WP4** will contribute by designing and testing interventions in F&V value chains that improve efficiency and reduce losses. **WP6** will handle the policy dimensions.

Measuring performance and results: Variations in the secondary (temporal) data on the quantity of vegetables produced, marketed and the market price will be analyzed to estimate the effect of biotic and abiotic stress factors. Qualitative data collected from farmers and traders using in-depth interviews will supplement the findings of the market (price) analysis. Using these insights, assumptions on the potential on-farm effects of the FRESH Initiatives will be formulated, and its economy-wide effects will be simulated under a multi-product, multi-region partial equilibrium model. Finally, the baseline survey and value chain analyses, planned as part of **WP3** and **WP4**, respectively, are expected to provide insights on how weather extremes and pest infestation affect the flow of vegetables and their market price.

Partners: NARES, Universities and research institutions as research partners; NGOs and private sector players will collaborate on improved access to research product to the farmers.

Human resources and capacity development of Initiative team: Collaboration with selected universities in 4 countries and the master's and Ph.D. students will be selected to study the impact of climate change in fruit and vegetable production. Workshops will be conducted among NARES on how climate change affects production and how climate smart technologies can be used for mitigation and adaptation of climate changes especially in F&Vs.

5.5 Environmental health and biodiversity

Challenges and prioritization: There are over 1,200 species of fruit in the Neotropics (Bioversity Intl. 2021) and over 1,000 species of vegetables worldwide (Meldrum et al. 2018). This diversity, which is a largely untapped resource of nutrient-dense foods, is threatened as production systems change toward a narrower range of globally important species (Pilling et al. 2020; van Zonneveld et al. 2021). At the same time, production systems are becoming more reliant on mineral fertilizers and chemical pesticides—the misuse of which creates further threats to the ability and resilience of natural ecosystems to support food production.

Research questions: FRESH aims to safeguard vegetable biodiversity and promote its use as a source of new traits for breeding and crop diversification with resilient and nutritious vegetables. Particular attention will be given to traditional vegetables, which have been neglected in conservation and genetic improvement. FRESH will also develop, test and scale crop management methods based on agroecological and regenerative principles to enhance the functioning of natural ecosystems, particularly emphasizing the synergies between soil health and plant health.

Components of Work Packages: **WP1** will identify and test options how to stimulate consumer demand for a diverse range of nutrient-dense F&Vs, including traditional vegetables. **WP2** will safeguard vegetable biodiversity, promote its use by farmers and breeders, and develop the traits needed for more resilient production systems. **WP3** focuses on good production practices based on a sound understanding of agroecology are a basis for safe and resilient production systems that enhance rather than deplete ecosystems. **WP4** will promote market actors to value diversity and safety while increasing availability by reducing postharvest losses. **WP6** ensures coordination between Work Packages and coordinated policy action across the food system.

Measuring performance and results: FRESH interventions will be analyzed on their impact on environmental health and biodiversity. Statistical comparisons between baseline and postintervention data will facilitate a quantitative evaluation of performance of interventions. The analysis of field data collected from selected sites will reveal the impact of proposed interventions on environmental health and biodiversity. Major performance categories of indicators will include food safety, pesticide and agrochemical use, water use, adoption of regenerative agriculture, soil erosion and occupational safety of farmers and farm workers, and water quality.

Partners: FRESH will collaborate with universities and research institutes in the partner countries to safeguard vegetable diversity through monitoring and rescue missions. Germplasm will be added to national genebanks with safety copies stored in the WorldVeg and other international genebanks (e.g., Svalbard) in compliance with international treaties. FRESH will coordinate its work with the Crop Trust. FRESH will partner with local research organizations in the adaptation and validation of safe production practices and help incorporate these into the extension programs of public and private sector organizations.

Human resources and capacity development of Initiative team: Impact on environmental health and biodiversity will require coordinated action across Work Packages. However, **WP2** and **WP3** will lead the effort. Capacity building of national partners in vegetable germplasm collection, characterization and conservation will be important. Another priority area is the capacity building of national partners in agroecological approaches to safe vegetable production.

6. Monitoring, evaluation, learning and impact assessment (MELIA)

6.1 Result framework

CGIAR Impact Areas				
Nutrition, health and food security	Poverty reduction, livelihoods and jobs	Gender equality, youth and social inclusion	Climate adaptation and mitigation	Environmental health and biodiversity
Collective global 2030 targets (the collective global 2030 targets are available centrally here to save space).				
<ul style="list-style-type: none"> End hunger for all and enable affordable healthy diets for the 3 billion people who do not currently have access to safe and nutritious food. Reduce cases of foodborne illness (600 million annually) and zoonotic disease (1 billion annually) by one third. 	<ul style="list-style-type: none"> Reduce by at least half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions. 	<ul style="list-style-type: none"> Offer rewardable opportunities to 267 million young people who are not in employment, education or training Close the gender gap in rights to economic resources, access to ownership and control over land and natural resources for over 500 million women who work in food, land and water systems. 	<ul style="list-style-type: none"> Equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems. 	<ul style="list-style-type: none"> Maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed genebanks at the national, regional, and international levels.
Common impact indicators that your Initiative will contribute to and will be able to provide data towards (refer to page 5 of Guidance for MELIA for selection of appropriate indicators)				
# of people meeting minimum micronutrient requirements # of cases of communicable and non-communicable diseases	# of people benefiting from relevant CGIAR innovations # of people assisted to exit poverty	# of women benefitting from relevant CGIAR innovations # of youth benefitting from relevant CGIAR innovations	# of people benefiting from climate-adapted innovations	#ha under improved management #km3 consumptive water use in food production
SDG targets				
2.1, 2.2, 2.4	1.5, 1.b, 8.3, 8.5, 11.3	5.5, 5.a	11.b	6.4, 6.a, 6.b, 11.a
Regional Agrifood Systems				
Action Area outcomes			Action Area outcome indicators	
ST 2 – Consumers have the information, incentives and wherewithal to choose healthy diets			STi 2.1 Diet quality score	
ST & RAFS & GI 1 - Women and youth are empowered to be more active in decision making in food, land and water systems			STRAFSGIi 1.2 Number of women, youth and people from marginalized groups who report input into productive decisions, ownership of assets, access to and decisions on credit, control over use of income, work balance, and visiting important locations	
ST 1 - Farmers use technologies or practices that contribute to improved livelihoods, enhance environmental health and biodiversity, are apt in a context of climate change, and sustain natural resources.			STi 1.3- Measurable implications of adoptions such as production, profitability, input use, product quality and associated price, environmental and health damage avoided, livelihood, employment and so forth.	
ST 4 - Food system markets and value chains function more efficiently, equitably, and sustainably and lead towards healthier diets			STi 4.1 Number of commodity value chain x country combinations that use tested innovations to improve efficiency, inclusion, sustainability and nutrition objectives.	
ST & RAFS 2 - National and local governments utilize enhanced capacity (skills, systems and culture) to assess and apply research evidence and data in policy making process			STRAFSi 2.1 Number of policies/ strategies/ laws/ regulations/ budgets/ investments/ curricula (and similar) at different scales that were modified in design or implementation, with evidence that the change was informed by CGIAR research	

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
Cross-cutting											
Outcome	At least 4 programs to influence consumer behavior are informed by country-specific F&V profiles and menu of evidence-based approaches	# of programs	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	4	2025
Outcomes	Web-based F&V Knowledge Hub that collates and consolidates F&V research is accessed by at least 5,000 users	# of users	Number	Global	Webpage	Web analytics	Continuous	0	2022	5,000	2025
Outcome	At least 10,000 farmers adopt improved climate-resilient vegetable cultivars across the 4 focus countries	# of farmers	Number	Benin, Tanzania, Sri Lanka, Philippines	Seed companies	Survey	End of Initiative	0	2022	10,000	2025
Outcome	At least 10,000 farmers adopt safe and sustainable vegetable production practices across the 4 focus countries	# of farmers	Number	Benin, Tanzania, Sri Lanka, Philippines	Farm households	Survey	End of Initiative	0	2022	10,000	2025
Outcome	At least 3 innovation packages for improved efficiency and optimized synergies of resources in vegetable production systems adopted by farmers across 4 focus countries	# of innovations packages adopted	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	3	2025
Outcome	At least 12 innovations for reducing post-harvest losses and/or improving food safety are piloted in focus countries	# of innovations tested	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	12	2025
Outcome	At least 4 programs aimed at making F&Vs more accessible and affordable use F&V country profiles and evidence-based guidance in their design	# of programs	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	4	2025
Outcome	At least 4 national-level programs, regulations, laws or policies across 4 countries prioritize F&Vs	# of new programs, regulations, laws or policies	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Project reports	Annual reporting	Annual	0	2022	4	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
Work Package 1 – Understanding and influencing consumer behavior											
Outcome	Change in knowledge of the context- and population-specific dietary patterns, barriers to F&V intake and options for addressing those barriers	% change in knowledge and awareness	Percentage	Benin, Tanzania, Sri Lanka, Philippines	Stakeholders	Survey	End of Initiative	N/A	2022	25	2025
Outcome	Scaling partners support (through investment or other support) the scaling of selected innovations/interventions	# of programs, policies, production plans that mention knowledge products generated through this Initiative	Number	Benin, Tanzania, Sri Lanka, Philippines	Stakeholders and documents	Survey and review of documents	End of Initiative	0	2022	4	2025
Outcome	National or sub-national governments invest in behavioral change innovations/interventions or integrate them into ongoing programs	# of governments (national or sub-national) investing	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	0	2022	2	2025
Outcome	Academic partners express interest in collaborating on evaluating the selected innovation(s)/intervention(s)	# academic partners	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	0	2022	4	2025
Output	Diet analysis for pregnant women, young children and adolescents, disaggregated by gender, socioeconomic status and rural/urban	# of analyses	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	F&V country profiles highlighting F&V intake levels, nutrient gaps, prevalence of micronutrient deficiencies, stunting and NCDs	# of profiles	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	N/A	N/A	4	2025
Output	Menu of options of behavioral innovation/intervention options and delivery platforms mapped to population groups	# of menus	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	N/A	N/A	4	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
Output	Iterative co-design workshops to select target groups, contextualize new and existing evidence, select interventions/platform combinations to test and develop	# of workshops	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	8	2025
Output	Country-specific piloting plans for behavioral innovations/interventions	# of piloting plans	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Analysis of intervention uptake and changes in knowledge, diets and nutritional outcomes and cost-effectiveness	# of innovations tested	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Work Package 2 - Vegetable biodiversity, genetic innovation and seed systems											
Outcome	Vegetable genebanks are better able to serve current and future needs of breeding programs	% of safety duplicated and available accessions	# of seed companies in focus countries	Benin, Tanzania, Sri Lanka, Philippines, Global	WorldVeg genebank	Annual reporting	Annual	68	2021	90	2025
Outcome	Seed companies use improved lines, cultivars, and hybrids	# of seed companies (in focus countries)	Number	Benin, Tanzania, Sri Lanka, Philippines	Seed companies	Survey	Annual	NA	2022	12	2025
Outcome	Seed companies are better able to scale cultivars	# of seed companies that confirmed strengthened capacity	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Seed companies	Survey	End of Initiative	NA	2022	12	2025
Output	At least 3 journal papers on vegetable biodiversity and prioritization for genetic improvement	# of journal papers	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Project reports	Annual reporting	Annual	N/A	N/A	3	2025
Output	600 germplasm accessions collected and characterized	# germplasm accessions	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Project reports	Annual reporting	Annual	N/A	N/A	600	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
Output	At least 100 people trained in vegetable cultivar evaluation and breeding	# persons trained	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Project reports	Annual reporting	Annual	N/A	N/A	100	2025
Output	At least 10 new cultivars shared with scaling partners	# of cultivars	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	N/A	N/A	10	2025
Output	At least 3 journal articles on multi-locational trials, trait prioritization and vegetable breeding methods	# of countries	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	3	2025
Output	At least 4 workshops organized on seed laws and regulations	# of workshops	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	At least 1 journal paper on regional seed sector laws and policy environment	# of journal papers	Number	Benin, Tanzania, Sri Lanka, Philippines, global	Project reports	Annual reporting	Annual	N/A	N/A	1	2025
Output	At least 2 journal papers on access to and adoption of improved vegetable seed including gender aspects	# of journal papers	Number	Benin, Tanzania, Sri Lanka, Philippines, global	Project reports	Annual reporting	Annual	N/A	N/A	2	2025
Output	1 journal paper on regional seed sector laws and policy environment	# of journal papers	Number	Benin, Tanzania, Sri Lanka, Philippines, global	Project reports	Annual reporting	Annual	N/A	N/A	1	2025

Work Package 3 - Safe and sustainable production of vegetables

Outcome	Safe & sustainable vegetable production expanded temporally and spatially	# technology packages	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	N/A	2022	16	2025
Outcome	Increased farm profit & greater resilience to changing	# of farmers	Numbers	Benin, Tanzania, Sri	Project reports	Annual reporting	End of Initiative	N/A	2022	10,000	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
	climates due to adoption of new technologies			Lanka, Philippines							
Outcome	Production technologies, quality inputs and farming services made accessible and affordable	# of farmers	Numbers	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	End of Initiative	N/A	2022	10,000	2025
Output	At least 3 journal articles describing challenges and opportunities to vegetable production systems in focus countries	# of journal articles	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	3	2025
Output	At least 4 technology packages developed in each country and rolled out	# of technology packages	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	At least 4 journal articles describing the results of on-farm experiments in each country	# of journal articles	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	At least 2 presentations at international conferences	# of presentations	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	2	2025
Output	At least 4 journal articles describing the results of modelling work	# of journal articles	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Work Package 4 - Post-harvest and inclusive markets											
Outcome	Value chain actors, particularly women and youth, gain better access to innovations in F&V value chains	# of value chain actors	Number	Benin, Tanzania, Sri Lanka, Philippines	Value chain actors	Survey among people trained	End of Initiative	0	2022	1200	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
Output	At least 4 reports/journal articles providing a detailed description of F&V value chains in the 4 target countries	# of journal articles	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Entry points for intervention identified and refined with stakeholders through workshops	# of workshops	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	8	2025
Output	4 country strategies describing pathways to F&V food safety and loss reduction through inclusive approaches	# reports	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	At least 12 innovations (3 per country) piloted and described in technical guides	# of innovations	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	12	2025
Output	Gender-sensitive training materials for successful innovations	# of training materials	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	4 journal articles documenting results	# of journal papers	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Work Package 5 - Food environments											
Outcome	Increased awareness among key stakeholders of food environment characteristics and options for addressing accessibility constraints across contexts and population groups	% change in knowledge and awareness	Percentage	Benin, Tanzania, Sri Lanka, Philippines	Stakeholders	Surveys and process tracing	Annual	Unknown	2022	25	2025
Outcome	Partners support the implementation and evaluation of programs	# of pilots taken forward or agreed	Number	Benin, Tanzania, Sri	Project reports	End of initiative	End of initiative	N/A	2022	1	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
	addressing Food Environment constraints through public and private innovations across contexts and population groups			Lanka, Philippines							
Output	Collaborative needs assessment	# of assessments	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Food environment profiles	# of profiles	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Comparative policy process assessments	# of knowledge products	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Menu of options for food environment interventions tailored to each of the four focus country contexts	# of menus	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Intervention co-design workshops	# of knowledge products	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	N/A	N/A	4	2025
Output	Country specific pilot / impact evaluation briefs	at least 1 pilot/intervention	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	End of Initiative	Annual	N/A	N/A	1	2025
Work Package 6 - Strengthening the enabling environment											
Outcome	Increase in knowledge and attitudes as well as in capacity to consider F&Vs in policies and programs	% change in knowledge and awareness	Percentage	Benin, Tanzania, Sri Lanka, Philippines	Key change agents	Surveys and process tracing	End of Initiative	N/A	N/A	25	2025
Outcome	Decision-makers explicitly consider F&V (policy, R&D)	# decision-makers	Number	Benin, Tanzania, Sri Lanka, Philippines, Global	Documents, decision-makers	Document review and interviews with decision-makers	End of Initiative	N/A	N/A	4	2025

Initiative and Work Package outcomes, outputs and indicators											
Result type (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
Output	Policy landscape analysis and identification of priorities in four focus countries	# of reports/paper	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	4	2025
Output	Network maps of key stakeholders in the F&V sector along the continuum from consumption to production	# of network maps	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	4	2025
Output	At least 8 capacity building events with key change agents	# of capacity building events	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	8	2025
Output	1 journal article (review paper)	# of journal papers	Number	Global	Project reports	Annual reporting	Annual	0	2022	1	2025
Output	1 study protocol and baseline for at least 2 countries	# of baseline data	Number	Global	Project reports	Annual reporting	Annual	0	2022	1	2025
Output	1 foresight report	# of reports	Number	Global	Project reports	Annual reporting	Annual	0	2022	1	2025
Output	1 workshop to share foresight results	# of workshops	Number	Global	Project reports	Annual reporting	Annual	0	2022	1	2025
Output	1 report or paper describing how capacity strengthening activities did (or did not) align priorities/create shared vision	# of reports	Number	Global	Project reports	Annual reporting	Annual	0	2022	1	2025
Output	At least 4 capacity strengthening events	# of capacity strengthening events	Number	Benin, Tanzania, Sri Lanka, Philippines	Project reports	Annual reporting	Annual	0	2022	4	2025

6.2 MELIA plan

Monitoring, evaluation and learning

We will use a three-pronged approach to monitor progress towards planned outputs and outcomes across the Work Packages and for the Initiative as a whole. First, for monitoring we will use the CGIAR Performance and Results System. Each WP will report progress quarterly indicating if outputs are on track, delayed or need to be cancelled and providing feedback on any challenges in carrying out their annual work plans. We will use quarterly and annual reporting to make any adjustments to WP plans and budgets as needed. The second part of our strategy will be to conduct annual rapid assessments and interviews with key stakeholders to take the pulse of how the Initiative is progressing in its' intended multi-stakeholder engagement strategy and progressing along the expected TOC. The focus of these assessments will be around capacity strengthening, policy engagement, and adoption of innovations and technologies. The last part of our strategy will be to evaluate the successes and challenges that our Initiative is experiencing. Given the short time frame of this first phase we will commission an evaluation of the Initiative early in the third year to learn from the evaluation and understand what is working and what needs to be improved and to adjust our plans for the second three-year phase of the Initiative accordingly.

Adoption and impact studies

Adoption studies will be conducted to quantify the number of companies, households or individuals that have started to use innovations developed by the Initiative. The number of adoption studies may be few in the first 3 years as the focus will be on innovation design and piloting; however, some adoption studies will be conducted on the use of improved vegetable cultivars by seed companies and smallholder farmers.

Process evaluation studies will be used to understand, from a largely qualitative perspective, how the Initiative's activities are influencing program and policy designs and intervention uptake in the case of behavioral interventions intended to shift dietary practices. The results from these studies will help us reassess assumptions and risks and guide adjustments that may be needed to our activities. It will also allow us to learn from program designs and adjust to better facilitate use and adoption. These studies and associated learning and course correction will be critical to the eventual scaling of successful innovations, approaches and programs by our scaling partners.

Finally, **impact assessment studies** will be conducted on selected interventions. The focus in phase 1 will be on evaluation interventions at a pilot (pre-scaling) stage to learn and draw lessons to inform scaling. As we plan to conduct dietary assessments to understand dietary patterns, where possible we will design these as part of baseline assessments for impact assessment. To the best extent possible, we will use randomized controlled trials to establish causality and will aim to create longitudinal cohorts that can be followed over the life of FRESH to enable assessment of short- and long-term impacts. We will also use mixed methods approaches, combining quantitative and qualitative research methods, to better understand the mechanism and possible bottlenecks to impact. Results from the impact assessments will be used collaboratively with our national and international partners (as relevant) to identify lessons learned in innovation or program design and identify next steps for advancing our knowledge in the relevant areas.

6.3 Planned MELIA studies and activities

Type of MELIA study or activity	Result or indicator title that the MELIA study or activity will contribute to	Anticipated year of completion	Co-delivery of planned MELIA study with other Initiatives	How the MELIA study or activity will inform management decisions and contribute to internal learning
Impact assessment learning studies	Analysis of intervention uptake and changes in knowledge, diets and nutritional outcomes and cost-effectiveness (WP1)	2025	Resilient Cities, SHiFT (alignment of assessment methods)	Contributes evidence of approaches that can be scaled to achieve Action Area Impacts
Adoption study	At least 10,000 farmers adopt improved climate-resilient vegetable cultivars across the 4 focus countries Seed companies use improved lines, cultivars, and hybrids (WP2)	2023, 2025	Genebanks, Nature Positive Solutions	Will inform the scaling approach for vegetable cultivars
Adoption study	At least 10,000 farmers adopt safe and sustainable vegetable production practices across the 4 focus countries (WP3)	2025	Nature Positive Solutions Excellence in Agronomy	Will inform the scaling approach for vegetable production practices
Mixed methods impact assessment	At least 12 innovations for reducing post-harvest losses and/or improving food safety are piloted in focus countries (WP4)	2025	Nexus Gains	Will inform about opportunities and constraints to innovation scaling
Baseline study	Food environment profiles (WP5)	2023	SHiFT	Serves as a baseline on food environments and informs subsequent interventions
Process evaluation	At least 4 programs aimed at making fruits and vegetables more accessible and affordable use F&V country profiles and evidence-based guidance in their design (WP5)	2025	SHiFT	Will inform about the process of policy change and possible bottlenecks
Process evaluation	Increased awareness among key stakeholders of food environment characteristics and options for addressing accessibility constraints across contexts and population groups (WP5)	2023, 2024, 2025	SHiFT	Will inform progress on changing stakeholder awareness
Process evaluation	Increase in knowledge and attitudes as well as in capacity to consider F&Vs in policies and programs (WP6)	2025	SHiFT Resilient Cities	Informs about progress toward policy change
Impact assessment learning studies	1 study protocol and baseline for at least 2 countries (WP6)	2022	Resilient Cities	Baseline for quantifying the impact of the end-to-end approach
Scaling readiness assessment study (all WPs)	Used to assess the number of innovations ready for scaling	2025		Used to inform Initiative scaling strategy

7. Management plan and risk assessment

7.1 Management plan

FRESH's management plan is guided by three key principles: (i) partner engagement and capacity development, (ii) adaptive management, and (iii) internal learning.

- 1. Partner engagement and capacity strengthening:** To ensure success in the proposed outcomes, FRESH will establish a F&V Stakeholder Group with relevant sub-committees for each WP in the focus countries. FRESH will work with these groups in an iterative and multilayered co-design process to inform FRESH's direction, share and discuss generated evidence and determine any necessary course corrections. We expect that this approach will foster shared responsibility and ownership of the successes and effective delivery of end-of-Initiative outcomes.
- 2. Effective management:** To facilitate effective management, FRESH will have clear guidance describing the roles and responsibilities for Initiative leaders as well as for partners. A collegial environment will be maintained through open and clear communications, ensuring technical coherence that is grounded in providing high-quality science for impact with a common goal of successful end-to-end approaches of increasing F&V intake within the four phase 1 countries. With support from project and finance management staff, this management structure will foster effective delivery.
- 3. Internal learning:** The iterative co-creation processes with key partners lends itself to a process of internal learning, whereby within each country context WPs will examine the successes and need for course correction along the TOC causal pathways. The creation of stakeholder platforms and regular meetings will provide an opportunity for cross-country learning, and within the countries, identification of emerging opportunities and priorities for partnership, research, innovation or scaling. FRESH will invest in knowledge management support and document change processes.

7.2 Summary management plan Gantt table

Initiative start date	Timelines												Description of key deliverables (maximum 3 per row, maximum 20 words per deliverable)
Apr. 2022	2022			2023				2024				2025	
WPs	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	
WP 1:	1		1		1	2	3		1		1		1. Iterative co-design workshops to select target groups, contextualize and use new and existing evidence, select interventions to develop and test. 2. Dietary analyses for pregnant women, young children and adolescents disaggregated by gender, socioeconomic status and rural/urban 3. F&V country profiles highlighting F&V intake levels, nutrient gaps, prevalence of micronutrient deficiencies, stunting and NCDs.
WP 2:						1		2				3	1. 600 germplasm accessions collected and characterized 2. At least 10 new cultivars shared with scaling partners 3. At least 2 journal papers on access to and adoption of improved vegetable seed including gender aspects
WP 3:				1			2					3	1. Analysis of constraints and opportunities for vegetable production systems in focus countries. 2. Technology packages developed in each country and rolled out 3. Journal articles with results of on-farm experiments in each country.
WP 4:				1			2					3	1. Country strategies describing pathways to F&V food safety and loss reduction through inclusive approaches. 2. At least 12 innovations (3 per country) piloted and described in technical guidance. 3. Journal articles with results of pilot tests
WP 5:					1		2					3	1. Country specific food environment profiles with an equity focus 2. Country specific menu of policy and innovation options 3. Country specific pilot/impact briefs
WP 6:				1		2			3				1. Policy landscape analysis and identification of priorities in four focus countries 2. Network maps of key stakeholders in the F&V sector along the continuum from consumption to production 3. Foresight report
Innovation Packages & Scaling Readiness												1	1. 5 documented scaling ambitions, vision of success and roadmap for use of Scaling Readiness for selected priority Core Innovations
MELIA			3							1 2	1 2	3	1. Adoption study to document progress towards 10,000 farmers adopting vegetable cultivars 2. Adoption study to document progress towards 10,000 farmers adopting safe and sustainable production practices 3. Diet baseline and impact assessment of behavioral intervention on knowledge, attitudes, diets and nutritional outcomes
Project management	2 3	1 2	1 2 3	1 2	1 2 3	1 2	1 2 3	1 2	1 2	1 2	1 2 3	1 2	1. Quarterly financial and progress reports 2. Biannual F&V Stakeholder consultations in each of the focus countries 3. Monthly program management meetings

7.3 Risk assessment

Top 5 risks to achieving impact (note relevant Work Package numbers in brackets)	Description of risk (50 words max each)	Likelihood	Impact	Risk score Likelihood x Impact	Mitigations
		Rate from 1-5	Rate from 1-5		
Funding uncertainty, budget insecurity or delay due to geopolitical events /disasters shifting funders' priorities (all WPs)	FRESH is a new Initiative. However, FRESH has an engaged donor group which will help align ideas and expectations. Furthermore, the development of FRESH comes during the UN International Year of Fruits and Vegetables which should help raise interest in this Initiative.	1	5	5	<ul style="list-style-type: none"> ▪ Met with donor advisory group to provide an update on the Initiative and to elicit their feedback and will plan for annual meetings once implemented. ▪ Aligning Initiative plans with focus country priorities and plan to have a co-creation process to facilitate ongoing engagement and alignment of workplan with country priorities.
Business interruption or delays due to pandemic, war, natural disaster or other incident affecting the Initiative or key dependencies (all WPs)	The COVID-19 pandemic may delay our planned initial in-depth co-creation processes. Travel and in-person meeting restrictions may also hinder planned capacity strengthening activities, pilot testing and other research activities. Natural disaster, civil strife, or war could have similar effects.	2	5	10	<ul style="list-style-type: none"> ▪ Countries were selected where CGIAR and WorldVeg already have a presence. ▪ Initial country stakeholder consultations were held virtually and this could be continued to facilitate the initial co-creation process ▪ If needed, we can initially focus on our research plans that are not dependent on in-person engagement or travel.
Unable to incentivize right behaviors by farmers, value chain actors, and policy makers needed for adoption (WP2,3,4,6)	The Initiative may be unable to increase national priorities attached to F&V production and value chains because of vested interests, particularly of well-organized groups lobbying for staple food crops and livestock.	2	4	8	<ul style="list-style-type: none"> ▪ FRESH will conduct research to understand vested interests and identify change mechanisms related to F&V value chains. ▪ Work with other Initiatives and Science Directors to influence policy priorities related to F&V value chains.
Failure to identify and operationalize mission critical partnerships (incl. scaling and research) or partnerships lost (i.e., non-One CGIAR partners)	FRESH relies on our engagement with partners. FRESH brings together a diverse group of scientists from across different organizations that will be important for the Initiative's success. FRESH also relies on co-design processes necessitating identification of key stakeholders, having	2	5	8	<ul style="list-style-type: none"> • The creation of stakeholder groups lends itself to create a space for key actors and partners to coordinate and identify areas to leverage impact (eventually at scale). The co-creation process within each country will foster a sense of

Top 5 risks to achieving impact (note relevant Work Package numbers in brackets)	Description of risk (50 words max each)	Likelihood	Impact	Risk score Likelihood x Impact	Mitigations
		Rate from 1-5	Rate from 1-5		
(All WPs)	transparent and inclusive processes and building strong working relationships to foster engagement.				<p>ownership and responsibility over the successes of the Initiative outcomes.</p> <ul style="list-style-type: none"> Establishing a Memorandum of Understanding or other relevant partnership agreement document to clarify how partnerships are intended to function.
Capability, and capacity constraints within and across the regions may hinder the uptake of innovations (WP 2,3,4, 6)	Focus countries have few researchers working on F&Vs and public extension systems are weak in this area, which may impede the scaling of certain innovations.	3	3	9	<ul style="list-style-type: none"> Integrate capacity building into Work Packages. FRESH will not only rely on public extension systems, but also work with private extension systems. Work closely with the private sector, particularly seed companies.

8. Policy compliance, and oversight

8.1 Research governance

Researchers involved in the implementation of this Initiative will comply with the procedures and policies determined by the System Board to be applicable to the delivery of research undertaken in furtherance of CGIAR's 2030 Research and Innovation Strategy, thereby ensuring that all research meets applicable legal, regulatory and institutional requirements; appropriate ethical and scientific standards; and standards of quality, safety, privacy, risk management and financial management. This includes CGIAR's [CGIAR Research Ethics Code](#) and to the values, norms and behaviors in CGIAR's [Ethics Framework](#) and in the [Framework for Gender, Diversity and Inclusion in CGIAR's workplaces](#).

8.2 Open and FAIR data assets

Researchers involved in the implementation of this Initiative shall adhere to the terms of the [Open and FAIR Data Assets Policy](#)."

FRESH will align with the OFDA Policy's Open and FAIR requirements, ensuring:

- Rich metadata conforming to the [CGIAR Core Schema](#) to maximize Findability, including geolocation information where relevant.
- Accessibility by utilizing unrestrictive, standard licenses (e.g. [Creative Commons](#) for non-software assets; General Public License ([GPL](#))/Massachusetts Institute of Technology ([MIT](#)) for software), and depositing assets in open repositories.
- Wider access through deposition in open repositories of translations and requiring minimal data download to assist with limited internet connectivity.
- Interoperability by annotating dataset variables with ontologies where possible (controlled vocabularies where not possible).
- Adherence to [Research Ethics Code](#) (Section 4) relating to responsible data (through human subject consent, avoiding personally identifiable information in data assets and other data-related risks to communities).

9. Human resources

9.1 Initiative team

Category	Area of expertise	Short description of key accountabilities
Research	Impact evaluation, Behavior change, Nutrition, Gender, Dietary assessment	Consumer behavior WP1 will design and manage causal impact assessments to understand how to increase F&V intake through behavioral approaches, working closely with WP5 and WP6. Accountable for design and implementation of pilot studies that leverage behavior and food-related programs/policies to increase F&V intake – including testing innovative new behavioral approaches and product development. Accountable for data management, analysis and dissemination.
Research	Plant Science, Vegetable Breeding, Bioinformatics, Plant Pathology, Seed Systems, Horticulture,	Breeding, genetic innovations, and sustainable seed systems WP 2 has a social equity focus in support of creating accessible, affordable, and sustainable seed systems. Accountable for design and implementation of trials, analysis of data, and support of dissemination of results. Outputs include breeding tools, seed cultivars, and outreach products. Will support eco-agro landscape analysis with WP 3.
Research	Agroecology, Plant protection, Water management, Natural Resource Management. Adoption and impact	Safe and sustainable production systems WP3 is accountable for design and adaptation of equity focused approaches to safe and sustainable F&V systems. Will deliver technological packages to reach farmers for large scale adoption. With WP2, will conduct agro-eco landscape analysis, to ensure that approaches are climate resilient and promote biodiversity of both farming systems and their environment.
Research	Microbiology and Food Safety, Agricultural Economics, Plant Science	Post-harvest and inclusive markets WP4 will focus on understanding and addressing postharvest losses and the standardization of food safety best practices, with a focus on social equity and job creation. Accountable for collaborating with internal/external partners on design and implementation of (1) context appropriate technology packages to reduce post-harvest losses and (2) technical and culturally appropriate food safety technologies/measures, the analysis of trial data, and scaling of technology. Work closely with WP3
Research	Nutrition, Social Science, Agricultural Economics	Food environments WP 5 Will design and implement affordability studies, GIS assessments, and qualitative work around food environment barriers to F&V accessibility and affordability. Will co-design impact assessments with partners to understand how innovations affect food environments in relation to fruits and vegetables and how social protection programs can be leveraged to increase F&V intake. Will collaborate with WP6 on political economy analysis.
Research	Governance, Political Economy, Social Sciences,	Enabling environments WP6 is accountable for analysis of local and national political economy as related to the political, social, and economic drivers of F&V consumption. Accountable for designing collaborative mechanisms/platforms for generating demand for evidence and facilitating capacity strengthening for all levels of governance. Will collaborate with all WPs.
Research Support	Program Management	Management and coordination of FRESH Initiative across WPs. Accountable for tracking outputs and outcomes, providing support to MELIA and communications teams. Will provide direct support to FRESH leadership and partners.
Research Support	Communications	Support FRESH communications, outreach, and dissemination events at local and regional levels. Communications expert will provide support in translation of research into policy practice (WP6) and for wider stakeholders (WP1-5). Accountable for communications across multiple mediums (website, social media), and reporting.
Research Support	Administration, finance, budgets, contracts	Accountable for support of all FRESH administrative, financial, and contracting work.
Research Support	Capacity Strengthening, Stakeholder Engagement	Support FRESH WPs in the design and delivery of capacity building-related activities. Accountable for identifying opportunities for shared capacity development interventions, ensure technical excellence in interventions delivered, and support the tracking of capacity strengthening across WPs. Together with WP6 and the communications expert, responsible for facilitating capacity strengthening and generating demand for evidence for policy makers at national, sub-national and local levels.

9.2 Gender, diversity and inclusion in the workplace

The Initiative team will meet CGIAR's gender target of a minimum of 40% women in professional roles and is comprised of individuals from diverse backgrounds. Women, minorities, and other under-represented groups will hold leadership roles in the Initiative team. This will be seen in the composition of our senior team and will extend to the fair allocation of leadership activities and accountabilities.

We will continue to support diversity in our leadership and management teams. We will also share the CGIAR Panel Pledge with our teams and encourage them to take the pledge. Co-creation and co-design with national stakeholders are central to our Initiative's conceptualization and thus we will ensure that we regularly hold workshops and other events with key stakeholders from diverse backgrounds in the countries in which we are working to ensure their voices are heard and we will aim to ensure that our national partners are key speakers and participants in the dissemination of results from our Initiative's activities. Lastly, we are committed to supporting the diversity of the next generation of scientists through leadership development/ mentoring programs for women, minorities and other underrepresented groups.

9.3 Capacity development

- Initiative team leaders and managers will complete training on inclusive leadership within 3 months of launch.
- Within 6 months of launch, Initiative team members will complete training on gender, diversity and inclusion, including on whistleblowing and how to report concerns.
- The Initiative kick-off will include an awareness session on CGIAR's values, code of conduct and range of learning opportunities available within CGIAR.
- Development opportunities will be made available for junior level Initiative team members, partners and stakeholders. These will include mentorship, internships and collaborations with master's and PhD students with representation of emerging professionals from under-represented groups. In addition, junior staff will be encouraged to lead and co-author peer-reviewed publications and participate in co-design processes with our multi-stakeholder groups and present research findings at different types of conferences and workshops (in focus countries and internationally).

10. Financial resources

10.1 Budget

10.1.1: Activity breakdown

USD	2022/2023	2023/2024	2024/2025	Total
Crosscutting across Work Packages	\$841,177	\$1,228,052	\$1,717,072	\$3,786,301
Work Package 1	\$801,309	\$1,227,370	\$1,349,221	\$3,377,900
Work Package 2	\$730,000	\$1,072,680	\$1,677,978	\$3,480,658
Work Package 3	\$950,000	\$1,072,680	\$2,143,572	\$4,166,252
Work Package 4	\$546,000	\$612,960	\$919,440	\$2,078,400
Work Package 5	\$622,599	\$843,824	\$881,626	\$2,348,049
Work Package 6	\$508250	\$538,256	\$614,876	\$1,661,382
Innovation packages & Scaling Readiness		\$40,000	\$60,000	\$100,000
Total	\$4,999,335	\$6,635,822	\$9,363,785	\$20,998,942

10.1.2: Geographic breakdown

USD	2022/2023	2023/2024	2024/2025	Total
Global (not specific country)	\$1,103,845	\$1,698,814	\$2,239,307	\$5,041,966
Benin	\$1,081,801	\$1,383,670	\$2,066,144	\$4,531,615
Philippines	\$833,432	\$1,089,750	\$1,478,161	\$3,401,343
Sri Lanka	\$993,694	\$1,248,744	\$1,784,275	\$4,026,713
Tanzania, United Republic	\$986,563	\$1,214,844	\$1,795,898	\$3,997,305
Total	\$4,999,335	\$6,635,822	\$9,363,785	\$20,998,942

11 Online annexes and references

11.1 Online annexes

A link to the FRESH Annexes can be found [here](#).

11.2 References

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