Protecting human health through a One Health approach

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1. General information and summary table

Initiative name	**Protecting Human Health Through a One Health Approach**
Primary Action Area	**RAFS**
Geographic scope	**Global, Vietnam, India, Bangladesh, Ethiopia, Kenya, Uganda, Côte d'Ivoire**
Budget	**US$ 35,000,000**
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2. Context

2.1 Challenge statement

COVID-19 is the sixth zoonotic pandemic since 1980. The frequency and severity of these events is increasing as people encroach on wildlife habitats and livestock and fish production systems intensify.[1] Animal production systems are reservoirs of zoonotic pathogens, and 60% of human communicable diseases originate from pathogens with zoonotic origin.[2] Trade of animals and ASF at increasing scales multiplies the magnitude of health and economic risks.[3] Limited available evidence shows that returns on zoonoses control interventions are high, and that integrating public health and veterinary services increases cost-effectiveness.[4] However, under-funding and separation of these functions remains the norm. Collaborative intervention studies with government agencies are needed to show proof of concept and build the evidence base for increased investment by national and international partners.

Antimicrobials are widely used in humans and in agriculture. While estimates of the volume of antimicrobial use (AMU)[1] in agriculture vary widely due to limited data availability, two thirds of the global use of antimicrobials is in livestock production,[5] which is expected to increase primarily in developing countries due to intensifying production.[6] Since AMU is a major driver of antimicrobial resistance (AMR) emergence and spread,[7] efforts to reduce use is a key action area to reduce the pressure on selection of AMR.[8] AMR causes 700,000 deaths annually and is projected to kill 10 million each year by 2050.[9] Addressing AMU in food systems is hampered by lack of evidence on scale of use, impact on reducing AMR infections in humans, and perceived negative impacts on productivity. Research to fill in these gaps and clarify trade-offs has the potential to catalyze decisive action at the national and global level address AMR.

Livestock generate 85% of global animal fecal waste, leading to environmental degradation and human exposure to antimicrobial residues and waterborne pathogens,[10] a key route through which these hazards enter food systems.[11] Foodborne disease takes a toll — primarily in low- and middle-income countries (LMICs) — comparable to each of tuberculosis, malaria, and HIV/AIDS,[12] but receives a small fraction of the investment from international donors.[13] Informal markets, which supply the majority of high-risk animal-source foods (ASF) and other perishables in LMICs, remain outside of the reach of traditional regulatory systems. Research to develop and test voluntary approaches through which food business operators can access public resources for food safety upgrading and quality assurance, paired with social marketing to create consumer

[1] A list of acronyms is provided in Annex 0.

demand, is needed to refine and scale a non-punitive, stepwise path to safer food in these settings. Assessment of the costs and benefits of supplying safe water to markets and abattoirs, is needed to evaluate the case for public investment in infrastructure at these critical control points.

International investment in One Health within food systems is growing, including through a new World Bank Multi-Donor Trust Fund, which will complement individual investments by ADB, BMGF, BMZ, FCDO/DFID, IDRC, Rockefeller Foundation (Pandemic Prevention Institute) and USAID (EPT, NEXT-GEN, DEEP VZN, TRANSFORM) among others.

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

While we expect achieve impact in all areas in each of the 7 focus countries by 2030, the following targets, to be achieved by the end of 2024, reflect prioritization within the first phase of the Initiative, based on existing relationships with governments and private sector partners:

- Budgetary contingency plans and decision support tools for emerging infectious diseases (EIDs) adopted by 1–2 countries
- Strategies integrating public health and veterinary services for prevention and control of neglected zoonotic diseases (NZDs) serve at least 100,000 livestock dependent individuals.
- Government and private sector support voluntary upgrading of informal food business operators serving 174,000 consumers through an Enabling, Capacitating, and Motivating (ECM) approach toward their integration into regulatory structures for food safety in at least 3 countries.
- At least 2 countries incorporate AMU or AMR reducing tools and targets based on CGIAR evidence in their AMR Action Plans.
- Role of the water in the transmission of pathogens and AMR, and proposed solutions for waste and water management, are recognized in national One Health planning processes of at least 2 countries.
- One Health policy planning processes in at least 3 countries take into account gendered constraints and incentives of small- and medium- scale food system actors, tradeoffs across policy goals, and the magnitude and distribution of impacts.

2.3 Learning from prior evaluations and impact assessments (IAs)

- A review of evidence on livestock zoonoses identified over-emphasis on single pathogens and those perceived as threatening to high-income countries, with insufficient attention to the health burden within LMICs.[14] Under-investment in community-based disease control systems and little involvement of end users and the private sector were also noted. Work on zoonoses control and surveillance will take a systems-based, multi-pathogen approach, align with national prioritizations, and be co-developed with local stakeholders including private veterinary input suppliers.
- The Initiative will fill the identified evidence gap on effective, sustainable and scalable interventions to improve food safety in domestic markets of LMICs[15] by continuing the CGIAR's focus on informal markets in these settings.
- Work on AMR will address research priorities identified in a review of AMR in LMICs,[16] including on the magnitude, costs and benefits of AMU in food production, and mechanisms of AMR transfer from agricultural use to pathogens in humans.

- Missed opportunities for inter- and multi-disciplinary approaches,[17] for sharing lessons and tools related to gender across research areas,[18] and a dearth of social science work on One Health topics are common findings across previous reviews and evaluations.[19] Integration of social science through the cross-cutting Work Package on Economics, Governance, and Behavior will address this concern.

2.4 Priority-setting

Priority-setting for the One Health Initiative takes as its starting point the CGIAR collective global 2030 targets to enable affordable healthy diets for the 3 billion people who do not currently have access to safe and nutritious food, and reduce cases of foodborne illness (600 million annually) and zoonotic disease (1 billion annually) by one third.

Based on this, major research topics within the context of LMIC food systems, and specific questions and innovations within these, were selected based on (1) the human health burden and economic costs, (2) potential to reduce these burdens by 2030, and (3) comparative advantage of the CGIAR. Work packages on Zoonoses, Food Safety, and AMR build on and leverage established One Health research portfolios within the CGIAR. A cross-cutting Work Package on the role of Water in One Health brings in a stronger focus on the environment as a conduit for zoonotic and foodborne pathogens, including those resistant to AMR, and antimicrobial residues. Finally, the Work Package on Economics, Governance and Behavior ensures that social science and gender analysis are integrated into all topical areas of focus.

Our emphasis on human health burden, led, based on reviews of the existing evidence, to a focus within food safety on infectious diseases, and on the largely informal markets on which the poor depend for perishable foods. Similarly, while the health burden due to specific zoonotic diseases is difficult to quantify due to a dearth of evidence, reviews indicate that the combined contribution of zoonoses to the total infectious disease burden is on the order of 5%, implying that approaches which target multiple zoonotic pathogens can be highly cost-effective and leading us to take a systems approach to zoonoses surveillance and control. Prioritization of research questions within the rapidly expanding area of AMR in LMICs was driven by the CGIAR's comparative advantages in cross-disciplinary work and field-based studies, as well as a strategic focus on research with the potential to generate greater political will to operationalize national AMR action plans.

To enable immediate impact, we build on the strong presence and history of CGIAR in East Africa by including Kenya, Ethiopia, and Uganda, all of which rely heavily on livestock production and thus have a strong interest in addressing zoonotic disease. Uganda, Côte d'Ivoire, and Vietnam are sites of significant biodiversity and interactions between humans and livestock with wildlife, presenting opportunities for the emergence or re-emergence of zoonoses with pandemic potential. India, Bangladesh, and Vietnam include highly intensified small-scale production systems and high rates of AMU; systems are rapidly intensifying in other focus countries as well. Key activities by Work Package and country are in Annex 1.

2.5 Comparative advantage

The CGIAR has over 20 years of experience of research on zoonotic diseases and has greatly expanded its work on Food Safety and AMR over the past 10 years through the CGIAR Research Program on Agriculture for Nutrition and Health. Past research in all three areas spans sub-Saharan Africa, South Asia and Southeast Asia, and One Health partnerships have been established between CGIAR, Departments of Veterinary Services, and Ministries of Health in

Kenya, Vietnam and Ethiopia. The CGIAR has helped raise donor interest in food safety through multiple high-profile reviews[20,21] and has an extensive portfolio of work on safe use of polluted water in food production, and on Resource Recovery and Reuse of fecal waste.

CGIAR hosts networks, programs and technical expertise required for an effective integration of One Health disciplines, including the Research Program on Climate Change Agriculture and Food Security (CCAFS), CGIAR Gender Platform, CGIAR Antimicrobial Resistance Hub, and the One Health Research, Education and Outreach Centre in Africa (OHRECA), and employs influential teams of economists with unrivalled expertise on foresight analysis, impact assessments and ecosystems services and trade-offs. CGIAR assets in focus countries include state-of-the-art lab facilities, and a research station and wildlife conservancy in Kenya that will be leveraged for research on livestock-wildlife interactions.

We will collaborate with non-CGIAR partners including, inter alia, EcoHealth Alliance, the Pandemic Institute at the University of Liverpool, Centre Suisse de Recherches en Côte d'Ivoire to bring in expertise on disease ecology and human interactions with wildlife.

2.6 Participatory design process

Consultation workshops were held virtually in all seven focus countries. Participants were drawn from government agencies, including Ministries of Agriculture, Health, Environment and Food Safety Authorities, mobilized through One Health Platforms. Potential innovation (researchers) and scaling (international organizations, nongovernmental organizations, private sector) partners were included in workshops or engaged bilaterally. In this way, we obtained feedback on the prioritization of Work Packages and research questions within these and identified missing elements.

A total of 325 participants (between 17–83 in each country) attended consultation meetings, and endorsements for the Initiative's program of work were secured from high level officials in each country, including the Additional Secretary (Planning) of the Ministry of Fisheries and Livestock of Bangladesh, Director of Veterinary Services of Côte d'Ivoire, Director of the Institute of Public Health of Ethiopia, DG of the Indian Council of Agricultural Research, Director of Kenya Medical Research Institute of Kenya, Commissioner of Animal Health of Uganda, and the DDG of International Department of Collaboration, Vietnam Ministry of Agriculture and Rural Development.

All seven countries have a legal framework to promote One Health. These vary across contexts and include One Health National Strategies, National Action Plans on AMR, Zoonoses and Food Safety. Participants expressed a demand to operationalize One Health principles and the need for greater resources to enable this. For example, in Vietnam there was a call for the CGIAR to continue its work on food safety and AMR, and in Ethiopia and Côte d'Ivoire to support national One Health platforms. The Initiative will produce valuable evidence to enable more effective implementation of national strategies, such as Kenya's Food Safety Strategy, and to fill knowledge gaps identified by National Actions plans for AMR.

Public sector stakeholders across countries articulated the need for evidence to mobilize resources and political will for greater investment and implementation of One Health policies. There was a call to strengthen One Health capacities (training, laboratory) and to build awareness among food system actors on zoonoses, food safety, and AMR.[22] Details on these consultations is in Annex 2.

We recognize the need for strong private sector engagement in One Health, in terms of providing veterinary health and other inputs for animal production, laboratory services, and quality control within ASF value chains. While many of our innovations involve small-scale, often informal private actors (input suppliers, farmers, processors, vendors), engagement of larger-scale, formal private sector partners in our focus value chains historically has been weak, and it will take time to build up these partnerships. Our engagement with current private and prospective sector partners (Sidai and iCOW, Kenya; GreenFarm, Bac Tom and BioSpring, Vietnam; Land O' Lakes Venture37, USA) during the design of the Initiative has been promising. However, this is still a work in progress and will be pursued vigorously during the early stages of implementation, including by connecting with the new USAID project 'Transformational Strategies for Farm Output Risk Mitigation' (TRANSFORM), led by Cargill, which harnesses private sector-led innovation to address EIDs and AMR in animal production value chains in Asia and Africa.

2.7 Projection of benefits

Breadth	Breadth	Depth	Probability
Nutrition, health & food security: # cases communicable and noncommunicable diseases			
Emerging zoonoses	11,398,184	Lives saved	Very low
Endemic zoonoses (direct)	1,285	DALYs averted	High
Endemic zoonoses (at scale)	310,494	DALYs averted	Medium
Food safety (direct)	105	DALYs averted	High
Food safety (at scale)	59,691	DALYs averted	Medium
Poverty reduction, livelihoods & jobs:			
# people prevented from entering poverty			
Emerging zoonoses	23,870,000		Very low (<10%)
AMR	644,647		Medium
# people benefiting from relevant CGIAR innovations			
Endemic zoonoses (direct)	315	Perceptible	High
Endemic zoonoses (at scale)	135,276	Perceptible	Medium
Gender equality, youth & social inclusion:			
# women and girls prevented from entering poverty			
Emerging zoonoses	11,935,000		Very low (<10%)
AMR	322,324		Medium
# poor women and girls benefiting from relevant CGIAR innovations			
Zoonoses & Food Safety (direct)	20,275	Substantial	High
Zoonoses & Food Safety (at scale)	5,893,914	Substantial	Medium
Climate adaptation & mitigation:			
# tonnes CO_2e averted	202,756		Low

Nutrition, health & food security:

Lives saved: We use the mean of estimated deaths from major epidemics and pandemics in the modern era (COVID-19,[23] 1918 H1N1,[24] 1957 H2N2,[25] MERS,[26] HIV/AIDS,[27] Zika,[28] Ebola[29]) as our estimate of the number of lives that could be saved through efforts at pandemic prevention to which we contribute. This assumes one pandemic per 9-year period, reflecting the increasing rate at which pandemics are occurring. Converting health losses to a dollar value based on the average number of disability-adjusted life years (DALYs) lost to the diseases above for which estimates are available (COVID-19,[30] MERS,[31] Ebola, HIV/AIDS, Zika[32]) and multiplying this by the average GDP per capita in LMICs (US$4,759), we calculate a that if work conducted through the Initiative reduces the probability of a major epidemic or pandemic by just 0.003%, it will have doubled the value of the requested investment.

DALYs averted: We model DALYs averted through food safety improvements in informal markets, based on evaluations of food safety interventions in Vietnam and Cambodia, which reduced Salmonellosis incidence via reduced contamination of pork products by 25%.[33,34,] Interventions through the project will directly reach 174,800 consumers. We expect that seven countries will scale this up to between 2.5% and 5% of their populations per year. Based on WHO Foodborne Disease Burden Epidemiology Reference Group (FERG) report data[35] and assuming that the interventions have the same impact on other foodborne diarrheal disease agents, we project that 1,609,515 foodborne disease cases, translating to 59,796 DALYs, will be averted either directly through the Initiative (with high certainty) or indirectly through scale-up (with medium certainty).

We use the estimate by Grace et al.[36] that 12.6% of the infectious disease burden in low-income countries is due to zoonoses, and apply this to the total infectious disease burden (as DALYs) per 100,000 in Kenya, the country of greatest focus for NZD control under the Initiative. We estimate a reduction of 30% through improved zoonotic disease surveillance and control can be achieved through innovations we test and scale based on observations from previous, for example HPAI control in Indonesia[37] and project 385 DALYs averted directly through our planned intervention study, assuming 100,000 people are reached. We project and that an additional 311,779 DALYs are averted by 2030 through national scale-up of this approach based on CGIAR's track record of influencing zoonosis control policy in Kenya.

Reduced AMU in animal production is expected to have a positive effect on human health, but the magnitude of this effect is difficult to quantify, as relationship between AMR in animal reservoirs due to the use of veterinary drugs and the subsequent prevalence of resistant pathogens affecting humans as a spillover from animals is poorly investigated and there is significant overlap between pathogens and AMR types. While we do not include a health benefit through this pathway in our projections, it is likely to be significant.

Poverty reduction, livelihoods & jobs:

prevented from entering poverty*:* An estimated 97 million people were pushed into poverty due to the COVID-19 epidemic.[38] As global estimates for the poverty impact of other pandemics were not found, we calculate deaths due to COVID-19 as a proportion of the average number of lives lost to the epidemics and pandemics used in the estimate of lives saved through pandemic prevention above (0.41), and divide the economic impact of COVID-19 by this number, to obtain a potential poverty impact of 238.7 million. Recognizing that the economic consequences of disease vary greatly, we conservatively estimate a poverty reduction impact of 10% of this value (23.87 million).

The World Bank estimates that AMR could push 18.7 million people in LMICs into extreme poverty by 2030, through a combination of costs due to impacts on the health of workers and those due to impacts on animal health.[39] We scale this value down based on the populations of Kenya and Bangladesh, the main focus countries for AMR work under the Initiative, as a proportion of the total LMIC population, and arrive at an impact of 644,647 people prevented from entering poverty through work to combat AMR in these countries, to which the Initiative will contribute.

 # *people benefiting from relevant CGIAR innovations*: We expect to reach 100,000 livestock-dependent people directly through the cluster-randomized trial of integrated zoonoses interventions in Kenya, and to scale this innovation nationally by 2030. As estimates of the poverty impact of controlling zoonoses in this context do not exist, we very conservatively estimate that the entire economic benefit of this intervention is through reduced condemnations at slaughter. One head of cattle is likely to be worth at least 10% of annual income for a family in the study region. We thus use the share of cattle condemned in a recent study (1.05%)[40] and assume that households sell, on average, one head of cattle per year. We estimate the total number of cattle keeping households in Kenya based on the 2015/16 Kenya Integrated Household Budget Survey as 5,586,200 and assume 5 members per household. This approach yields a direct impact through the Initiative of 315 people benefiting at the level of 10–50% of annual income directly through the Initiative, and a total of 135,276 benefiting at this level at scale.

Gender equality, youth & social inclusion:

 # *women and girls assisted to exit poverty:* As the poverty impacts of shocks such as animal disease, and human disease at either the individual and societal level, are typically felt most acutely by marginalized groups, we anticipate that the poverty benefits of work to prevent EIDs and AMR will be at least equally shared by women and girls, and multiply the poverty estimates above by 51% to arrive at this measure.

 # *women benefiting from relevant CGIAR interventions:* In order to ensure that the different needs of male and female livestock keepers served by zoonoses interventions, and food vendors engaged in ECM interventions, are identified and differentially met, quantitative gender studies to identify women's needs will be conducted during the development and adaptation of innovations. Findings will be integrated into the design of innovations to be tested and scaled. We assume that all livestock-keeping households reached through zoonoses interventions include one woman (5,586,200), and that 51% of vendors reached through ECM are female (156,934), for a total of 5,893,914 women benefiting at scale, and 20,275 benefiting directly through interventions conducted as part of the Initiative.

Climate adaptation & mitigation:

 # *tonnes CO_2e averted:* By 2030, we expect that our efforts will contribute to 63,200 smallholder dairy farmers with 5 cattle each adopting better manure management practices. Assuming 10% adopt bio-digestion (36% reduction in CH_4, 94% reduction in N2O), and 90% adopt composting (57% reduction in CH_4,[41] 50% reduction in N_2O), this implies a total cumulative reduction of 37,059 MT of CO_2e using default IPCC excretion rates of volatile solids (for CH_4) and nitrogen (for N_2O), and emission factors,[42] and conversion factors for CH_4 and N_2O to CO_2e.[43] This corresponds to a 55% reduction compared to the baseline of business-as-usual (i.e. manure stockpiles without any management).

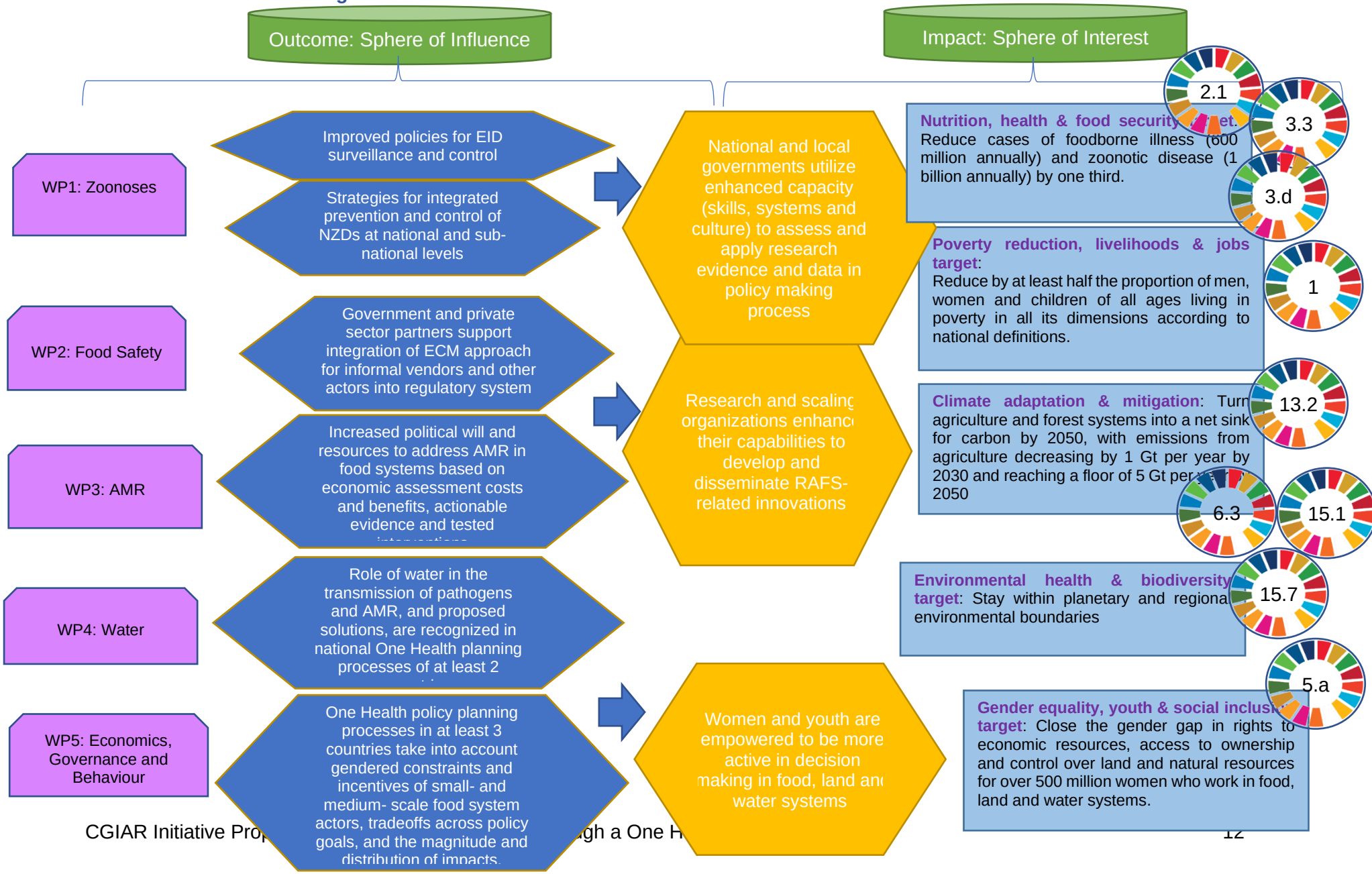
In addition, we estimate, based on the % of animals fully or partially condemned at slaughter, and the median weight of the condemned portion,[44] that an average of 2.46%, 1.21%, and 0.58% of cattle, sheep, and goat meat in Kenya is wasted due to zoonotic infection. Using the 30% reduction in zoonoses infections across Kenya projected above, and applying CO_2e/kg and total

available food values in Kenya reported by FAOSTAT, we estimate 107,696 MT of $C0_2e$ emissions will be averted annually through improved efficiency of livestock production through zoonoses control, and a cumulative savings of 165,697 MT of $C0_2e$ by 2030.

Synergies with other Initiatives: We anticipate synergies with other Initiatives as per our theory of change (TOC). We have not assumed additional impact from these synergies in this set of projections, to ensure these are conservative and to avoid double counting of beneficiaries between Initiatives. We will be further developing the synergies and factoring these into future projections during the inception period, in particular with Livestock, Climate and System Resilience (LCSR) and Sustainable Animal Productivity for Livelihoods, Nutrition and Gender inclusion (SAPLING).

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

3.1.1 Full Initiative TOC diagram



3.1.2 Full Initiative TOC narrative

Through co-creation of EID surveillance and control tools with decision makers, by demonstrating the potential of these to improve targeting efficiencies and impact of control measures, promotion through stakeholder workshops, and the nomination of CGIAR staff and collaborators to technical working groups of key line ministries and inter-ministerial coordinating bodies, we expect that these decision support tools will be adopted by governments in EID hotspots, leading to fewer, and better-contained, zoonotic disease outbreaks.

We hypothesize that barriers to the integration of public health and veterinary services across separate public and private entities can be overcome through institutional learning in the context of an intervention trial funded through this Initiative. By establishing proof of concept for integrated service delivery, the impact of such a study could be transformative in motivating partnering and other governments, supported by private input suppliers, to adopt a One Health approach to zoonosis control which reduces disease incidence.

We will evaluate impacts of an ECM approach on food safety and business outcomes. Assuming that these impacts are positive, we expect food business operators to support scale-up, and governments to integrate the approach into systems for food safety governance, reducing food safety risk in informal markets, and reducing the burden of foodborne illness.

To increase the will to address AMR, aligning with identified global health priorities, we will provide actionable evidence on how to do so. We anticipate that this Initiative will help catalyze implementation of the AMR action plans already adopted by our focus countries. Evidence generated through this Initiative will also be used to build the case for greater international investment to support LMIC farmers in making the transition to lower and better-targeted AMU.

Reduced burdens due to zoonotic and foodborne illness, including those resistant to treatment with antimicrobials, translate directly to lower cost of health care and thus reduced rates of poverty. In addition, the productivity impact of improved zoonosis control and preservation of the effectiveness of existing antimicrobial drugs used in food production will directly impact the incomes of smallholder farmers.

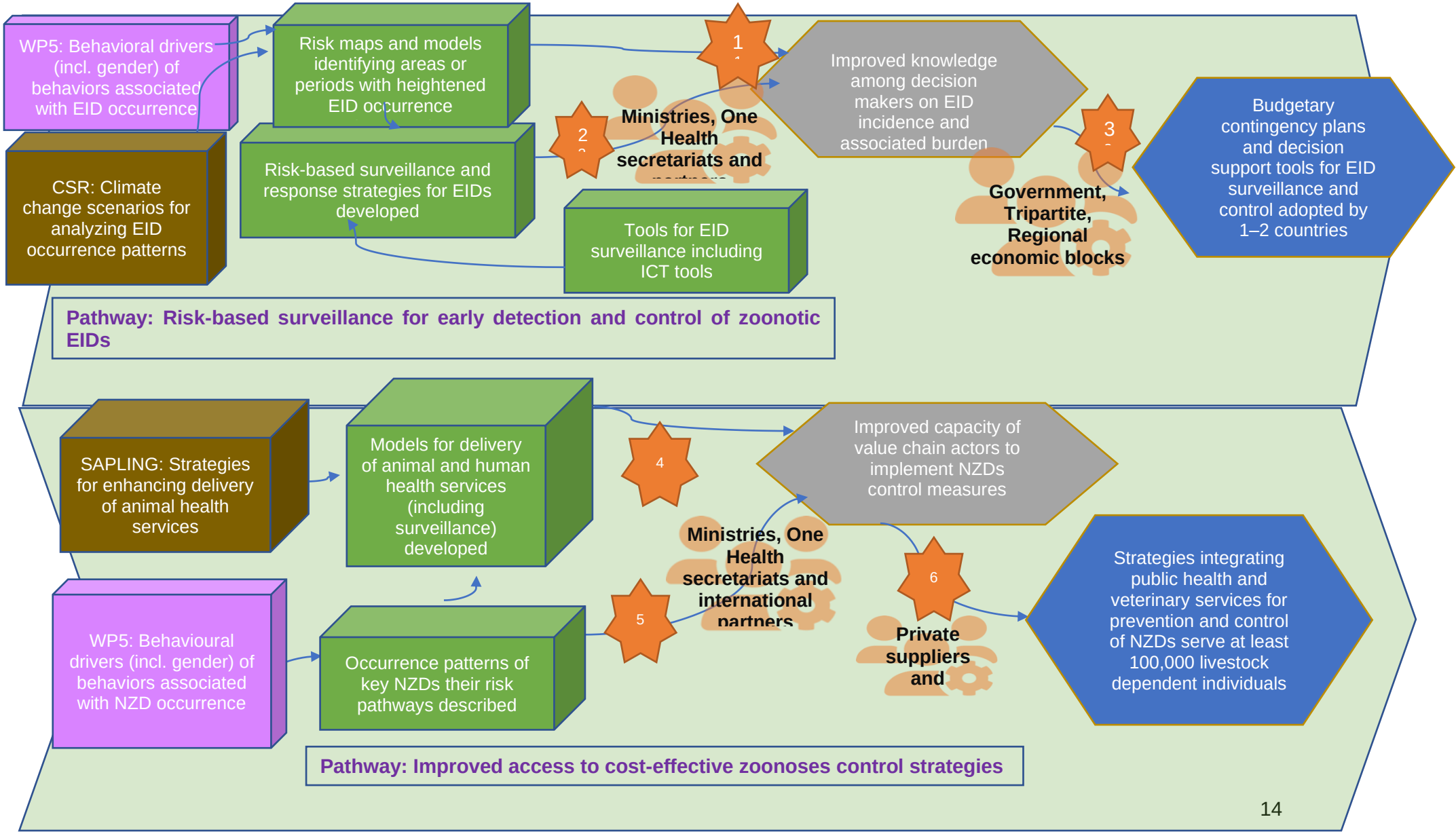
By integrating water management into One Health planning processes and making the case for greater investment in provision of safe water at key nodes in ASF value chains, we expect to leverage highly cost-effective investments in water quality management and infrastructure provision, resulting in reduced circulation of antimicrobial residues in the environment, and reduced transmission of pathogens.

Promotion of improved manure management practices by farmers through analysis of the business case for reuse as composted fertilizer and/or biogas production is a key strategy for reducing the transmission of zoonotic pathogens and antimicrobial residues into the environment, and implies the co-benefit of lower greenhouse gas (GHG) emissions. Reduced waste from condemnation of livestock at slaughter due to zoonotic infection similarly results in lower GHG emissions as fewer animals are required for an equivalent volume of food produced.

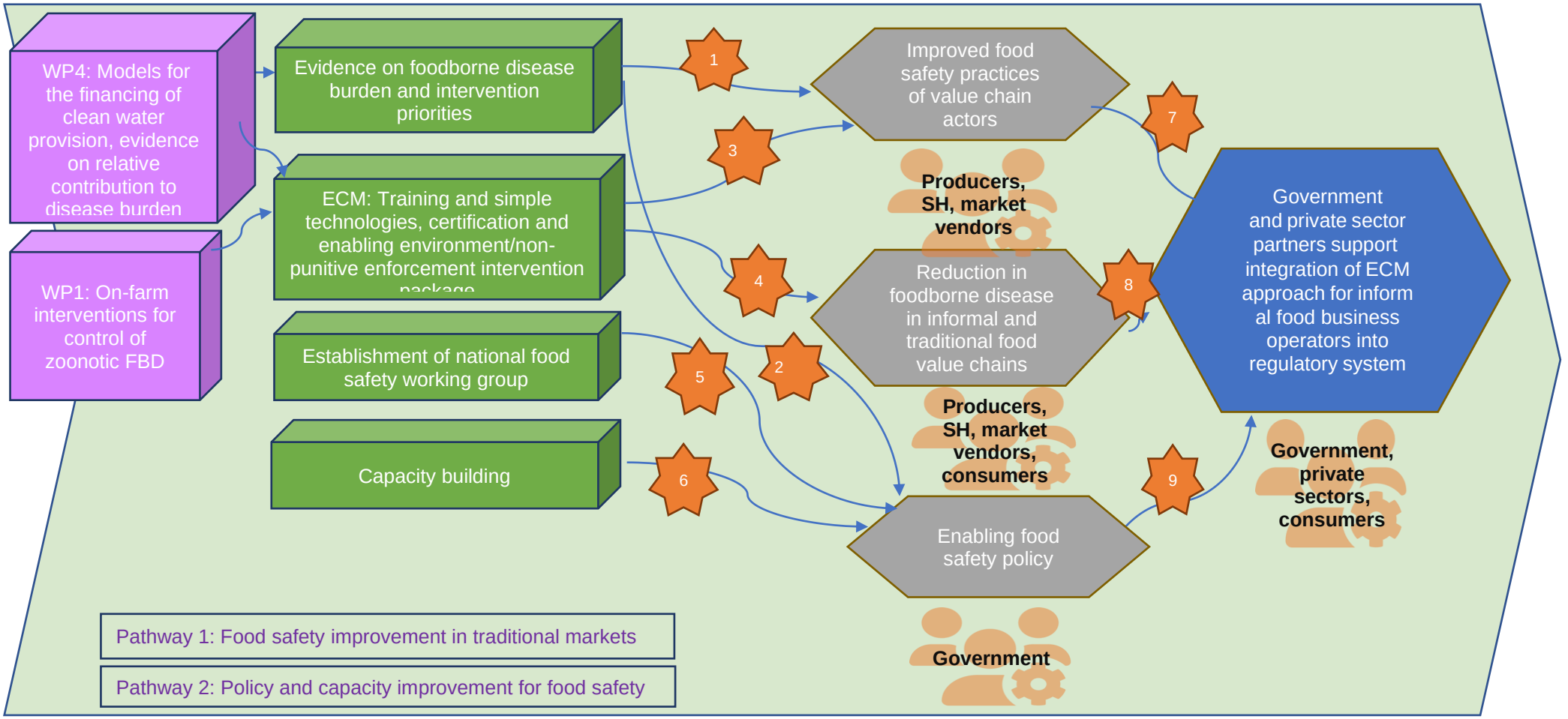
By introducing the gendered constraints and incentives of small- and medium- scale food system actors, as well as considerations of trade-offs and distributional impacts of policies into One Health planning, and into all of the interventions and innovations promoted through this work, we anticipate that policies and programing in this area will become more inclusive of women, youth, and marginalized groups.

Research and scaling efforts have been discussed with and will be implemented in coordination with the SAPLING, LCSR, Resilient Cities, HER+, SHiFT, and Digital Transformation Initiatives.

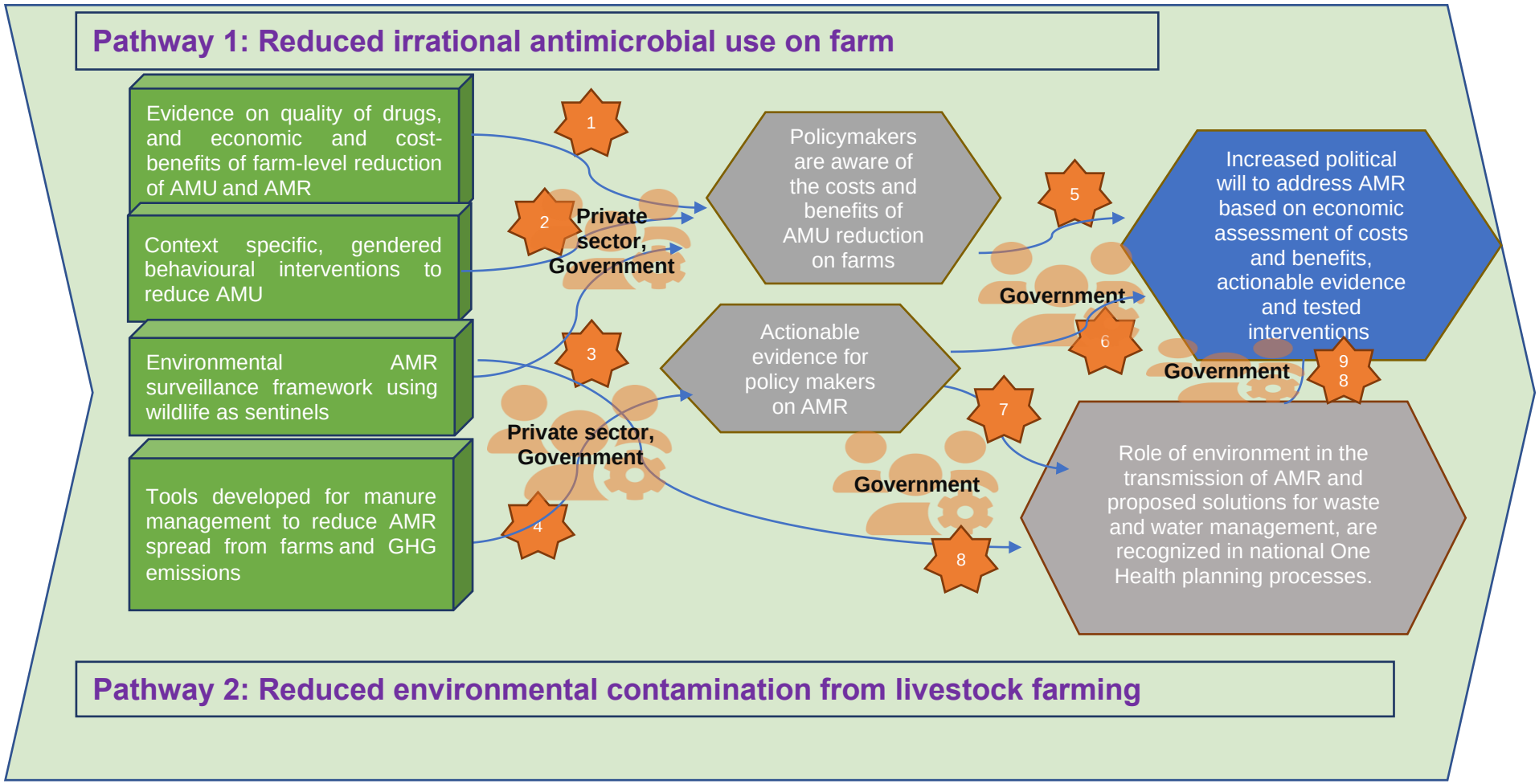
WP1: Zoonoses



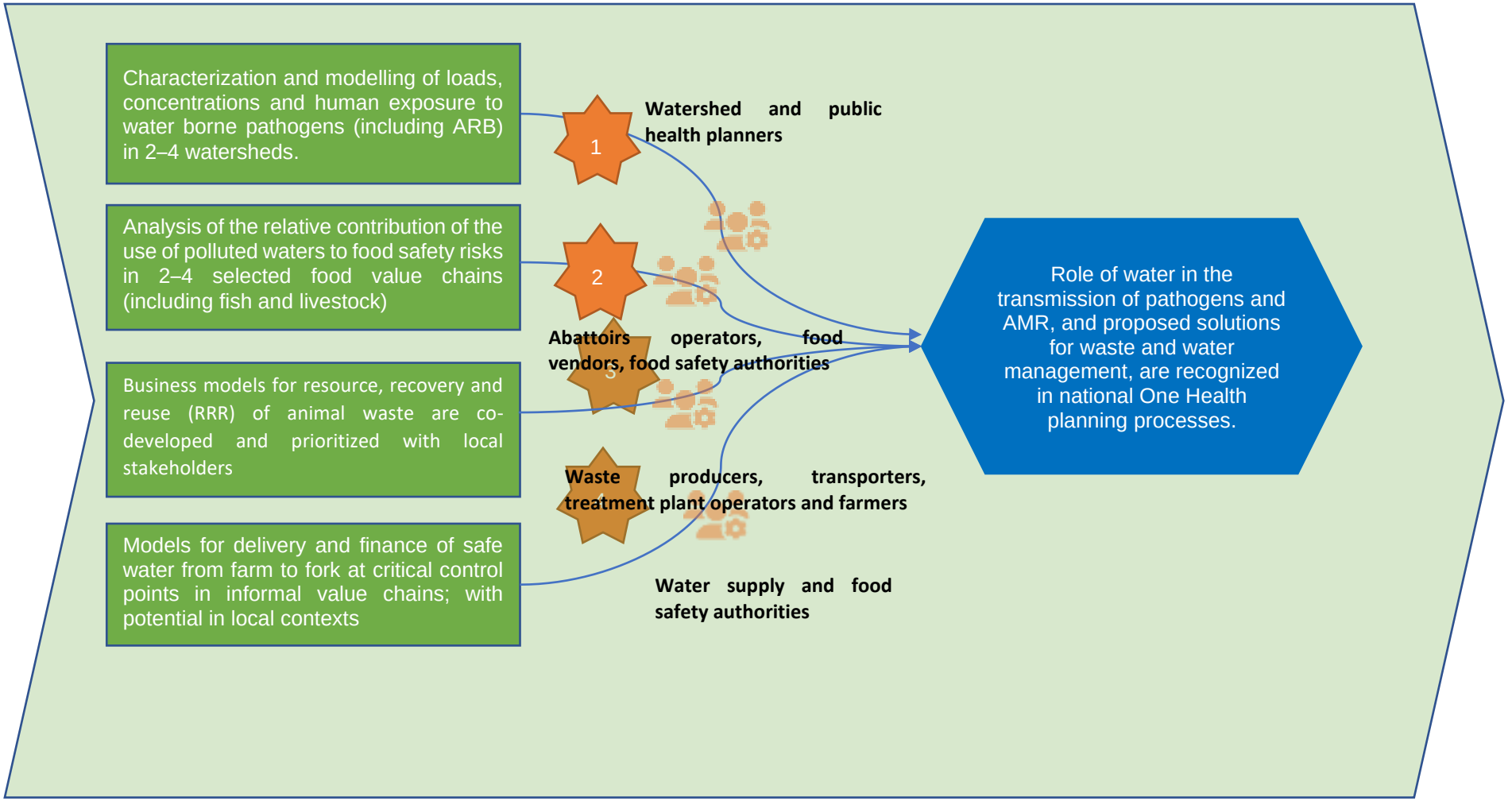
WP2: Food safety



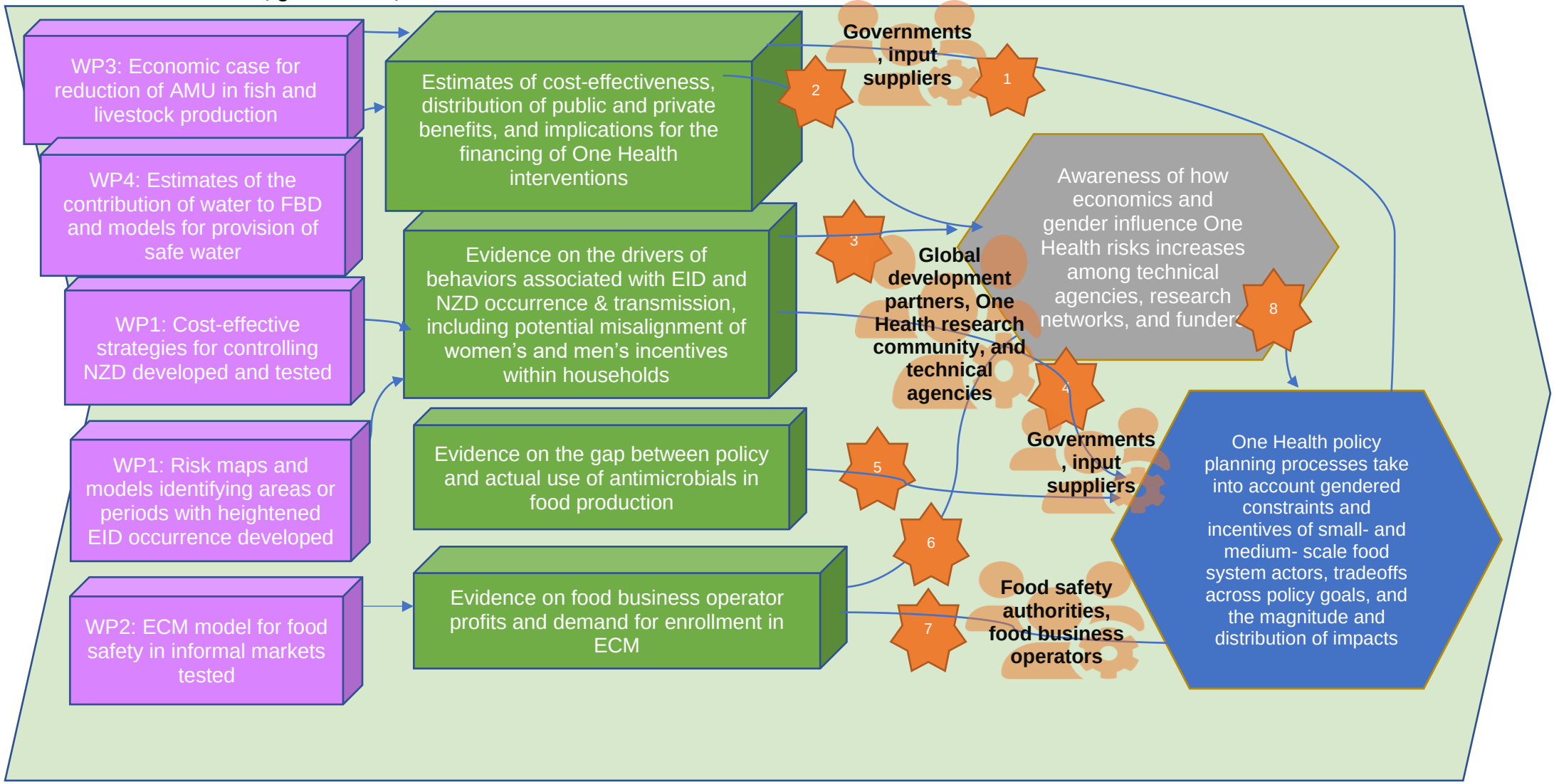
WP3: AMR


Pathway 1: Reduced irrational antimicrobial use on farm
Evidence on quality of drugs, and economic and cost-benefits of farm-level reduction of AMU and AMR
Context specific, gendered behavioural interventions to reduce AMU
Environmental AMR surveillance framework using wildlife as sentinels
Tools developed for manure management to reduce AMR spread from farms and GHG emissions
1
2
Private sector, Government
3
Private sector, Government
4
Policymakers are aware of the costs and benefits of AMU reduction on farms
Actionable evidence for policy makers on AMR
5
Government
6
Increased political will to address AMR based on economic assessment of costs and benefits, actionable evidence and tested interventions
Government
9
8
7
Government
8
Role of environment in the transmission of AMR and proposed solutions for waste and water management, are recognized in national One Health planning processes.
Pathway 2: Reduced environmental contamination from livestock farming

WP4: Water


Characterization and modelling of loads, concentrations and human exposure to water borne pathogens (including ARB) in 2–4 watersheds.
Analysis of the relative contribution of the use of polluted waters to food safety risks in 2–4 selected food value chains (including fish and livestock)
Business models for resource, recovery and reuse (RRR) of animal waste are co-developed and prioritized with local stakeholders
Models for delivery and finance of safe water from farm to fork at critical control points in informal value chains; with potential in local contexts
1
2
3
4
Watershed and public health planners
Abattoirs operators, food vendors, food safety authorities
Waste producers, transporters, treatment plant operators and farmers
Water supply and food safety authorities
Role of water in the transmission of pathogens and AMR, and proposed solutions for waste and water management, are recognized in national One Health planning processes.

WP5: Economics, governance, and behavior



3.2.2 Work Package research plans and TOCs

Work Package title	WP1: Emerging and neglected zoonoses
Main focus and prioritization	Pre-empt emergence and spread of zoonoses with epidemic and pandemic potential at the interface of wildlife, livestock, and people, including in bushmeat value chains, through surveillance, identification of high-risk behaviors and geographies, and epidemiological-behavioral modeling; reduce incidence of zoonotic pathogens associated with poverty by demonstrating and scaling cost-effective control through integrated provision of public health and veterinary services.
Geographic scope	Kenya, Ethiopia, Vietnam, Côte d'Ivoire

WP1 Science

Research on emerging zoonoses will be implemented in Vietnam and Côte d'Ivoire given significant human-livestock-wildlife interactions and consumption of bushmeat and other wildlife products in these countries, while that on NZDs will be implemented in Kenya, and Ethiopia to leverage data and expertise developed through previous and ongoing projects. In Kenya, ZooLinK, UrbanZoo, Co-infection, HORN and OHRECA have generated findings on risk factors and ecological drivers for neglected zoonoses which would inform the design of their surveillance and control strategies. Similar results have been generated in Ethiopia and India under the HORN and APART projects, respectively.

We will work with ministries of public and animal health sectors in the target countries and international development partners such as the FAO, WHO, OIE and UNEP, in the analysis of historical data on emerging zoonotic diseases to identify drivers of EIDs and generate "hotspot" maps. Transdisciplinary studies will be implemented jointly with public and animal health sectors in selected "hotspots", specifically in Vietnam and Côte d'Ivoire, to obtain data on socio-economic and gendered drivers of practices that could influence EID occurrence.

Key partners for research on control of neglected zoonotic disease will be sub-national governments and private firms providing veterinary input and advisory services.

The Table below lists the main research questions for this work, methods that would be used, and expected outputs.

Question	Methods	Output
What are the drivers of emerging zoonotic diseases, and in what ecologies are these diseases likely to emerge?	Collate historical data on zoonotic EIDs and potential predictors, and analyze them using statistical and mechanistic models (with EcoHealth Alliance, University of Liverpool)	Multiscale drivers of zoonotic EIDs (which may include land use and climate change) will be identified. These analyses will also generate maps for predicting hotspots for future events
How can gender-responsive, integrated surveillance systems be designed and used sustainably for detecting emerging zoonotic diseases?	Determine gaps on existing surveillance systems, develop an infrastructure which addresses these gaps (e.g., based on ICT), build capacity, and deploy the system in defined hotspots, conduct parallel bio-surveillance activities for validation (with University of Liverpool, sub-national Departments of Agriculture and Public Health)	Integrated surveillance system that supports early detection of zoonotic EID events developed. At the same time, pathogens with EID potential are characterized.
What is the economic burden of nationally prioritized zoonoses?	Surveys on animal production costs and outputs, and subsample serological analysis, in a sub-nationally representative sample of producers	Burden of disease estimates using standard metrics (DALYs, zDALYs) combined with economic data and analysis under WP5, to justify

		national investment in and donor prioritization of zoonosis control
What strategies can be used to improve the delivery of integrated (veterinary and public) health services in marginalized areas to better manage neglected zoonoses?	Epidemiological studies in the target areas, followed by a randomized on-farm trial on integrated human and animal health interventions founded on One Health principles	Models or frameworks for the delivery of integrated (veterinary and public) health services developed and evaluated

WP1 Theory of change

The Work Package will use two pathways to realize its expected impact of decreasing the burden of zoonoses in the LMICs. These include: (i) risk-based surveillance to enable early detection and control of EIDs, and (ii) improved access to cost-effective control options for NZDs.

The main assumption underlying the first pathway is that reliable predictions of hotspots will be generated based on historical data on EID outbreaks. We further assume that through joint work to build risk maps, as well as the human and digital capacity established for surveillance, decision makers in focus countries will become more knowledgeable about EID risk, incidence, and the associated burden as illustrated in sub-pathway 1. The second assumption is that this knowledge will motivate decision-makers to set up contingency budgets, develop and adopt new decision support tools to improve their effectiveness on EID surveillance and control (sub-pathway 2). These strategies will be enhanced in partnership with the Digital Transformation Initiative and will inform the targeting of interventions. They will be reviewed jointly with international partners including the Tripartite and the regional economic communities to inform the development of EID control policies that support national stakeholders (line ministries) in the institutionalization of budgets for operationalizing EID control.

The focus of the second impact pathway is ensuring that poor communities that suffer the greatest burden of NZDs can access quality and effective integrated (public and animal) health services when they need them. CGIAR researchers and local partners will conduct epidemiological studies to generate more knowledge on occurrence patterns of NZDs. Results produced from these studies will be used together with findings from SAPLING on herd health and animal health service delivery systems to design models and frameworks that can be used to deliver sustainable integrated public and animal health services on the ground. Two sets of services will be deployed, (a) ICT-based surveillance systems which will be implemented in Kenya and Ethiopia, and (b) more intensive zoonoses control measures which will be deployed in selected areas in Kenya. Based on qualitative formative work and consultation with female stakeholders, we will design these programs in ways that include women and men to minimize gender bias and ensure that women and children are among the beneficiaries of these interventions. Delivery models and frameworks will be developed that provide incentives for private sector actors to take a lead role in the deployment of these services to ensure sustainability beyond the life of the project (sub-pathway 4 and 5). The expected outcome of this work is that national and sub-national governments will develop strategies for integrating public health and veterinary services for the prevention and control of NZDs as indicated in sub-pathway 6. Women and children are expected to be among the greatest beneficiaries of these interventions given that they bear a greater burden of zoonotic

disease relative to other groups in LMICs. Estimated disease and economic burdens will be submitted to FERGII, GBADs and GBD as inputs to these programs. Demand and scaling partners for this work include the World Organisation for Animal Health (OIE), FAO, Ministries of Agriculture, Ministries of Public Health, and NGOs such as VSF Germany.

Work Package title	WP2: Food safety
Main focus and prioritization	Reduce the burden of foodborne disease with a focus on animal-source and other perishable foods, including in informal and traditional food systems, through developing, testing and scaling the gender sensitive ECM approach. ECM will support food value chain actors from production to consumption to improve food safety by Enabling environment with non-punitive governance, Capacitating by training and developing simple technologies, and Motivating for behavior change. We will focus on food vendors in traditional markets.
Geographic scope	Vietnam, India, Kenya, Ethiopia, Côte d'Ivoire

WP2 Science

Through this Work Package, we aim to reduce the burden of foodborne disease with a focus on high-risk animal-source and other perishable foods, including in informal and traditional food systems, by enabling, capacitating and motivating food value chain actors from production to consumption. Research will be implemented in Vietnam, India, Kenya, Ethiopia, and Côte d'Ivoire.

We will use a risk-based approach to generate evidence on multiple foodborne disease burdens, as this is more closely tied to health outcomes than a hazard-based approach. Work undertaken will include risk assessments and risk factor analyses to prioritize interventions. We will continue the development and implementation of the gender sensitive ECM approach to improve food safety in informal value chains, through which most of the high-risk, perishable foods consumed in LMICs are produced and traded. ECM includes i) creating an enabling environment with non-punitive governance, ii) training and developing simple technologies, and iii) motivating for behavior change for food value chain actors from production to consumption. We will strengthen established or new national food safety working groups under One Health platform in each country to generate and disseminate evidence and support the development of effective regulatory approaches to food safety. We will strengthen the capacity of government staff who are part of these group and platform in food safety. We will work with universities to strengthen curricula and teaching on food safety. Evidence on factors underlying successes and failures in these efforts to transform food safety systems will be synthesized.

Questions	**Method**	**Outputs**
Evidence on foodborne disease burden and intervention priorities What are the burdens of foodborne disease? What are the critical control points? What are the priorities for interventions?	Risk assessment (survey, lab analysis, risk modelling), risk communication Risk factor studies Cost-benefit analysis (CB) Cost-effectiveness (CEA)	Evidence on foodborne disease burdens and intervention priorities
Enabling, capacitating, motivating interventions What technologies, training and information do VC actors need to improve food safety? What are the incentives and nudges that will motivate behavior change?	Iterative piloting to co-develop and adapt proven interventions to study context Randomized evaluations to assess impacts on knowledge, practices, hazards, and risk	Feasible approaches and technologies developed Evidence on approaches that can best improve food safety in informal markets.

How can the public sector provide an enabling regulatory environment and infrastructure?		
Capacity building Support universities in capacity building and develop / benchmark food safety curriculum and government staff from food safety working group and One Health platforms	Workshops to identify needs Co-development of curriculum with demand partners	Training curricula on food safety at universities
Success and failure evaluation of existing food safety interventions What are the success and failure factors of food safety interventions?	Evaluation method (SLR on evaluation of food safety interventions, qualitative studies with actors doing interventions, Outcome harvesting) Theory of change: reviewing project TOCs	Documentation of success and failure factors of food safety interventions, lessons learnt

WP2 Theory of change

This Work Package will investigate the critical assumptions that cause interventions to succeed or fail, in order to draw widely applicable lessons and inform innovations that can be scaled. Such approaches might include, for example, upgrading basic slaughterhouses through metal grids, separating 'clean' and 'dirty' areas and peer-monitoring of informal vendors to improve the adoption of improved practices. We will synthesize evidence on what approaches work, where and why they work, their added value (including equity and nutrition benefits) as well as what doesn't work. Activities in this thematic area will focus on consumer demand, information and market forces as drivers of sustainable improvement.

We will work with stakeholders, who will be responsible for implementing the research outputs. For example, government officers in India will conduct most of the capacity building under this theme, while in Vietnam, a greater role is envisaged for the private sector. The program will test our hypotheses that working with a small number of actors (vendors in markets who are mostly women, slaughterhouse workers) at critical control points can improve safety for millions of consumers and that interventions will be effective if they create an enabling regulatory environment and a strong incentive for behavioral change such as peer pressure or consumer demand. We propose to use the gender sensitive ECM intervention innovation that support value chain actors to reduce burdens of foodborne disease through supporting: i) an enabling regulatory environment, ii) technologies and training, iii) incentives for behavior change (causal pathways 3, 4). For example, non-punitive co-regulation, color-coded containers for raw and cooked foods, food safety culture. We believe that these approaches will continue to succeed if we can engage and convince decision makers of their feasibility, effectiveness and cost-benefit. At country level, we will work with the authorities and partners to integrate Initiative innovations into the food safety programs (for example SAFEGRO project in Vietnam) to scale the innovation (pathways 7, 8, 9). Key partners will be Universities, NARS, Ministries (animal health workers, food safety authorities) and private sectors (market management, slaughterhouse, food processors). We will continue to support food safety working groups in Vietnam and start new working groups in Kenya, Ethiopia, India, Uganda through the existing One Health coordination platform and where we have large ongoing projects (pathways 5, 6). We will continue to generate evidence and grow partners' ability to use it for better decisions and resource allocation (pathways 1, 2). This will require evidence on disaggregated burdens, risk factors and critical control points. Such evidence underpins risk prioritization and management, including testing appropriate technologies and behavioral change mechanisms and evaluating their scalability. Partners will include universities, NARS, CSRS Côte d'Ivoire.

We will also strengthen understanding of risks and benefits of formal and informal systems, rural and urban markets. Evidence will be disseminated in partnership with the SAPLING and Resilient Cities Initiatives.

At the regional level, we will collaborate with other One Health programs (OHRECA, OACPS in Africa) to work with FAO, WHO, OIE on traditional market communication and advocacy, and support the regional economic communities on food safety strategy and curriculum. We will also work with ASEAN, APAARI, SEAOHUN, AFROHUN, in SEA to scale up the risk-based approach to food safety through trainings.

Work Package title	WP3: Antimicrobial resistance (AMR)
Main focus and prioritization	Reduce selection and spread of AMR from livestock, fish and crop production systems through reduced and better-targeted AMU, surveillance of AMU and AMR in animals and ASF, improved manure management, and a better understanding of the environment as a reservoir for AMR.
Geographic scope	Kenya, Uganda, Bangladesh, Vietnam, Côte d'Ivoire

WP3 Science

In LMICs, AMR constitutes an additional layer on existing herd health, zoonoses, and food safety challenges. Most countries struggle to implement national AMR containment strategies. Moreover, the unintended consequences of implementing AMR reducing interventions developed in high-income countries in less optimized production systems may have dire productivity and economic effects on small-scale farmers. We will generate country-specific evidence and solutions and make an economic case to farmers as well as to policy makers for adoption of farm-level strategies to reduce both the use of antimicrobials and the spread of AMR through animal fecal waste.

Good human and animal health requires access to quality drugs. It has been estimated that up to 15% of all drugs sold are fake of substandard, and in parts of Africa and Asia this exceeds 50%.[45] Substandard veterinary drugs have a negative effect on food safety and security, and control of zoonoses. We will assess the quality of the common antimicrobials sold over the counter and work with national drug authorities to identify potential policy interventions.

While wildlife is generally not treated with antimicrobials, the sharing of common habitats increases the probability of transmission of resistant bacteria and due to their long migratory movements, wildlife can spread AMR. We will investigate whether wildlife can be used as environmental sentinels of AMR and an alternate AMR surveillance framework, particularly in contexts without a national monitoring program.

We will work with key local and international partners to implement the proposed research and engage other relevant AMR projects within a country to identify duplications and find synergies (e.g. Fleming Fund, USAID Transform). Examples of partners include local research and government institutions, London School of Health and Tropical Medicine, University of Copenhagen, CEFAS FAO AMR Reference Center, and private companies such as 17Triggers and RESISTOMAP.

Questions	Method	Outputs
How does better targeting and overall reduction of on-farm AMU e.g. eliminating antimicrobial growth promoters and increasing herd health practices in small-scale, semi-intensive livestock and aquaculture farms, affect production, farm profits and AMR prevalence? What are the potential impacts of these farm-level AMU/AMR reducing interventions on human AMR?	Microbiology, mathematical modelling, cost-benefit and economic analyses	Economic case for reduction of AMU and AMR on farms. Evidence on farm-level interventions and impacts on AMR in human health.
What proportion of antimicrobials purchased by farmers are substandard? Do production enhancing vitamins contain antibiotics? Are farmers aware that these vitamins contain antibiotics?	Biochemistry, Survey	Evidence on frequency of substandard antimicrobials Evidence on improper marketing and labelling of antimicrobials for non-therapeutic purposes
Which manure management practice enhances degradation of antibiotic metabolites and reduction of antimicrobial resistant bacteria and resistance genes? Do antimicrobials in manure affect microbial-mediated processes, such as decomposition, nutrient losses and GHG emissions?	Microbiology biochemistry, GHG measurements	Manure management interventions to reduce the spread of AMR from livestock systems to the environment and reduce adverse environmental effects
What behavioral interventions (incentives, nudges) promote better targeted AMU and improved manure management among small-scale livestock farmers, or reduce antimicrobial prescriptions in informal drug retailers? Is gender important for implementation of AMR reducing interventions in agriculture?	Social science, economic analyses	Context-relevant, gendered behavioral science interventions
Can wildlife be used as bioindicators for AMR contamination in the environment? Can wildlife-human-livestock interfaces (e.g. common water sources) for environmental AMR surveillance be a proxy for community levels of AMR?	Microbiology, cost-benefit analyses	Environmental AMR surveillance framework using wildlife as sentinels.

WP3 Theory of change

Reducing AMR requires a multi-pronged approach: 1) reducing AMU including irrational use (e.g. targeting non-susceptible pathogens) and inappropriate use (e.g. antimicrobial growth promoters), 2) reducing the availability of falsified or poor quality antimicrobials to reduce selection for AMR, and 3) reduce transmission of AMR (resistant organisms and resistance genes). In LMICs, lack of country specific data on the burden of AMR (both economic and health) is a major reason for low prioritization coupled with limited resources to implement national action plans, and infrastructural deficiencies. In WP3, we will test the hypothesis that implementing on-farm animal health management practices and eliminating antimicrobial growth promoters, will not negatively impact productivity in LMICs and will be cost-effective in the long run for farmers. We will also model the potential impacts of farm-level interventions on human associated AMR, providing much needed evidence on the costs vs benefits of agricultural interventions that target human health outcomes. Together, this evidence will be used to generate political will to prioritize effective governance, and incorporated in the revision of national action plans in at least two countries (pathways 1, 2, 5, 6).

Manure is a major by-product of livestock farming with both beneficial effects (use as organic fertilizer in crop production) and negative effects (transmission of AMR, GHG emissions, water pollution and soil degradation). We will evaluate the extent to which manure management

practices (e.g. composting or anaerobic digestion) can reduce the spread of AMR from farms into the broader environment (pathways 4, 6, 7, 8, 9).

In Kenya, the estimated costs of an annual AMR surveillance program (humans only, using 9 laboratories) is US$2 million.[46] This staggering amount is not economically sustainable and would be higher if livestock and animal sourced foods were included. We will investigate the potential to use wildlife as AMR sentinels, to enable more cost-effective AMR monitoring and provide key information on circulating AMR phenotypes clinically relevant to humans and animals (pathways 3, 5, 8).

Expected scaling partners include: International Center for Antimicrobial Resistance Solutions (ICARS), UN agencies with a strategic plan to address AMR in agriculture and the environment (FAO, OIE, UNEP), iCOW (a mobile app delivering a variety of information to improve livestock production, reduce zoonotic diseases and promote good farming practices to farmers in East Africa), SNV (a Dutch development organization promoting biodigesters to produce green energy (biofuel) from animal manure), World Animal Protection (a nonprofit animal rights organization supporting a global ban on antimicrobial growth promoters and focused on improving production without compromising animal welfare), the international AMR advocacy group ReAct, Land O'Lakes Venture37 (which is working closely with various pharmaceutical companies to provide training to farmers, agrovets, and animal health providers on how to use and store their medicinal products, and SeaBoS, a unique collaboration between researchers and seafood companies, working collectively to lead a global transformation towards sustainable seafood production and improving ocean health.

Work Package title	WP4: Water
Main focus and prioritization	Improve waste and water management, with a focus on pollution from livestock and aquaculture (including zoonotic pathogens, antimicrobial residues and antimicrobial resistant bacteria and resistance genes) for the reduction of human health risks through livestock and fish food value chains.
Work Package geographic scope	Ethiopia, India, Kenya and Bangladesh

WP4 Science

Interventions to prevent waste from livestock and aquaculture production from entering water bodies,[47,48] and to provide safe water for food processing and preparation,[49,50] are likely to be highly cost-effective as public health interventions. This Work Package will generate locally relevant evidence to motivate and support such interventions and will co-develop locally relevant solutions for adoption, replication and scaling in subsequent phases.

While it is often claimed that "many foodborne illnesses can be related back to poor water quality used in food production and/or post-harvest processing and/or food preparation",[51] the relative contribution of water to foodborne pathogens is rarely quantified. We will address this gap in the context of value chains for ASF, focusing on slaughterhouses and markets, through which large quantities of food pass and may become contaminated with pathogens present in water or cross-contaminated from other food products via reuse of water.

A separate research activity will entail generating actionable evidence and user-friendly tools for policy-makers, based on microbiological monitoring and modelling at the watershed level and analysis of fate and transport of pathogens from different sources that pose risks through different pathways. Based on these models, we will assess risks from microbial pollution and AMR in watersheds and test ex-ante the cost-effectiveness of solutions (e.g. improved livestock waste treatment) to manage and mitigate health risks.

We will also incorporate, for the first time within a watershed model, a module to analyze the development and spread of AMR in water systems.

Core research questions, methods, and associated outputs:

Questions	Method	Outputs
What are the sources, loads, transport, fate, and pathways to human exposure of pollutants such as zoonotic pathogens, antimicrobial residues, and antimicrobial resistant bacteria and resistance genes in selected watersheds?	Watershed water quality monitoring and modeling.	Characterization/Modelling of loads, concentrations and human exposure to selected water borne pathogens (including ARB) in 2-4 watersheds.
What is the importance of contaminated water relative to other sources, as foodborne pathogens in ASF at critical control points (e.g. abattoirs and markets)?	QMRA	Analysis of the relative contribution of the use of polluted waters to food safety risks in 2–4 selected food value chains
What solutions for RRR of animal waste have greatest potential? What are the value proposition, customer segments, cost structure and revenue streams for the proposed solutions?	Cataloguing and characterization of solutions, and co-development and prioritization with stakeholders based on cost-effectiveness and SWOT analysis	Business models for RRR of animal waste are co-developed with local stakeholders
What options for delivery and finance of safe water have greatest potential? What is the potential cost-effectiveness of these solutions?	Cataloguing and characterization of solutions, co-development & prioritization with stakeholders based on cost-effectiveness and SWOT analyses	Models for delivery and finance of safe water from farm to fork at critical control points in informal value chains

WP4 Theory of change

The Work Package will engage from its inception a broad spectrum of stakeholders, including national universities and research centers, for the delivery of the four main outputs outlined above. Through co-creation of these evidence products and innovations with national partners, and CGIAR involvement in One Health platforms, we are confident that the role of water in the transmission of pathogens (including those resistant to antimicrobials), and the waste and water management solutions identified, will be recognized in the national One Health planning processes of at least 2 countries.

To deliver this outcome, we recognize: 1) the need to work at multiple levels and with multiple stakeholders, 2) the importance of behavior and attitudinal change of these stakeholders, and 3) the need to provide stakeholders with clear evidence, knowledge and skills to make decisions and achieve incremental change during and after the project. We assume that target actors understand research outputs, and to ensure this is the case we will do the following:

The Work Package will refine existing One Health stakeholder assessments and mappings to better understand their interests, roles and responsibilities and will implement a comprehensive strategy for their engagement and communication. Such stakeholders will include watershed and public health planners, livestock waste managers and entrepreneurs as well as water supply and food safety authorities.

We will develop a communication strategy to support knowledge sharing and learning opportunities, and will repackage research, case studies and other materials into compelling multi-media products tailored to different groups. The project will engage with media and other actors to increase awareness of the role of water in One Heath.

Work Package title	WP5: Economics, governance, and behavior
Work Package main focus and prioritization	Test effects of capacity building, incentives, and monitoring on behavior of value chain actors and government personnel providing support or oversight for relevant sectors, with attention to the influence of gender on constraints, motivations, and capacities through randomized evaluations. Assess cost-effectiveness of innovations and assess the private and public case for investment.
Work Package geographic scope	Bangladesh, India, Vietnam, Kenya, Ethiopia, Uganda, Côte d'Ivoire

WP5 Science

Economics and other social sciences are not commonly part of One Health research. We see the integration of these disciplines with biophysical research as critical to achieving the objectives of this Initiative. Research under this Work Package will be integrated across each of the others. We will seek to understand:

- Economic and behavioral drivers of and constraints to the adoption of recommended practices by food system actors, including those influenced by gender
- Public and private benefits of innovations developed and evaluated through the Initiative, trade-offs between these, and implications for the efficient allocation of public funds
- Distributional effects and trade-offs between health, economic outcomes, and food security; mechanisms to ensure that innovations incubated through this Initiative maximize benefits, and minimize potential harms, to the poor, women, youth, and other marginalized groups

We will utilize experimental methods to the extent possible, through integration of behavioral and economic outcomes, and cross-randomized treatments, within trials of innovations at a relatively mature stage (e.g. integrated zoonosis control, ECM approach to food safety). Smaller-scale, individually randomized experiments, lab-in-the-field methods, and quantitative and qualitative surveys will be used to answer questions that contribute to the design of earlier-stage innovations.

Cost effectiveness analyses will be undertaken using standardized metrics such as the zDALYs to ensure comparability with results from other projects including the GBADs program.

Key Questions	**Methods**	**Outputs**
What anthropogenic factors or practices, including those influenced by gender, precipitate zoonotic EID and events and transmission of NZDs?	Qualitative and quantitative surveys in selected EID and NZD "hotspots" in the target countries, value chain analysis under WP1	Evidence on the role of gender and other socio-economic factors contributing to zoonotic EID events and NZD transmission
What is the economic case for building zoonoses control interventions into public health programs?	Cost-effectiveness analysis based on zoonosis control trial under WP1	Evidence supporting integration of zoonoses control into public health systems

Do women under-invest in livestock health due to exclusion from benefits of livestock production?	Cross-randomized treatment within zoonosis control trial under WP1	Evidence on how to encourage women's engagement in zoonosis surveillance and control
Can consumer demand for safer food, stimulated through social marketing, lead food business operators (FBOs) to submit to third party monitoring of their food safety processes or outcomes? How do gender and firm size relate to firms' participation in and benefits from voluntary food safety upgrading?	Inclusion of economic outcomes (consumer demand, vendor profits, vendor demand for ECM) in RCTs with WP2	Evidence on whether voluntary ECM approach can be scaled
To what extent is AMU privately rational but publicly irrational? How does the profit impact of reducing AMU in livestock and aquatic food production compare to farmers' perceptions? What support (information, training, services, materials) do producers need to reduce reliance on AM while maintaining income?	Surveys modules eliciting farmer perceptions, profit impact of different types of AMU within of AMU reduction experiments with WP3	Needs assessment to protect farmer livelihoods while reducing AMU
What is the extent of AMU in food production? How does this compare to national policy?	Tracking of sales by input suppliers	Scalable tracking system for antimicrobial sales used in food production
What is the case for public provision of safe water infrastructure at markets and abattoirs?	Cost-effectiveness analysis in collaboration with WP2 and WP4	Investment case for public provision of safe water provision
How to work through National One Health Platforms and technical working groups to influence national policy	Stakeholder engagement and analysis, process evaluation	Evidence on policy influence pathway for strengthening One Health delivery

WP5 Theory of change

The theory of change for this Work Package assumes that in order for policies and programs for the control of zoonoses, improvement of food safety, and rationalization of AMU to be effective, they must be designed around the incentives and constraints faced by food system actors, including those influenced by gender. Further, tradeoffs in benefits — for example between farmers' private gains from use of antimicrobials as growth promoters vs. public the value of preserving the efficacy of these drugs — must be understood and addressed in order to design policies and service delivery modalities that are socially acceptable and achieve lasting impact. The theory of change reflects the cross-cutting nature of the Work Package, with each of the outputs linked to at least one from another Work Package.

Key scaling partners to achieve the End-of-Initiative outcome that One Health planning processes take into account gendered constraints and the incentives of small and medium-scale food system actors, and distributional impacts and tradeoffs, include One Health coordinating bodies and their constituent government agencies, fish and livestock input suppliers, and associations of informal food business operators. We will also aim to influence the polices and priorities of international development partners, including global and regional technical agencies (OIE, WHO, FAO, UNEP; ASEAN, AU-IBARS and Africa-CDC) and

funders of global One Health efforts (development banks, philanthropic foundations, bilateral donors).

In order for Work Package outputs to affect national policies (causal pathways 1, 4, 5, 7), and to address the risks to take-up of evidence described in Section 7.3, we will engage local researchers with ties to One Health coordinating bodies as collaborators and partners from the inception phase of the Initiative. Further, the capacity of these coordinating bodies to understand and utilize evidence based on economic and other social science analysis will be built through the nomination of CGIAR and collaborating researchers to serve on technical working groups. Through active engagement and technical backstopping of One Health policy processes at the national level, CGIAR staff and partners will facilitate and promote inter-agency and cross-disciplinary information-sharing toward more integrated planning and implementation of One Health policies.

Research findings on how economics, gender, and other social factors affect One Health behaviors and risk exposures, as well as findings on tradeoffs between health, economic and food security outcomes, and the cost-effectiveness of interventions, will be shared through global research and capacity-building networks (GBADs, GBD, FERGII, SEAOHUN, AFROHUN, Global AMR Hub, ReACT, the Global One Health Initiative at Ohio State). Through the use of standardized methods and metrics, we will contribute to a coherent body of evidence on best-buys for One Health which can be used to inform funding priorities (causal pathways 2, 3, 6) and through these, national policy (pathway 8).

Private sector partners will be engaged in work to understand how commercial delivery of veterinary services and inputs can be better targeted and expanded to underserved areas, for example through public-private partnerships (pathway 1). Informal food business operators will be engaged from the inception stage in research on the commercial impacts of food safety upgrading through ECM, as their support is expected to be critical for its effective implementation by Food Safety Authorities (causal pathway 7).

4.Innovation Packages and Scaling Readiness Plan

The innovations our Initiative aims to scale lend themselves well to aggregation as scaling packages. For example, integrated public health and veterinary services for zoonosis control should be targeted using zoonotic disease risk maps and surveillance systems based on diverse data sources. The investment case for the provision of safe water in key nodes of ASF value chain must be made within systems in which evidence is used to inform One Health governance, and are expected to drive infrastructure provision, a key element of an enabling ("E") regulatory environment for food safety in the ECM approach to food safety in informal markets.

22% of the 9 Innovation Packages targeted for scaling through the One Health Initiative are at scaling readiness levels 4–7, being already used by other projects, organizations or actors, while the rest are at earlier stages. Scaling activities will be initiated in Q4 2022 (light track) and Q3 2023 (standard track), during backstopping wave 2. We aim to apply the Innovation Packages and Scaling Readiness approach to 76–100% of the total Initiative innovation portfolio by end of 2024.

We have allocated US$600,000 to implement the Innovation Packages and Scaling Readiness plan (2022: US$0; 2023: US$300,000; 2024: US$300,000). Dedicated activities, deliverables, indicators and line-items are included in the Management Plan, MELIA and Budget Sections.

5. Impact statements

5.1 Nutrition, health & food security

Challenges and prioritization: The COVID-19 has caused 4.7 million deaths and increased global poverty and malnutrition. Other zoonotic diseases with pandemic potential could lead to similar consequences. Endemic zoonoses mostly affect poor people and their animals causing low productivity and economic and health loss. [52] 60% of human infectious diseases originate from animal pathogens. AMR causes 700,000 human deaths annually[53] these are expected to rise sharply by 2030. Foodborne diseases cause a health burden that is comparable to each of HIV/AIDS, TB and malaria. None of these challenges receive levels of investment commensurate with their impact. The One Health Initiative will generate evidence to catalyze greater levels of investment and action in these areas, to reduce the human disease burden due to zoonoses, foodborne illness, and AMR, and to promote animal health, thus contributing to increased productivity, better nutrition and food security.

Research questions: How can integrated surveillance systems be designed and used sustainably for detecting emerging zoonotic diseases? What strategies can be used to improve the delivery of integrated (veterinary and public) health services in marginalized areas to better manage neglected zoonoses? What technologies, training and information do value chain actors need to improve food safety? What are the incentives and nudges that will motivate behavior change to improve food safety? How can the public sector provide an enabling regulatory environment and infrastructure for food safety? How does reducing on-farm AMU affect production outputs and farm profits, prevalence of AMR in fish and livestock and the farm environment, and the potential impacts on human health associated AMR? What incentives and nudges can improve targeting of and reduce AMU by small-scale livestock farmers or reduce antimicrobial prescriptions by veterinary drug retailers? What is the case for public provision of safe water infrastructure at markets and abattoirs?

Components of Work Packages: All 5 Work Packages will contribute to this Impact Area. WP1 (Zoonoses), WP2 (Food Safety) and WP3 (AMR) will be primarily focused on achieving impacts on health.

Measuring performance and results: All of the 3-year end-of-Initiative outcomes and metrics contribute to the health impact of the Initiative. Contributions to this area will be measured through randomized evaluations testing the impact of interventions on zoonosis prevalence and food safety outcomes, combined with modeling of health outcomes.

Partners*:* Demand partners include Ministries of Agriculture and Public Health, FAO, UNEP, OIE, regional economic organizations ASEAN, AU, National institutions (universities, NARS), livestock input suppliers, food businesses. Innovation partners are local research institutions in all countries, NARS, EcoHealth Alliance, international research institutions such as University of Liverpool, LSHTM, UCPH, Exeter University, Saint Louis University. Scaling partners will include governments, livestock input suppliers, food business operators, regional economic organizations ASEAN, AU, donors, NGOs.

Human resources and capacity development of Initiative team: Epidemiologists, microbiologists, biochemists, parasitologists, economists, anthropologists, sociologists, mathematical modelers, environmental scientists will collaborate on transdisciplinary projects to deliver impact in this area. PhD students in various fields will be recruited to work on specific components. External partners from EcoHealth Alliance and University of Liverpool will contribute specific inputs on wildlife and public health. Collaboration with HER+ on WP1, 3 and 5.

5.2 Poverty reduction, livelihoods & jobs

Challenges and prioritization: *The poor are disproportionately exposed and vulnerable to zoonoses, FBD, and AMR.* The COVID-19 pandemic pushed an estimated 97 million people into extreme poverty globally.[54] Other zoonotic diseases are primarily diseases of the poor, and 98% of the foodborne disease burden is borne by LMIC populations.[55] The poor are also more reliant on older-generation drugs, of which efficacy is being eroded by AMR as well as a higher likelihood of purchasing a fake or poor quality as they are prevalent in Africa and Asia.

Poverty exacerbates global One Health risks. Poverty is a likely driver of EID transmission events, for example through hunting and consumption of illegal bushmeat. It constrains people's capacity to adopt preventive animal health measures such as vaccination and biosecurity. Income considerations underlie the use of antimicrobial drugs for growth promotion and prophylaxis, eroding the global public good of antimicrobial efficacy; tradeoffs between preserving antimicrobial effectiveness and farmers' incomes and the cost of ASF must be taken into account in the design of policies for antimicrobial stewardship.

Research questions: Research questions regarding the production and profit impact of better-targeted, lower AMU will address trade-offs between current livelihoods and long-term public health outcomes. Development, testing, and scaling of strategies to improve the delivery of integrated (veterinary and public) health services in marginalized areas to better manage neglected zoonoses will both increase incomes (through improved animal productivity) and reduce the economic burden of health shocks on poor populations. Research to understand how food safety can be improved in informal value chains for ASF on which the poor rely, and scale-up efforts of successful approaches, will likewise reduce health risks and costs among poor populations. This work will also seek to ensure that low-income food business operators are included in efforts to upgrade food safety practices and outcomes and will assess how firm size relates to participation in and benefits from this approach.

Components of Work Packages: All Work Packages aim for impact on poverty and address decision-making within the constraints imposed by poverty. WP5 in particular will address how poor and vulnerable populations are affected by One Health policies.

Measuring performance and results: The End-of-Initiative outcome that *One Health policy planning takes into account gendered constraints and incentives of small- and medium-scale food system actors, and the magnitude and distribution of policy impacts*, aims to ensure that the capabilities of the poor are considered when designing One Health policies, and that the impacts of these policies on the poor are positive. In addition, the other outcomes, which relate to improved control of zoonoses, food safety, and AMR all benefit the poor by contributing to the reduction of the infectious disease burden disproportionately shouldered by this population. Metrics for this Impact Area: include stakeholder statements regarding the incorporation of livelihood considerations and distributional impacts in formulation of One Health policy, the number of livestock-keepers served by improved zoonosis control programs, and the number of consumers served by food business operators whose food safety outcomes are improved through capacity-building and surveillance under and ECM approach.

Partners: Innovation and scaling partners in this area include sub-national governments providing public health and veterinary services, private providers of livestock services inputs for zoonoses control, national One Health coordinating bodies, food safety authorities, and informal food business operators.

Human resources and capacity development of Initiative team: Work on this Impact Area will be led by microeconomists with experience in poverty measurement and the evaluation of interventions targeting health and livelihood outcomes of the poor. Partnerships with local researchers will be used to integrate findings into policy processes and achieve impact at this level.

5.3 Gender equality, youth & social inclusion

Challenges and prioritization: Women in livestock-dependent households provide significant labor inputs, and yet reap disproportionally lower economic benefits from these activities.[56,57] This creates a misalignment of incentives within households and may lead to under-investment in preventive health measures for animals that reduce the need for antimicrobials, or zoonotic disease incidence. Veterinary services tend to focus on serving male livestock keepers. Women in these households, who may have responsibilities or cultural restrictions that constrain their mobility, thus miss out on important knowledge that would enable them to better manage animal health.[58] Women's livestock knowledge is often under-valued and underutilized.[59] Valuing and respecting this knowledge can improve animal health outcomes and reduce zoonotic disease burdens. On the other hand, women's time is often under-valued. Understanding how the labor costs of practices promoted through the Initiative relate to gender and ensuring that One Health interventions do not contribute to women's time poverty, is critical.

Research questions: What anthropogenic factors or practices, including those influenced by gender, precipitate zoonotic EID and events and transmission of NZDs? Do women under-invest in livestock health due to exclusion from benefits of livestock production? How does gender relate to time spent on zoonoses reporting and control, manure management, and herd health measures that substitute for AMU? How does gender relate to firms' participation in and benefits from voluntary food safety upgrading?

Components of Work Packages: Research under Work Packages 1 and 5 to design and test gender-inclusive zoonoses surveillance systems and interventions, under WP5 to investigate the impact of an intervention to increase women's access to livestock profits on their participation in zoonoses surveillance systems or control efforts, and under WP2 to ensure inclusion of female food business operators in the benefits of voluntary food safety upgrading of informal firms.

Measuring performance and results: The End-of-Initiative outcome that *One Health policy planning takes into account gendered constraints and incentives of small- and medium-scale food system actors, and the magnitude and distribution of policy impacts*, aims to ensure that gender considerations are incorporated into policies influenced through the Initiative. We will measure progress toward this outcome through surveys of key stakeholders involved in government planning processes. In addition, we will track women's active participation and time spent use in all interventions tested and scaled through the Initiative (zoonoses control, food safety practices, alternatives to AMU, manure management).

Partners: We will coordinate with the HER+ Initiative on research investigating the influence of gender roles on investment in animal health and disease reporting. Potential innovation and scaling partners for gender-sensitive interventions include BRAC the Women Farmers Association of Kenya (WoFaAK).

Human resources and capacity development of Initiative team: A full time gender specialist will be employed at the cross-Initiative level to support gender work under all Work Packages, and a post-doc will be hired under WP3 (AMR) to support work on incentives and nudges to reduce reliance on AMU. Economists hired under WP5 have experience on the evaluation of gender-sensitive and gender-transformative interventions, and on the measurement of women's economic agency and voice within the household.

5.4 Climate adaptation & mitigation

Challenges and prioritization: Animal diseases, including zoonoses, reduce animal productivity and increase GHG emissions from the animals and their manure, implying high emissions intensities in LMICs.[60] Condemnation at slaughter due to zoonotic infection is a significant additional loss, which increases GHG emissions per unit of output.[61] Improved manure management alone has the potential to reduce CO2 equivalent emissions in the settings where we work by over 45%. In addition, many of these diseases are climate sensitive, meaning that climate change would significantly alter their epidemiological patterns by influencing vector, pathogen and host interactions. It is expected that smallholder and pastoral farming systems will suffer higher impacts from these diseases given their limited capacities to adapt to external shocks. The One Health Initiative will contribute to this Impact Area through i) reduced GHG emissions as a co-benefit of improved animal health, reduced condemnations, and manure management interventions, and ii) understanding the impact of climate change on zoonotic disease transmission and emergence, leading to disease prevention and control.

Research questions: What are the drivers (including land use and climate change) of emerging zoonotic diseases, and in what ecologies are these diseases likely to emerge? What solutions for resource, recovery and reuse (RRR) of animal waste have greatest potential? What are the value proposition, customer segments, cost structure and revenue streams for the proposed solutions?

Components of Work Packages: *B*etter control of zoonoses through WP1 will reduce rates of condemnation at slaughter, resulting in reduced GHG emissions per unit of ASF output. WP1 will also use climate change data to predict changes in occurrence patterns of climate sensitive zoonotic diseases. Improvements to manure management through Work Package 3 and 4 will reduce GHG emissions and soil degradation.

Measuring performance and results: End-of-Initiative outcomes related to climate are: improved EID surveillance capacity and policy and strategies integrating public health and veterinary services for prevention and control of NZDs are implemented; evidence on the AMR reducing effects of manure management strategies (composting or anaerobic digestion) and inclusion of manure management in revised national action plans on AMR; role of water in the

transmission of pathogens and AMR, and proposed solutions for waste and water management, are recognized in national One Health planning processes.

Partners: Demand: Ministries of Agriculture and Public Health, FAO, UNEP, OIE; Innovation: Universities, NARS, EcoHealth Alliance, University of Liverpool, LCSR**;** Scaling: government, private sectors, regional economic organizations ASEAN, AU, donors, NGOs

Human resources and capacity development of Initiative team: Epidemiologists, microbiologists, parasitologists, environmental scientists will contribute to this Impact Area.

5.5 Environmental health & biodiversity

While the One Health Initiative does contribute to aspects of environmental health (water pollution, improved management of wildlife interfaces) we do not expect to achieve substantial impacts on the CGIAR's collective targets in this area (reduction of consumptive water use in food production, zero net deforestation, reduced application and increased efficiency of nitrogen and phosphorus application, maintenance of genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species). We therefore do not address this Impact Area here.

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.				
Common impact indicators that the Initiative will contribute to and will be able to provide data towards				
DALYs averted	# poor people benefiting from relevant CGIAR innovations	# women benefiting from relevant CGIAR innovations	# tonnes $C0_2e$ averted	# ha under improved management
SDG targets				
3.3, 3.d	1.5	5.a	13.2	15.7

Action Area title (Resilient Agrifood Systems)	
Action Area outcomes	**Action Area outcome indicators**
Research and scaling organizations enhance their capabilities to develop and disseminate RAFS-related innovations	RAFSi 2.1 Number of organizations.
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
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

Initiative and Work package outcomes, outputs and indicators											
Result type	*Result*	*Indicator*	*Unit of measurement*	*Geographic scope*	*Data source*	*Data collection method*	*Frequency of data collection*	*Baseline value*	*Baseline year*	*Target value*	*Target year*
Zoonoses											
Output	Hotspot maps for EIDs in sub-Saharan Africa and southeast Asia developed	A technical report describing analyses done and maps	#	SSA and SEA	WHO, FAO and other international databases	Desk reviews and GIS extraction methods	Once at the start of the project	?	2022		2023

		generated posted on-line									
	ICT tools and infrastructure for syndromic surveillance for EIDs and zoonoses developed and applied for routine surveillance	Surveillance reports generated routinely and circulated among key stakeholders	Number of reports	Vietnam, Kenya, Côte d'Ivoire	Communities and actors in food value chains	Active and passive surveillance activities	Continuous for passive reporting, monthly for active surveillance	1 report on quarterly basis	2022	One report per month	2024
	Integrated One Health control measures for multiple zoonoses delivered in poor settings	MoUs or protocols demonstrating collaboration across sectors at sub-national level	Number of MoUs and protocols	Sub-national, Kenya	Institutions participation in the interventions	Key informant interviews	Start, mid and end of the project	0	2022	1	2024
Outcome	Improved knowledge on EIDs and zoonoses among decision makers	Report demonstrating increased knowledge among decision makers on zoonoses	number	Vietnam, Kenya and Côte d'Ivoire	Questionnaires administered to decision makers	Questionnaire surveys and observations	Before and after the intervention	0	2022	1 per country	2024
	Increased participation of private sector in zoonosis control	The private sector leads the provision of some of the One Health services previously implemented by the public sector	Number of interventions implemented	Sub-national, Kenya	Participating institutions	Key informant interviews	Beginning, mid and end of the program	0	2022	3	2024
	Existing Contingency Plans and decision support tools updated based on new knowledge generated by the project	Contingency Plans updated and presented for use in	Contingency plans	Kenya, Vietnam and Côte d'Ivoire		Key informant interviews, grey literature	Annual				
Outcome	Reduction in the burden of zoonoses	Lower disease burden observed in	DALYS	Kenya, Vietnam	WHO and other	Desk studies and modelling	Annual		2022		2030

	in animas, humans and the environment	intervention areas		, Côte d'Ivoire	surveillance centers						
Output	Process evaluation on factors inhibiting integration of public health and veterinary services, and to overcome these	Report	#	Kenya	Stake-holder surveys	In person surveys	3 times (baseline, mid-term, end-line)	0	2022	1	2024
Food Safety											
Outcome	Consumers served by informal food business operators have access to safer food.	Consumers	#	Vietnam, India, Ethiopia	Consumer and vendor reports	Surveys	Before and after interventions	0	2022	174,000	2024
Outcome	Governments integrate ECM approach for food safety into regulatory structures.	Policy	#	Vietnam, India, Ethiopia	Stakeholder letters	Elicitation of statements from partners in government	Annual	0	2022	1	2024
Output	Evidence on foodborne disease burdens and intervention priorities	Technical report, article	#	Kenya, Côte d'Ivoire, Uganda	Markets, consumption, value chain actors	Survey, lab analysis, modelling	Repeated sampling	0	2022	3	2024
Output	Feasible approaches and technologies developed and evidence on approaches that can best improve food safety in informal markets.	ECM approaches	#	Vietnam, India, Ethiopia	Intervention	Survey, lab analysis, KAP, RCT	Before and after intervention	0	2022	3	2024
Output	Training curricula on food safety at universities	Training modules on food safety	#	4 countries	University partners and ministry of Education	Meeting with key university partners	Annual	0	2022	4	2024

Output	Training curricula on food safety at universities (same output)	Short courses and training on food safety	#	4 countries	University partners and ministry of Education	Meeting with key university partners	Annual	0	2022	4	2024
Output	Documentation of success and failure factors of food safety interventions, lessons learnt	Report, article	#	2 countries	National programs, research projects on food safety intervention	Interviews, literature reviews	Once	0	2022	2	2024
Immediate outcome	Improved food safety practices and knowledge of value chain actors	Slaughterhouse workers, market vendors trained in adoption and delivery of food safety	#	Vietnam, India, Ethiopia (countries of intervention)	Results from RCT intervention	RTC research	Before and after intervention	0	2022	TBC	2024
	(same outcome)	Slaughterhouse workers, market vendors, consumer improved their knowledge and practices in food safety	#	Vietnam, India, Ethiopia (countries of intervention)	Results from RCT intervention	RTC research	Before and after intervention	0	2022	TBC	2024
Immediate outcome	Enabling food safety policy of ministries	Policy on food safety	#	Vietnam, India, Ethiopia	Proof of contacts with and statement of ministries on food safety policy changes (revision of regulation)	Meetings, documentations	Annual	0	2022	1	2024

Immediate outcome	Strengthened capacities of experts and government staff working on food safety	Staff capacitated in using risk-based approach in assessment and advocacy of food safety policy	#	Vietnam, India, Ethiopia, Kenya	Working group report, intervention report	Documentation and review, meetings	Annual	0	2022	TBD	2024
Immediate outcome	Reduction in foodborne disease in informal and traditional food value chains	Incidence of FBD (estimated number of new cases /100,000 people/year) in country	#	Vietnam, India, Ethiopia (countries of intervention)	Report from ministries, FERG report, research project reports	Documentation and review, meetings	Annual	0	2022	TBD	2024
AMR											
Outcome	Increased political will to address AMR based actionable CGIAR evidence and tested interventions	Inclusion of CGIAR evidence during revision of AMR National Action Plans.	Policy	Bangladesh, Kenya	Policy document	Policy review	annual	0	2022	2	2024
Output	Evidence on economic and cost-benefits of farm-level reduction of AMU and AMR	Peer viewed papers, reports, briefs,	#	Bangladesh, Kenya,	Report	Report	Annual	0	2022	2	2024
Output	Evidence on quality of drugs sold over the counter	Dataset, peer reviewed paper, report, policy brief	% of substandard drugs	Bangladesh, Kenya, Uganda, Côte d'Ivoire	Survey	Report	24 months	15%	2022	4	2024
Output	Context specific, gendered behavioral interventions to reduce AMU	Tools, peer reviewed papers, reports	#	Vietnam, Uganda	Survey	Report	Annual	0	2022	2	2024
Outcome	Role of the environment in the transmission of	Brief, report	#	Bangladesh, Kenya	Stakeholder survey	Workshop	Annual	0	2022	2	2024

	pathogens and AMR, and proposed solutions, are recognized in national One Health planning processes.										
Output	Tools developed for manure management to reduce AMR spread from farms and GHG emissions	Tools, dataset, peer reviewed paper, brief, report	#	Kenya	Annual Report	Report, workshop	Annual	0	2022	1-2	2024
Output	Environmental AMR surveillance framework using wildlife as sentinels	Tools, dataset, peer reviewed paper, brief, report	#	Kenya, Uganda, Côte d'Ivoire	Annual report	Report	Annual	0	2022	TBD	2024
Water											
Outcome	Role of water in the transmission of pathogens and AMR, and proposed solutions for waste and water management, are recognized in national One Health planning processes.	Number of One Health policies, plans and strategies that explicitly mention the role of water and proposed solutions.	Number of…	At least 2 focus countries	Policy documents	Policy reviews	18 months		2022	2	2024
Outcome	Role of water in the transmission of pathogens and AMR, and proposed solutions for waste and water management, are recognized in national One Health planning processes.	Number of key personnel in relevant government and international agencies that champion policy recommendations that consider the role of water	Number of	At least 2 focus countries	Stake-holder survey	Phone interviews	Annual	?	2022	3	2024

		and proposed solutions									
Output	Characterization/Modelling of loads, concentrations and human exposure to selected water borne pathogens (including ARB) in 2-4 watersheds.	Peer-reviewed papers, reports, briefs, tools, datasets	#	At least 2 focus countries	Annual report	Annual report	Annual	0	2021	4	2024
Output	Analysis of the relative contribution of the use of polluted waters to food safety risks in 2-4 selected food value chains	Peer-reviewed papers, reports, briefs, tools, datasets	#	At least 2 focus countries	Annual report	Annual report	Annual	0	2021	4	2024
Output	Business models for resource, recovery and reuse (RRR) of animal waste are co-developed with local stakeholders	Peer-reviewed papers, reports, briefs, tools, datasets	#	At least 2 focus countries	Annual report	Annual report	Annual	0	2021	8	2024
Output	Models for delivery and finance of safe water from farm to fork at critical control points in informal value chains	Peer-reviewed papers, reports, briefs, tools, datasets	#	At least 2 focus countries	Annual report	Annual report	Annual	0	2021	4	2024
Econ / Governance/ Behavior											
Impact	One Health policy planning processes incorporate understanding of gendered constraints and incentives among small- and medium- scale food system actors, and distributional impacts	policies	#	All focus countries	Stake-holder survey	Phone interviews and/or online form	Annual	?	2022	3	2024

	of policies and programs.										
Impact	Awareness of how economics and gender influence One Health risks increases among technical agencies, research networks, and funders	Change in capacity of key organizations & networks	Orgs	Global	Stake-holder survey	Phone interviews and /or online form	Annual	?	2022	3	2024
Output	Estimates of cost-effectiveness, distribution of public and private benefits, and implications for the financing of One Health interventions	Peer-reviewed papers, reports, tools, datasets	#	Global	Annual report	Annual report	Annual	0	2021	12	2024
Output	Evidence on the effect of competition on food business operator participation in ECM system	Peer-reviewed papers, reports, tools, datasets	#	Global	Annual report	Annual report	Annual	0	2021	5	2024
Output	Evidence on the drivers of behaviors associated with EID and NZD occurrence & transmission, including potential misalignment of women's and men's incentives within households	Peer-reviewed papers, reports, tools, datasets	#	Global	Annual report	Annual report	Annual	0	2021	6	2024
	Scalable tracking system for antimicrobial sales used in food production	Innovation	#	Kenya, Bangladesh	Baseline survey	Tracking data	Monthly	0	2021	2	2024
Output	Process evaluation on influence of research organizations on	Report	#	Global	Stake-holder surveys	In person surveys	At least 3 times (baseline,	0	2022	1	2024

	national policy through One Health Platforms and technical working groups						mid-term, end-line)				

6.2 MELIA plan

a. Narrative for MEL plans

At least three large-scale cluster-randomized evaluations on food safety interventions and integrated zoonosis control will be conducted within the Initiative lifespan (by 2024) to assess impacts of core innovations. Representative baseline and follow-up data will be collected on targeted groups, so that population-level impacts can be estimated. Smaller-scale experiments will assess the impact of reduced antimicrobial on farm profits in two systems. An Initiative-wide process evaluation will be conducted to assess CGIAR influence on One Health relevant policies and curricula across all 7 focus countries. This evaluation will use an adapted version of the Network for Evaluation of One Health (NEOH) tool for assessment of One Health Capacity. Separate process evaluations will be used to learn lessons about institutional challenges and success factors within the context of food safety and zoonoses control interventions.

Results from both IA studies and process evaluations will inform modifications to Innovations, Work Package Theories of Change, and Research Plans both within the 3-year Initiative lifespan and beyond. We do not expect making major adjustments to the management plan based on these results, but they will inform post-2024 management of One Health research in the CGIAR. Outcome mapping and outcome harvesting methods developed by IDRC will be used to evaluate progress toward the outcomes listed in the Performance Framework table above.

b. Narrative for impact assessment research plans

Learning questions related to key assumptions to be tested through causal impact assessment research will include:

- *Zoonoses:* Does the integration of public health and veterinary services increase the cost-effectiveness of these currently separate systems?
- *Food Safety:* Can a voluntary program to upgrade the food safety capacity and monitor the performance of informal food business operators, combined with consumer demand-building, be sustained by competitive pressure?
- *AMR:* What is the profit impact of reducing AMU in food production?

Activities and policy advice will aim to improve the scaling (readiness) of innovations and Innovation Packages, and to lay the groundwork for potential long-term, large-scale impact studies. In particular:

- Working with a sub-national (county) government in Kenya, we will demonstrate the cost-effectiveness of **integrating health and veterinary services** through an intervention study. We expect that based on this experience the partner government will adopt this approach at scale. A longitudinal study could potentially track the impact of the approach on zoonotic disease burden through a comparison of health records between this and other counties. Over time, building evidence will induce additional counties and national governments to adopt.
- Voluntary **food safety upgrading programs** will be tested in collaboration with public health authorities and informal food business operators through cluster-randomized trials. Positive results will induce governments to **integrate this approach into regulatory frameworks and practices**, and development partners to invest in it.
- Evidence on the impact of reducing AMU in food production on profit and needs assessment for farmers to make a profit-positive or profit-neutral transition to low-AMU production, will be communicated to government bodies and farmer organizations, enabling a way forward for the **implementation of national AMR Action Plans**.

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 (based on 2022-24 Initiative timeline)***	***Co-delivery of planned MELIA study with other Initiatives (tentative)***	***How the MELIA study or activity will inform management decisions and contribute to internal learning***
cluster-RCT	Consumers served by food business operators participating in food safety ECM	2024	Resilient Cities	Tests assumption that competition among food operators leads to adoption of voluntary ECM Tests assumption that evidence on reduction of food safety risks leads governments to incorporate ECM into regulatory approach
cluster-RCT	Farmers (including women) served by integrated public health/veterinary services	2024	HER+	Tests assumption that integrating service delivery improves cost-effectiveness
Qualitative Study	Farmers (including women) served by integrated public health/veterinary services	2023	HER+	Tests assumption that women in livestock-keeping households can be motivated to participate in zoonoses control
Process Evaluation	Strategies integrating public health and veterinary services for prevention and control of	2024		Within the intervention study to assess the impact of integrated zoonoses control, we will conduct a process evaluation testing the assumption that

	NZDs serve at least 100,000 livestock dependent individuals.			institutional barriers to integration of health and veterinary services can be overcome, and sheds light on how to achieve this.
Process Evaluation	AMR Action Plans, One Health Strategies, Food Safety Frameworks, curricula or their implementation are informed by CGIAR research	2024		Lessons learned during the first phase (2022–2024) of the Initiative will inform strategy for integrating evidence into policy processes during subsequent phases.
Scaling Readiness Assessment Study	Number of Initiative Innovation Packages that have undergone evidence-based and quality controlled/ validated Scaling Readiness assessments informing innovation and scaling strategies	2024		The study will inform the design, implementation and monitoring of an innovation and scaling strategy, and scaling readiness metrics can feed an optional Initiative innovation portfolio management system

7. Management plan and risk assessment

7.1 Management plan

An intensive planning process will be undertaken during the first three months of the project to build up the team, conduct scoping studies, and develop protocols for intervention trials. This will include a series of half-day virtual meetings for Initiative and Work Package leaders, and in-person meetings if circumstances allow.

Initiative and Work Package leaders will meet quarterly as a group to coordinate activities and check in on progress toward individual and joint outputs. Reporting against outputs and outcomes described in the Performance Framework and MELIA will occur annually. Based on these reports and research findings, the Work Package and overall Initiative TOC, risk assessments, and work plans will be adjusted.

Scaling readiness activities will be undertaken starting in Q3 of 2023 and applied to innovations based on the status and likely success of each as assessed at that point. Projection of benefits will be reassessed prior to the end of the 3-year duration of the Initiative.

7.2 Summary management plan Gantt table

Initiative start date		Timelines												Description of key deliverables
		2022				2023				2024				
Work Packages	**Lead organization**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	
Work Package 1: Zoonoses	CGIAR				**1**			**2**					**3**	*1. Risk-based surveillance and response framework for EIDs developed in Vietnam and Côte d'Ivoire* *2. Technical report: Drivers of emerging infectious diseases* *3. RCT on integrated (public health and agriculture) zoonoses control intervention in Kenya complete*
Work Package 2: Food Safety	CGIAR				**1**		**2**						**3**	*1. Food safety risk assessments in informal markets* *2. ECM approach developed and validated* *3. ECM RCTs completed*
Work Package 3: AMR	CGIAR								**1**		**2**		**3**	*1. Identified and piloted gendered behavioral science interventions that encourage rational AMU or prudent prescribing* *2. Policy brief on drug quality and highlighting potential policy interventions to improve veterinary drug registration, labelling and marketing* *3. Evidence on an economic case for eliminating antimicrobial growth promoters in a small-scale, LMIC farming context in livestock and aquaculture*
Work Package 4: Water	CGIAR				**1**				**2**		**3**			*1. Selected sites, partnerships built and validated methodologies* *2. Preliminary evidence on the relevance of water and proposed solutions in one-health* *1. Policy brief on the relevance of water and proposed solutions in one-health and recommendations to integrate into policy*
Work Package 5: Economics	CGIAR				**1**				**2**				**3**	*1. Strategies to increase women's role in zoonoses surveillance and control* *2. Evidence on the role of gender and other socio-economic factors contributing to zoonotic EID events and NZD transmission* *3. Evidence on scalability of ECM approach*
Innovation Packages & Scaling Readiness	CGIAR										**1**	**2**	**3**	*Evidence-based Scaling Readiness assessment reports and related scaling strategies for (1) Food Safety, (2) Zoonoses Control, (3) AMR Innovation Package*
MELIA	CGIAR		**1**										**2**	*1. Network for Evaluation of One Health (NEOH) tool for assessment of One Health Capacity refined and used to complete baseline study* *2. Follow-up assessment using adapted NEOH tool and mapping and outcome harvesting methods developed by IDRC*
Project management	CGIAR	**1**					**2**					**3**		*1. Inception meetings* *2. Mid-term meeting* *3. Close out and next stage meeting*

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** **Rate from 1-5**	**Impact** **Rate from 1-5**	**Risk score** Likelihood x Impact	**Opportunities**
Institutional barriers to inter-agency coordination are difficult to overcome	The way most government ministries and units within these currently operate does favor the cross-sectoral collaboration required to effectively address One Health challenges such as zoonotic disease, food safety, and AMR. Integrated surveillance of diseases may pose a challenge for collaboration across institutions responsible for public health, animal health, and the environment.	2.5	3.5	8.75	Document challenges and successes through process evaluation within integrated zoonoses intervention study. Identify ways to implement effective programs within single agencies.
Budget to adopt and scale innovations cannot be mobilized by partners	One Health is often not prioritized within public LMIC budgets and has relied to a large extent on external financial support. Convincing governments to invest in One Health is challenging.	2.5	5	12.5	Prioritize research to make an economic case for investment in One Health at the national level. In addition, use evidence to mobilize resources from international development community by emphasizing international public good dimensions of One Health.
Reluctance of national authorities to accept evidence or admit problems due to potential trade implications	Evidence on topics such as disease outbreaks and food safety risks are sensitive these can affect export and tourism sectors.	4	2.5	10	Co-create research agenda with national stakeholders, build relationships, use concern about sensitive sectors to motivate preventive action.
Delays in obtaining permits, for example for human and animal subjects research, international transfer of samples	Processes to obtain required research clearances can be time-consuming and unpredictable, as approval from multiple review boards and committees is often necessary.	2	5	10	Use institutional relationships to move processes forward
Preference for silver bullets over packages of simple incremental improvements discourages adoption	An expectation of immediate and strong impact based on a single intervention may inhibit support for integrated approaches such as ECM and integrated zoonoses control. For example, the ECM approach aims at developing with policy makers an enabling regulatory environment that is not	2	4	8	Co-creation of research and sustained engagement with national bodies to build capacity and communicate evidence

	punitive to food safety actors, but regulators often prefer reinforcement of existing punitive policies.				

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

The One Health Initiative 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 (e.g. CGSpace, DataVerse).
- 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) for assets derived from research with human subjects, including prior informed consent (PIC) and ensuring confidentiality of personally identifiable information (PII). When conducting research in countries, in addition to the approval from institutional ethical committee (IREC at CGIAR for example, an ethical approval from the country needs to be obtained.

9. Human resources

9.1 Initiative team

Category *Guidance: please enter 'research' or 'research support'.*	***Area of expertise***	***Short description of key accountabilities*** *Guidance: we suggest that this field is an opportunity for IDTs to make clear to funders how the composition of your team is well aligned to your TOC and Initiative priorities*
Research (management unit)	Research leadership	Overall research portfolio management, partnership development
Research (management unit)	Gender and Work Packages	Integration of a gender lens and gender-related research questions into all Work Packages

Research support (management unit)	Project management	Reporting (including M&E) and finances
Research support (management unit & Work Packages)	Communication, stakeholder engagement	Communication outreach, media/website management
Research (WP1)	Disease ecology, public health, epidemiology, disease control policy	Design, data analysis and epidemiological modelling, stakeholder engagement, supervision and reporting
Research (WP2)	Food safety risk assessment and interventions	Design, implement fieldwork, lab analyses, modelling, student and team supervision
Research (WP3)	Microbiology, mathematical modelling, biochemistry, environmental science, social science, economics	Design, implement fieldwork, lab analyses, epidemiological and sociological analyses, mathematical and economic modelling (shared with WP5), publish, supervision, stakeholder engagement
Research (WP4)	Water quality assessment in watersheds, water quality modeling, microbiology, waste management and business modeling	Design, implement and publish research and supervise researchers and support staff and students.
Research (WP5)	Economics, impact evaluation, governance	Design, execute, and publish studies investigating economic and governance questions. Contribute to impact and process evaluations.

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 (1) 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.

9.3 Capacity development

1. Initiative team leaders and managers will complete training on inclusive leadership within 3 months of launch.
2. Within 6 months of launch, Initiative team members will complete training on gender, diversity and inclusion, including on whistleblowing and how to report concerns.
3. The Initiative kick-off will include an awareness session on CGIAR's values, code of conduct and range of learning opportunities available within CGIAR.
4. Development opportunities will be made available for junior level Initiative team members, partners and stakeholders, including mentorship, training at the MSc and PhD and post-doctoral level, and short courses on research ethics and methods, and data management and analysis, with representation of emerging professionals from under-represented groups.

10. Financial resources

10.1 Budget

10.1.1 Activity breakdown (US$)

USD	2022	2023	2024	Total
Crosscutting (Across Work Packages)	1,362,696	1,099,388	1,137,916	3,600,000
WP1: Zoonoses / Wildlife	2,460,056	2,672,656	2,167,287	7,300,000
WP2: Food Safety	2,112,233	1,922,660	1,965,107	6,000,000
WP3: AMR	2,282,114	2,318,612	1,906,273	6,506,999
WP4: Environment / Water	1,281,679	1,429,250	2,282,071	4,993,001
WP5: Econ/Gov/Behaviour	2,000,000	2,000,000	2,000,000	6,000,000
				0
Innovation Packages & Scaling Readiness	0	300,000	300,000	600,000
Total	**11,498,778**	**11,742,567**	**11,758,655**	**35,000,000**

10.1.2 Geographic breakdown (US$)

USD	2022	2023	2024	Total
Global (not specific country)	1,362,696	1,399,388	1,437,916	4,200,000
Bangladesh	1,419,068	1,419,068	1,671,374	4,509,510
Côte d'Ivoire	1,281,809	1,329,552	1,149,223	3,760,584
Ethiopia	1,154,320	1,223,145	1,335,576	3,713,041
India	1,031,317	1,089,512	1,227,212	3,348,041
Kenya	2,701,963	2,714,979	2,649,404	8,066,346
Uganda	749,183	736,430	670,626	2,156,239
Vietnam	1,798,423	1,830,493	1,617,325	5,246,241
Total	**11,498,779**	**11,742,567**	**11,758,655**	**35,000,000**

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