RESEARCH PROGRAM ON Agriculture for Nutrition and Health

Led by IFPRI

REFERENCE DOCUMENT for PHASE II THEORIES OF CHANGE

Updated in January 2019

Contents

THE OVERALL CRP

GOALS, OBJECTIVES, TARGETS

The goal of A4NH is to strengthen the capacity of CGIAR to contribute globally to the second System Level Outcome (SLO2) on *improved food and nutrition security for health* and the 2030 Agenda for Sustainable Development (**Table 1**).

A4NH will contribute to all four Intermediate Development Outcomes (IDOs) under the SLO on *improved food and nutrition security for health* (**Figure 1**). Through four of its flagships, A4NH will contribute to specific IDOs under SLO1 on *reduced poverty.* Together with the CRPs on Water, Land, and Ecosystems (WLE) and Climate Change, Agriculture, and Food Security (CCAFS), we will contribute to specific IDOs under SLO3 on *improved natural resource management and ecosystem services.* The four CGIAR cross-cutting issues — *gender and youth, policies and institutions, climate change and capacity development* — will be integrated into all A4NH flagships. We will collaborate with CCAFS on *climate change*, with special emphasis on healthy, sustainable food systems; WLE on sustainability of food systems; and Policies, Institutions, and Markets (PIM) on gender and youth and policies and institutions. The cross-cutting issues of *gender and youth,* as well as *policies and institutions* have been central to the A4NH Results Framework since Phase I and we have had a strong emphasis on capacity development for agriculture, nutrition and health research, program implementation and enabling.

During Phase II, A4NH will make significant contributions to three of the SRF's SLO targets for 2022:

- **20 million more farm households in at least 12 countries** will have adopted improved varieties, breeds or trees and/or improved management practices (Flagship 2: Biofortification and Flagship 3: Food Safety);
- **150 million more people, of which 50% are women, in at least 14 countries** will be without deficiencies of one or more of the following essential micronutrients: iron, zinc, iodine, vitamin A, folate, and vitamin B12 (Flagship 2: Biofortification and Flagship 4: Supporting Policies, Programs and Enabling Action through Research); and
- **10% fewer women of reproductive age in Ethiopia, Bangladesh, Viet Nam and Nigeria** will be consuming less than the adequate number of food groups (Flagship 1: Food Systems for Healthier Diets).

IMPACT PATHWAY AND THEORY OF CHANGE

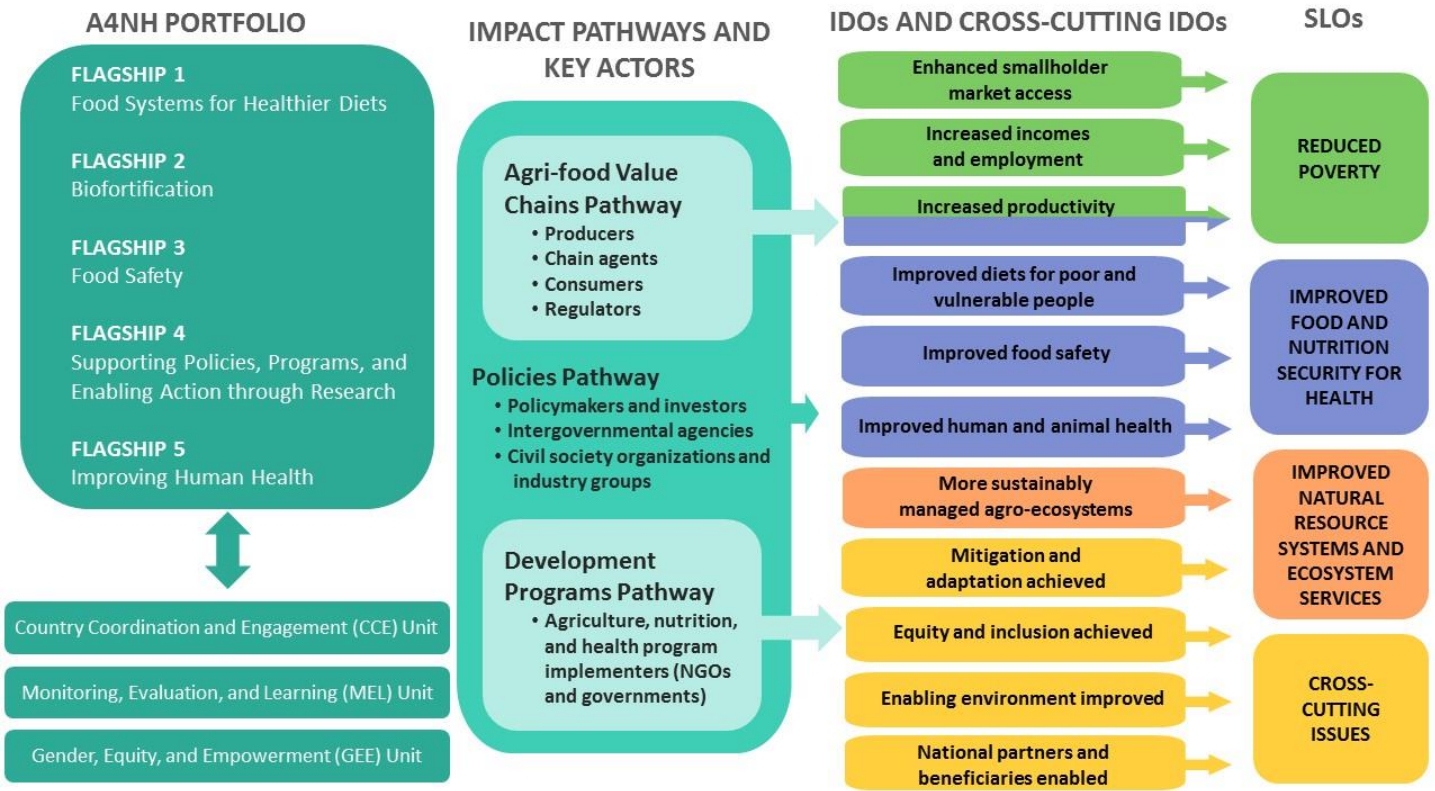
The A4NH Results Framework (**Figure 1**) describes our impact pathways, reflecting the different ways in which A4NH research activities and outputs, including knowledge, technologies, capacity, and stakeholder engagement, contribute to outcomes in food systems. In some cases, A4NH research provides value chain actors with technologies and capacity to enhance and protect the nutritional content of foods, while mitigating key food safety risks (**agri-food value chains pathway**). We also provide evidence and tools to development implementers to increase the effectiveness of their nutrition- and health-sensitive agricultural programming (**development programs pathway**). Finally, we support governments and donors to improve an enabling environment and create better-informed, better-targeted, and better-implemented policies (**policies pathway**). Value chains, policies and programs are key components of the food system, and while we seek to have impact through individual pathways, it is always with an eye toward how the changes in the pathway(s) will influence the system as a whole. The three food system pathways are mutually reinforcing, with the policy pathway underlying and sustaining the other two.

Table 1. A4NH contributions, by flagship, to the 2030 Agenda for Sustainable Development and the CGIAR Strategy and Results Framework

SDGs	SLOs	IDOs	Sub-IDOs	Expected A4NH Flagship (FP) Contributions by 2022 (x) and beyond (*)				
				FP1	FP2	FP3	FP4	FP5
1, 2, 3	Reduced poverty	Enhanced smallholder market access	Reduced market barriers			x		
		Increased incomes and employment[1]	Increased livelihood opportunities				x	
		Increased productivity	Closed yield gaps through improved agronomic and animal husbandry practices		x			
1, 2, 3, 6, 13, 15	Improved food and nutrition security for health	Improved diets for poor and vulnerable people	Increased availability of diverse nutrient-rich foods	x	x		x	
			Increased access to diverse nutrient-rich foods	x	x		x	
			Optimized consumption of diverse nutrient-rich foods	x			x	
		Improved food safety	Reduced biological and chemical hazards in the food system			x	*	
			Appropriate regulatory environment for food safety			x	*	
		Improved human and animal health through better agricultural practices	Improved water quality				*	
			Reduced livestock and fish disease risks associated with intensification and climate change				*	x
			Increased safe use of inputs				*	x
1, 13, 15	Improved natural resource systems and ecosystem services	More sustainable managed agro-ecosystems	Increased resilience of agro-ecosystems and communities- especially those including smallholders					x
			Enhanced adaptive capacity to climate risks	*				x
13	Climate Change	Mitigation/ adaptation achieved	Enabled environment for climate resilience				x	
1, 2, 3, 5	Gender and youth	Equity and inclusion achieved	Gender-equitable control of productive assets and resources			x	x	
			Improved capacity of women and young people to participate in decisionmaking	x	x		x	x
1, 13, 17	Policies and institutions	Enabling environment improved	Increased capacity of beneficiaries to adopt research outputs			x	x	
			Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research		x		x	
			Conducive agricultural policy environment	x	x		x	
			Conducive environment for managing shocks and vulnerability, as evidenced in rapid response mechanisms					x
17	Capacity development	National partners and beneficiaries enabled	Enhanced institutional capacity of partner research orgs	x	x	x	x	x
			Enhanced individual capacity in partner research organizations through training and exchange			x	x	x
			Increased capacity for innovation in partner research orgs	x			x	
			Increased capacity for innovation in partner development organizations and in poor and vulnerable communities				x	

[1] Since the Full Proposal, Flagship 1: Food Systems for Healthier Diets, removed its contribution to 'diversified enterprise opportunities' a sub-IDO under 'Increased incomes and employment.'

Figure 1. A4NH Phase II Results Framework



Agri-food value chains pathway

There are several points along agri-food value chains where actors can use A4NH research outputs to contribute to nutrition and health outcomes. At the **farm level,** a traditional area of strength in CGIAR, two flagships work closely with public- and private-sector actors, mainly in input supply, to demonstrate and learn from the delivery at scale of two technologies to improve nutrition and health (biofortified varieties by Flagship 2: Biofortification, and biocontrol and good agricultural practices [GAP] by Flagship 3: Food Safety). The delivery at scale of biofortified varieties represents an important part of A4NH's contribution to the SRF targets on micronutrient deficiency, but together, the two technologies represent our main contribution to this target. The impact pathways for these farm-level technologies go from on-farm production either directly to consumption by the farm household members or through sale to traders and, in some cases, processors, to eventual purchase and consumption by target consumers. All along the pathway, there are important assumptions underlying expected outcomes. Gender and equity issues are key in most of the outcomes, from deciding what crops to plant and sell or what foods to purchase, to determining intra-household food allocation. The detailed theories of change developed for each of these cases (N. Johnson, Guedenet, and Saltzman 2015; N. Johnson, Atherstone, and Grace 2015), together with assessments of the strength of existing evidence for the assumptions, will guide decisions about delivery and support learning about the potential for on-farm technologies to contribute to improvements in nutrition and health. This work will take place within each flagship and in collaboration with the agri-food system CRPs (AFS-CRPs), and with CCAFS to consider the impacts of climate change on the effectiveness of technologies and practices.

Another point along the value chain where A4NH research can contribute to improved nutrition and health outcomes is through **improving trader practices.**[2] This is especially important in value chains for perishable foods, which can lose their nutritional value or even become a risk for foodborne infections or zoonotic pathogens, such as avian influenza, if not handled properly. Flagship 3: Food Safety is working on proof of concept of an institutional innovation for traders called 'training and certification' (T&C), designed to improve the quality and safety of livestock products in informal and formalizing value chains. T&C provides traders with the capacity and incentives to improve their practices in contexts where enforcement of regulations through penalties is challenging. The theory of change describes the conditions under which T&C can lead to increases in consumption of safer animal source foods (ASF) by target consumers, as well as the

[2] We use the term traders, but this could be any group of intermediaries between what's produced on the farm and the consumer.

conditions under which such a scheme can be sustainable and scalable (N. Johnson et al. 2015). The T&C innovation is currently being implemented at scale in dairy value chains in India and Kenya, reaching 6.5 million consumers. Based on lessons learned from this experience, A4NH is adapting the approach to markets for other livestock products in collaboration with the CRPs on Fish, Livestock, and, with WLE, on vegetables. Gender and equity issues are important along the pathway, in particular because risk of foodborne disease (FBD) often varies by gender when men and women play different roles along the value chain, from production through slaughter and processing, to sale.

Agricultural value chain analysis and interventions have typically focused on the supply side, but if the goal of value chain development is to improve diets, then analysis needs to extend to the demand side. Changing **consumer behavior** will need to become a key entry point for improving value chain performance (keeping in mind that in many of our contexts, consumers may also be producers and traders). In Phase I, a conceptual framework was developed (Gelli et al. 2015) and is being validated with development partners such as the World Food Program (WFP) and the International Fund for Agricultural Development (IFAD). In Phase II, more research will build upon these initiatives. Our work with CCAFS on sustainable food systems and on the environmental implications for changing diets (Gill et al. 2015) will be particularly important, and is expected to have impacts on both under- and over-nutrition. It will be through this consumer-oriented work on improving value chains in a food systems context that we expect to achieve our SRF target on improving dietary quality and diversity.

Development programs pathway

Markets are the drivers of agricultural development, but development programs that successfully integrate agriculture, nutrition, and health also represent an important avenue for reaching key target beneficiaries cost-effectively (Masters et al. 2014). **Nutrition-sensitive agricultural programs** are important for reaching two critical target populations: pregnant women and children under two years of age. These groups are particularly vulnerable to poor diets, and improvements in diets can have life-changing impacts on a child's physical and cognitive development and future potential. Similarly, integrated agriculture and health programs can be cost-effective options for achieving both public health and agricultural development objectives, especially in poor, rural areas. The disease, cysticercosis, is a priority example, where elimination is possible with coordinated and sustainable control efforts between public health and agricultural programs linked with value chain incentives and interventions (Maurice 2014).

During Phase I, Flagship 4: Supporting Policies, Programs, and Enabling Action through Research (known then as Integrated Programs and Policies) began building an evidence base on *how* and *how much* integrated agriculture and nutrition programs can improve nutrition outcomes, working closely with both development programs and with the governments and donor agencies that fund them. Findings from these studies are being incorporated into the design of new programs and the scale-up of future programs, enhancing their coverage and effectiveness. For example, on the basis of emerging evidence on gender-agriculture-nutrition linkages, the Ministry of Agriculture of Bangladesh is investing in a large-scale evaluation of alternative approaches to integrating nutrition and gender into agricultural extension. This work constitutes an important part of A4NH's contribution to the SRF target on reducing micronutrient deficiencies.

Policies pathway

A4NH research provides the evidence base, knowledge, tools, and technical inputs to help decisionmakers make smarter policy choices and better (and bigger) investments. All flagships have policy objectives, but these vary. For example, the first three flagships will focus on national and sub-national policies and regulations that influence farmers, market agents and small and medium enterprises along and, especially, across agri-food value chains to support safe, healthy and sustainable food system transformation. Flagship 4: Supporting Policies, Programs, and Enabling Action through Research will focus on national processes and capacities of national actors to shape public policy and programs so that improved nutrition and health outcomes can be achieved through agriculture. Key assumptions that underlie the pathway from policy commitment to implementation and impact on the ground relate to the availability of (1) knowledge and evidence, especially about implementation at scale, (2) cross-sector political commitment both from supporting integrating ministries such as finance, planning and science and technology and fostering understanding on potential synergies from ministries that compete for funding such as social development, health and agriculture, and (3) sufficient capacity and resources, which often requires careful prioritization of actions (Gillespie et al. 2013; Gillespie, Menon, and Kennedy 2015). A4NH expects that that half of its commitment to the SRF target on reducing micronutrient deficiencies (as well as to other country priorities such as stunting and anemia) will come from improvements in the enabling environment.

While the challenge for undernutrition is converting policy commitment to action, the challenge for other health and nutrition issues is to get on the policy agenda. The agriculture sector has not seen health as a priority (and vice versa), but this is changing as more evidence becomes available on the burden of agriculture-associated diseases, the incidence and

impacts of FBDs (Havelaar et al. 2015), and on the availability of cost-effective policy options. Similarly, the availability of better data on changes in diets at the national and subnational level and on links between diets and food systems is expected to influence policies that shape food systems. Getting these issues on the policy agenda will be a key objective for Flagship 1: Food Systems for Healthier Diets, Flagship 3: Food Safety and Flagship 5: Improving Human Health in Phase II and will involve engaging with key stakeholders in agriculture, health, and other sectors. It will also involve building country-level capacity for cross-sector policy analysis so that analysts can identify and assess appropriate policy options. The policy pathway is expected to lead to important reductions in exposure to FBDs and other agriculture-associated diseases and in overnutrition. Indicators and targets will be set for these impacts.

In addition to the three food systems pathways described above, as an ICRP A4NH contributes indirectly to outcomes through the support it provides to other CRPs, by facilitating networking and mutual learning through communities of practice (CoPs) and learning platforms. While we expect these contributions to be reported through other CRPs, following the advice of the A4NH external evaluation and true to the role of an ICRP, we will develop theories of change for our investment in networking, co-learning and bridging work in order to be more systematic about monitoring and learning from these investments. This has already been done for the gender-nutrition CoP which was established in Phase I and will be done for others once they are operational.

FLAGSHIP 1: FOOD SYSTEMS FOR HEALTHIER DIETS

OBJECTIVES AND TARGETS

The overarching goal of Flagship 1 is to understand how changes in food systems can lead to healthier diets, and to identify and test entry points for interventions to make those changes. We focus on measuring changes in diet quality among (young) women, their children, and vulnerable populations, who are most at risk for malnutrition.

This flagship's contribution to CGIAR's 2022 target will be a **10% reduction in consumption of less than the adequate number of food groups among women of reproductive age and their children in the four target countries**. In addition, this flagship will contribute to development outcomes in three ways:

1. By providing evidence on drivers of and constraints to diet changes among target populations and food system performance related to healthier diets, to inform policy discussions and multi-stakeholder dialogues in target countries;
2. By improving the performance of multiple nutrient-rich agri-food value chains and identifying options to upscale effective food system innovations to large segments of target populations; and
3. By supporting agri-food system CGIAR Research Programs (AFS-CRPs) through communities of practice (CoP) that can guide researchers in using food-system pathways and strategies for strengthening and leveraging agri-food systems for healthier diets in CGIAR research.

This knowledge will support scaling up through targeted capacity building, knowledge dissemination, and policy engagement. Through an agri-food value chains pathway and a policies pathway, the flagship directly addresses the second system level outcome (SLO2) on *improved food and nutrition security for health*, through the sub-intermediate development outcome (IDO) on *improved diets for poor and vulnerable people.* It also has important links with the SLO on *reduced poverty*, through the contributions to the sub-IDO on *diversified enterprise opportunities,* and to SLO3 on *improved natural resource systems and ecosystem services*, through the contribution to the sub-IDO on *enhanced adaptive capacity to climate risks*. Given the wide-ranging implications of food system changes, it also contributes to three of the cross-cutting issues (**Figure 2**)[3].

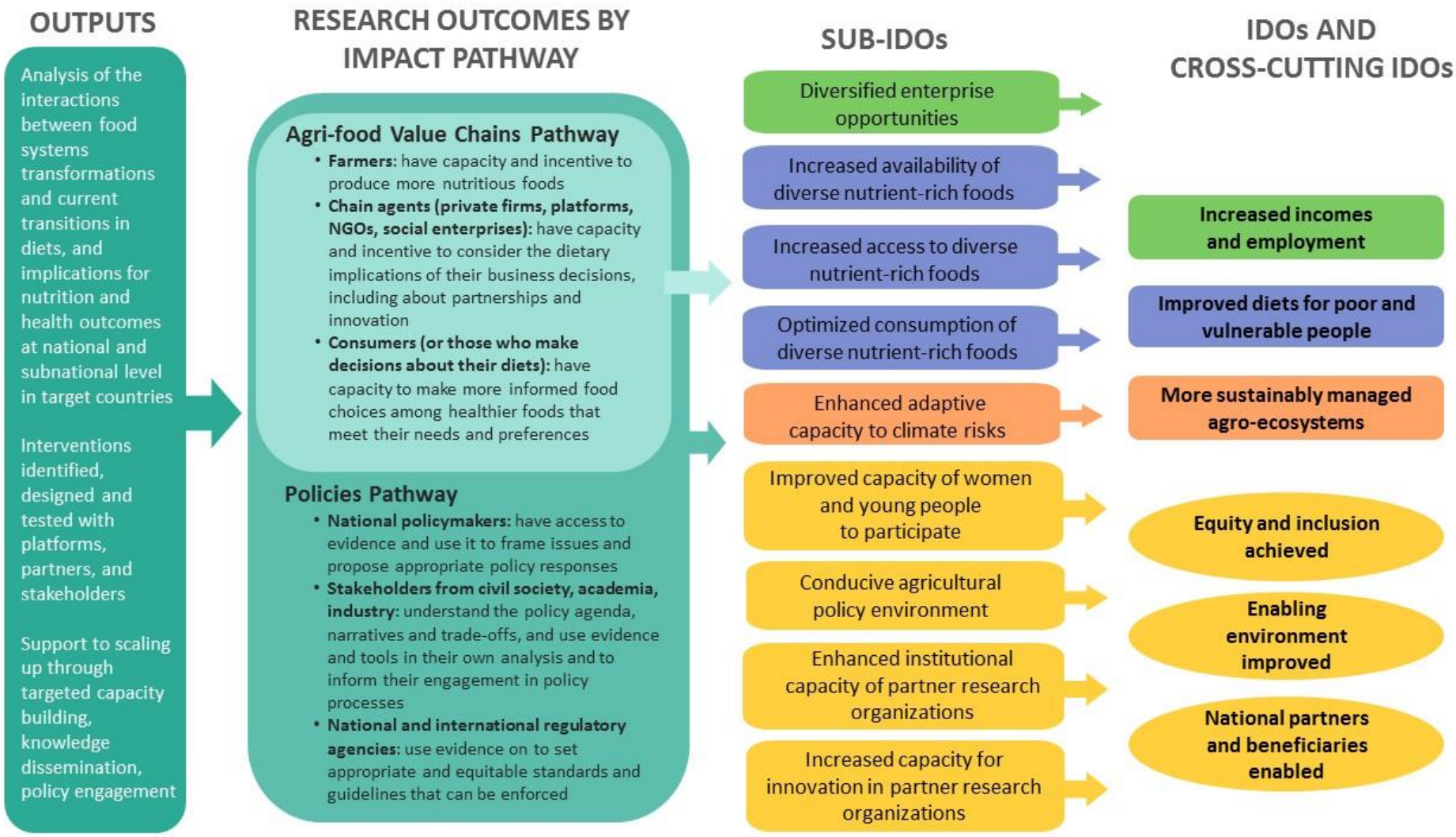
By 2022, this flagship expects its research to contribute to four main outcomes[4]:

- Partners and other CRPs incorporate nutrition, health, and gender in agri-food value chains and food system programs.
- Partners, including value chain actors, use evidence from impact evaluations when making operational and investment decisions.
- Public-private partnerships formed to promote implementation of A4NH strategies for agri-food value chain/food system innovations.
- Key partners, stakeholders, and institutions (including national and local policy makers, private sector, consumer organizations, and other CRPs) are effectively implementing the evidence and lessons learned at scale in their food system related strategies and policy agenda.

[3] In 2018, minor modifications were made to the list of sub-IDOs to which Flagship 1 research will contribute: the sub-IDO: 'Diversified enterprise opportunities' was removed as this sub-IDO will not be a target of the flagship. The sub-IDO: 'Enhanced individual capacity in partner research organizations through training and exchange' was added.

[4] Most outcomes have been re-worded since the approval of the A4NH Full Proposal. In 2018, Flagship 1 added a fourth outcome related to policy engagement and learning.

Figure 2. Results Framework for Flagship 1: Food Systems for Healthier Diets



Target Geographies

Flagship 1 will focus on two regions: Africa south of the Sahara, and South and Southeast Asia. In addition, complementary studies may be conducted in Latin America on specific experiences with food system innovations and dietary change. In the focal regions, we will examine trends and variability in healthier diets within and across countries and population segments, linking them to changes in food system dynamics. To provide a deeper understanding of diets and food system interactions at national and subnational levels, we will conduct more detailed analysis of diets and food systems **in four target countries: Bangladesh, Ethiopia, Nigeria, and Viet Nam**. These countries provide a range of diet and (sub)-national food system contexts at various stages of food system transformation and urbanization. In other countries, specific interventions may be piloted and scaled up, but not research on the national and sub-national food systems.

IMPACT PATHWAY AND THEORY OF CHANGE

Flagship 1 contributes to development outcomes and impacts through three main pathways through: (1) diagnosis and foresight activities that contribute to generating understanding evidence and leverage points for improving diets using a food system perspective by research partners; (2) testing out successful food system innovations with food systems actors being producers, chain actors and consumers (Agri-food Value Chains Pathway); and (2) providing evidence to influence key decision makers and policy processes to support food system transformation for healthier diets (Policies Pathway). All three pathways are linked and synergies and trade-offs are recognized. While the second pathway provides the necessary evidence to make policy decisions, in turn, policy decisions may also influence the pathway. Both are strongly context specific; and the diagnosis/foresight work and testing of identified food system innovations are important for adjusting the Theories of Change (ToCs) to national level.

In the first pathway, diagnosis and foresight activities in the flagship will result in a suite of metrics, analytical methods and tools for food system-diets diagnosis, foresight and impact assessment. The development and identification, of diet quality indicators, also in collaboration with other institutes working in the area of diet quality assessment such as INDDEX, is seen as critical for the assessment of dietary gaps and changes in these during the years, and to understand the role of changing food systems in these. Support to the development of food based dietary guidelines is important to increase knowledge on what a healthy diet entails in different contexts. Foresight analysis methods will assist in identifying and discussing scenarios of food system changes and resulting dietary outcomes with relevant stakeholders and will contribute to the identification of potential leverage points for entry for improving diets through a food system perspective. Based on results of our diagnosis and foresight work, we will reach out to our research partners (including relevant CRPs, CGIAR Centers and (local) research institutes to enhance incorporation of the use of the metrics, methods and tools in their work. Awareness on the importance of incorporation of diet considerations within a food system approach and willingness to use the proposed metrics, methods and tools is essential and will be supported by a continuation of the strong (inter) national priority given to diets and nutrition, and food system approaches, also within the CGIAR. Appropriate incentives will support further incorporation of healthy diet considerations using a more systemic approach in the work of our research partners including the CGIAR. We have to show that taking a food system approach with a dietary perspective will lead to useful and important new insights relevant for identification of appropriate and effective programmes for reinforcing food system adaptation and transformation leveraging for healthier diets.(Figure 3). If these assumptions can be met, research partners will increasingly incorporate diet considerations within a food system perspective in their work, generating further understanding, evidence and leverage points for improving diets through a food system approach.

In the second pathway, diet quality is improved and human well-being increased through changes in multiple nutrition-relevant agri-food value chains. For target populations with low dietary diversity, we will explore how to support more rapid development of (in)formal agri-food value chains for nutritious foods—whether single foods (e.g. fruits, vegetables, animal source foods, grain legumes, and biofortified staples) or combinations of foods (e.g. processed foods)—to enhance diet quality among women and children. The ToC in Figure 4 has both supply (left) and demand (right) components. In the focus countries, this flagship will identify the best leverage points for entry into food system dynamics from a dietary perspective. On the demand side, changes in diets can occur in response to changes in cultural or social norms, preferences, education, and access to information, relative prices of foods, income, or through behavior change. Changing behavior requires five steps: making new behaviors understood, easy, desirable, rewarding, and habitualized (Weed 2012). On the supply side, entry points include the types of products and their key characteristics, such as affordability and accessibility. To attain the IDOs, it is important to identify the agri-food value chains and partners most relevant for healthier diets. The goal of CoA 2: Food System Innovations, is to test the effectiveness of such interventions.

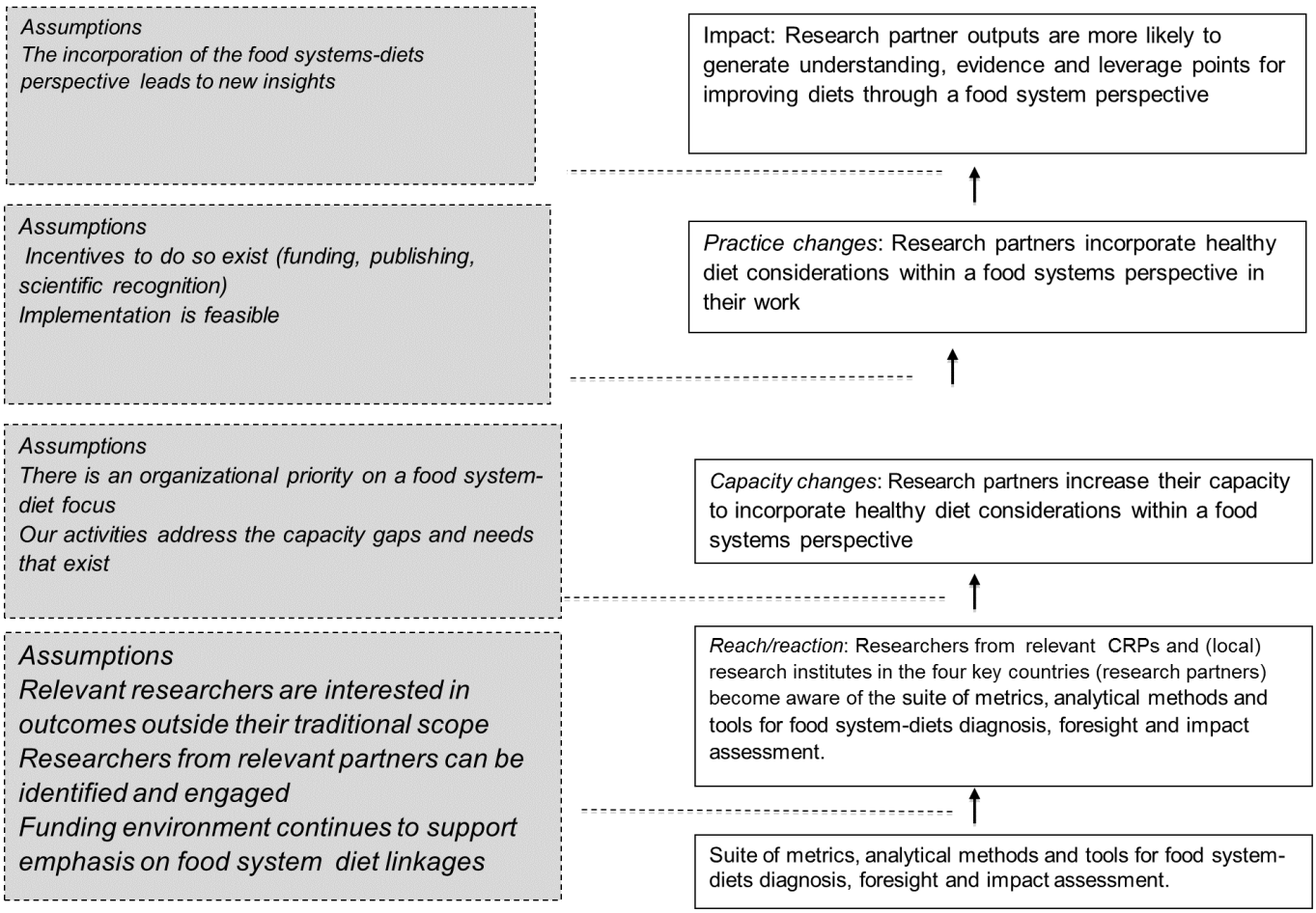
The supply side offers several key testable assumptions. For example, do producers or agri-food value chains actors have the resources and perceive benefits from opportunities for new, healthier products? We will measure available

endowments and attitudes among key groups for specific, identified opportunities and then test whether producers/actors are willing to take the risk embedded in these new opportunities by investing in new crops or products. On the supply side, it is particularly important to pay attention to the role of gender; when specific crops are produced, processed, and/or sold by either men or women, gender relationships along the food production side of the chain can influence welfare, bargaining, and, ultimately, nutritional outcomes. Finally, Flagship 1 will assess how beneficial, detrimental, or vulnerable a specific innovation is to the environment and integrate those insights into decision-making processes.

On the demand side, this flagship will test whether or not information about healthier diets reaches targeted beneficiaries or those who purchase food for them (especially mothers), as well as whether those knowledge changes are leading to behavior changes. This flagship will also measure the relative cost of more nutritious foods to understand whether these foods fit income constraints and whether decisionmakers have the agency, information, resources, and desire to purchase and consume more nutritious foods. If these assumptions can be met, improved accessibility of nutritious foods could lead to improved diet quality among (young) women, children, and vulnerable populations. Being the future workforce, leaders and bearers of the next generation, needs and aspirations of the adolescent girls and young women are important to consider as in this period of life youth is receptive to new ideas and make lifestyle (including diet) choices determining their future health. If they cannot be met, it is important to trace where assumptions break down so that projects can adapt.

In the third impact pathway, this flagship will contribute to development outcomes through policy processes, initially in target countries and later in other countries (Figure 4). National and sub-national governments, and other local and regional actors, can influence policy and regulatory frameworks to promote healthier foods and reduce unhealthy components and to make food systems more environmentally sustainable and resilient to climate change. To inform policy discussions and regulatory options, this flagship will conduct policy analysis and provide evidence on diet and food system changes and their links to national and sub-national policy processes, in relation to direct domains (e.g. food safety, health, agriculture subsidies) and indirect domains (e.g. urbanization, infrastructure planning, environment or climate change). Key decisionmakers and stakeholders (i.e. from private sector and consumer organizations) will be identified and engaged early in the four target countries. Results of the diagnostic work can help frame policy debates. Later, evidence on specific policy interventions can help shape the policies themselves or how they are implemented (e.g. through public-private investments). We will work closely with A4NH's Flagship 4: Supporting Policies, Programs and Enabling Action through Research (SPEAR), which works on public good program pathways and looks at country SDG indicators for nutrition and health, while this flagship concentrates on food policy, regulations, and investments linked to the agri-food value chains pathway. While in both pathways, diet quality for (young) women and children is the main outcome, we will also work closely with the CRPs on Climate Change, Agriculture, and Food Security (CCAFS) and Policies, Institutions, and Markets (PIM) to ensure that we consider synergies and tradeoffs between impacts of food system innovations on diets with other outcomes, such as equity, empowerment, economic performance, and sustainability.

Figure 3. Theory of Change for Flagship 1's Diagnosis and Foresight Impact Pathway[5]

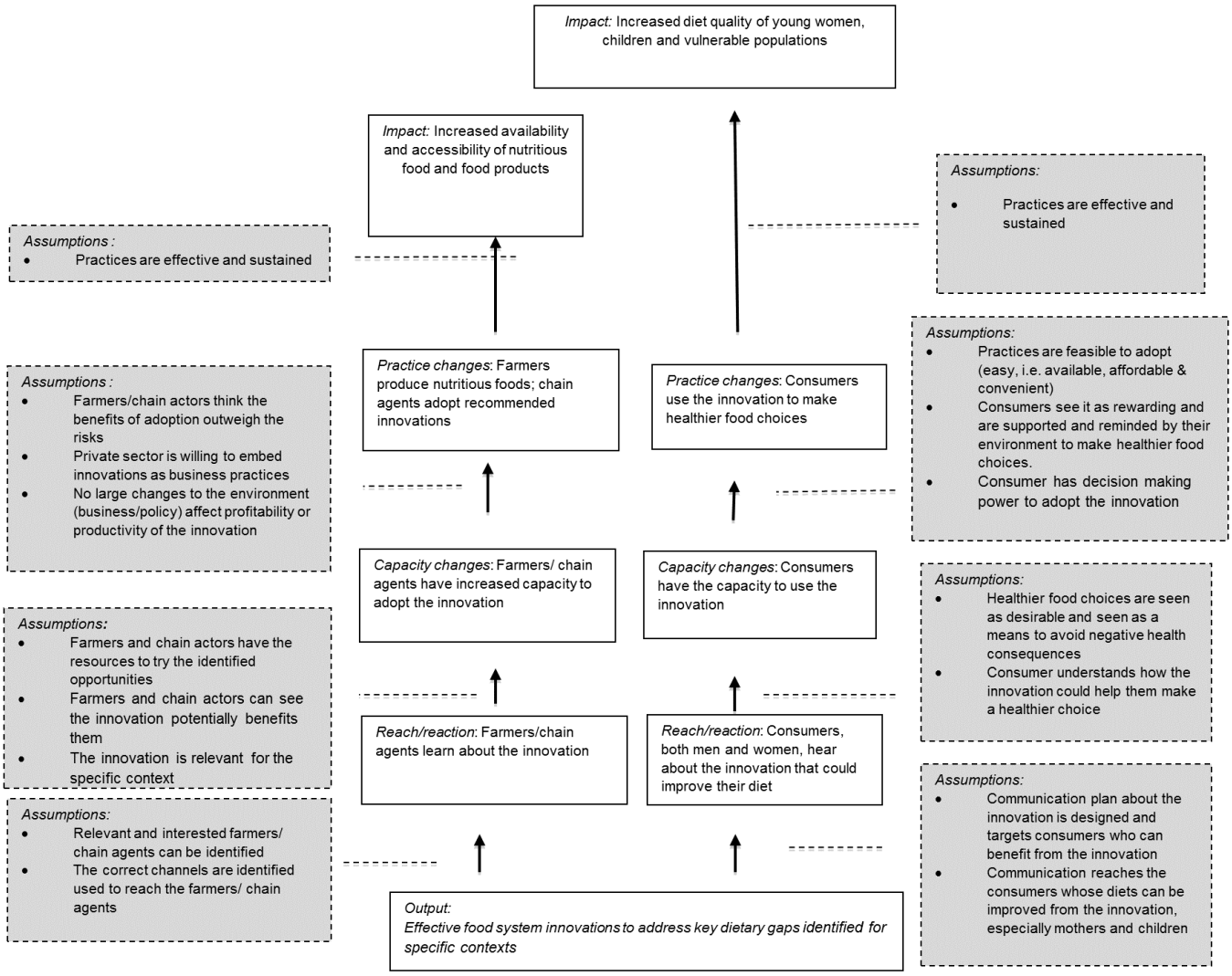


[5] This theory of change and the evidence table were added in the 2018 Plan of Work and Budget.

Table 2. Assumptions and the current strength of evidence for achieving the outcomes in the diagnosis and foresight impact pathway

Outcomes and likelihood of occurrence	Assumptions	Strength of evidence
Will incorporation of food system-diets perspectives lead to research outputs that generate understanding and leverage points for improving diets through a food system perspective? *Likelihood:*	Incorporation of the food system-diets perspective leads to new insights	Weak (Absent)
Will increased research capacity in food-system- diet linkages results to practice changes? *Likelihood:*	There are incentives to do so Implementation of metrics, methods and tools is feasible	High: more funding, possibility to publish, to present, scientific recognition. For some high feasibility (DDS), for some low (24 hr recall) for some we still have to collect evidence on this (consumer demand for example)
Is the awareness sufficient motivation to learn a new approach? *Likelihood: Low*	There is an organizational priority on food systems-diets focus Our activities address these priority capacity	High, medium and low. For other CRPs low (let A4NH do it); some other organisations seem to have it more internalized.
Will information on the suite of metrics, tools and methods reach our research partners? *Likelihood: High*	Relevant researchers are interested in outcomes outside their traditional scope Researchers from relevant partners can be identified and engaged Funding environment continues to support emphasis on food-system-diet linkages	High, helped by the climate of the SDGs Medium (for flagship and CRPs high, but others medium). Self-identifying, involvement of Flagship 1 researchers in other CRPs High: numerous high level reports on food systems and diets, interest in linkage to NCDs is increasing, lots of requests to Flagship 1 researchers to be included in programmes and proposals, GAIN turns into food systems.

Figure 4. Theory of Change for Flagship 1's Agri-Food Value Chains Pathway[6]



[6] This theory of change was updated in the 2018 Plan of Work and Budget.

Table 3. Assumptions and the current strength of evidence for achieving the outcomes in the agri-food value chains impact pathway

Outcomes and likelihood of occurrence	Assumptions	Strength of evidence
Will sustained adoption of innovation of farmers/change agents lead to increased availability and accessibility of nutritious food and food products? Will sustained adoption of innovation by consumers lead to increased diet quality of (young) women, children and vulnerable populations? *Likelihood:*	Practices are effective and sustained	Weak
Will increased capacity lead to sustained adoption of the recommended innovations? *Likelihood:*	• Farmers and chain actors think the benefits of adoption outweigh the risks • Private sector is willing to embed innovations as business practices • No large chances to the environment affecting the profitability of the innovations • Practices are feasible to adopt (easy, i.e. available, affordable & convenient) • Consumers see it as rewarding and are supported and reminded by their environment to make healthier food choices • Consumer has decision power to adopt the innovation.	• Weak to moderate • Weak • High evidence of negative effects • High (otherwise we do not implement them) • High evidence that environment is important so should be included in the innovation implementation • High evidence that vulnerable groups do not have the decision power
Is the awareness sufficient motivation to learn about the innovation? *Likelihood: Low*	• Healthier food choices are seen as desirable and as a way to avoid negative health consequences • Consumer understands how innovation could help them make a healthier choice • Farmers and chain actors can see the innovation potentially benefits them • Farmers and chain actors have the resources to try the identified opportunities • Innovation is relevant in the specific context of the farmers/chain agents	• Moderate evidence that consumer don not care so much • Weak • Weak • Weak
Will information on the food system innovations reach farmer and chain agents and consumers? *Likelihood: High*	Relevant farmers and chain agents can be identified The right channels are identified and used Communication plan about innovation is designed and targets consumers who can benefit from the innovation Communication reaches the consumers whose diets can be improved from the information, especially mothers and children	Self selection? Through platforms, part of association? High for farmers; moderate to weak for chain agents High High (we know how to reach consumers, what channels to use, sms, smartphone, radio, etc)

Figure 5. Theory of Change for Flagship 1's Policies Impact Pathway

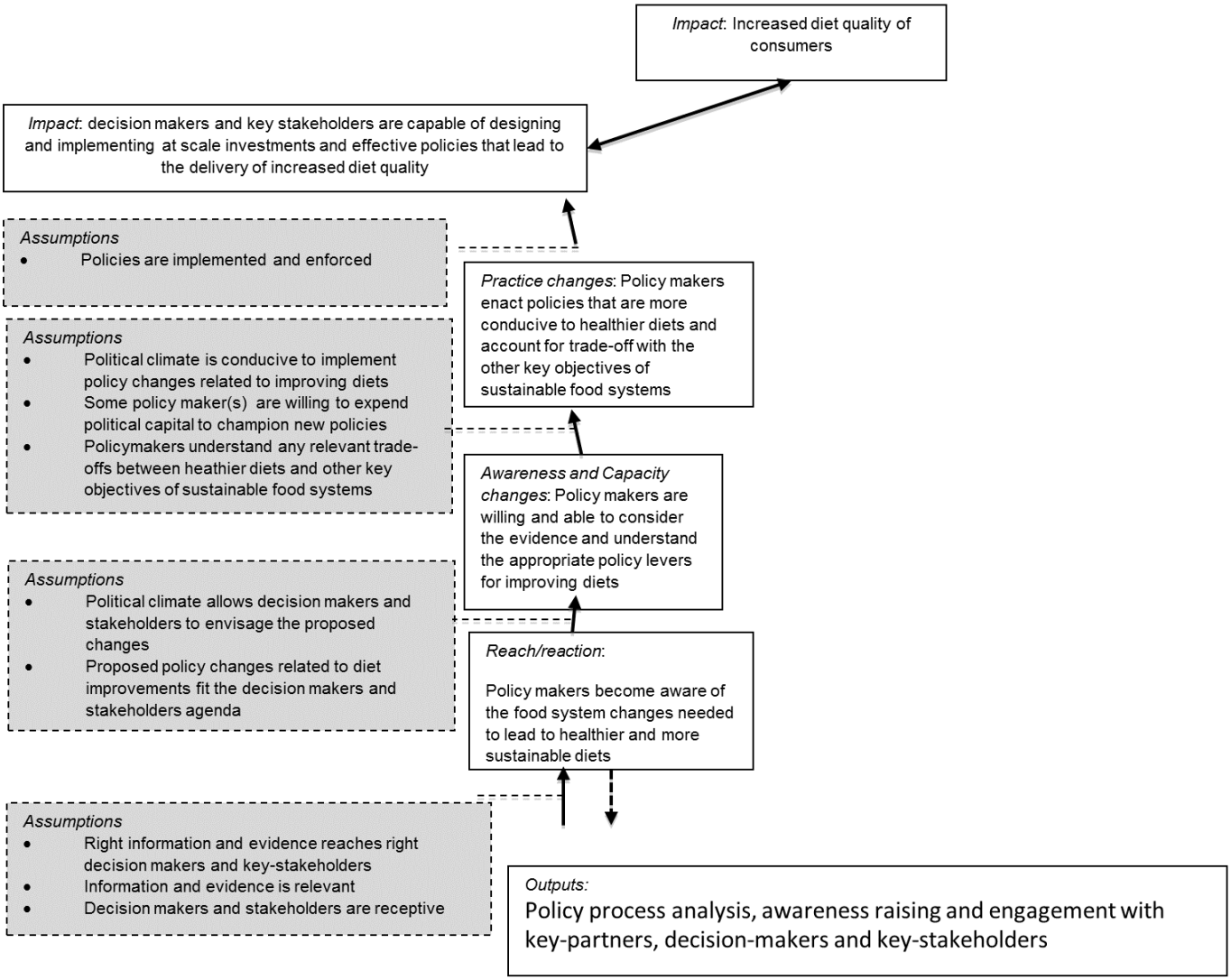


Table 4. Assumptions and the current strength of evidence for achieving the outcomes in the policies impact pathway

IMPACT: Decision makers and key stakeholders are capable of designing and implementing at scale investments and effective policies that lead to the delivery of increased diet quality		
Outcomes and likelihood of occurrence	**Assumptions**	**Strength of evidence**
Will implemented and enforced policies lead to increased diet quality of consumers? Likelihood: low	Policy makers enact policies that are more conducive to healthier diets and account for trade-offs with other key objectives of sustainable food systems	Weak
Will policy makers be willing and able to consider the evidence and understand appropriate policy levers for improving diets Likelihood: Medium to low	Political climate is conducive to implement policy changes related to improving diets Policy makers understand the relevant trade-offs between healthier diets and other key objectives of sustainable food systems Political climate allow decision makers and stakeholders to envisage the proposed changes Proposed policy changes related to diets improvement fits the decision makers and stakeholders agenda	Weak but very much country-specific
Will policy makers become aware of the changes needed to lead to healthier and more sustainable diets; LIKELIHOOD: medium to high	Right information and evidence reach right decision makers and key stakeholders Information and evidence is relevant	Medium to high, right venues selection to convey scientific inputs and right processes stirred with country teams and partners

FLAGSHIP 2: BIOFORTIFICATION

OBJECTIVES AND TARGETS

Flagship 2 addresses the problem of micronutrient deficiency due to inadequate dietary intake of micronutrients, contributing to the second system-level outcome (SLO2) on *improved food and nutrition security for health* through the intermediate development outcomes (IDOs) of *improved diets for poor and vulnerable people* and *increased productivity* (Figure 6) and all three cross-cutting IDOs. Improvements in productivity will also contribute to the SLO on *reduced poverty*.

During Phase II, this flagship aims to:

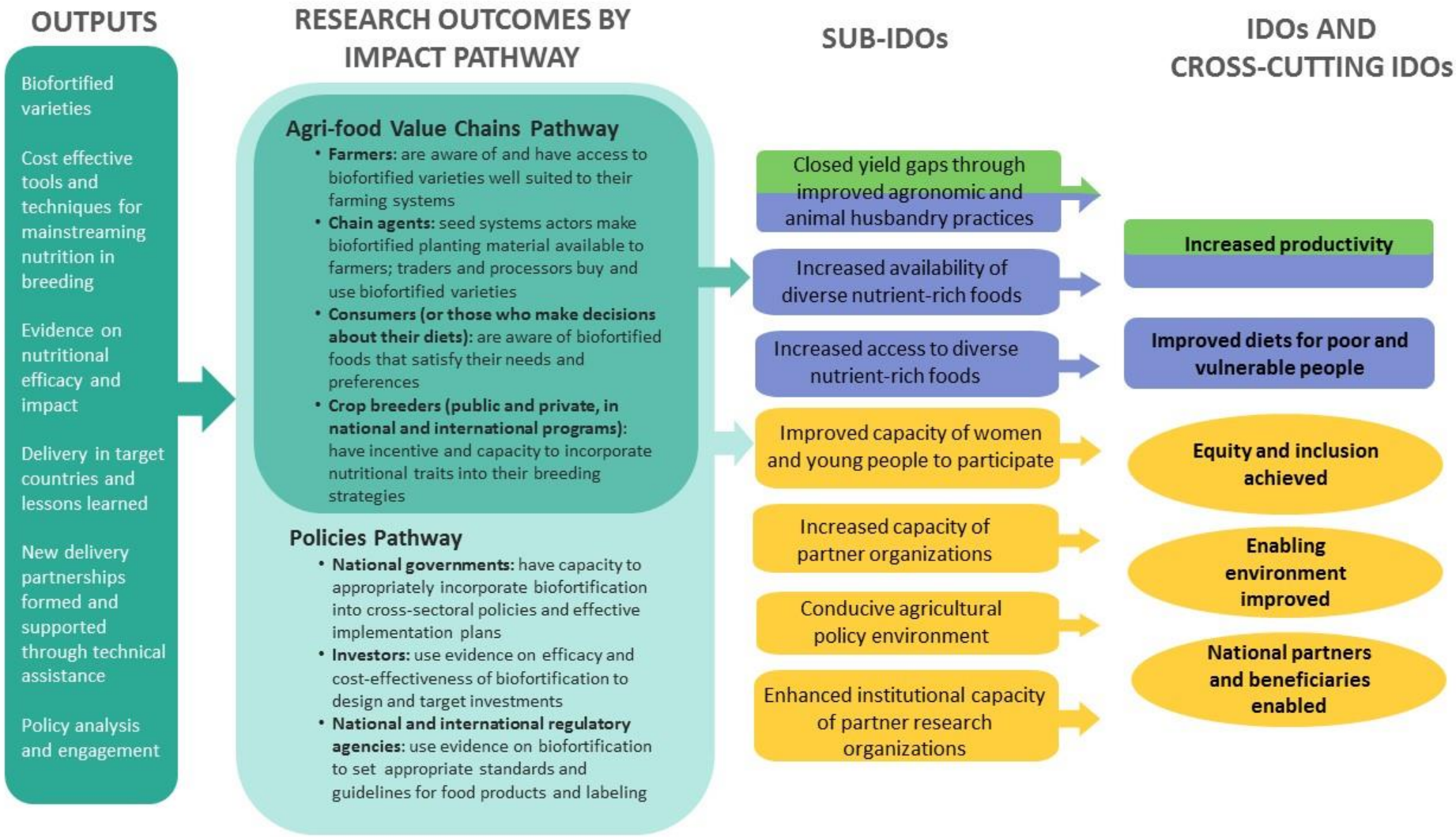
1. Assess the viability, cost-effectiveness, and impact of scaling up in the nine priority countries (Bangladesh, Democratic Republic of Congo (DRC), Ethiopia, India, Nigeria, Pakistan, Rwanda, Uganda, and Zambia) where HarvestPlus and national partners are taking the lead, in addition to those reached by partners working in other countries;
2. Develop and submit for national release biofortified varieties in target and expansion countries, while mainstreaming biofortification into CGIAR and national agricultural research system (NARS) breeding efforts; and
3. Provide evidence and analysis and strengthen capacity and leadership to integrate biofortification into policy, program development, and implementation, to support the scaling up of biofortification.

By 2022, Flagship 2 expects to have achieved the following:

- 20 million households will be growing and consuming biofortified crops (14 million reached directly by HarvestPlus and delivery partners [8.5 million in Africa and 5.5 million in Asia]; 6 million reached directly through partners and institutions);
- Varieties with the full target micronutrient content will be released in target countries and will be in release pipelines in partnership countries;
- Biofortified traits will increasingly be mainstreamed into CGIAR Centers' crop development work for target crops/agroecologies, annually increasing by 2.5% of breeding efforts
- Effectiveness evidence will be published for bean, wheat, and multi-crop system (orange sweet potato and bean) and will inform scaling efforts;
- Delivery lessons learned in target countries will be documented and applied in scaling up biofortification;
- Capacity will be built in at least 12 partner organizations to implement technically strong, cost-effective, and gender-sensitive programs that drive the uptake of biofortified crops;
- 20 countries with biofortified crops will be included in nationally or externally funded programs, with an array of public and/or private partners;
- Codex Alimentarius will adopt criteria for use of biofortification terms on food labels; and
- Biofortification will be included in national and regional policies, as well as WHO guidelines on micronutrient deficiencies.

More specifically, Flagship 2 will make contributions to two of CGIAR's 2022 targets: **20 million more farm households that have adopted biofortified varieties** and **43.1 million more people, of which 50% are women, without deficiencies of one or more of the following essential micronutrients: iron, zinc, iodine, vitamin A, folate, and vitamin B12**.

Figure 6. Results Framework for Flagship 2: Biofortification



Target Geographies

HarvestPlus's delivery science work focuses on the nine target countries (Bangladesh, DRC, Ethiopia, India, Nigeria, Pakistan, Rwanda, Uganda, and Zambia) where HarvestPlus and national partners are taking the lead. Target countries represent a variety of market environments for biofortified crops, from a primarily commercial private sector approach (India, Zambia), to various mixed public-private delivery systems (Bangladesh, Nigeria, Rwanda, Uganda), to primarily public or social marketing systems (DRC). HarvestPlus also works closely with government-sponsored biofortification programs in Brazil, China, and India. Through the HarvestPlus Latin American and Caribbean (LAC) program, led by EMBRAPA, HarvestPlus provides technical assistance and support to government-driven biofortification programs in Bolivia, Colombia, Guatemala, Haiti, Nicaragua, and Panama and is exploring efforts in several additional countries. Increasingly, HarvestPlus is seeking partners to take the lead in scaling up biofortification in partnership countries, a growing list that includes Ghana, Kenya, Malawi, Tanzania, and Zimbabwe, and is expected to include several additional countries, such as Cambodia, Indonesia, Myanmar, Nepal, Sri Lanka, and Viet Nam by the end of Phase II.

By 2030, HarvestPlus's aspirational goal is for 1 billion people to be regular consumers of biofortified staple foods. The roadmap to reaching 1 billion is still under development and continues to be informed by lessons learned in target countries, detailed value chain analyses, and capacity assessment and strengthening of key actors, all of which will be a focus in the first years of Phase II. Key considerations for sustainability and scaling up are discussed in the next section.

IMPACT PATHWAY AND THEORY OF CHANGE

Available evidence and experience suggests that the goal of reaching 1 billion people by 2030 is audacious, but not impossible. To date, HarvestPlus has facilitated the release of biofortified varieties of six staple crops (vitamin A orange sweet potato, iron beans, vitamin A cassava, vitamin A maize, zinc rice, and zinc wheat), and several secondary staples (vitamin A banana/plantain[7], iron cowpea, zinc and iron lentils, iron and zinc potato, and iron and zinc sorghum). Biofortified varieties have now been released in 30 countries and are in multi-location testing in 42 countries. In 2015, biofortified planting materials reached more than 2 million farmers in HarvestPlus priority countries.

The pathway from research—through seed dissemination, adoption, and consumption—to improved diet and micronutrient status is long, complex, and context-specific. HarvestPlus has a good understanding of the pathway, specifically in contexts where delivery is taking place. In Phase I, we developed a series of country-by-crop-combination ToCs to identify key outcomes, underlying assumptions and risks for each, and availability of evidence to test them (Johnson, Guedenet, and Saltzman 2015). ToCs identify key areas for research in Phase II, guide country-level delivery and monitoring, and provide a framework for country-level and cross-country learning. ToCs inform scaling approaches in market environments, from the commercially oriented delivery of vitamin A maize in Zambia, to mixed public-private delivery models used in Nigeria and Rwanda. They help identify key areas for further research, like the role of youth in biofortification activities; gender-based differences in preferences and adoption; and unintended consequences of introducing biofortified crops.

Scaling and sustaining impact in target countries during delivery will require: (1) mainstreaming biofortification in agricultural research, together with crop CRPs; (2) learning from existing delivery efforts and developing operational partnerships in new countries; and (3) establishing a policy environment conducive to biofortified crops, in cooperation with the CRP on Policies, Institutions, and Markets (PIM). Based on lessons learned in the first years of delivery and potential risks identified by the ToCs, these activities are critical to attaining the 2022 and 2030 goals. They align with the three critical elements involved in scaling up biofortification: *supply* (agricultural research entities recognize high mineral and vitamin content as core plant breeding objectives), *demand* (consumers see the value of, and demand, high mineral and vitamin content in their staple foods), and *policy* (a wide range of public officials recognize the impact of biofortification to improve public health, and the high economic return to investments and commercial feasibility of biofortification). Scale in Phase II can be achieved only by working with other organizations and institutions to pilot, expand, and manage biofortification initiatives.

Investments in this flagship have launched breeding pipelines in CGIAR Centers and NARS with biofortified varieties that are agronomically competitive, disease resistant, have preferred end-use qualities, and have full target levels of micronutrients. To sustain this investment, CGIAR Centers and NARS partners must mainstream biofortification, using

[7] Provitamin A-rich banana varieties are naturally high in pVACs. They are being introduced from their center of origin in the Pacific to Eastern Africa.

micronutrient-dense materials throughout their breeding programs. In 2014, Director Generals (DGs) of CGIAR Centers made a commitment to mainstream biofortification, but this commitment requires concrete planning.

To support adoption in target countries and beyond, Phase II will focus on expanding knowledge in key areas, such as farmer and consumer acceptance, youth involvement, nutritional efficacy for a wider range of age and gender groups, and cost-effectiveness assessments (discussed further below). This evidence of lessons learned will be valuable, both to adjust delivery strategies for efficiency, and to help stakeholders decide whether and where to invest in biofortification. We will develop operational partnerships with development organizations interested in mainstreaming biofortified crops. In new partnership countries, we will facilitate multi-location testing by NARS and provide technical assistance and training for NARS. Once a crop is released, partners will take the lead in introducing and using the biofortified varieties.

Significant progress has already been made in mainstreaming biofortification into regional and national policies. At the Second International Conference on Nutrition (ICN2) in 2014, representatives from Bangladesh, Malawi, Nigeria, Pakistan, and Uganda highlighted the role of biofortification in their national strategies to end malnutrition by 2025. Panama and Colombia were among the first countries to include biofortification in their national food security plans. Since the 2nd Global Conference on Biofortification in 2014, biofortification has been included in national nutrition strategies in Nigeria, Rwanda, and Zambia. HarvestPlus is engaged with regional and global processes, like the African Union's Comprehensive Africa Agriculture Development Programme (CAADP) and the Scaling Up Nutrition (SUN) Movement, to ensure an enabling environment for biofortification. Efforts are underway to include biofortification in global standards and guidelines for food products and labeling, such as the Codex Alimentarius, the food standards-setting agency administered jointly by the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) and recognized by the Sanitary and Phytosanitary Agreement (SPS) of the WTO as its reference organization. This work will be linked to work in A4NH's Flagship 4: Supporting Policies, Programs and Enabling Action through Research (SPEAR).

FLAGSHIP 3: FOOD SAFETY

OBJECTIVES AND TARGETS

This flagship addresses the problem of poor health due to the production and consumption of contaminated foods, contributing to the second system-level outcome (SLO) on *Improved food and nutrition security and health* through the intermediate development outcomes (IDOs) on *Improved food safety*[8], *Enhanced smallholder market access*, and to three cross-cutting IDOs (*Equity and inclusion achieved*, *Enabling environment improved*, and *National partners and beneficiaries enabled*) (**Figure 7**). The bulk of activities in this flagship are oriented toward improving the performance of value chains and their supporting policy environments, while smaller research activities explore the potential of programs to improve food safety. In doing so, it targets the first three Sustainable Development Goals (SDGs) to "end poverty in all its forms everywhere," "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" and "ensure healthy lives and promote well-being for all at all ages."

Flagship 3 will work primarily through two impact pathways:

- Agri-food Value Chains Pathway (primarily through CoAs 2 and 3): This pathway has a target population of the moderately poor earning between $1.25 and $10 per day, a population which makes up a majority of the global poor, shows high levels of undernutrition and stunting (The World Bank 2015), and has an increasing intake of risky, fresh foods purchased in informal markets. The focus of this pathway is market-based solutions driven by consumer demand, public health concern, and direct, near-term incentives for value chain actors. The main outcome sought is reduced exposure of consumers to hazards, which requires an appropriate regulatory environment and improved capacities of all partners. Underpinning the approach is a focus on safeguarding or improving access to markets and thus supporting the livelihoods of women, who dominate most informal markets but are often excluded from formal markets and providing opportunities for youth. The latter is especially critical in Africa, where the population is predicted to double by 2050, yet many are pessimistic on the prospects of the formal sector or agriculture to provide the hundreds of millions of acceptable jobs that need to be created. This flagship will work closely with A4NH's Flagship 1: Food Systems for Healthier Diets to ensure that its value chain development work is done within a food systems perspective, and also to ensure that food safety is appropriately considered in food systems work.
- Policies Pathway (primarily through CoA1): This pathway targets investors and decisionmakers. Food safety is a relatively new focus for international agriculture research, and the informal food sector has been long neglected. Hence, it is important to generate information on food safety burden and management, to build capacity to access and understand this information, and to encourage investors and policymakers to support appropriate food safety–specific and food safety–sensitive policies and interventions.

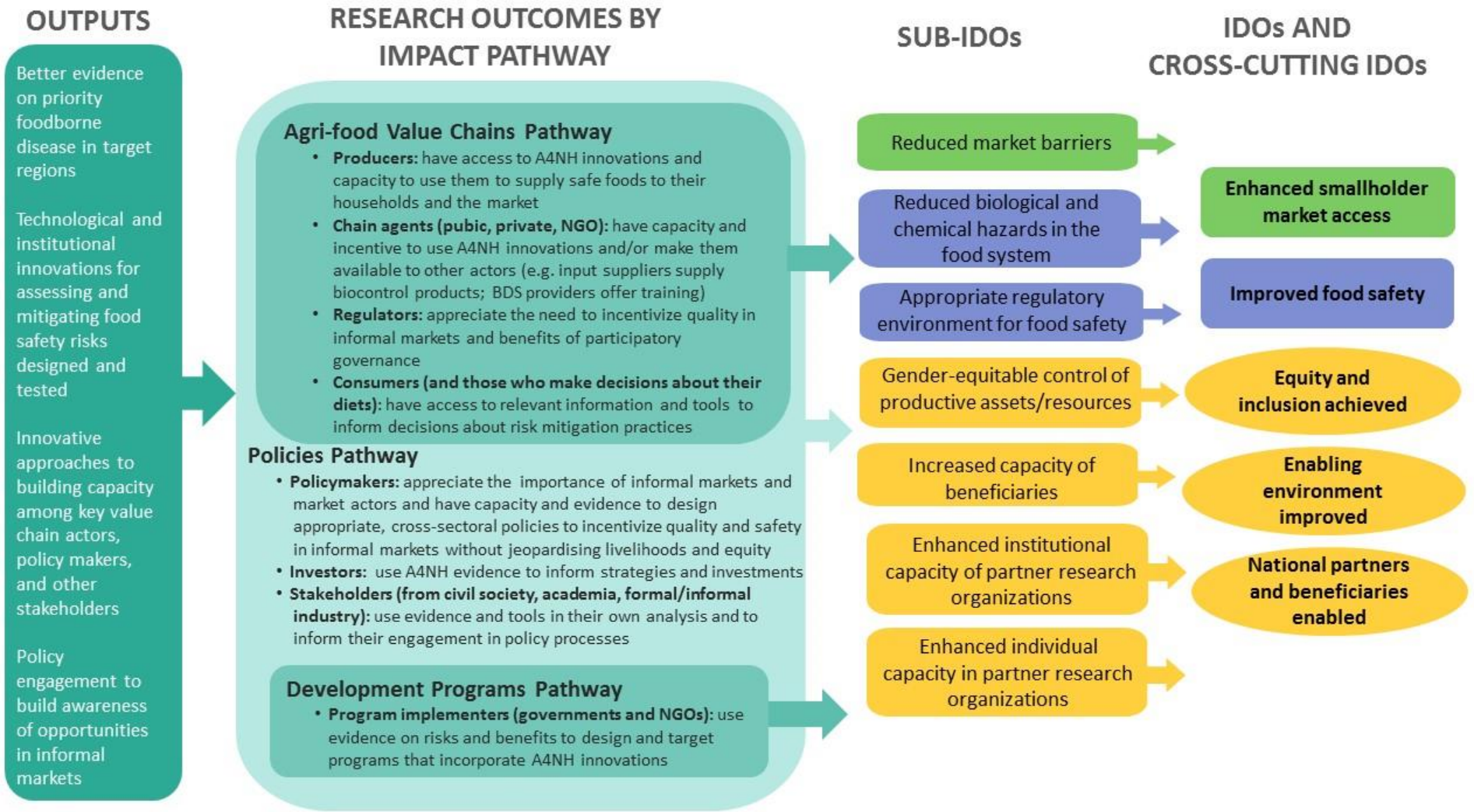
By 2022, this flagship expects its research to contribute to three main outcomes:

- Key food safety evidence uses (donors, academics, INGOs, national policymakers, civil society, and industry) are aware of and use evidence in the support, formulation and/or implementation of pro-poor and risk-based food safety approaches.
- Market-based food safety innovations delivered at scale in key countries, along with understanding of their impact and appropriate use.
- Biocontrol and GAP delivered at scale in key countries along with understanding of their impact and appropriate use.

This flagship's contribution to CGIAR's 2022 target is approximately **469,000 more farm households that have adopted biocontrol, GAP, or improved varieties that reduce aflatoxin contamination**. In addition, we expect up to **12,000 traders and 3 million on-farm consumers and 23 million other consumers in Kenya, Uganda, Tanzania, and Viet Nam will benefit from improved food safety practices** in target value chains by 2022.

[8] Flagship 3: Food Safety will contribute to improved water quality (sub-IDO 2.3.1) however their contributions are captured in the sub-IDO on reduced biological and chemical hazards in the food system (sub-IDO 2.2.1).

Figure 7. Results Framework for Flagship 3: Food Safety



Target Geographies

Research in CoA1: Evidence that Counts will look at **global, regional**, and foresight issues, focusing in countries where A4NH has a track record and good partnerships, but flexible in identifying new and important issues.

CoA2: Safe Fresh Foods will focus on value chains in partnership with the CGIAR Research Programs (CRPs) on Fish and on Livestock, emphasizing dairy in **Tanzania** and pork in **Uganda** and **Viet Nam**. Future collaborations with CRP Livestock will be explored in **Kenya, Ethiopia, Burkina Faso**, and **India** and with CRP Fish's work in **Bangladesh**. In Uganda and Viet Nam, we will link with the CRP on Water, Land, and Ecosystems (WLE) on issues related to water and livestock waste. We will prioritize the young, old, pregnant women, malnourished, and immune-suppressed who are most at risk of infectious FBD.

CoA3: Aflatoxin Mitigation will focus on Africa, which has the highest levels of exposure and an increasing aflatoxin-associated health burden. This cluster will benefit from strong existing alliances, notably with the Partnership for Aflatoxin Control in Africa (PACA). Currently, Flagship 3 has large projects in three countries: **Kenya**, **Nigeria**, and **Senegal**, and project activities with partners in nine other countries in Africa where the aflatoxin burden is greatest (**Burundi, Ghana, Malawi, Mali, Mozambique, Niger, Rwanda, Tanzania**, and **Zambia**). We will explore opportunities to collaborate in **India** during Phase II.

IMPACT PATHWAY AND THEORY OF CHANGE

Impact will occur through two main pathways: (1) generating evidence to influence key decisionmakers and policy processes (mainly CoA1) and (2) taking food safety solutions from successfully tested pilots to scale (mainly CoAs 2 and 3). The theory of change (ToC) identifies critical assumptions that underlie the outcomes along the pathways. A ToC for CoA1 will be developed with Flagship 4: Supporting Policies Programs and Enabling Action through Research (SPEAR) in 2016-17. ToCs for the other CoAs have already been developed, peer reviewed, and published. While ToCs are living documents that are regularly updated based on new evidence and experience, it is important to make them publicly available to build understanding of how agricultural research contributes to nutrition and health outcomes in practice.

The ToC for CoA2 (Safe Fresh Foods) is largely based on behavioral change rather than changes in technology, infrastructure, or market structure. It looks at how an institutional innovation – training and certification (T&C) – can improve the quality and safety of fresh foods (Johnson et al. 2015). The relatively small number of fresh meat and produce sellers (thousands as opposed to millions of consumers and farmers) means market agents are leverage points where low-cost interventions can have profound up- and downstream impacts. Moreover, informal markets have low barriers to entry and are important sources of employment for women and youth, added justifications for investments.

Initial evidence from a relatively small number of A4NH projects supports the assumption that informal sector market agents change their practices as a result of participating in the program and experience social and economic benefits, even if they do not receive a higher price from consumers (**Table 5**). Some pilots have also shown that food safety and quality improved for substantial numbers of customers, however there have not yet been studies on their health outcomes. Likewise, though food sold was initially safer, no studies assess longer-term safety or sustainability. There are significant challenges in attaining political acceptability for initiatives in informal markets. Attaining real, rather than token, compliance with standards at scale and over long periods of time has not been demonstrated. Although there are several examples of food currently being certified as safe in niche developing country markets, there are no examples of credible food safety assurance in mass domestic markets in developing countries.

Addressing research constraints will require multi-disciplinary teams. We will build on existing partnerships in CRP Livestock and CRP Fish value chains, with public health researchers in A4NH's Flagship 5: Improving Human Health (on health risks and benefits), and with academic partners such as the International Institute on Environment and Development (IIED) who recognized expertise in informal markets in developing counties. Partnerships with government regulators will be crucial for scaling up, and even for piloting innovations, in places where the informal sector is currently banned. New partnerships may be needed to implement market-based innovations at scale, for example, by the government (e.g. dairy in Kenya) or by an NGO or private firm (e.g. supplier of business development services).

Table 5. Assumptions and the current strength of evidence for the outcomes in the impact pathway related to taking an institutional innovation to improve the quality and safety of fresh foods to scale (adapted from Johnson et al. 2015)

Outcomes	Assumptions	Evidence*
Exposure decreases if perishable food is safer	Currently fresh foods are mostly unsafe Most fresh foods are bought in wet markets	Fair to strong Strong
Food is safer if traders change practices	Practices are effective	Fair short-term, weak long-term
Practices can be changed	Practices are feasible and generate benefits Traders and consumers are motivated	Fair Weak
Traders buy in to scheme	Traders can access training Materials and approaches are effective, relevant	Fair Fair
Traders are reached by scheme	Most traders can be reached Policy environment can be made enabling	Weak to fair Fair

The ToC on CoA3 (Aflatoxin Mitigation) looks at how use of farm level mitigation technologies and practices (GAP, resistant varieties, and/or biocontrol (aflasafe™) could reduce exposure among consumers (Johnson, Atherstone, and Grace 2015). Where economic incentives are sufficient, farmers readily adopt technologies, however evidence to date suggests there are significant challenges to ensuring incentives and reaching target consumers (**Table 6**). Unlike the case for perishables, aflatoxin contamination often originates on farms, so reaching farm households and changing post-harvest practices on farms and in markets will be important. Improving the ability of consumers to recognize and demand safe food risks increasing exposure through concentration of contaminated grain in markets used by the poor.

Table 6. Assumptions and the current strength of evidence for the outcomes in the impact pathway related to taking farm level mitigation and practices to reduce consumers exposure to aflatoxin (Johnson, Atherstone, and Grace 2015)

Outcomes	Assumptions	Evidence
Exposure to aflatoxins significantly decreases if staples are safer	Currently staples are often contaminated Staples most important source of aflatoxins	Strong Strong
Consumers eat aflatoxin-safe products	Aflatoxin-safe foods are available Consumers can identify safe foods	Weak to fair Weak
Consumers are aware and convinced of risks	Information gets to consumers Information is appropriate and useful	Fair Fair
Traders buy from farmers with adopted practices	Staples produced meet market needs Staples below standards find other use	Weak to fair Very weak
Farmers adopt technologies and practices	Technologies and practices are accessible/affordable Technologies and practices deliver visible and desired benefits	Weak to fair Very weak
Farmers are aware and convinced of benefits of aflatoxin mitigation	Information reaches farmers Information is appropriate and useful	Weak to fair Weak to fair

Although there is a strong case that aflasafe™ and GAP may reach millions of farmers in the next five years, it may not be sustainable or affordable. A4NH will actively research how the formal private sector can overcome this challenge. Agronomic benefits of GAP and bundling of yield-enhancing inputs with aflasafe™ will help motivate farmer adoption. The intensive livestock sector is a promising market for aflatoxin-safe grain that may require less regulatory oversight than markets for human food due to the deleterious impact of aflatoxins on animal health. More research is needed on the costs and benefits of aflasafe™ compared to other, less expensive means of aflatoxin mitigation. Aflatoxins are responsible for a relatively small proportion of the overall known health burden in developing countries (although the likely health impacts are much greater), but more research is needed on the full public health benefits of aflatoxin mitigation, and the relative advantage of agriculture-based interventions in delivering these.

Key research partnerships will be with CRPs on Dryland Systems, Livestock, and MAIZE on technology adoption, with A4NH's Flagship 1: Food Systems for Healthier Diets on consumer demand for low-aflatoxin products, and with other A4NH flagships (4 and 5) on nutrition and health impacts. Partnerships with governments will ensure that the technologies are available, for example in the case of aflasafe,™ whose commercial production requires regulatory approval, and to support production of low-aflatoxin grain in target areas The private sector and NGOs will be crucial for scaling out to smallholders, and filling the research gaps related to farmer and consumer awareness and acceptance will be important to defining their roles.

FLAGSHIP 4: SUPPORTING POLICIES, PROGRAMS AND ENABLING ACTION THROUGH RESEARCH (SPEAR)

OBJECTIVES AND TARGETS

The main objective of Flagship 4 or SPEAR is to understand and enhance agriculture's contribution to improving nutrition at scale, aiming to:

1. Understand, document, and enhance the impact of nutrition-sensitive agricultural programs on dietary quality and health- and nutrition-related outcomes in children, adolescent girls, and women of reproductive age;
2. Understand and document the barriers and opportunities, and test approaches for strengthening enabling environments for agriculture to support nutrition and health goals; and
3. Strengthen capacity and leadership to promote evidence-informed decisionmaking along the policy, program development, and implementation continuum, to enhance the impact of agriculture on nutrition- and health-relevant policy and programming.

This flagship will impact the second system-level outcome (SLO2) on *improved food and nutrition security for health* (**Figure 8**), with the potential to contribute to SLO1 on *reduced poverty*. We will focus primarily on undernutrition, and also consider the growing challenge of overweight and obesity. The three CoAs will contribute indirectly to all three intermediate development outcomes (IDOs) under SLO2. We envision short term impact through the IDO on *increased incomes and employment* and long-term impact by building human capital.[9]

Impact will be achieved through four cross-cutting IDOs, with direct relevance for the IDO on *enabling environment improved*, defined as, "the wider political and policy processes which build and sustain momentum for the effective implementation of actions that reduce undernutrition" (see blog post and (Gillespie et al. 2013). Since sustainability is a key element of an enabling environment for nutrition and health, this flagship, in collaboration with the CRP on Climate Change, Agriculture, and Food Security (CCAFS) and other Integrating CRPs (ICRPs), will also contribute to the sub-IDO on *mitigation and adaptation achieved* by re-viewing policies, programs, and interventions through a climate lens. Our focus on gender equity and empowerment of men and women, and on youth (school-age children and adolescent girls in particular) will contribute to the cross-cutting IDO on *equity and inclusion achieved*. We will contribute directly to the fourth cross-cutting IDO on *national partners and beneficiaries enabled.*

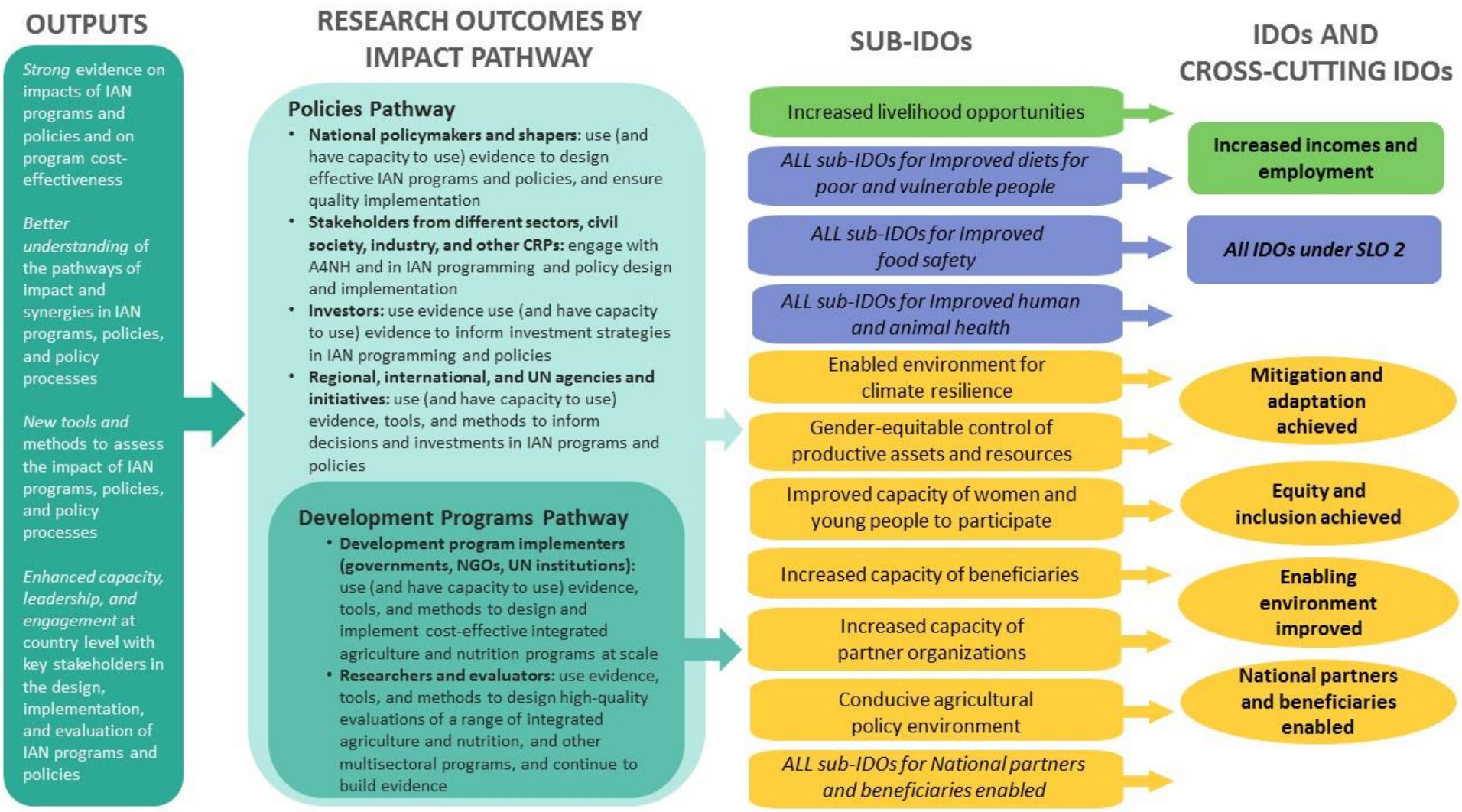
By 2022, SPEAR will contribute to five main outcomes:

- Development program implementers and investors (governments, non-governmental organizations [NGOs], United Nations [UN] institutions) use evidence, tools and methods to design and implement cost-effective nutrition-sensitive agricultural programs at scale.
- Researchers and evaluators, including in CGIAR and other CRPs, use evidence, tools, and methods to design high-quality evaluations of a range of nutrition-sensitive agricultural and other multisectoral programs, and continue to build evidence.
- Regional, international, and UN agencies and initiatives, and investors use evidence, tools, and methods to inform decisions and investment strategies to guide nutrition-sensitive agriculture programming and nutrition-sensitive policies.
- National policymakers and shapers from different sectors, civil society, and industry engage in policy environment analysis/stories of change in 7 focal countries: Bangladesh, Ethiopia, India (state level), Nepal, Tanzania, Viet Nam, and Zambia.
- Stakeholders from different sectors, governments, UN institutions, civil society, and industry, including CGIAR and other CRPs, have improved capacity to generate and use evidence to improve nutrition-sensitive agricultural programming, nutrition-sensitive policymaking, and implementation.

These outcomes will contribute to the 2022 CGIAR target of **73 million people being without deficiencies in key micronutrients in 10 focal countries**.

[9] Improving nutrition in utero and the first few years of life can improve cognitive development, educational achievement, employment and wages, and health and nutrition at adulthood and in future generations (Prendergast and Humphrey 2014; Addo et al.; Hoddinott et al. 2013).

Figure 8. Results framework for Flagship 4: Supporting Policies, Programs and Enabling Action through Research (SPEAR)[10]



[10] In this figure, NSA is shorthand for "nutrition-sensitive agriculture".

Target Geographies

The primary geographic focus of this flagship is on countries where poverty and high burdens of malnutrition and ill health coexist; we will therefore focus on Africa south of the Sahara and South/Southeast Asia. Our central focus is on enabling and sustaining *country-level* impact, thus aligning with the Busan declaration for aid effectiveness that fosters country ownership and a focus on results, transparency, and accountability. Within countries, we will "zoom in" to optimize the impact of nutrition-sensitive agricultural programs and to understand the policy-implementation nexus at a *subnational* level. In selecting target areas for subnational analysis and engagement, we will emphasize the role of gender relations in influencing agriculture and nutrition outcomes, and on climate vulnerability, liaising with CCAFS. Given rapid urbanization, we will expand in Phase II to look at programs and policy issues as they apply to urban-rural linkages and urban/peri-urban/urbanizing environments, including their potential impacts on overweight, obesity, and the double burden of under- and overnutrition, where relevant. We will also focus on populations affected or displaced by ongoing agrarian change and agricultural intensification.

Geographically, our focus will initially[11] be on **10 countries in Africa (Burkina Faso, Ethiopia, Malawi, Mali, Tanzania, and Zambia)** and **Asia (Bangladesh, India, Nepal, and Viet Nam)** that are home to nearly 1 billion people within landholding households (and more from agriculture-dependent but landless households). An estimated 82 million stunted young children (over 50% of the global total) reside in these 10 countries.

IMPACT PATHWAY AND THEORY OF CHANGE

SPEAR seeks to achieve impact via outcomes generated through the *Policies Pathway* and the *Development Programs Pathway* (**Figure 8**). More elaborate theories of change (ToCs) will be developed in which the roles of, and synergies between, the three CoAs will clarified, building on ToCs that originated in Phase I. A set of ToCs will be developed, contextualized, and validated in a participatory manner with stakeholders.

Policies Pathway. Scaling and sustaining research impact requires creating and supporting an enabling environment for nutrition- and health-sensitive agricultural development and policy. This requires policy dialogue and adaptation to different national and sub-national contexts, informed by evidence, guided by stakeholder analysis, and implemented through partnerships. Promoting the development of nutrition-sensitive agricultural policies will support adequate implementation strategies and resource commitments. We will build on recent work on scaling up impact on nutrition (Gillespie, Menon, and Kennedy 2015) and the fourth paper of the *Lancet* Maternal and Child Nutrition Series (Gillespie et al. 2013) to apply lessons learned from past attempts to create and sustain large-scale enabling environments. We will deepen our ongoing engagement, via CoA3: 3C, with regional and global platforms, such as the Comprehensive Africa Agriculture Development Program (CAADP) and the Scaling Up Nutrition Movement (SUN), as well as directly engaging with other CRPs, the other A4NH flagships, and partners, including governments, in our focal countries.

Through CoA3: 3C, SPEAR will represent CGIAR as a convener in nutrition and health policy and program processes, bringing information about what CGIAR has to offer to national and global processes, and feeding back information and guidance to CRPs about where and how their work can contribute. This will allow sharing of lessons learned in agriculture and nutrition, which will optimize the collective impact of CGIAR on improving diet quality and nutrition in focus countries and regionally. In sum, this will help enhance the impact of investments in CGIAR and individual CRPs on nutrition and health outcomes. By bringing agriculture and nutrition and health stakeholders together, SPEAR will help stimulate an enabling environment for partnerships and joint program and policy-making in the area of agriculture and nutrition.

Development Programs Pathway. CoA1: NSAP seeks to facilitate improved design, targeting, implementation, and scale-up of nutrition-sensitive agricultural programs, by development implementers. Building on Phase I work, it will continue to translate evidence on what program design and implementation modalities work, into actionable recommendations, and disseminate them to a broad range of implementers (including governments) nationally and internationally, to ensure that lessons learned are used to inform decisionmaking about program choice, targeting, design, and scale-up. This type of decisionmaking is often influenced by investors, with whom we work closely to ensure that evidence supports and informs strategies and investment choices. Examples include the U.S. Government's Feed the Future initiative, which promotes the improvement of nutrition through multi-sectoral approaches linking agriculture, health and nutrition in 19 target countries, and the Bill & Melinda Gates Foundation's newly launched nutrition strategy, which includes a strong focus on leveraging agriculture and food systems to improve nutrition.

[11] If and when funds become available and opportunities arise, we will explore options for working in additional CGIAR/A4NH priority countries.

Uptake also requires that program implementers can operationalize findings and adapt them to their own contexts. To facilitate uptake of our research outputs by programs, SPEAR will work closely with program implementers to formulate research questions, define program impact pathways, and discuss findings from process and impact evaluations. Through CoA3: 3C, it will work with *knowledge brokers*, defined here as communication experts or other specialized staff who work closely with researchers on evidence synthesis, knowledge translation, and knowledge mobilization. They will work with program implementers, policymakers, and investors to stimulate demand for information and feed contextual knowledge back to research teams. They will create and moderate a dialogue between researchers and policy and program actors and decisionmakers.

In Phase I, researchers in this flagship worked closely on dissemination and capacity-strengthening activities with external institutions (e.g. the FANTA and SPRING projects and select NGO and UN institutions). In Phase II, we will work more closely with a mix of in-house and external knowledge brokers and engage with in-country staff and institutions who can support A4NH's work and that of other relevant CRPs. Knowledge mobilization activities will include connecting different stakeholders to tailored and relevant nutrition information, data, knowledge, and tools; targeted policy and media engagement; and the translation of knowledge and evidence into lessons learned, guidance, and actionable recommendations. We will draw from successful work connecting stakeholders with nutrition knowledge in India through our Partnerships and Opportunities for Strengthening and Harmonizing Actions on Nutrition in India (POSHAN).

In Phase II, we will continue to collaborate with researchers and mentor students from academic institutions and across CGIAR to further the reach and use of our outputs, continue to build a multi-disciplinary research culture, and to benefit from the methods, tools, and evidence generated by a broad range of researchers working in the agriculture, nutrition, and health development continuum. In Phase II, SPEAR researchers will continue to play an important role supporting the A4NH gender-nutrition community of practice (CoP) and other A4NH-supported CoPs or learning platforms.

FLAGSHIP 5: IMPROVING HUMAN HEALTH

OBJECTIVES AND TARGETS

This flagship is designed to directly contribute to the system level outcome (SLO) on *improved food and nutrition security for health* and the IDO on *improved human and animal health through better agriculture practices* (and its sub-IDOs), (**Figure 9**). It will also contribute to SLO3 on *improved natural resource systems and ecosystem services.* Importantly, this is a cross-disciplinary activity between sectors (agriculture/animal health and public health), with added value benefits achieved by joint actions. **CoA1**: Diseases in Agricultural Landscapes will address the IDO on *improved human and animal health through better agricultural practices* and the IDO on *more sustainably managed agro-ecosystems*. **CoA2**: Emerging and Neglected Zoonotic Diseases directly and jointly addresses the IDO on *improved human and animal health through better agricultural practices* and its sub-IDOs by focusing on human health benefits achieved by targeting transmission from livestock. A major emphasis is on sustainable control of cysticercosis in poor communities in Africa and South Asia, a defined World Health Organization (WHO) priority, and it will also make major contributions to the cross-cutting IDOs on *equity and inclusion achieved*, *enabling environment improved*, and *national partners and beneficiaries enabled* (see **Figure 9** for main sub-IDOs under these cross-cutting IDOs). **CoA3**: Global Challenges on Agriculture and Health will work mainly on AMR and will focus on human health benefits of better-managed antibiotic use in animals (livestock and fish) and align with the CRP on Livestock that will focus on animal health benefits and risks of better managed antibiotic uses. Work on insecticide resistance will also generate human health benefits in terms of resistance events averted. Both will contribute to the IDOs on *more sustainably managed agro-ecosystems*, at national and community levels.

This flagship aims to:

1. Understand and manage the gendered human health impacts (both risks and benefits) arising from intensification and changes in land-use;
2. Deliver gender-sensitive interventions targeted at livestock systems that improve health outcomes for zoonotic diseases with livestock reservoirs (with CRP on Livestock); and
3. Understand and manage interacting health and agriculture interventions, including AMR and insecticide resistance.

By 2022, this flagship expects to contribute to three main outcomes[12]:

- Agricultural practices modified to reduce health risks.
- Agricultural and public health policymakers and implementers deliver coordinated and effective solutions to cysticercosis and other zoonotic threats.
- Public and private sector policymakers implement measures to reduce health risks from AMR and other interactions.
- Agricultural research and funding institutions initiate collaboration with public health counterparts to solve complex intersectoral problems.

Target Geographies

For diseases in agricultural landscapes, particularly expansion of irrigation, we will build on current projects in **Benin and Kenya** and may expand later to other countries in West Africa (Cameroon, Côte d'Ivoire, Mali, and Nigeria) and East Africa (Tanzania and Uganda). **Uganda** will likely be one of the initial countries for work on insecticide resistance. Additional target geographies, aligned with irrigation expansion projects, will be determined in consultation with colleagues from the CRPs on RICE (AfricaRice) and Water, Land, and Ecosystems (WLE) (through the International Water Management Institute [IWMI]). For our initial target zoonotic disease – cysticercosis – our geographic targets are based on WHO targets and livestock opportunities (World Health Organization 2011), and include **Kenya/Uganda, India**, and **Viet Nam**. For work on AMR in humans and animals, initial biological work (collecting bacterial isolates from humans and livestock and using state of the art molecular tools to characterize population level diversity) will build on established sites in **Tanzania and Kenya** (an existing aligned, bilateral project). Further work will be based on work already started on assumptions and geographies in **China, India, Kenya, Thailand, and Viet Nam**. Flagship 5 will also deliver research outputs at global and regional levels for Africa and Asia (South, Southeast, East).

[12] For the 2018 POWB, slight changes in wording were made to Outcomes 5.1 and 5.3 and a fourth outcome was added to represent the aims of a cross-cutting activity related to the facilitation of agricultural and public health sector engagement across all three Flagship 5 clusters, and potentially across A4NH and CGIAR in general.

Figure 9. Results Framework for Flagship 5: Improving Human Health

IMPACT PATHWAY AND THEORY OF CHANGE

For Flagship 5, the two primary impact pathways are through programs and policies (**Figure 9**). Evidence generated by this flagship will influence agriculture and health program implementers in designing and implementing more cost-effective programs, while also helping enablers, like policymakers, decisionmakers, and donors, to make sound policy and investment decisions to improve human health. This research will build on theories of change (ToCs) already developed in A4NH, such as how research influences program implementers and how to create an enabling cross-sectoral policy environment.

For CoA2: Emerging and Neglected Zoonotic Diseases, there is complementarity with A4NH's Flagship 3: Food Safety, which focuses on interventions through the agri-food value chains impact pathway and this flagship, which works through agriculture or public health program interventions. The partners for enabling policies and regulations include FAO, World Organization for Animal Health (OIE), WHO, and with food, public health, and veterinary agencies in countries. ILRI has an important role in these policy and regulatory convenings through its participation in the Livestock Global Alliance. Policy relevant research will link to policy analysis and process research in A4NH's Flagship 4: SPEAR.

One key assumption underlying both the program and policy ToCs is that agriculture and health researchers must work productively together. The usefulness of outputs and outcomes from interdisciplinary research in this flagship will largely depend first on researchers, then on governments' willingness to break down sectoral silos and establish effective institutional arrangements between sectors, as envisaged in the SDGs. To date, the greatest agriculture-health cross-sectoral successes have come through the application of a One Health approach, which describes the integrated effort of multiple disciplines working together to attain optimal health for people, animals, and the environment. One Health has been successfully implemented at scale, for example, in the control of *rhodesiensis* sleeping sickness (a zoonosis) in Uganda, brucellosis in Mongolia, and for avian influenza in a number of countries. Researchers in this flagship have developed frameworks to consider the cross-sectoral benefits of managing brucellosis using One Health (McDermott, Grace, and Zinsstag 2013) and more broadly, WHO (2011) has highlighted the added benefits from the One Health approach, which goes well beyond researchers cooperating effectively and into the adoption of an integrated approach by policymakers. For example, our work in Kenya contributed to two kinds of achievements: *structural*, in the establishment of a Kenyan One Health office, which is jointly funded by health and agriculture government ministries, and *functional*, in that the collaboration resulted in the design of a joint integrated response to Rift Valley fever (RVF) outbreaks (Mbabu et al. 2014). Methods of joint work between sectors will be a key secondary output of this flagship, linked closely with policy work planned in Flagship 4: SPEAR.

We have already explored the potential for cross-sectoral ToC development in a series of regional consultations with agriculture and health researchers held in 2015, where A4NH's overall approach to impact pathways and ToCs (Mayne and Johnson 2015) was enthusiastically endorsed. Initial ToCs were developed for cysticercosis and AMR, for further development and integration into the research process, summarized in the consultation report. Beyond direct health benefits, outcomes across all proposed research will likely integrate equity, gender, youth and vulnerability issues. For example, emerging zoonoses often cause panic and lead to market disruption, reduced access to inputs, and diversion of funding to emergency responses, that can be much more harmful to poor producers and consumers than direct losses from the disease (McDermott and Grace 2011). Key assumptions in the ToCs include the acceptability and accessibility of solutions for intended beneficiaries and the degree to which program implementers and enablers can jointly design and adapt interventions that are feasible, scalable and sustainable.

In newer areas of research, this flagship will generate research outputs through evidence gap mapping and systematic reviews supported by epidemiological studies, analysis of geospatial data on changing patterns of agriculture and health, formally assessed intervention trials in multiple countries, and bacterial genetics studies on AMR to assess and quantify risks. We will also undertake innovative economic assessments of health costs of agricultural practices, intersectoral cost-benefits of different interventions, and how the benefits and costs are distributed by gender, age and other social categories. This will provide guidance, and an economic justification, for implementing proposed outcomes. New research approaches will be developed, including innovative ways to combine existing agriculture and health data and synthesize evidence across sectors and contexts.