Livestock, Climate and System Resilience

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Proposal

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Initiative name	Livestock, Climate and System Resilience
Primary Action Area	Resilient Agrifood Systems
Geographic scope	Latin America, Africa, Central Asia
Budget	US$ 55,000,000

1. General information

- **Initiative name**: Livestock, Climate and System Resilience (LCSR)
- **Primary CGIAR Action Area**: Resilient Agrifood Systems
- **Proposal Lead and Deputies**: Polly Ericksen (CGIAR), Jacobo Arango (CGIAR), Fiona Flintan (CGIAR), Mounir Louhaichi (CGIAR)
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2. Context

2.1 Challenge statement

Low- and middle-income countries (LMICs) require solutions that adapt livestock systems to climate change while improving nutritional security, reducing poverty, increasing social equity and socio-political security, without accelerating greenhouse gas emissions (GHGe) or degrading land, water, and biodiversity. Rangeland systems, home to 46% of ruminant production systems, face additional challenges to their long-term climate resilience, including land fragmentation and degradation, and long-term neglect (Herrero et al., 2016[i]; Ayal et al., 2018[ii]; FAO, 2018[iii]; Cervigni and Morris, 2016[iv]). Strategic, well-targeted action research can provide answers to the tough choices and tradeoffs as well as 'investable' solutions that attract policy attention and climate finance.

Facing a climate emergency, research must provide proven adaptive measures that safeguard and capitalize on livestock benefits[v]. Livestock are essential to the income and livelihoods of almost 930 million poor Africans and South Asians[vi], especially in drylands, where livestock production is the most ecologically rational farming choice[vii]. Consuming animal-source foods has positive impacts on our cognitive development[viii] and growth[ix], and animals are a critical safety net and source of income for women.

Livestock production is highly vulnerable to rising temperatures, erratic precipitation and increasing extreme events[x]. About US$311 billion in livestock production value (~40% of total) are exposed to various climate hazards, especially drought (US$88 billion), climate variability (US$84 billion) and heat stress (US$61 billion)[xi]. Dryland pastoral systems experience intensifying impacts from climate change and other forces (Herrero et al., 2016[xii]; Cervigni and Morris, 2016[xiii]). Climate is a threat multiplier, exacerbating existing risks and insecurities that may lead to further tensions[xiv] and conflicts[xv]. This is important for livestock agrifood systems (LAFS), where conflicts

on natural resources access, use and management (land, pasture and water) are a widespread concern[xvi]. Innovations such as improved and widely disseminated climate information services show promise[xvii], but there is little experience using them in LAFS.

Research must also provide innovations that mitigate livestock climate impacts. Livestock cause ~15% of human-induced GHGe[xviii] largely due to low feed efficiencies[xix] land use change[xx], land degradation[xxi] and deforestation[xxii]. Land degradation in rangelands is a particular concern; while restoration offers opportunities for carbon sequestration, rangelands receive little attention compared with forests (CDKN, 2021[xxiii]; IISD, 2016[xxiv]; Andrieu et al., 2017[xxv] ; Haddad et al., 2021[xxvi]; Cervigni and Morris, 2016[xxvii]). Nearly 50% of LMICs prioritize livestock-actions in their Nationally Determined Contributions (NDCs) — national blueprints for climate action[xxviii], and some are developing livestock-based Nationally Appropriate Mitigation Actions[xxix] (NAMAs), but implementation lags. Governments need technical support to access finance, implement programs and report mitigation achievements[xxx]. These challenges apply equally to the private sector where large-scale production changes landscapes, and supply and demand shifts can provide major benefits and influence consumer behavior, yet evidence for the livestock sector is scarce, meaning that investment in resilient, low emissions (RLE) practices by private actors along livestock value chains is low[xxxi].

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

By 2024, pastoralists and farmers adopt improved governance, management and restoration practices on 500,000 hectares of land used for livestock production, with at least 25% increase in women's active participation in decision-making processes.

By 2024, at least 300,000 livestock producing households implement RLE technologies appropriate to their production system, aiming to improve their adaptation to climatic stresses, reduce GHGe intensities and reversing land degradation. Labor-saving RLE technologies and mechanisms to support the potential for women to benefit will be developed, e.g. collective action approaches.

By 2024, at least 300,000 livestock producers (50% women and youth), and 13 public and private organizations access bundled climate information, insurance and credit services delivered through public-private partnerships. Women and youth, at least 25-50%, will show an increase in their use of the bundled services.

By 2024, impact investors, private sector entities, and international finance institutions plan US$50 million toward socially inclusive resilience building and/or low emission LAFS interventions.

By 2024, international agencies and policymakers use LCSR products to shape at least five policies or investments for stronger RLE and socially-inclusive LAFS, including at least three aiming to realize climate change related adaptation or mitigation progress.

2.3 Learning from prior evaluations and impact assessments

- CGIAR Research Program (CRP) on Livestock and Fish evaluation[xxxii] highlighted the need for a flagship focused on livestock and the environment.
- Lessons from CCAFS:

- Partnering with entities who express demand for research generated the most impact. It requires services rather than research projects. Partnership with the GRA provided legitimacy as well as extended networks. Regular engagement in UNFCCC COP events builds visibility, expanded partnerships and can lead to inclusion in IPCC reports.
- Climate-smart agriculture adoption is low due to lack of incentives, extension system capacities, and inadequate scaling networks to enhance uptake[xxxiii]. Analysis of available mitigation options versus NDC commitments in Latin America[xxxiv]
- Climate information services in Latin America[xxxv]; Honduras[xxxvi], Africa[xxxvii], Rwanda[xxxviii] highlight the need for institutional capacity building, user-centric design, and policy support for scaling and sustainability.

- Lessons from the Livestock CRP and PIM: For pastoral areas and rangelands: Governance is a precondition for further work; a flexible approach to restore rangelands is best[xxxix]; Participatory rangeland management[xl] strengthens governance and management of resources and improves productivity.
- Social inclusion insights and lessons were documented in diverse recent articles published under CCAFS and the Livestock CRP, and guided this Initiative[xli].

2.4 Priority-setting

Approach to priority-setting

LCSR implemented a multi-criterion prioritization approach[xlii] with three steps:

1. We first considered two dimensions: (i) the relevance of a country and value chain with respect to seven challenges for the livestock sector globally; and (ii) the importance of a country, livestock system and value chain in terms of rural people, value of production, tropical livestock units and pasture area.
2. Data analysis and evidence synthesis added geographical and value chain focus.
3. Assessment with additional criteria for targeting including CGIAR capacity and stakeholder demand in each of the countries.

Challenge statements

1. Climate change, climate variability and extremes hinder LAFS.
2. Despite their potential, the use of climate information services in LAFS is limited.
3. Social norms and practices limit or marginalize women, youth, or other vulnerable social groups from benefitting from livestock, and climate change can exacerbate this.
4. Livestock are responsible for a significant proportion of GHGe from agriculture.
5. Rangelands are under stress from climate change and anthropogenic pressure.
6. Public and private investors are reluctant to invest in livestock production.
7. Development and climate change policies on livestock lack coordination and coherence.

Resulting priorities

Evidence synthesis and data analysis for each of these challenges, followed by an assessment of CGIAR capacities and stakeholder demand suggests that LCSR should focus on rainfed mixed and pastoral livestock systems in the countries shown in Table 1. These priority countries and systems respond to known demand, capitalize on achievements from two phases of CRPs, and maximize synergies among the WPs, and between LCSR and other Initiatives (i.e., SAPLING, ClimBer, U2, LACResiliente, HER+, Data Harnessing, OneHealth, Genebank).

Table 1 Geographic focus for the LCSR Initiative

Region	Priorities
ESA	– 2022–2024: KE-Kenya, ET-Ethiopia, TZ-Tanzania, focusing on scaling and south-south exchange – post 2024: UG-Uganda, SS-South Sudan, MZ-Mozambique, ZW-Zimbabwe, MW-Malawi
WCA	– 2022–2024: SN-Senegal (scaling, breaking new ground), ML-Mali (breaking new ground) – post 2024: NG-Nigeria, BF-Burkina Faso, NE-Niger, GH-Ghana
LAC	– 2022–2024: CO-Colombia (scaling, south-south learning), GT-Guatemala (breaking new ground) – post 2024: HN-Honduras, SV-El Salvador, PE-Peru, EC-Ecuador, BR-Brazil
SA	– 2022–2024: None – post 2024: IN-India
SEA	– 2022–2024: None – post 2024: VN-Vietnam, PH-Philippines, ID-Indonesia
CWANA	– 2022–2024: TN-Tunisia (scaling, and south-south learning) – post 2024: KG-Kyrgyzstan, SD-Sudan, TJ-Tajikistan

We recognize that climate adaptation and mitigation for the livestock sector should be a top priority in many countries, and that the list of countries proposed for the 2022–2024 cycle is relatively small compared to the identified needs (Ramirez-Villegas et al., 2021[xliii]). We thus propose a bifurcated approach. In Kenya, Tunisia, and Colombia we are building upon years of research and stakeholder engagement under previous CRPs (Livestock and CCAFS) as well as bilaterally funded projects. This work has produced innovations ready to go to scale as well as policy influence. Work in these countries will focus on: (i) South-South exchange of innovations into other countries and regions, (ii) filling specific research-for-development gaps in LAFS adaptation, resilience, and mitigation; and (iii) testing specific innovations (e.g., improved forages) that are applicable across to other countries. Efforts in countries such as Mali, Senegal, or Guatemala where past CGIAR investment has been lower will focus on the full spectrum of LCSR interventions. In addition, this prioritization work points to a broader geographic range of countries that LCSR currently has resources to accommodate. We hope that the second (2025–2027) and third (2028–2030) phases will allow LCSR to work in other priority countries especially in South Asia, Central Asia, and Southeast Asia.

2.5 Comparative advantage

This Initiative is **uniquely positioned** to deliver evidence and outcomes to the CGIAR's mission to transform food, land, water — and livestock — systems in a climate crisis.

- We bring together **interdisciplinary expertise** (see section 9.2) across CGIAR institutions and beyond, including dryland systems, grasslands, gender, rangelands, finance, governance, livestock and climate modeling, GHGe measurement, policy engagement, impact assessment, digital applications, markets and more. Though diverse, the core attention of this expertise is united around climate change through a wide livestock lens.
- We offer a strong **track record** in academic publications[xliv] and research-for-development outcomes[xlv], covering all core areas where the lack of data, information and credible options stalls action. These results are not from 'ivory towers', our work comes from productive **multidisciplinary collaborations** that we nurture and leverage to achieve outcomes. Scientific quality and collaboration are both crucial for the success of LCSR.
- Beyond collaborative knowledge co-creation, LCSR researchers are **trusted brokers** working closely with demand-side development and humanitarian partners (e.g., 296-WFP, 285-IFAD, 125-WB, 60-IUCN, 765-SNV, 1189-2ODI, 298-WWF, 156-USAID), national governments, and international conventions and platforms (e.g., 265-UNCCD, 4326-UNFCCC, 6939-Global

Landscapes Forum and 462-IPCC). These local to global, practice to policy, insights, experience and reach provide confidence that LCSR can deliver research and scaling outcomes at all the levels outlined in this proposal[xlvi].

- The One CGIAR and LCSR have the most **advanced facilities** for measuring livestock-related GHGe in the Global South[xlvii] and **the intellectual capacity** driving innovation in big data analytics for climate change[xlviii].

2.6 Participatory design process

LCSR responds to challenges and needs identified in stakeholder consultations and strategic discussions in target countries and regions, and by CGIAR Funders[xlix] and other global stakeholders. LSCR has been formally endorsed by governments, Regional Economic Communities (RECs) and global networks[l].

Notably, LCSR directly responds to the Regional 2-Degree Initiative (2DI)[li]; the Climate Change Adaptation and Sustainability US$100 million GCF program[lii], conclusions from the Commission on Livestock Development for Latin America and the Caribbean[liii]; the WB US$60 million Accelerating Impacts of CGIAR Climate Research for Africa[liv]; the WB/IFAD US$440 million Lowlands Livelihoods Resilience Project in Ethiopia[lv]; the US$60 million USAID Resilience in Pastoral Areas Ethiopia project[lvi]; the US$222 million IFAD/WB/USAID Agriculture and Livestock Competitiveness Program in Senegal;[lvii] other IFAD investments in target countries;[lviii] the Regional Sahel Pastoralism Project II[lix]; and Africa drought risk financing consultations.[lx] Country strategies including NAMAs,[lxi] country climate strategies,[lxii] focus on livestock to achieve mitigation targets. Past engagement with Greening Livestock[lxiii]and the Programme for Climate-Smart Livestock[lxiv] highlighted the need for research to improve progress tracking for climate targets[lxv].

In addition, direct consultations with demand partners in the design of LCSR include:

- Community consultations in past/current project areas with filmed interviews available.
- Livestock group at WB[lxvi], IFC, and GRA[lxvii] seeking technical support to attract climate finance to reduce GHGe in livestock sector.
- African Group of Negotiators needing capacity development in RLE strategies.[lxviii]
- Bilateral conversations with IFAD technical advisers and country directors together with a series of webinars on CGIAR-IFAD collaboration.[lxix]
- Agreement with SNV for collaboration.[lxx]
- Discussions with FAO for collaboration.[lxxi]
- Participation in Tanzania IDT livestock teams' consultation workshop.[lxxii]
- Consultations with private companies including MINVERVA Colombia[lxxiii]; and Oromia dairy project in Ethiopia, iCow and Mediae in East Africa.[lxxiv]
- Conversations with UNEP program managers including missions to Senegal and Mali.[lxxv]

2.7 Projection of benefits

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

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

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

LCSR developed these estimates independently of other proposed CGIAR Initiatives — the full method and results description are available[lxxvi].

We anticipate synergies with other Initiatives as per our TOC and based on discussions with ClimBer, SAPLING, HER+ OneHealth, Ukama Ustawi, MITIGATe+, LAC Resiliente, Transforming Agroecology, Genebank) and Digital Harnessing. To ensure the estimates are conservative and to avoid double counting of beneficiaries between Initiatives, we have not assumed additional impact from these collaborations in this set of projections. We will further develop the synergies and factor in the outcomes of these during the inception period.

Table 2 Projected benefits of the LCSR Initiative

Breadth	**Depth[lxxvii]**	**Probability[lxxviii]**
Numbers reached	Intensity of effect	Degree of certainty
1. **Nutrition, health and food security:** 1.97 million people benefiting from relevant CGIAR innovations	**Significant** – a 100% increase in annual income or 10% permanent increase in income	High – between 50% and 80%
2. **Poverty, livelihoods and jobs:** 2.96 million people benefiting from relevant CGIAR innovations	**Significant** – a 100% increase in annual income or 10% permanent increase in income	Medium – between 30% and 50%
3. **Gender, youth and social inclusion:** 4.94 women benefiting from relevant CGIAR innovations	Of the 4.94 million women benefiting, we expect 3.7 million to benefit **significantly** – with differential needs met. We further expect the benefit to be **transformative** for 1.2 million women, with the Initiative contributing to change process which could shift underlying, constraining gender norms and dynamics.	Medium – between 30% and 50%
4. **Climate adaptation and mitigation:** 9.87 people benefiting from climate-adapted innovations	Of the 9.87 million people benefiting we expect: 2.96 million to benefit **substantially** (with a permanent increase in income of around 50%) 5.92 million to benefit **significantly** (10% permanent increase in income) 1 million to benefit **perceptibly** (1 – 5% permanent increase in income)	Very high - > 80%
5. **Environmental health and biodiversity:** 2.0 million hectares under improved management	**Transformative:** we expect improved management to delivers improvements in soil health and fertility, delivers biodiversity gains, and provides additional ecosystem service improvements	High – between 50% and 80%

Note: The figures in the table are not exact predictions of what LCSR will deliver by 2030. Rather, they are reasonable, illustrative projections to help CGIAR and its Funders understand the potential benefits of LCSR.

Expected benefits for Impact Areas: 1. Nutrition, health and food security (IA1); 2. Poverty reduction, livelihoods and jobs (IA2); 3. Gender equality, youth and social inclusion (IA3); 4. Climate adaptation and mitigation (IA4)

Breadth

We implemented a bottom-up approach that takes the project budget and assumptions about innovations and innovation scaling readiness as the starting point. Briefly, we use cost per beneficiary from past and current investments in the areas of work of LCSR and multiply these times the total investment over the 2022–2030 period to estimate overall beneficiaries at the Initiative level. For 2022–2024 we assume US$60 million direct investment by the CGIAR system, and for the remaining six years, we conservatively assume that LCSR is capable of leveraging a total of US$150 million. The Climate Funds Update[lxxix] documents about 89 investments in the agricultural sector (virtually all of which include livestock) valued at about US$150 million per year. Based on past experience with the CCAFS and LIVESTOCK CRPs, we believe this assumption is conservative. For instance, between 2015 and 2016 the CCAFS low emissions and climate-smart agriculture Flagships helped catalyze US$223 million for the dairy sector NAMA[lxxx] and US$250 million for climate smart-agriculture in Kenya[lxxxi]. Our calculations also account for innovation diffusion; that is, each beneficiary in the 2022–2024 period influences five beneficiaries in the remaining six years. Further refinement of leveraged investments is possible only once LCSR implementation is underway.

The total number of people benefitting from LCSR by 2030 is **9.87 million**. These were then disaggregated into each of the One CGIAR Action Areas. LCSR's theories of change offer direction to do these allocations. For IA4 (Climate adaptation and mitigation), we assume the projected beneficiaries equal the total number of benefitting people based on the rationale that the entire LCSR Initiative is focused on climate adaptation and mitigation. For IA3 (Gender), we multiply the total benefitting people times 0.5 (equivalent to the fraction of women in LCSR target areas). For IA2, we multiply the total number of people benefitting times 0.3 (fraction of people living in extreme poverty. For IA1 (Food insecurity and nutrition), we use a multiplier of 0.2 (percentage of people with insufficient food consumption[lxxxii]). Results indicate **1.97 million** people (IA1), **2.96 million** people (IA2), **4.94 million women** (IA3), and **9.87 million** (IA4) are projected to benefit from LCSR by 2030.

Depth and probability

IA1. We foresee **significant** impacts. The Evidence for Resilient Agriculture meta-dataset includes more than 400 livestock studies that took place in Africa. Evidence on income improvements of example LCSR interventions range between an average of 21% and 68% depending on the livestock species[lxxxiii]. Given direct impacts on food availability from healthier and more productive livestock, and benefits mediated through income and reductions in asset loss (due to greater capacities to manage climatic extremes), the probability that these projections come to pass by 2030 is **high.**

IA2. Based on the same evidence as for Impact Area 1, we foresee **significant** impacts. However, because extreme poverty (as considered for this Impact Area) can be a constraint to adopting innovations, the scaling pathways are often more constrained than for other types of beneficiaries. Thus, we give this projection a **medium** probability to come to pass by 2030.

IA3. Women are both vulnerable to climate change, but also powerful agents of change, yet the depth of impact for women and youth is difficult to determine. This is due to the difficulty to separate impact levels based on literature and past work, and to the lower levels of evidence of gender impacts from CGIAR climate change research compared to other areas of work[lxxxiv]. LCSR will work with a gender lens to address capacity and adaptation needs of women and youth, and to foster policies that seek to transform gender dynamics. LCSR will likely yield a combination of Gender sensitive and Transformative impacts, with the majority (70–80%) of direct and indirect beneficiaries likely in the category of **gender sensitive**, and the rest (20–30%) fall will likely experience **transformative** effects. Due to the uncertainty in the impact levels (depth), we assign a **medium** probability.

IA4. We project **significant** impacts. Based on a review of income gains from RLE agriculture practices, climate information services, and insurance, we find that income gains of up to 50% are possible[lxxxv]. Together with the technologies implemented by WP2, which can boost productivity by up to 50% (see IA1), these interventions will very likely improve permanent incomes by up to 50% or more. However, given the variable performance of these technologies, we argue that most (60–70%) beneficiaries will perceive, on average, Significant impacts. A second group will likely experience **substantial impacts** (20–30%), and a third group (<10%) will likely experience **perceptible** impacts. Based on past outcomes and achievements, the existence of scaling networks, and LCSR's TOC, we assign a **very high** probability that these projections come to pass by 2030.

Expected benefits for Impact Area 5 (IA5): Environmental health and biodiversity

Breadth

We estimate that **2 million hectares** will be under improved management by 2030. Applying the same approach as for IA1–4, we convert the cost per beneficiary and breadth figures above to area under improved management. Households are assumed to adopt improved practices on a quarter of the average land holdings, 0.5 and 5 ha per household in Africa and Latin America, respectively. We apply these conversions to 75% and 25% of the beneficiaries calculated in IA4, based on the assumption that this is the expected relative Initiative effort between the two regions. Where LCSR targets improved rangeland management directly (WP1), we estimate a cost per ha, using a cost per ha value of US$62 based on historical and existing similar donor funded projects in the target region.

Depth and probability

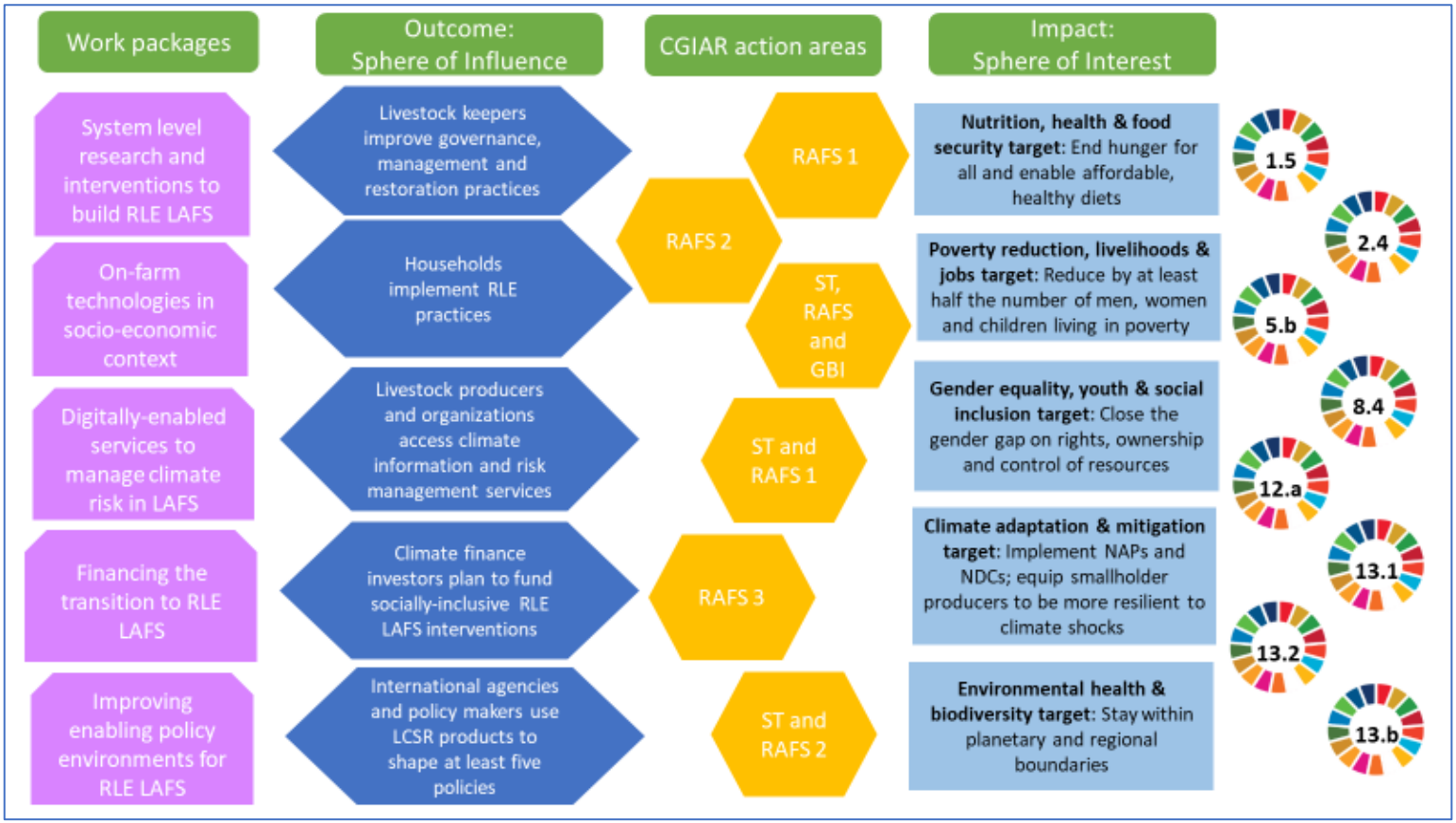
Improving land management at the scale suggested will be **transformative**. The land use and land cover change processes associated with livestock and landscape, rangeland and forest degradation contribute significantly to pushing Earth's support systems beyond its safe operating space. With these systems linked with important biodiversity and influencing infectious disease emergence, achievement of IA5 becomes one the most compelling reasons for LCSR, in collaboration with the other livestock Initiatives SAPLING and OneHealth. Based on the success of previous projects and taking into account the scalability of the approaches proposed in LCSR, we assign this projection a **high** probability.

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

3.1 Full Initiative TOC

3.1.1 Full Initiative TOC diagram

Figure 1: Full Initiative TOC diagram



3.1.2 Full Initiative TOC narrative

The livestock sector urgently needs to adapt to climate change while reducing its impact on the global climate system. Pastoral systems operating in drylands need to strengthen their resilience, and other livestock systems need to cut deforestation and reduce GHGe. LCSR will partner with public and private actors to develop and deliver actionable innovations that measurably help producers, businesses, and governments adapt LAFS to climate change and reduce GHGe, contributing to all five CGIAR Impact Area outcomes. LCSR will contribute to sustainability and development goals across different livestock systems in Colombia, Guatemala, Senegal, Mali, Kenya, Tanzania and Ethiopia.

Each Work Package is focused at a particular level, but linked to ensure they contribute to one another and the overall Initiative and Action Area outcomes. Innovation Packages will be co-designed with partners drawing from across Work Packages, with 35+ innovations conceptually formulated and available to view[lxxxvi].

Beginning at the livestock production system level, **Work Package 1** will support pastoralists and farmers to adopt improved governance, management and restoration practices that build the resilience of their systems to climate-related stresses and crises by offsetting GHGe, reducing conflicts over resources, and enhancing capacities to manage climatic risk, particularly in pastoral systems **(RAFS 1, ST&RAFS 1).** We assume that an approach beginning with governance arrangements ensures all land users are enabled to implement improved land management at the production level, reducing pressure on forests and grazing lands. Improved land management will result at least in part from smallholders and other actors having capacities to implement improved practices and technologies developed in **Work Packages 2 and 3**, together leading to improvement in smallholder abilities to cope with climate risks (**ST&RAFS 1, ST&RAFS&GI 1**).

At the household level, **in Work Package 2**, LCSR will work with livestock producers to promote promising practices to build adaptive capacity and reduce GHGe towards climate neutrality (**RAFS 1**, **ST&RAFS 1**). The uptake of value chain-level technologies to manage climate risk, **from Work Package 3**, will be increased, we assume, by removing constraints including user capacities, affordability, and high transactional costs. For all three Work Packages, attention to gender and age dynamics and key partnerships will ensure that gender and youth-specific opportunities and constraints are addressed. This contributes to enhancing partners capabilities to disseminate innovations (**RAFS 2**).

LCSR will engage with various public and private sector climate investors through **Work Package 4**. We will build investor confidence in the livestock sector by better understanding their needs for investment and monitoring, and improving the capacity of SMEs to absorb finance. A key assumption is that we can build trust and understand investor constraints and needs, and respond with sufficient evidence. While climate investors are key to scaling, public finance will also be needed to sustain and scale LCSR interventions and contribute to investment in climate smart business models (**RAFS 3**). Finally, **Work Package 5** improves the national, regional and global enabling policy environment for system resilience-building, technology uptake and scaling and increased climate financing in the livestock sector whilst supporting governments to fulfill their climate-related monitoring and policy commitments. This assumes that we continue to work cooperatively and meaningfully with decision makers (**ST&RAFS 2**).

3.2 Work Package TOCs

3.2.1 One-page diagrams per Work Package

Figure 2: Work Package 1 TOC diagram

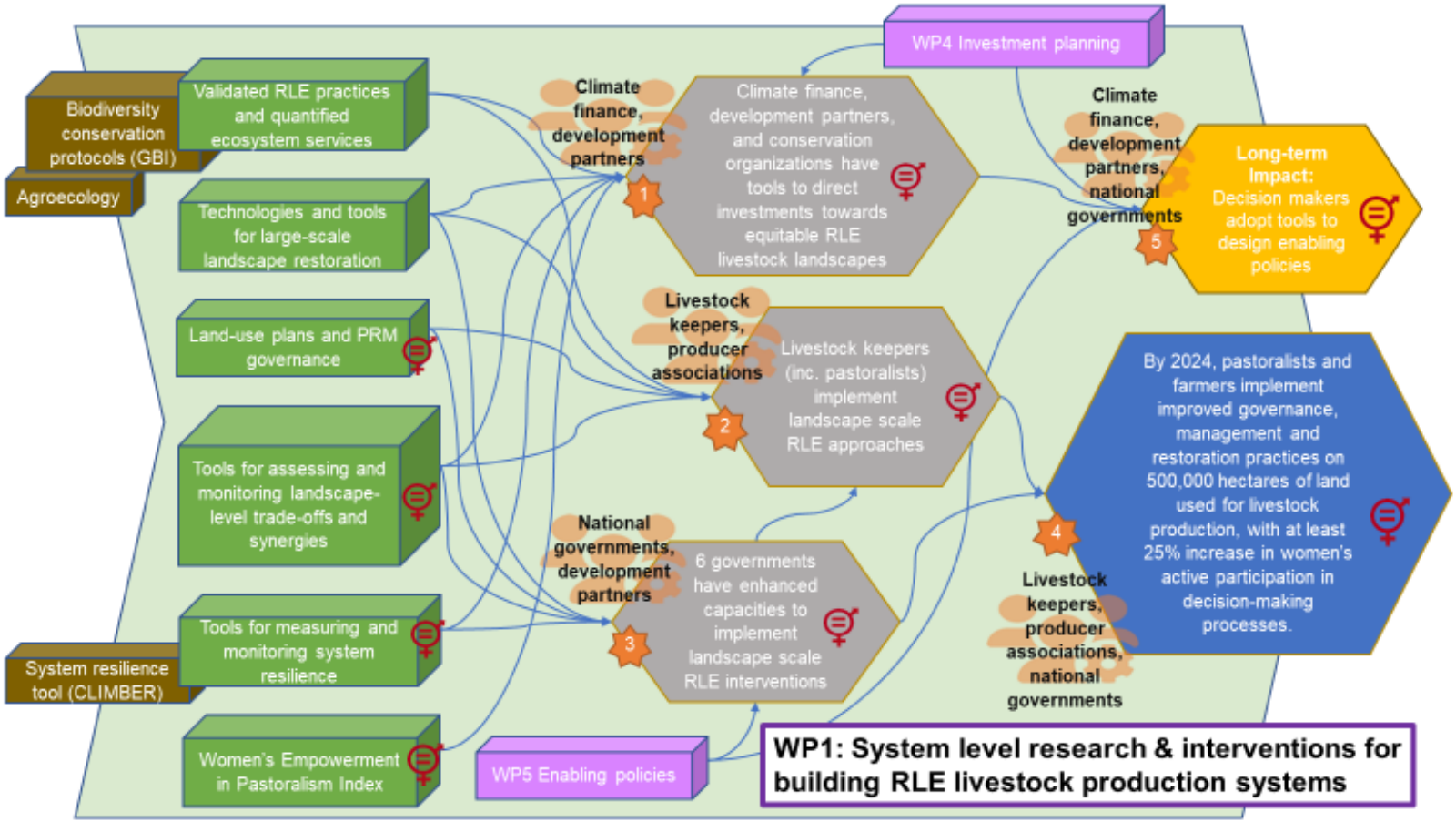


Figure 3: Work Package 2 TOC diagram

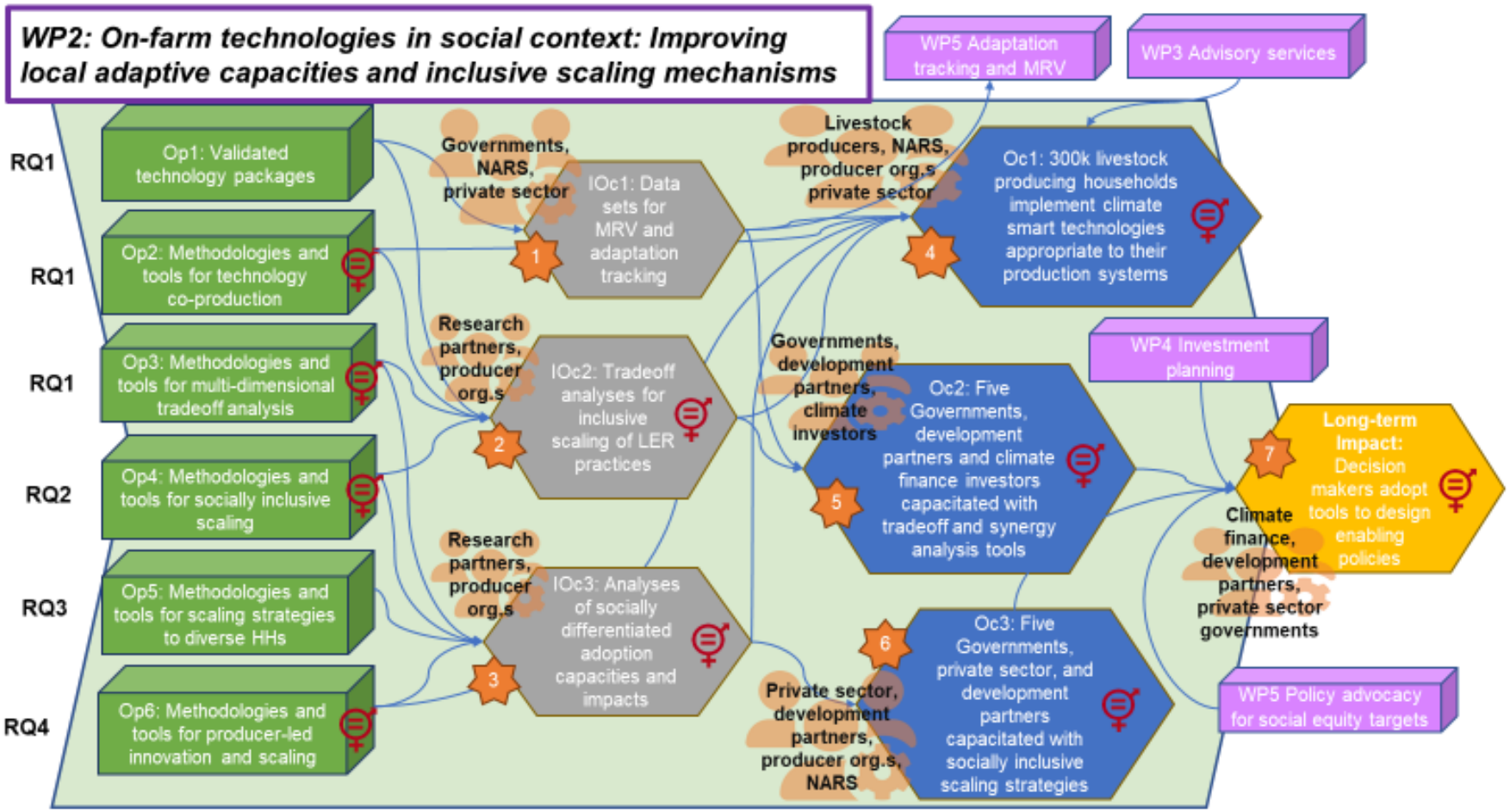


Figure 4: Work Package 3 TOC diagram

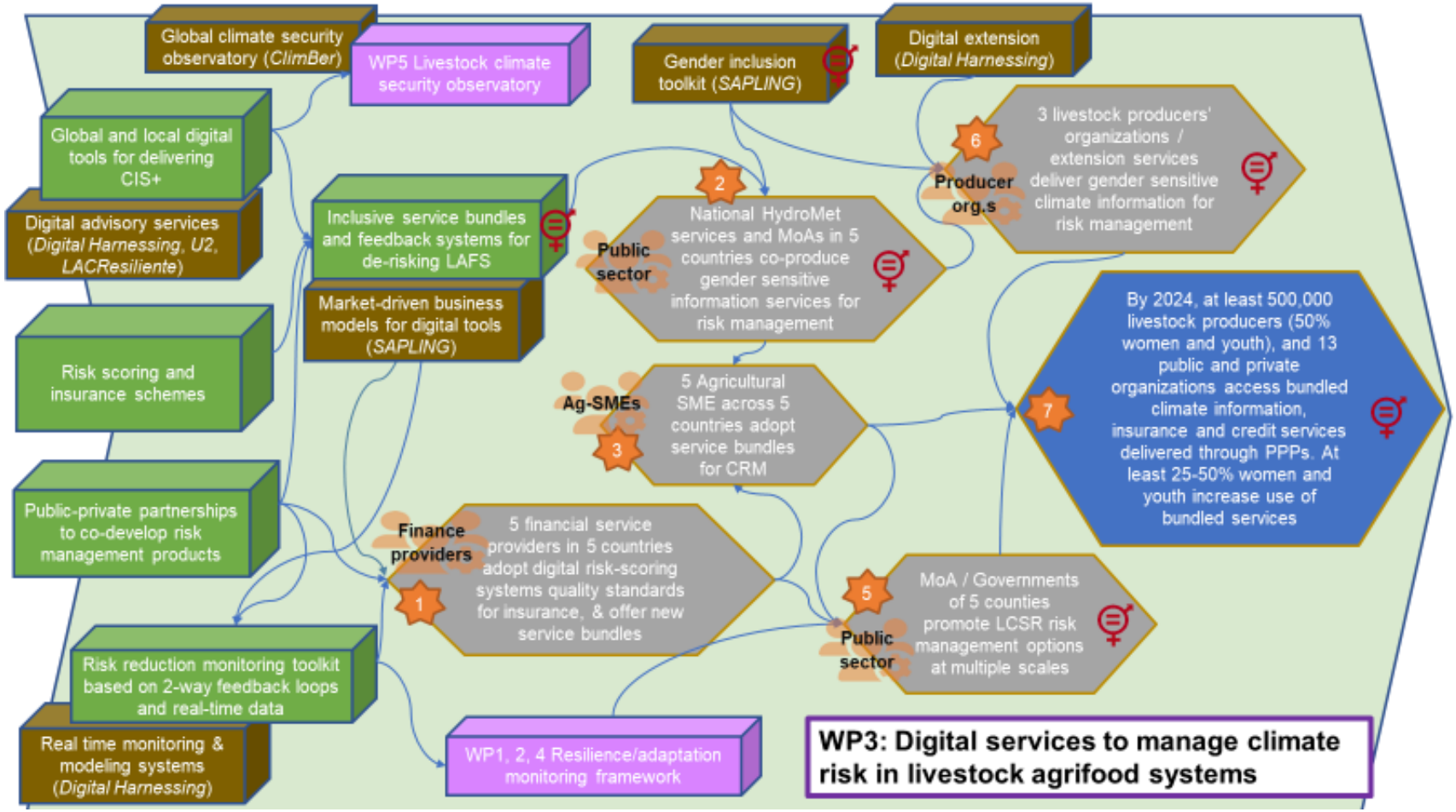


Figure 5: Work Package 4 TOC diagram

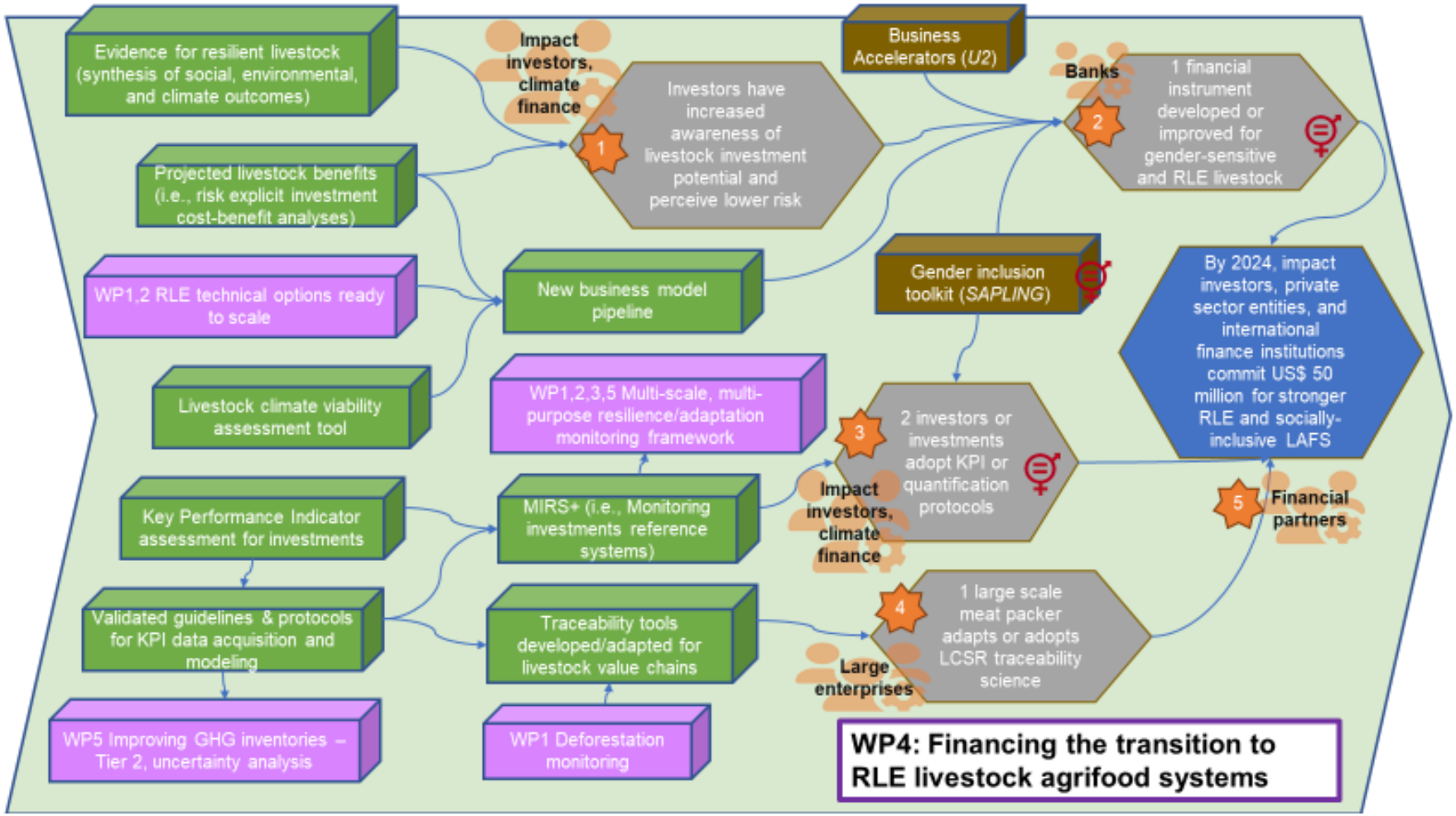
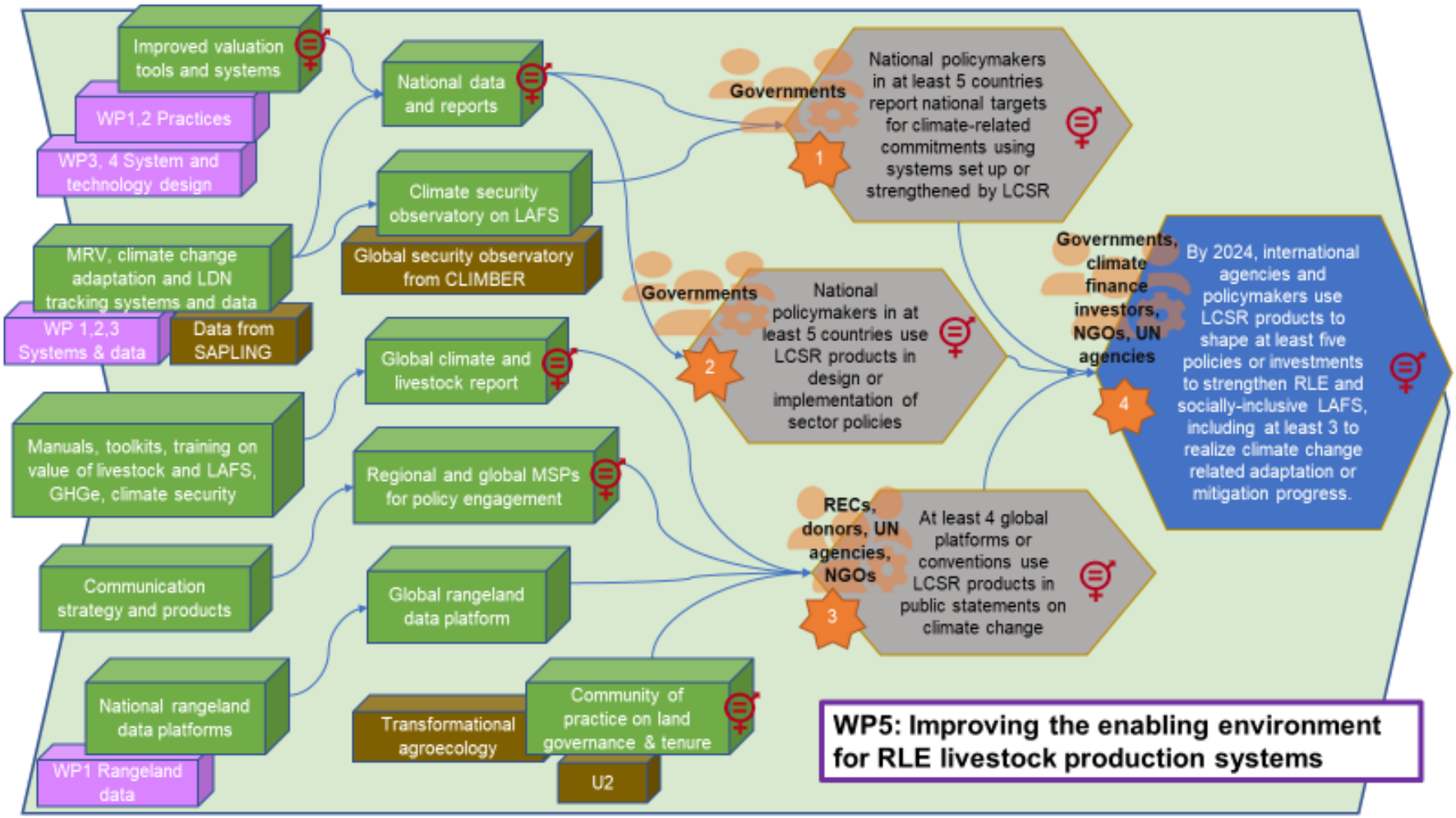


Figure 6: Work Package 5 TOC diagram



3.2.2 Work Package research plans and TOCs

3.2.2.1 Work Package 1

Work Package title	**System level research and interventions for building RLE livestock production systems**
Work Package main focus and prioritization	Building climate-related resilience of LAFS is a priority, particularly of pastoral systems. Despite progress in household resilience-building, the resilience of systems of which these households are part is not prioritized (Douxchamps et al., 2017[lxxxvii]; GIZ, 2014[lxxxviii]) compromising development/humanitarian intervention impacts[lxxxix]). Through action research, WP1 will contribute to LAFS system resilience in at least 6 countries, prioritizing pastoral systems. Core to this is good socially inclusive land/natural resource governance, management and participatory multistakeholder multilevel land use planning — WP1 supports improvements in these, building on achievements of CRPs. Reversing degradation and restoring lands, particularly rangelands, is targeted by developing regenerative livestock activities and strengthening appropriate integration of trees.
Work Package geographic scope	Latin America (CO-Colombia, GT-Guatemala); West Africa (SN-Senegal, ML-Mali); East Africa (KE-Kenya, ET-Ethiopia, TZ-Tanzania); Central Asia and North Africa (TN-Tunisia)

WP1 Science

Research questions	Scientific method(s)	Key output(s)
1. Quantification of LAFS characteristics at the landscape level • What are socio-economic and environmental costs and benefits of LAFS? • How can landscape level ecosystem services — e.g. GHGs, biodiversity — be measured, monitored and valued? • What are relationships between LAFS and landscapes including physical, social and political-economic aspects? • How can tradeoffs and synergies between environmental and socio-economic values be managed and reconciled?	• Comparative analysis of LAFS options by context research at systems level. • Complex adaptive systems framework[xc] • Life Cycle Analysis • Soil carbon analysis • Implementation of different GHG metrics towards climate neutrality • Socio-economic valuation of landscapes • Resource flow mapping • Climate security mapping • Multi-criteria analysis, foresight	• Tools for assessing multi-dimensional tradeoffs and synergies at landscape level • Quantified ecosystem services
2. Measuring and building system level resilience to climate change • How can system level resilience be measured? • How can climate resilience be enhanced for different stakeholders and priorities?	• FAO Resilience Index Measurement and Analysis[xci] • Gender analysis in governance of NRM • Household surveys	• Tools and indicators for understanding, valuing, measuring resilience of LAFS at system level. • Multistakeholder partnerships to build resilience of LAFS. • Manuals/guides on building resilience of LAFS including climate security interventions

• What socio-economic factors influence adoption of resilience-building innovations?	• Key informant interviews	• Women/youth Empowerment in Pastoralism Index
3. Participatory landscape approaches • How can good governance, tenure security and conflicts between land users in LAFS-dominated landscapes be improved? • How can land use planning in LAFS-dominated landscapes be improved? • How does implementation of PRM affect gender relations in communities and households?	• Social network analysis • Participatory mapping • Participatory GIS • Political ecological analysis of land tenure and access institutions • Tradeoff analysis	• Tools, processes, manuals for improved good governance, tenure, land use planning, and biophysical indicators. • Land use plans and/agreements at appropriate scales • Upscaled participatory rangeland management (PRM) and pilots in new countries with gender mainstreamed • Guidelines on scaling gender in PRM in different contexts
4. Restoration at scale for climate-resilient LAFS and landscapes • How can landcover maps help locate best opportunities for land restoration? • What technologies, processes and capacity building can best support restoration at scale? • How can the role of rangelands and grasslands in offsetting GHGe and sequestering carbon be captured in climate-related monitoring? • How can livestock feed and forage be better managed to build resilience?	• Rangeland and forage inventory tools • LandPKS[xcii]; participatory mapping • Soil carbon and GHGe measuring • Improved forages and grazing management • Remote sensing • Digital technologies and drones • Methods to evaluate soil health parameters	• Manuals, tools, technologies and tools for large-scale restoration (SRM toolkit) • Book on key rangeland/forage species suited for rangeland restoration in the dry areas • Online course for sustainable rangeland restoration • Native forage and rangeland species (biodiversity) identified, collected and conserved
5. Building resilience of LAFS through trees • What is the contribution of trees to construction of resilient low-emission LAFS? • What is the potential for increasing trees in LAFS including GHG offsetting? • What technologies, processes, capacity buildings can support the increase of trees in LAFS?	• Forest inventory tools • Digital technologies e.g. drones • Multi-criteria analysis • Foresight • Forest selection and multiplication	• Validation of remote sensing tool for deforestation monitoring • Establishment of silvo-pastoral system pilots • Manuals and trainings on benefits of trees in LAFS. • MRV system and GHG inventories accounting for tree carbon sinks

WP1 Theory of change

By 2024, WP1 will support pastoralists and farmers to adopt improved governance, management, and land restoration practices on 500,000 hectares of land used for livestock production in six countries, with at least 25% increase in women's active participation in decision-making processes. Furthermore, research in WP1 will provide evidence-based options and improve livestock keepers', governments', and development actors' capacities for socially inclusive, climate-resilient LAFS. WP1 will focus on landscape approaches, especially land restoration at

scale. We will work directly with government, development and conservation partners, communities and others in undertaking research, problem-solving, prioritization and piloting of proposed interventions. Sites will be selected to optimize opportunities for capacity building and scaling. As much as possible, activities will be embedded in government-led development projects and be measured against climate action targets and biodiversity conventions. Systems will be set up with governments to continue monitoring and data collection. Innovations will be developed for upscaling, whilst working with WP5 on improving the enabling policy environment.

Demand partners include national government, communities, livestock herder unions and development agencies including 125-WB, 285-IFAD and 296-WFP. Innovation partners include NARS, ARIs, 1270-CIRAD, 765-SNV, 1407-GIZ, 60-IUCN, local NGOs, the 1820-ESA, GMV (technology company), 117-GRA, 69-FAO forest desk, Pastoralist Knowledge Hub, 1892-ILC, 670-The Nature Conservancy and livestock producers' associations. Embedding research within government-led projects will optimize scaling opportunities. UN and development agencies will also play a key role. Other scaling partners include 1845-CSAYN, 6939-GLF, 1830-UNEP (Decade on Ecosystem Restoration), Resilient Landscapes.

Our overarching assumptions are that: (i) the interest of governments and other stakeholders to support interventions in LAFS is sustained; (ii) LAFS can be resilient with lower GHGe (emission offset and reduction) when a landscape approach is taken; (iii) communities and other stakeholders are willing to adopt resilience-building innovations; (iv) informed interventions that include innovations and capacity building are effectively implemented at scale delivering expected benefits, and; (v) LAFS can contribute to stopping deforestation and biodiversity losses.

WP1 has the following linkages with other Work Packages:

- **WP2**: Technical packages related to feed and forages, for example, are developed in WP2 for application at landscape level in WP1.
- **WP3:** digital technologies, credit lines, digital providers (SMEs), insurance products, climatic forecast and literacy for producers and investors ready for application at landscape level in WP1.
- **WP4**: Climate-related investors and finance are mobilized for investing in LAFS.
- **WP5**: The enabling environment will be improved for LAFS broadly and more specifically the scaling up and sustainability of interventions beyond the project lifetime. A tool for cost-benefit analysis of land use change will be developed in WP5 and implemented in WP1.

WP1 will co-create Innovation Packages with government and other stakeholders, which will assist them build resilience of LAFS to climate-related shocks and stresses, drawing from at least 13 innovations, as currently listed under WP1 here and complementary innovations from other WPs. During design and implementation, bottlenecks and challenges will be addressed. Scaling readiness assessment will be applied to core innovations in WP1 prioritizing innovations #1.1, #1.4, #1.5 #1.6 #1.8, #1.11 and #1.12 starting in 2022.

3.2.2.2 Work Package 2

Work Package title	**On-farm technologies in social context: Improving local adaptive capacities and inclusive scaling mechanisms**
Work Package main focus and prioritization	WP2 conducts interdisciplinary analyses of on-farm technology packages to support inclusive scaling of resilient low-emissions practices. Taking an action research approach, promising technology packages will be introduced and/or promoted in each site. Biophysical measurements of technologies' performance will parameterize their RLE efficacy. Socio-economic analyses — especially gender, youth, and asset base — will

	identify the distribution of benefits and burdens associated with new practices. Livestock keepers will also assess technologies according to their own criteria. Taken together, data from WP2 will be used to analyze tradeoffs and synergies. WP2 actions and analyses will build capacities to support inclusive scaling of validated technologies.
Work Package geographic scope	Latin America (CO-Colombia, GT-Guatemala); West Africa (SN-Senegal, ML-Mali); East Africa (KE-Kenya, TZ-Tanzania);

WP2 Science

Research question	Scientific methods	Key outputs
1. What are the multi-dimensional tradeoffs and synergies of technological options and packages in different systems?	• Action research • Biophysical measurements of technology performance capturing productivity, GHGe implications and contributions to adaptation • *Ex ante* and *Ex post* evaluation of proposed technologies • Producers' assessment of technologies according to their priority criteria • Tradeoff and synergy analysis integrating biophysical data from RQ1 with social data from RQs2 and 3.	• Validated technology packages for RLE production • Methodological innovation and tools for technology co-production • Tradeoff and synergy analysis tools • Scientific papers on productivity and low-emission potential of practices, action research learning, tradeoff and synergy analysis
2. How do intra-household gender and age dynamics affect an individual's ability to adopt climate-smart livestock practices, and how do different climate-smart livestock practices, in turn, influence intra-household dynamics?	• Mixed methods and approaches to analyze the ways that social norms and practices impact, and are impacted by adoption and implementation of technologies • Ethnographic analysis of technologies in practice	• Methodological innovation and tools for socially inclusive scaling • Gender responsive technology guidelines for implementation of climate smart technologies • Scientific papers on gender and youth opportunities and constraints regarding RLE practices
3. How does inter-household variability within smallholder communities and production systems affect differential ability to adopt and benefit from CS livestock practices?	• Large-N household survey to analyze variability in household characteristics and technological practices • Observational analysis of technologies in practice	• Methodological innovation and tools for tailoring technical interventions for different household types • Scientific papers on socio-economic heterogeneity and variable adaptive capacity
4. How can local adaptive capacities and scaling networks be sustainably institutionalized through a 'positive deviance' approach?	• Action research • Qual/quant analysis of local adaptation innovators and innovations • Facilitate producer to producer networks for innovation exchange	• Methodological innovation and tools for producer-producer innovation and scaling • Scientific papers on positive deviance in climate change, network analysis

WP2 Theory of change

WP2 will technically validate practices and generate producer-to-producer extension networks to reach 300,000 producers by 2024. Specific practices will build on previous work from CCAFS, with the SAPLING and ClimBer Initiatives. WP2 will analyze social factors relating to adoption and socially inclusive scaling to develop tools for future RLE implementation. The integrative

analysis of biophysical and socio-economic characteristics will support identification of context- and gender-specific tradeoffs and synergies between complex environmental and social objectives. Tradeoff and synergy analysis from WP2 will feed into policy engagement and investment planning in WP4 and 5.

The urgency of climate action is well established. We will reach 300,000 producer households through development implementation partners in each country. However, synergies and tradeoffs between technical climate actions and socially inclusive scaling is an emerging agenda and there are few methodologies that can directly address this tension or analyze socially differentiated factors in scaling. WP2 will engage research partners (1-WUR, 198-IDS) to develop these methodologies and tools. By 2024, we will lead capacity building interventions for NARS, climate finance organizations and development implementation partners in inclusive scaling.

Our first assumption is that RLE technologies and practices will meet producers' needs. The second is that NARS, policymakers, livestock producers' associations and climate investment institutions are committed to inclusive scaling strategies. Specifically, we assume that:

- Researchers and farmers can work together within an integrative evaluative framework to assess and disseminate RLE technologies.
- Civil society, NARS and private sector actors will support farmer-led innovation and farmer-to-farmer extension networks.
- Governments, private sector and climate finance investors are motivated to consider socio-economic inclusivity targets alongside productivity and environmental targets.

Some production technologies from SAPLING will be analyzed for RLE characteristics. Because producer practices are key to achieving RLE livestock production, WP2 will link with all the other Work Packages. WP1, 3 and 4 develop systemic interventions that will interact with adoption of on-farm practices. WP2 will ensure these interactions are captured in terms of research and scaling strategies. Measurements and estimations (e.g., activity data and emission factors) from WP2 will be aggregated in WP5 to support MRV and adaptation tracking. WP2 and WP5 will work closely on tradeoff and synergy analysis, with WP2 focusing on measurement and analysis, and WP5 using those outputs to promote inclusive development at national level. WP2 will collaborate with the HER+ Initiative to test gender-transformative approaches to scaling RLE practices.

WP2 delivers two Innovation Packages which will be co-created with implementation and research partners as well as livestock keepers. First, we will co-develop on-farm technologies with livestock keepers, research and development partners (Innovations #2.5 and #2.6). Participatory scaling readiness assessments will be conducted on ripe technologies in all countries. Second, WP2 will deliver decision support tools that enable governments, climate action investors, and implementation partners to plan and implement inclusive scaling, as well as weighing potential tradeoffs between diverse environmental and socio-economic objectives (Innovations #2.1, #2.2 and #2.3).

3.2.2.3 Work Package 3

Work Package title	**Digitally enabled services to manage climate risk in LAFS**
Work Package main focus and prioritization	Enabled by an understanding of the decision space in livestock production and value chains, this WP will implement a socially inclusive approach to de-risk LAFS. The WP will co-design, test and scale out digitally enabled and inclusive service bundles of climate information, risk transfer, and credit tailored to LAFS. It will improve risk profiling methods with Micro-Financial Institutions and inform decision-making of producers and value chain actors. We will also contribute to tracking adaptation for investors (WP4) and governments (WP5).

	Scaling out/up will be facilitated by public-private partnerships, scaling networks (WP2), and by harnessing digital technologies.
Work Package geographic scope	Latin America (CO-Colombia, GT-Guatemala); West Africa (SN-Senegal); East Africa (KE-Kenya, ET-Ethiopia, TZ-Tanzania)

WP3 Science

Research questions	Scientific method(s)	Key output(s)
1. Information for adapting to climate and other risks • How do climate and other risks affect livestock producer and value chain actor decision-making? • How should decisions change to respond to climatic variations? • Who gains access to, uses and benefits from climate information? • How is climate information use socially differentiated by gender, age, and other social factors?	• Livestock, climate and health prediction, and agent-based models to understand how climate affects livestock AFS and decision-making. • Map risk perception and decision space of livestock producers and value chain actors through digital and participatory tools. • Conduct gender and age analyses to understand social dynamics of access, use and benefits from climate information to manage risk • Mapping climate-security risks via biophysical and economic modeling.	• Data platforms and decision support systems for livestock AFS. • Ontology of farmer, herder, and value chain actor hazards, impacts and decisions. • Gender and age specific needs for climate service content mapped. • Tactical advisory operationally available through inclusive ICTs and participatory climate services approaches. • Capacities created of farmers, private/public sector to use information for decision making.
2. Livestock financial services (insurance, loans) • Which insurance designs are most effective and affordable for livestock AFS actors of different gender, age, and socio-economic backgrounds? • What are suitable metrics for measuring the biophysical, social, and economic performance of insurance designs? • What are the major challenges, social or otherwise, that influence insurance and credit uptake?	• Review and testing of methods for model-based risk assessment of livestock AFS that accounts for multiple risks. • Quantitative and qualitative evaluation of metrics to measure insurance design adequacy, sustainability, and potential. • Dry testing of existing and new insurance designs and other financial products for livestock AFS. • Gender analysis of insurance and credit uptake	• Risk scoring system integrating multiple risks available to financial companies. • Methodology for insurance design evaluation • Validated insurance designs • 2-way feedback systems to monitor information use • Identification of strategic insurance options to target and benefit women and youth
3. Bundled climate information and financial products • Which business models enhance uptake of service bundles by livestock producers of different gender, age, and socio-economic characteristics? • How do uptake and preferences for specific	• Model-based cost/benefit/uptake evaluation of service bundles and their business models (with SAPLING WP4). • Focus groups and key informant interviews to map and assess inclusive information delivery mechanisms. • RCTs for evaluating bundled products by sex and age.	• New/improved bundled insurance/loan/information products available to livestock AFS actors, including women and youth • Stakeholder and information service maps for target value chains. • Enhanced 2-way feedback systems

service bundles vary by gender or age? • What are the most effective and inclusive mechanisms for service delivery?	• Quantitative analysis of use of new services using feedback loops.	• Context-specific models for inclusive service delivery
4. Measuring adaptation / resilience benefits • What are the most suitable metrics for tracking risk reduction that account for the full spectrum of socio-economic conditions? • How can risk reduction metrics be integrated in resilience and adaptation measuring systems? • What are the adaptation and resilience benefits of service bundles for climate risk management, and how do these differ between women and men?	• Definition of metrics to measure compound risk, resilience or adaptation (with WP1&2). • Quantitative assessment of risk reduction across population of farmers, different social groups / pastoralists, and other value chain stakeholders.	• Framework and quantitative methods for quantifying risk reduction in livestock AFS, feeding from to 2-way feedback systems (feeds into WP1) • Operational service and reporting for investors (with WP4) and governments (with WP5) on adoption/effectiveness of CRM interventions in livestock AFS.

WP3 Theory of change

By 2024, WP3 will de-risk 500,000 livestock producers (50% women and youth), 10 livestock value chains across five countries via climate information, insurance and credit products and services enabled by digital technologies. The risk reduction products and services will help manage climate and other risks by anticipating seasonal variations, buffering incomes and assets against unexpected shocks, and helping avoid other risks (e.g., food insecurity, migration, conflict). For this, CGIAR **brokers** new public-private partnerships (PPPs) between at least three public (e.g., NARS, Hydro-Met services) and 10 private (farmer organizations, Ag-SMEs, Ag-Tech, Finance) organizations, and **builds** their capacities to co-create bundled financial (insurance, loan) and information services that help anticipate and manage climate, animal health, and price shocks, and where relevant also security risks (WP1, WP2, WP4, ClimBer, OneHealth and SAPLING). Scaling is **facilitated** by (1) the improvement of existing or creation of new and inclusive ICTs (Data Harnessing, SAPLING); (2) leveraging scaling platforms in WP2, U2, and LACResiliente; (3) the identification of successful business models for bundled service delivery (SAPLING); (4) building of capacities at the local level (WP2); and (5) creation of 2-way feedback loops to track service use and quality. The feedback loops will also inform progress toward adaptation and resilience for Governments and investors (WP4, WP5) and climate-security sensitive programming (WP1, WP5, ClimBer). Our overarching assumptions are that (1) CGIAR can broker new PPPs to co-develop service bundles to de-risk livestock AFS; (2) PPPs invest resources for creating an enabling environment and market for the bundled services; and (3) target groups (producers, Ag-SMEs) are willing to adopt the new services and digital tools as enough awareness creation mechanisms have been put in place.

WP3 will leverage the expertise of innovation partners (academia, Ag-Tech companies, insurance providers) to develop solutions tailored to the needs and capacities of demand and scaling partners. At the global level, academia (1-WUR, 2526-ITC/Twente, 1692-UC Davis, 2300-University of Strathclyde, and 4639-University of Milan) will help develop livestock-climate models, risk measuring methods, and insurance evaluation frameworks. In all countries, NARS,

HydroMet Services, and Universities will be demand and innovation partners. In ESA and WCA demand and scaling partners will also include WFP, IFAD, MoA, local and regional organizations (e.g., BOMA project, NCBA, 1102-Vétérinaires Sans Frontière). In 1820-ESA, Ag-Tech/ICT (e.g., iCow, Mediae) companies will contribute as innovation partners. In LAC, farmer organizations (3091-Fedegan, APOGUA, FEGAGUATE, CPLG) are key demand and scaling partners, and financial firms (YAPU, MiCRO) will contribute as demand and innovation partners.

Scaling is optimized by building partnerships with clearly defined roles, using inclusive digital technologies (Digital Harnessing), embedding the developed services and technologies into scaling networks (WP1, WP2, LACResiliente, and U2), and by engaging regional and global stakeholders (e.g., 1878-AfDB, 2664-GCF, 759-IADB, 3441-GCA, GGW) jointly with WP4 and WP5.

WP3 will co-create **Innovation Packages** with the abovementioned partners to de-risk production and value chains. We will draw on six innovations whose development will be led by WP3 (see https://bit.ly/3u9Dfxg, innovations #3.1-#3.6), and on several innovations from other WPs (e.g., #1.12, #1.7, #2.2, #4.2, #4.3, #5.5). Co-design of solutions will be crucial to innovation delivery and scaling. Scaling readiness assessment will be applied to all core innovations (#3.1–#3.6), starting with #3.2, #3.3 and #3.6 in collaboration with other Initiatives (ClimBer, LACResiliente and U2).

3.2.2.4 Work Package 4

Work Package title	**Financing the transition to low emission and resilient livestock agrifood systems**
Work Package main focus and prioritization	This WP addresses the factors that limit LAFS access to climate finance. Working closely with investors, it will co-design and implement a research program that rigorously identifies LAFS investments that yield resilience, emission, and social inclusivity goals in addition to generating favorable economic returns under social and climate risks, thus building investor confidence. We will also equip partners with the monitoring tools required to verify benefits that enable continued and expanded financial flows. Scaling will be facilitated by partnerships with impact investors, international finance institutions, and climate funds.
Work Package geographic scope	Global: Latin America (CO-Colombia); East Africa (KE-Kenya, ET-Ethiopia, TZ-Tanzania)

WP4 Science

Research questions	Scientific method(s)	Key output(s)
1. Data for defining the LAFS opportunity ● What is the existing evidence for social inclusivity and climate outcomes from LAFS intervention? ● What are the economic and climate costs and benefits of livestock investments? ● What is the viability of SMEs targeting LAFS opportunities whose interventions affect climate?	● Systematic review and meta-analysis ● Probabilistic project-level cost-benefit analyses considering climate impacts ● Rapid enterprise viability assessment; key informant interviews	● Journal articles; Database and predictive models; Interactive data visualizations ● Cost benefit analysis report/journal articles for livestock investments across regions, co-authored with public and private investors ● Slide deck of bankable gender-sensitive and climate-specific projects

2. Investment monitoring, reporting, and verification ● What key performance indicators need to/can be tracked (e.g., for resilience/adaptation and social inclusivity), by what methods, and for what costs? ● What measurement approaches meet scale, accuracy, aggregation, and cost requirements of monitoring investment KPIs? ● Do product traceability tools improve business performance, reduce environmental harm, and drive social inclusivity? ● Can soil carbon (e.g., in rangelands) be monitored at a scale and certainty to sell carbon credits?	● KPI audit; uncertainty analysis ● Comparative studies - e.g., remote sensing and digital tools vs. face-to-face surveys ● Digital tool and software design and evaluation ● Methods assessment of existing protocols; uncertainty analysis	● Report on KPI cost-effectiveness and uncertainty ● Validated data collection protocols for KPIs ● Traceability system to track cattle and deforestation ● Validated data collection protocols

WP4 Theory of change

WP4 envisages a profound increase in climate and sustainability finance directed toward LAFS enterprises, by 2030, immediately contributing to investments of US$50 million in LPAFS that target social and environmental performance by 2024. Increased financial flows will be facilitated by: (i) an increased awareness of investment potential and reductions of perceived risks; (ii) new or improved financial instruments for gender-sensitive and resilient, low-emissions livestock; (iii) adoption of KPIs and quantification protocols for investments, (with WP 1, 2, 3 and 5) and (iv) use of monitoring tools including traceability and evidence developed by LCSR (with WP 1 and 5). New investment assessment tools, business models, performance monitoring instruments, protocols and guidelines will help to strengthen the scientific base aimed to incentivize increased livestock investments that are gender-sensitive and environmentally sustainable. Monitoring tools will allow investors to verify benefits and track progress. These efforts will contribute to LCSR's Innovation Package on tools and processes for participatory and multi-dimensional decision-making and analysis for LAFS. Our key assumptions are that robust and accessible data and KPIs will lower perceived investment risks and increase investors' awareness of opportunities, spurring private sector interest in adopting environmentally and socially sustainable business practices and in increasing investment in gender-sensitive and climate-resilient, low-emissions livestock.

Aligned with our TOC, WP4 will work in close collaboration with partners who will play a pivotal role in activity co-design and scaling of results. WP4 results have been already requested by international finance institutions (i.e., 125-World Bank's Livestock Finance Group, International Finance Corporation, 1878-African Development Bank Adaptation Benefits Mechanism, 759-Interamerican Development Bank, NAMA Facility and 2664-Green Climate Fund) and private funds and banks (i.e., 3390-Rabobank, 4012-Bancolombia, 1177-Livelihoods Fund and &Green). We see additional opportunities to work closely with foundations (e.g., 154-Bill and Melinda Gates Foundation, Bezos Earth Fund). Such partners will co-design/refine the research and technical assistance agenda ensuring it is demand driven, tailored to specific needs, opportunities and locations, and has immediate potential for impact. Innovation partners include institutions providing credit guarantees such as 156-USAID's Development Credit Authority as well as technical and private enterprises such as Athena Foods-Minerva. Many of our demand partners are also scaling partners given their role in the finance and livestock agrifood system ecosystem.

Additional scaling partners will include the 6939-Global Landscape Forum, Resilient Landscapes, 117-Global Research Alliance and national partners such as cattle growers' associations (e.g.; 3091-Fedegan-Colombia), global environmental NGOs (e.g., 670-TNC) and climatic consultancy firms (e.g., 2759-Climate Focus). Our approach is to become trusted neutral brokers of evidence that build investor confidence and provide the financial justification and tools to direct finance toward RLE livestock. Partnerships will be built in an entrepreneurial spirit, building on historic relationships while actively seeking out new opportunities to support change.

3.2.2.5 Work Package 5

Work Package title	**Improving the enabling policy environment for more resilient, low emissions LAFS**
Work Package main focus and prioritization	There is a weak enabling policy environment for building the resilience of LAFS and addressing issues such as GHGe (Douxchamps et al., 2017[xciii]; GIZ, 2014[xciv] ; Laderach et al., 2021[xcv]). Related monitoring and reporting are patchy[xcvi]. Livestock and GHGe are often misunderstood and misrepresented. WP5 addresses these gaps at global and national levels with policymakers in at least five countries shaping policies or investments that build system resilience, climate change adaptation and mitigation, using data and data systems developed by LCSR. We will support governments to better quantify and monitor the contributions of livestock to national and global climate-related commitments. Knowledge will be generated and shared to inform and improve agricultural sector policies. Related engagement and partnerships through global platforms/processes will be strengthened for global policy influencing.
Work Package geographic scope	Latin America (CO-Colombia, GT-Guatemala); West Africa (SN-Senegal, Mali); East Africa (KE-Kenya, ET-Ethiopia, TZ-Tanzania); Central Asia and North Africa (TN-Tunisia) & Global

WP5 Science

Research questions	Scientific method(s)	Key output(s)
1. Valuing livestock systems • How can the true value of livestock be better captured in national valuations? • How are values of livestock likely to change in response to climate change and under different scenarios of adaptation and resilience building? • What are the costs and benefits of i) land use change from livestock use to other, and ii) restoration of land?	• Cost-benefit analysis • Foresight analysis • Climate modeling • Risk mapping • Sector level analysis of climate change impact e.g. CLEANED+ and GLEAM-i.	• Co-authored articles, briefs, publications. • Valuation tools and systems. • National reports on LAFS. • Cost-benefit analysis reports.

2. Role of livestock in reaching national and global commitments on climate change and environment • How can the contribution of LAFS to national targets in NDCs, LDN, biodiversity etc. be better tracked and captured? • What (i) monitoring, reporting and verification (MRV) systems for LAFS and; (ii) climate change adaptation tracking systems can best serve government reporting?	• National system analysis. • Piloting of MRV and improved adaptation tracking. • Foresight.	• Training (and materials) for NARS, governments • LAFS and national target tracking systems and data • MRV and climate change adaptation tracking systems and data • GHGe tracking including uncertainty calculator, validated data collection protocols, inventories with country-specific parameters • New/strengthened MSPs for policy engagement
3. Capacity building of national and global actors • What gaps exist in data and capacities of policymakers for more informed climate-related livestock policy development and how best can these be filled? • How to strengthen coherence of climate, livestock, agriculture policies to build an enabling environment for LAFS? • What role does good governance play in the development and implementation of livestock policies?	• Gap analysis • Policy coherence assessment • Collective action approaches • Good governance matrix analysis.	• Training (and materials) on LAFS, GHGe, climate security. • Strengthened environment sections in Livestock Master Plans • LAFS climate security observatory • Climate security policy coherence toolkit
4. Policy engagement and investments • What tradeoffs, synergies and incentives exist at national level for investing in LAFS? • What is the role of policy and policy engagement in decisions and actions related to investments in the livestock sector and consumption of animal-source foods? • What is required to ensure that global and national policymakers give the same (or greater) attention to rangeland restoration as they do to forests?	• Trade off analysis • Policy assessment • Communication strategy analysis • Impact assessment	• Sections in national development plans on livestock and climate change. • National, global databases on rangelands including monitoring • Community of practice on good land and natural resource tenure and governance • Positive public statements on LAFS, also on GHGe. • National and global commitments to and proposals for rangeland restoration

5.Strengthening social inclusivity • How can the enabling policy environment be tter support and enable women and youth's capacity to adapt to climate change? • How can the enabling policy environment be improved to close gender gaps in LAFS including in land, livestock and digital resources? • How can the enabling policy environment better incorporate and reflect youth-specific interests and needs?	• Gender in adaptation tracking • Gender policy analysis • Gender budgeting analysis;	• National reports, policy briefs • Framework on how to improve social inclusiveness in adaptation strategies • Gender and climate sections in government documents.

WP5 Theory of change

There is clear **demand** from governments (ministries of agriculture, livestock, environment) in all Initiative countries for WP5 to assist them in generating information to report national commitments to e.g. NDCs, LDN, and from regional/global parties and conventions consolidating this information. Further, there is demand from communities and local actors for a more enabling policy environment for resilience-building of LAFS and greater investment in the livestock sector, including rangelands restoration.

WP5 has **three main transformational pathways** to reach its EOI outcome of international agencies and policymakers using LCSR products to shape at least five policies or investments that strengthen RLE and socially inclusive LAFS. The **first pathway** establishes national systems and platforms that generate and consolidate data (also drawing from WP1 and WP2, SAPLING) to ensure an improved accounting of livestock in targets for climate-related commitments, whilst building capacities to use this data (with systems/technologies developed in WP3 and adapted from ClimBer).

The **second pathway** focuses on generating and consolidating information on livestock including costs and benefits, synergies and tradeoffs for uptake by governments in agricultural policies. The **third pathway** is global, filling in data gaps in livestock and climate change and e.g. rangelands, and mobilizing global actors to positively influence global and national policy, greater investments in low emissions livestock (messaging developed with WP4) and evidence-based public statements on livestock and climate change. At the same time WP5 will improve the enabling environment for all WPs broadly and particularly for interventions carried out in WP1.

Success **assumes** that: (i) evidence is generated by the Initiative for use in policy influencing; (ii) policymakers are receptive to evidence shared and willing to act on it leading to 'better' policies; and (iii) co-creation of evidence leads to trust in and use of evidence in policymaking and implementation.

Policy influencing will be strengthened by working in **partnership** with national, regional (e.g. 401-CILSS, 194-ECOWAS and 2138-IGAD) and global partners (e.g. 285-IFAD, 69-FAO, 125-WB, 298-WWF, 1830-UNEP) donors, climate finance investors and other Initiatives (e.g. Transforming Agroecology and Ukama Ustawi) and working hand-in-hand with innovation partners such as 765-SNV, 1189-Overseas Development Institute, GMV digital solutions and 1270-CIRAD.

With government and other stakeholders, WP5 will co-create Innovation Packages that can be used to produce more-informed agricultural/livestock and environmental sector policies and decisions, and improved climate-related reporting systems. It will draw from at least 13 WP5 innovations[xcvii] as well as complementary innovations from other WPs. During design and implementation, bottlenecks and challenges will be addressed. Scaling readiness assessment will be applied to core innovations in WP5 prioritizing #5.3, #5.4, #5.5, #5.6, #5.8, #5.9 starting in 2022.

Scaling is optimized by directly engaging, building partnerships, capacity building and joint problem-solving with those we want to influence including governments and global actors. Further, building on well-established relations we will work with networks and Initiatives that are far-reaching across different sectors and audiences including the newly established 69-FAO Sub-Committee on Livestock, Global Alliance for Sustainable Livestock, Livestock Data4Decisions, 117-GRA, Sustainable Beef Roundtable, the International Year of Rangelands and Pastoralists, CASSECS (Elevage Sahelian et bilan carbone), the 1892-ILC Rangelands Initiative, Climate Smart Youth Network, Great Green Wall Initiative, the UNFSS and the UN Decade of Ecosystem Restoration.

4. Innovation Packages and Scaling Readiness Plan

LCSR will apply the Scaling Readiness approach and participatory tools such as ADOPT[xcviii] to adapt and sharpen WP research and outputs, and to improve pathways to impact[xcix]. LCSR will start its scaling activities in Q1–2022 (first 'Backstopping Wave'), prioritizing innovations in WP1, WP2, and WP3, and aims to cover half of LCSR innovations by the end of 2024. Innovation Packages will be co-designed with partners drawing from LCSR's 40 innovations (with more incubating) listed here[c], which include the scaling of earlier innovations developed under CRPs, such as participatory rangeland management, digital climate services platforms, index-based livestock insurance and CLEANED+, as well as new ones (e.g., agri-risk scoring system). Several of our innovations will be shared with SAPLING, OneHealth, Mitigate+, HER+ and ClimBer, especially in areas of productivity improvement, gender transformation, bundled climate and financial services, reducing GHGe, and disease surveillance under a changing climate.

LCSR has provisionally allocated US$700,000 to implement the Innovation Packages and Scaling Readiness plan (2022: US$150,000; 2023: US$250,000; 2024: US$300,000). Dedicated activities, deliverables, indicators and line-items are included in the Management Plan, MELIA and Budget sections below.

5. Impact statements

5.1 Nutrition, health and food security

Challenges and prioritization

Livestock provide essential nutrient dense proteins and micronutrients for undernourished people, with particular benefits for women and children[ci]. Threats to the future of livestock production from climate change, land degradation and the loss of pastoral production reduce the availability of and access to these nutrient dense foods. Our prioritization process (section 2.4) indicates that LCSR should focus on areas where food and nutritional security is a challenge. LCSR works to ensure alignment between adaptation and mitigation targets, since the pressure to reduce GHGe from livestock through the stigmatization of animal-source foods consumption is problematic and could lead to scaling options that negatively affect availability of and access to animal source foods and represent maladaptation[cii].

Research questions

LCSR research on social dynamics and gender maps into IA1. WP1 and WP2 analyses of tradeoffs and synergies on the adoption of resilience-building innovations will help identify how these innovations contribute to nutritional and food security outcomes. Tradeoff analyses and M&E in WP4 and WP5 will also seek to understand and address nutrition, health, and food security. Furthermore, research activities of the climate security observatory in WP3 and WP5 will question the climate triggers of conflict and how conflicts affect food insecurity in LAFS.

Components of Work Packages

1. WP1: Women/youth empowerment in Pastoralism Index
2. WP2: Technology packages for RLE production scaled with a socially inclusive lens; gender responsive technology guidelines for implementation of RLE technologies,
3. WP3: Capacities created of farmers including women and youth, private/public sector to use inclusive service bundles.
4. WP4: Report describing consumer trends, CSR commitments and capacity gap analysis and laying out CSR roadmaps.
5. WP5: National target tracking systems and data; Livestock Master Plansclimate-security observatory explicitly addressing food insecurity concerns with governments.

Measuring performance and results

Our analysis of projected benefits shows that in LCSR countries, around 20% of beneficiaries (on average) experience food insecurity. By measuring our end-of-Initiative (EoI) Outcomes 2 and 3, and understanding the socio-economic and food insecurity characteristics of these beneficiaries (e.g., through data collected by WP2 and WP3), LCSR will be able to measure its performance and results toward IA1.

Partners

- GASL and the GLAD Initiative, along with the World Bank and IFAD, along with other donors who are concerned that OECD country focus on GHGe from livestock threatens their development promise.
- The World Food Programme and national governments, with which LCSR will co-develop and implement a global climate-security agenda addressing the climate-conflict-food insecurity nexus in LAFS.

Human resources and capacity development of Initiative team

Includes dedicated gender expertise, advocacy, and expertise on the climate-conflict-food insecurity nexus. Partnership with WFP and with SAPLING for food security and nutrition expertise.

5.2 Poverty reduction, livelihoods and jobs

Challenges and prioritization

Climate change impacts on livestock production threaten livelihoods and jobs across the entire sector (Rahimi et al., 2021[ciii]; Thornton et al., 2021[civ]; Jones and Thornton, 2009[cv]). LCSR's priority setting approach considers poverty rates to identify areas where adaptive capacity needs to be substantially strengthened (section 2.4). Across Africa, the livelihoods of 300 million people rely significantly, or even exclusively, upon income from livestock production[cvi], In Latin America, progress and transformation in the livestock sector offer economic and poverty reduction opportunities, but the rapid pace of change could marginalize smallholder farmers[cvii]. The challenge of climate change adaptation is fundamentally about how to maintain, or even improve, livelihoods and reduce poverty in the face of shifting climatic conditions. We anticipate that three million rural poor will benefit from LCSR (section 2.7).

Research questions

Many of the socio-economic drivers explored and addressed by LCRS in relation to adaptive capacity and climate resilience are also directly linked to poverty. WP1 and WP2 address questions about how changes in material technologies and NRM practices can improve livelihoods and reduce poverty in the face of climate change. WP3 complements these interventions with questions about how production practice can be de-risked through improved information systems — e.g. climate information services or financial and market information. WP4 and WP5 make longer term contributions to livelihood improvement by creating enabling financial and policy environments.

Measuring performance and results

We anticipate that 30% of LCSR beneficiaries are in extreme poverty, and an additional 15–20% are at risk of falling into extreme poverty. This means some 90,000 and 150,000 livestock producers in poverty will access RLE technologies and de-risk their production (respectively) by 2024. Furthermore, land management over 500,000 hectares will build the climate resilience of landscapes and hence support livestock production. Poverty headcount ratios especially in rangeland areas are particularly high (up to 50%). By supporting climate resilience and adaptive capacities at landscape, production system, and household levels, LCSR will have measurable effects on poverty reduction.

Partners

Climate change adaptation is an urgent priority for governments and livestock keepers alike. Our scaling partners will include private sector actors, NARS, producer organizations, and development partners (e.g., 296-WFP, 129-UNDP) appropriate to the countries and systems.

Human resources and capacity development of Initiative team

This Initiative includes CGIAR researchers with a wide range of disciplinary backgrounds, as well as experience in different geographies.

5.3 Gender equality, youth and social inclusion

Challenges and prioritization

The impacts of and abilities to adapt to climate change are unevenly distributed across social categories (Kaijser and Kronsell, 2014[cviii]; Djoudi et al., 2016[cix]). Gender gaps in women's rights to access, own and manage productive resources exacerbate the social differentiation of climate change impacts (Njuki and Sanginga, 2013[cx]; Ravera et al., 2016[cxi]). Social norms and practices that limit women, youth, or other vulnerable social groups from accessing, managing and benefitting from productive resources constrain the potential of livestock in climate adaptation strategies in households, communities and value chains (Tavenner and Crane, 2018[cxii]; Njuki and Sanginga, 2013[cxiii]; Kristanjson et al., 2010[cxiv]; Bullock et al., 2020[cxv]; Kinati and Mulema, 2019[cxvi]). With climate change adaptation and mitigation becoming key touchstones in livestock development, we need robust evidence and tools to plan, implement and measure social equity in adaptation and mitigation pathways[cxvii]. To address these knowledge gaps, LCSR proposes to prioritize: Socio-economic dimensions of technological impacts in households and communities, digital services to mitigate climate risks, rangelands governance, assessing equity tradeoffs and policy investments to enhance scaling of socially inclusive climate adaption strategies.

Research questions

Gender and social inclusion research questions are integrated in all five Work Packages to substantially improve gender equality and socially inclusive climate outcomes. A focus on the role of age and gender will yield insights about how to also optimize youth-specific opportunities for young women and men. WP1, 2 and 3 all ask research questions about the ways RLE and risk management technologies interact with social differentiation, both in terms of how social norms and practices affects adoption, but likewise how adoption affects social norms and practices. In short, these will pay particular attention to the distribution of burdens and benefits of RLE practices, as well as mechanisms to avoid potential pitfalls. These WPs will deliver decision support tools aiming to mainstream social inclusion mechanisms into the design, implementation and tracking of RLE interventions. Recognizing that social inclusion objectives often require higher order incentives, WP4 and WP5 ask research questions that promote the gender and youth inclusion agendas in CSR and policymaking spaces.

Measuring performance and results (TBD)

By measuring our end-of-Initiative (EoI) Outcomes 1, 2 and 3, and understanding the socio-economic characteristics of these beneficiaries (e.g., through data collected by WP2 and WP3), LCSR will be able to measure its performance and results toward IA3. We also have embedded gender and social inclusivity targets throughout the WP TOCs.

Partners

While gender inclusivity is not yet deeply embedded within the climate change community, donors and international organizations increasingly emphasize gender equality in development outcomes[cxviii]. Scaling partners will include NARS, the 1845-CSA Youth Network, national gender in agriculture civil society organizations (e.g. Association of Women in Agriculture Kenya), along with local development partners and private sector.

Human resources and capacity development of Initiative team

There is substantial expertise on gender and social inclusion in the proposal development team, but we anticipate recruiting several post-docs and PhD students to build capacity suitable for the scope of LCSR's ambitions.

5.4 Climate adaptation and mitigation

Challenges and prioritization

The seven challenges identified, analyzed and documented as part of the LCSR prioritization process[cxix] (section 2.4) all map to the outcomes of the climate adaptation and mitigation Impact Area, and hence LCSR will contribute to all three outcomes. The rationale for this is clear. First, climate change, climate variability and extremes hinder LAFS[cxx]. Roughly half of total livestock value in LMICs (US$203 billion) is exposed to various climate hazards, especially climate variability and heat stress[cxxi]. Second, direct and indirect livestock emissions account for ~15% of human-induced GHGe[cxxii]. Finally, there is a general lack of alignment between adaptation and mitigation at the policy level, while also reluctance from public and private investors to target the livestock sector[cxxiii].

Research questions

We synthesize one overarching research question per Work Package for this Impact Area:

1. What is the set of interventions that build climate resilience in agricultural landscapes where livestock systems are the main livelihood strategy? (WP1)
2. What are the adaptation and mitigation tradeoffs and synergies of technological options and packages in different systems, and how can institutionalized scaling networks facilitate rapid scaling? (WP2)
3. What are the most effective and socially inclusive service bundles, delivery mechanisms, and business models for climate risk reduction? (WP3)
4. What investments are most needed, and what instruments are most effective, to finance and de-risk livestock system transformation across value chain actors and actions? (WP4)
5. What are the capacities, policies, and incentives needed to enable investments in the livestock sector that target climate adaptation, mitigation, productivity, ecosystem services protection and restoration, and peace and security, and how can these outcomes be tracked to inform progress? (WP5)

Components of Work Packages

LCSR is centered on climate change adaptation and mitigation, and hence all WP activities contribute to this Impact Area. WP1 improves the resilience of livestock landscapes through testing and scaling WP2 and WP3 innovations, and by understanding how resilience links with adaptation. WP2 scales out adaptation options with livestock producers and seeks to understand tradeoffs with mitigation. WP3 seeks to reduce risks from climate variability, extremes, and climate-driven outbreaks and emergence of animal health problems, and where relevant, climate security issues. WP4 seeks to leverage public and private finance for mitigation and adaptation. Finally, WP5 informs and influences climate policy.

Measuring performance and results

See section 2.2 for Initiative-level outcomes. These are all the same for this Impact Area.

Partners

LCSR will engage with local farmers' organizations, NARS, ministries of agriculture, HydroMet Services, governments, Ag-Tech companies, Ag-SMEs, and investors across all CGIAR regions, and with specific focus on the target countries.

Human resources and capacity development of Initiative team

LCSR draws on the experience gained during two CRP phases, especially regarding climate change (CCAFS) and livestock (LIVESTOCK CRP). The capacities and tools and approaches developed around climate-smart technologies, climate services and safety nets, mitigation, and climate finance, are all being brought into LCSR.

5.5 Environmental health and biodiversity

Challenges and prioritization

Environmental health and biodiversity are key to the future of our planet, and livestock production has both positive and negative impacts on these. Around 45 million hectares of forests were cleared for intensive cattle production between 2001 and 2015[cxxiv]. Livestock manure can pollute rivers and soils[cxxv], but if managed and used well, contribute to soil health/fertility. According to UNCCD, the Sahel, is a region most severely affected by land degradation, with the livelihoods

of around 135 million people dependent on degraded lands[cxxvi]. Through LCSR research and innovations, we will improve positive and reduce negative environmental and biodiversity impacts of livestock through a multi-level approach.

Research questions

LCSR seeks to increase the resilience of livestock production systems to climate change-related shocks and stresses whilst reducing GHGe and optimizing opportunities to reduce deforestation and conversion of grasslands to croplands, reducing pollution from livestock waste, reversing land degradation and improving land productivity including biodiversity. Relevant research questions focus on how best to build the resilience of LAFS for different stakeholders and priorities including ecosystem services and biodiversity, with rangeland restoration and increasing integration of trees (WP1), what technologies (WP2) and information and financial systems (WP3) and climate finance can support this (WP4), and how best to strengthen the enabling environment including understanding how LAFS contributes to such through national and global biodiversity commitments.

Components of Work Packages

- Tools and processes to improve landscape and land use planning, land and natural resource governance, tracking and monitoring of nutrients and pollution for LAFS that better provide environmental and biodiversity benefits (WP1).
- Regenerative livestock tools and processes for reversing degradation and contributing to land improvement and restoration at scale increasing biodiversity and integration of trees (WP1 and WP2).
- Tools and processes to improve decision-making on land use and rangeland restoration with cost-benefit analysis including environmental and biodiversity indicators (WP1 and WP5).
- Tracking systems capturing livestock's contribution to national commitments including LDN and biodiversity targets (WP1 and WP5).
- Increased climate finance for biodiversity and environmental benefits from LAFS (WP4).

Measuring performance and results

By 2024, pastoralists and farmers adopt improved governance, management and restoration practices on 500,000 hectares of land used for livestock production, with at least 25% increase in women's active participation in decision-making processes (WP1 and WP2); By 2024, investors plan to invest US$50 million toward socially-inclusive resilience building and/or low-emissions LAFS interventions (WP4); International agencies and policymakers use LCSR products to shape at least eight policies or investments to strengthen LAFS resilience (WP5).

Partners

Key demand partners include: (i) communities wanting more environmentally sustainable livestock production systems that provide ecosystem services and contribute to biodiversity, whilst building their resilience to drought; (ii) governments wanting to fulfill their commitments to environmental and biodiversity conventions; and (iii) Initiatives such as Great Green Wall and UN Decade of Ecosystem Restoration.

Human resources and capacity development of Initiative team

Scientists with experience in land/natural resource governance, land use planning and management; restoring rangelands and integration of trees; development of monitoring and tracking systems; mapping and GIS.

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 your Initiative will contribute to and will be able to provide data towards (refer to Guidance for MELIA for selection of appropriate indicators)				
# people benefiting from relevant CGIAR innovations	# people benefiting from relevant CGIAR innovations	# women benefiting from relevant CGIAR innovations	#$ climate adaptation investments # people benefiting from climate-adapted innovations	# ha under improved management
SDG targets				
5.b		8.4	13.1, 13.2, 13.b	12.a
Action Area: Resilient Agrifood Systems				
Action Area outcomes and indicators				
RAFS 1- Smallholder farmers use resource-efficient and climate-smart technologies and practices to enhance their livelihoods, environmental health and biodiversity.			RAFS 1.1 Number of resource- efficient and climate-smart technologies at stage IV (uptake by next user), disaggregated by type	
RAFS 2 – Research and scaling organizations enhance their capabilities to develop and disseminate RAFS-related innovations			RAFS 2.1 Number of organizations.	
RAFS 3 – Public and private financial resources are invested to fund climate-smart business models.			RAFS 3.1. Total amount invested in climate smart business models.	
ST and RAFS 1 – Smallholder farmers implement new practices that mitigate risks associated with extreme climate change and environmental conditions and achieve more resilient livelihoods.			ST RAFS 1.1. Number of smallholder farmers who have implemented new practices that mitigate climate change risks, disaggregated by gender and type of practice.	
ST and RAFS 2 – National and local governments utilize enhanced capacity to assess and apply research evidence and data in policy making processes.			ST RAFS 2.1. Number of policies/ strategies/ laws/ regulations/ budgets/ investments/ curricula at different scales that were modified in design or	

					implementation, with evidence that the change was informed by CGIAR research.						
ST & RAFS &GI 1 Women and youth are empowered to be more active in decision making in food, land and water systems.					ST RAFS GI 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 (outcome or output)	Result	Indicator	Unit of measurement	Geographic scope	Data source	Data collection method	Frequency of data collection	Baseline value (outcome only)	Baseline year (outcome only)	Target value	Target year
EoI outcome	Governance and restoration practices implemented	Area under improved practices	Hectares	Regional (ESA, WA, LAC, CWANA)	Primary + Sec: Remote Sensing	FGDs and RS analysis	Annual	0	2022	500,000	2024
EoI outcome	Climate-smart technologies appropriate to context implemented Equitable distribution of labour & benefits	# household (HHs) implementing practices % household reporting equitable access to labor/benefits	Households	Regional (ESA, WA, LAC, CWANA)	Primary	FGDs, HH surveys	Annual	0	2022	300,000	2024
EoI outcome	Livestock producers and organizations access products and services	# beneficiaries of services, disaggregated by beneficiary type and gender	LS producers (men/women/youth) Organisations (publ/priv)	Regional (ESA, WA, LAC, CWANA)	Primary	Partner and Initiative 2-way feedback systems	Annual	0	2022	500,000 (250K/150K/100K) 13 (7/6)	2024
EoI outcome	Commitments by investors and companies	Amount of finance committed # companies that change practice	US$; Companies	Regional (ESA, WA, LAC, CWANA)	Primary			0	2022	US$100 million 10 private companies	2024
EoI outcome	Policies based on evidence and outputs	# countries that include LCSR	Number of countries	Regional (ESA, WA,	Primary			0	2022	5	2024

		evidence and tools		LAC, CWANA)							
WP1 outcome	6 governments have enhanced capacities to implement landscape scale RLE interventions	# partners using innovations, approaches, and tools	Number of countries	Regional (ESA, WA, LAC, CWANA)	Primary	Partners, direct tracking	Annual, Continuous	0	2022	TBD	2024
WP1 outcome	Funders and organizations have tools to direct efforts towards RLE livestock landscapes	# hectares rehabilitated or restored	Ha	Regional (ESA, WA, LAC, CWANA)	Primary	Partners, Direct tracking (pilot sites), Sec: Remote Sensing	Annual, Continuous	0	2022	500,000 ha	2024
WP1 output	Tools and indicators for measuring and monitoring system resilience	# tools and processes developed	Material	Regional (ESA, WA, LAC, CWANA)	Primary	Partners, Direct tracking	Annual	0	NA	TBC	TBC
WP1 output	Validated RLE practices and quantified ecosystem services	# data sets	Data sets	Regional (ESA, WA, LAC, CWANA)	Primary	Direct tracking	Annual	0	NA	TBD	TBC
WP1 output	Technologies and tools for large scale landscape restoration	Implementation guidelines	# guidelines	Regional (ESA, WA, LAC, CWANA)	Primary	Direct tracking	Annual	0	2022	TBC	2024
WP1 output	Women/youth Empowerment in Pastoralism Index (WEPI)	WEPI	One index developed	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	By the end of phase 1 (2024)	NA	2022	1	2024
WP2 outcome	300 k livestock keepers are empowered to adopt and adapt technologies appropriate to their circumstances	# livestock keepers empowered	Individuals (men, women)	Regional (ESA, WA, LAC, CWANA)	Primary	FGD, HH surveys	Baseline, endline	0	2022	300,000	2024

WP2 outcome	5 Governments, climate investors adopt tradeoffs and synergy analyses to guide investments	# organizations using analyses	Organizations (by type)	Regional (ESA, WA, LAC, CWANA)	Primary	Direct tracking	Continuous	0	2022	5	2024
WP2 outcome	5 Governments, private sector and development and partners adopt inclusive scaling strategies	# organizations adopting inclusive scaling strategies	Organizations (by type)	Regional (ESA, WA, LAC, CWANA)	Primary	Direct tracking	Continuous	0	2022	5	2024
WP2 output	Methodological innovations and tools for tailoring technical interventions and inclusive scaling	# methodologies and tools (by type)	Material	Regional (ESA, WA, LAC, CWANA)	Primary	Direct tracking	Continuous	NA	NA	2	2024
WP2 output	Assessments of practices' benefits and burdens incurred by women and youth	Report with analysis results published	Publication	Regional (ESA, WA, LAC, CWANA)	Primary	Direct tracking Reference check	Continous, Annual	NA	NA	5	2024
WP3 outcome	LS producer organization /extension services deliver CIS	# organizations delivering services, by type	Organizations	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	0	2022	Min. 3	2024
WP3 outcome	5 agricultural SME across 5 countries adopt service bundles for CRM	# SMEs adopting service bundles	Organizations	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	0	2022	5 SMEs across 5 countries	2024
WP3 outcome	National Hydromet services and MoA in 5 countries have improved capacities to produce gender-sensitive information services for risk management	# Capacity of organizations to co-produce gender-sensitive climate information (scale 1 to 5) Type of gender-sensitive	Countries (Governments, Ministries)	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	0	2022	5 countries	2024

		information promoted									
WP3 output	New/improved bundled insurance/loan/information products available to livestock AFS actors	# new/ improved products available to LAFS actors	Products	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	NA	NA	TBD	2024
WP3 output	Risk reduction monitoring toolkit based on two-way feedback loops and real-time data	# countries including risk reduction in their adaptation tracking	Countries	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	NA	NA	1	2024
WP4 outcome	Financial partners have increased awareness of livestock investment potential and perceive lower risk	Partners' level of awareness of investment potential and risk, qualitative scale, 1 (very low) 5 (very high)	Awareness level	Regional (ESA, LAC)	Primary	Direct	Annual	Level 1	2022	Level 5	2024
WP4 outcome	2 investors or investments adopt KPI or quantification protocols	# investors adopting KPI or quantification protocols	Organizations	Regional (ESA, LAC)	Primary	Direct	Annual	0	2022	2	
WP4 outcome	1 financial instrument developed for improved for gender-sensitive and resilient, low-emissions livestock	Financial instrument developed Approaches to incorporate gender-sensitivity in financial instrument development. Improvement (qualitative)	Instrument Approaches	Regional (ESA, LAC)	Primary	Direct	Annual	0	2022	1	2024
WP4 output	Monitoring investments	MIRS+ developed	Tool	Regional (ESA, LAC)	Primary	Direct	Annual	0	NA	1	2024

	reference system (MIRS+)										
WP4 output	Traceability tools developed/ adapted for livestock value chains	# and type of traceability tools developed or adapted	Tool	Regional (ESA, LAC)	Primary	Direct	Annual	0	NA	1	2024
WP5 outcome	Governments in at least 6 countries report targets for climate-related commitments using systems set up or strengthened by LCSR	# countries reporting climate targets based on LCSR evidence	Reports	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	0	2022	6	2024
WP5 outcome	Policymakers in at least 6 countries use knowledge generated by LCSR in design and/or implementation of agricultural sectoral policies	# countries designing and/or implementing sectoral based on LCSR evidence and knowledge	Policy documents	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	0	2022	6	2024
WP5 outcome	At least 4 global platforms or conventions use knowledge generated by the project outputs in public statements on climate change	# global platforms mentioning project outputs in public statements	Public statements	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual	0	2022	4	2024
WP5 output	Reports, Framework on how to improve social inclusiveness in adaptation strategies	Framework established	Publications	Regional (ESA, WA, LAC, CWANA)	Primary	Direct	Annual		NA	TBC	TBC
WP5 output	Climate security observatory for LAFS	Climate security observatory for		Regional (ESA, WA,	Primary	Direct	Annual		NA	1	2024

		LAFS established		LAC, CWANA)							
Innovation and scaling Output		# core innovations for which scaling ambition, vision of success and roadmap have been co-created, agreed up and documented	Number	Regional				0		4	2022
Innovation and Scaling Output		# Innovation Packages that have undergone evidence-based and quality controlled validated scaling readiness assessments informing innovation and scaling strategies	Number	Regional				0		4	2023
Innovation and Scaling Output		Percentage of innovation portfolio monitored and managed through a structured portfolio management system using scaling readiness metrics	Percentage	Regional				0		50%	2024

6.2 MELIA plan

a. Narrative for MEL plans

The Initiative will implement a monitoring system to visualize and report how activities and resources are being implemented compared to expectations and whether any corrective action is required. This is an essential process in implementation, as it informs stakeholders and assists decision-making during the course of the Initiative. The Initiative Lead, who is not in charge of any Work Package, will work with a dedicated M&E specialist and a communications and knowledge management specialist. We have allocated a dedicated budget for MELIA activities each year.

We will hold reviews of progress with course correction every six months, using the learning questions below and using the indicators for key outputs in in Table 5.1.C. Progress against the TOC will be evaluated according to key outputs against targeted dates of delivery as laid out in the GANNT charge in Section 7.2. Corrections to the TOC will reflect any advances or delays in this progress. We will also revisit the key assumptions for each WP and the overall Initiative.

The following key learning questions will be used to evaluate the internal **processes of coordination amongst Work Packages** and with other Initiatives.

- Is WP2 feeding into WP1 and WP3 so that findings relevant to scaling strategies are being shared?
- Are WP3 and WP4 working together to develop the evidence case for private sector financial investors?
- Are WP1 through WP4 feeding into WP5 to ensure targeted policy and advocacy messages across the multiple objectives that both reflect LCSR findings and address policy maker needs?

We will also implement MELIA studies shown in table 6.3 below.

b. Narrative for impact assessment research plans

The overall question we seek to answer is whether the processes followed and evidence generated by LCRS is triggering behavioral and institutional changes that eventually lead to: (i) the end-of-Initiative outcomes; and (ii) contributed towards the projected benefits and One CGIAR Impact Areas. Therefore, the IA plans include tracking of WP and EoI outputs and outcomes as well as the impact of piloting and scaling activities. As the Initiative is new, we do not propose any IA studies. The WP outputs and the EoI results could feed into impact assessment or planning for subsequent Initiatives to advise their TOC and targeting

We will report on empirical progress towards impact for three of the One CGIAR System indicators:

- #$ climate adaptation investments — this is a direct outcome from WP 4
- # people benefiting from climate — adapted innovations — this is an outcome of WP 2 and 3
- # ha under improved management — this is a direct outcome of WP 1.

We will use learning questions to evaluate the key assumptions for each Work Package TOC during the annual meetings.

In section 4 and the WP descriptions, we outlined our innovation and scaling readiness plan. During the inception phase, for the first set of innovations, we will develop a plan to monitor progress to the next stage, with a key indication of progress along the scaling readiness pathway (e.g. a new user, an increase in dissemination to new areas).

Work Packages 4 and 5 include specific investment and policy targets. The WP4 TOC outlines our logic to first better understand climate finance investor needs and standards, second to provide a better evidence case to improve investor confidence, and third to track investment cases and commitments. We will track this ourselves through partner interviews and discussions. WP5 outlines the policy influence we hope to have, from improving capacity to monitor and report on climate targets through to increased recognition of the importance of livestock in global climate change and rangeland platforms. Building on what we have learned from policy engagement work in CCAFS and the Livestock CRP, we will set policy influence targets each year, and employ interviews and review of policy statements to measure our progress.

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	How the MELIA study or activity will inform management decisions and contribute to internal learning
Learning study on defining and operationalizing components of climate resilience in LAFS at landscape level	WP1: Tools and indicators for understanding, valuing and measuring resilience and ecosystem services	2023	TBD with ClimBer	It will help us to realize the feasibility of targets for climate resilience in systems and focus WP 1 activities and outputs.
Learning study on feasibility of farmer-to-farmer extension networks for outscaling	WP2: 5 Governments, private sector and development and partners adopt inclusive scaling strategies	2024	TBD with SAPLING	This question underpins our scaling strategy for the uptake of innovations to contribute to RAFS 1 and ST RAFS 1.
Learning study on public-private partnerships for sustained delivery of bundled climate information and financial services	WP 3: 5 agricultural SME across 5 countries adopt service bundles for CRM	2022	TBD with ClimBer	This study will identify good examples that we can replicate and scale in LCSR.
Learning study on viable business opportunities in the livestock sector that increase gender and social inclusion	WP4: 1 financial instrument developed for improved for gender-sensitive and resilient, low-emissions livestock	2022	TBD with ClimBer, HER+ and SAPLING	This will help to assess the feasibility of achieving climate investments that also can promote gender inclusion.
Learning study on capacity strengthening processes for national	WP5: Governments in at least 6 countries report national	2023	TBD with ClimBer and Mitigate+	This will inform the stakeholder engagement

stakeholders to improve monitoring and reporting on climate targets	targets for climate-related commitments using systems set up or strengthened by the project			process and the utility of our efforts to build capacity.

7. Management plan and risk assessment

7.1 Management plan

The LCSR TOC indicates the contribution of each WP to the EoI outcomes, and each WP TOC describes the key deliverables that will contribute to these outcomes. They also specify the main actors that will help us in this delivery process. In the MELIA section we explain our plans to use the TOCs to monitor our progress, along with the GANTT chart (7.2) which indicates key time steps and deliverables. These will be evaluated every six months and we will correct our courses as need be.

The management team for LCSR will consist of the overall leader, and M&E expert, and the five WP leaders. This group will be responsible for monitoring progress against the workplans and TOCs. Where necessary we will adjust TOCs, if our learning questions, especially those regarding the TOC assumptions and internal processes. These adjustments will be made on an annual basis, in line with the reporting and work planning timelines.

A significant risk to the Initiative is the uncertainty regarding financial resources, especially in the first year. Thus, although the prioritization setting exercise and the projected benefits indicate the geographies and empirical targets we aspire to work in and achieve, this is entirely contingent upon adequate allocation of financial resources. We have considered three funding scenarios, and will scale down (or up) our targets accordingly once the implementation phase begins. The other major risks, some of which are tied to key TOC assumptions, could affect uptake of our innovations and private sector investment in the LCSR outcome and Impact Areas.

7.2 Summary management plan Gantt table

Initiative start date		Timelines												Description of key deliverables (maximum 3 per row, maximum 20 words per deliverable)
		2022				2023				2024				
Work Packages	Lead organization	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Work Package 1:	CGIAR			1				2					3	1.Tools to assess tradeoffs and synergies at landscape level. 2. Tools and indicators to measure resilience at system level. 3. Upscaled PRM and pilots in new countries with gender mainstreamed
Work Package 2:	CGIAR				1				2		3			1. Methodological tool for technology co-production; 2. Validated technology packages tailored to specific agro-ecologies; 3. Methodological tool for socially inclusive scaling
Work Package 3:	CGIAR				1			2			3			1. Data and modeling systems and global and local digital tools and capacities for 2-way advisory delivery and use; 2. Risk scoring system and approach for insurance design evaluation; 3. New service bundles available and adopted by producers and Ag-SME.
Work Package 4:	CGIAR			1					2	3				1.Assessments of financial instruments and KPIs to support investments: 2. Investment-level cost-benefit analysis of livestock system interventions to reduce investment risk: 3. Livestock and Climate Agrifood System SME Accelerator.
Work Package 5:	CGIAR				1				2			3		1. Climate Security Observatory for LAFS data. 2. Article on cost and benefits of rangeland restoration. 3. Article on the role of livestock in reaching national and global commitments related to climate-change
Innovation Packages and Scaling Readiness	CGIAR				1					2			3	1. Four documented scaling cases for four priority core innovations. 2. Four evidence based scaling readiness assessments and reports for the Innovation Package. 3. One Initiative innovation portfolio management system.
MELIA	CGIAR				1				2	3				1. Learning studies for WP3 and WP4 inform next activities. 2. Learning activities for WP1 and WP4 determine next activities. 3. Learning study for WP2 informs next activities.
Project management	CGIAR		1			2				3				1. Inception phase with revised workplans and targets. 2. Workplans for year 2 reviewed and targets confirmed. 3. Workplans for year 3 reviewed and targets confirmed.

7.3 Risk assessment

Top 5 risks to achieving impact (note relevant Work Package numbers in brackets)	**Description of risk**	**Likelihood**	**Impact**	**Risk score** Likelihood x Impact	**Opportunities**
		Rate from 1-5	**Rate from 1-5**		
Funding uncertainty, budget insecurity or delay (all)	Donors are already slow to commit the full aspirational portfolio to the One CGIAR; lack of adequate resources will delay delivery of all EoI outcomes.	4	5	20	Donors may yet be reached and motivated to fully fund the LCSR.
Conflicting consequences of innovations for NRM, GHGe, and social and economic aspects (all)	There are some key tradeoffs among climate change targets and social and economic objectives not only of households but other actors across landscapes. These challenge the calculation of return on investments for all relevant actors.	3	3	9	Tradeoff/synergy analysis tools generated in the project create a framework for considering conflicting implications of innovations.
Lack of sense of ownership of the innovation and research strategy by stakeholders involved in the priority setting processes (4 and 5)	Public and private sector investors already struggle to see the value of investments in the livestock sector, in part because of conflicting goals and objectives, plus an inadequate evidence base.	3	4	12	LCSR team members are well connected to ongoing investor dynamics and are responding to clear demands.
Unable to incentivize right behaviors by farmers, value chain actors and policy makers needed for adoption (1, 2 and 3)	Uptake of many innovations already is slow in smallholder livestock AFS, owing to many constraints that they face, and an underinvestment in livestock.	4	4	16	Project design, including scaling readiness assessment, accommodates an adaptive approach to incentivizing adoption.
Business interruption or delays (all)	In addition to the major disruptions that the COVID pandemic has brought to field work and travel, LCSR works in several risky settings such as the Sahel and the Horn of Africa.	3	4	12	Adapting to business interruptions could incentivize the project to decentralize the implementation strategy and devolve capacities.

8. Policy compliance, and oversight

8.1 Research governance

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

8.2 Open and FAIR data assets

Researchers and organizations involved in this Initiative will adhere to the terms of the CGIAR Open and FAIR Data Assets Policy, which covers all knowledge and information products, including research data and software, for all Initiative data asset outputs and ensuring:

- Wider and open access by adopting unrestrictive, standard licenses (e.g. Creative Commons for non-software assets; General Public License (GPL) or similar for software) and depositing assets in open repositories (e.g. CGSpace, DataVerse) that serve the goals of the Initiative, its partners and ultimate users and are optimized for users with limited internet connectivity.
- Use of rich metadata for all data assets that conform to the CGIAR Core Schema and others (including ontologies and/or controlled vocabularies) that make them findable, accessible, inter-operable and re-usable, ensuring that these metadata are accessible even when the asset is not.
- Adherence to the CGIAR Research Ethics Code for assets derived from research with human subjects, including prior informed consent (PIC) and ensuring confidentiality of personally identifiable information (PIC).

9. Human resources

9.1 Initiative team

Category	***Area of expertise***	***Short description of key accountabilities***
Research	Participatory tech. development	Assess and scale technologies (WP1, 2)
Research	Agricultural economics	Social economy, modelling and policy research (WP2, 5)
Research	Rangeland governance	Participatory approaches (WP 1, 5), Cost-benefit & tradeoff analysis (WP1 2,5)
Research	Gender specialist	Intrahousehold burdens and benefits of technologies (WP2)
Research	Adaptation tracking specialist	Development and testing of adaptation tracking protocols (WP5)
Research	Risk assessment/ag economist	Cost-benefit analysis for investment (WP4)

Research	Financial instruments	Assess key performance indicators; design instruments (WP4)
Research	Climate security observatory	Multidisciplinary team develops data, analyses, guidelines, software systems and institutional engagement for climate security (WP1,3,5)
Research	Gender inclusion in CC targets	Design inclusive DSTs, services, and technologies (WP1,2,3).
Research	Anthropology of technology	Technologies in practice and social inclusion mechanisms (WP1,2,3)
Research	Human geographer	Socio-economic heterogeneity in production landscapes (WP1,2 3)
Research	Agricultural Innovation specialist	Scaling research (WP1,2,3)
Research	Policy research and engagement	Research on policy processes and science-policy interactions (WP5)
Research	GIS and Remote Sensing	Spatio-temporal assessment, targeting and priority setting (WP3,5)
Research	Landscape restoration	Design and management of field experiments (WP1)
Research	Landscape ecology	Rangeland restoration, monitoring and assessment (WP1)
Research	Dryland hydrology	Design and management of water harvesting; modeling (WP1)
Research	Soil science	Soil health and soil organic carbon assessments (WP1, 2)
Research	Rangeland ecology and mgmt.	Design and management of field experiments, (WP1)
Research	Plant taxonomy and physiology	Biodiversity conservation, monitoring and assessment, and adaptation to heat, water stress (WP1)
Research	Forage ecology and agronomy	Design and management of field experiments (WP2)
Research	Livestock-climate modeling team	Livestock, climate modeling and tradeoff analysis (WP2 & 3). CIS development (WP3).
Research	Software development team	Software systems for CIS, service bundles (WP3), and decision support tools (WP1, WP2, WP5)
Research	Insurance design team	Risk scoring systems and service bundles (WP3)
Research	Livestock nutrition & physiology	Measuring productivity and GHG outcomes (WP1, 2)
Research	GHGe measurements	Data collection and analysis (WP1, 2, 5)
Support	Country coordination	Country point person to track activities and manage partnerships
Support	Communication	Develops and maintains LSCR brand and international visibility
Support	Data management	Coordinates the storage and integration of LCSR data sets
Support	Monitoring and evaluation	Design and track project activities, outputs, and outcomes

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 that is also comprised of individuals from diverse backgrounds. We already have an IDT that meets this minimum target for gender. The scientists in the IDT each work with diverse teams, including many staff and students from the global south, as most of us are based in Africa or Latin America.

9.3 Capacity development

1. Initiative team leaders and managers will complete training on inclusive leadership within three months of launch.
2. Within six 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. LCSR is committed to targeted recruitment of women and junior scholars from the global south. Not only will these junior scholars benefit from careful scientific training appropriate to their disciplines, but they will also receive mentorship in career skills, conference presentation and networking skills, interdisciplinary collaboration and connecting research to development through stakeholder engagement. LCSR also has a strong emphasis on capacity building for development partners, private sector, government and livestock producers. Topics include conducting GHG inventories and adaptation tracking, inclusive development strategies, rangeland governance and science-producer co-production of technologies. Our objective is to enhance the capacities of southern partners to independently implement many of the RLE livestock activities supported by LCSR as a result of our trainings.

10. Financial resources

10.1 Budget

10.1.1 Activity breakdown (thousands of US$)

USD	2022	2023	2024	Total
CrosscuttingacrossWorkPackages	500,000	1,000,000	1,500,000	3,000,000
WorkPackage1	2,575,000	4,150,000	6,725,000	13,450,000
WorkPackage2	2,605,000	5,210,000	6,815,000	14,630,000
WorkPackage3	1,466,000	2,931,000	3,397,000	7,794,000
WorkPackage4	718,000	1,436,000	2,054,000	4,208,000
WorkPackage5	1,636,000	3,373,000	3,909,000	8,918,000
Innovationpackages&ScalingReadiness	500,000	1,000,000	1,500,000	3,000,000
Total	**10,000,000**	**19,100,000**	**25,900,000**	**55,000,000**

10.1.2 Geographic breakdown (thousands of US$)

USD	2022	2023	2024	Total
Country (Senegal)	1,781,000	3,561,000	4,342,000	9,684,000
Country (Kenya)	1,541,000	2,183,000	3,624,000	7,348,000
Country (Ethiopia)	1,427,000	2,853,000	3,280,000	7,560,000
Country (Tanzania)	1,398,000	2,796,000	3,195,000	7,389,000
Country (Colombia)	1,136,000	2,273,000	3,308,000	6,717,000
Country (Guatemala)	1,037,000	2,073,000	3,111,000	6,221,000
Country (Mali)	853,000	1,705,000	2,558,000	5,116,000
Country (Tunisia)	791,000	1,584,000	2,375,000	4,750,000
Global (not specific country)	36,000	72,000	107,000	215,000
Total	**10,000,000**	**19,100,000**	**25,900,000**	**55,000,000**

Annex 1. Abbreviations

2DI: 2-Degree Initiative
ABC: Alliance of Bioversity International and CIAT
ARI: advanced research institute
CIRAD: Centre de coopération Internationale en Recherche Agronomique pour le Développement
CSAYN: Climate Smart Agriculture Youth Network
CSR: corporate social responsibility
ESA: European Space Agency
FAO: Food and Agriculture Organization of the United Nations
FEDEGAN: Federación de Ganaderos de Colombia
FEGAGUATE: Federación de Ganaderos de Guatemala
GHGe: Greenhouse gas emissions
GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GLF: Global Landscapes Forum
GRA: Global Research Alliance on Agricultural Greenhouse Gases
IADB: Inter-American Development Bank
IBLI: index-based livestock insurance
ICARDA: International Center for Agricultural Research in the Dry Areas
ICRAF: World Agroforestry
ICRISAT: International Crops Research Institute for the Semi-Arid Tropics
IFAD: International Fund for Agricultural Development
ILC: International Land Coalition
ILRI: International Livestock Research Institute
IPCC: Inter-governmental Panel on Climate Change
IUCN: International Union for Conservation of Nature
KPI: key performance indicator
LAFS: Livestock Agrifood Systems
LCA: life cycle analysis
LCSR: Livestock, Climate and System Resilience
LMIC: Low and Middle Income Countries

MRV: monitoring, reporting and verification
NAMA: Nationally Appropriate Mitigation Action
NARS: National Agricultural Research Systems
NDC: Nationally Determined Contribution
NGO: non-governmental organization
OECD: Organisation for Economic Co-operation and Development
PCSL: Programme for Climate-Smart Livestock
PIM: CRP on Policies, Institutions and Markets
PPPs: public-private partnership
PRM: participatory rangeland management
RCT: randomized control trial
RLE: resilient, low emissions
SME: Small and Medium Enterprises
SNV: Netherlands Development Organisation
SRM: sustainable rangeland management
UNEP: United Nations Environment Programme
UNFCCC COP: United Nations Framework Convention on Climate Change Conference of Parties
USAID: United States Agency for International Development
WB: World Bank
WFP: World Food Program
WP: Work Package
WUR: Wageningen University and Research

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[xliv] **P. Ericksen** (h-index=28) has published extensively on livestock, food systems, and climate change, with notable contributions around food systems and environmental change (https://bit.ly/3ibnr8v, https://bit.ly/2XQjfnt, https://bit.ly/3CQz10Q), and sustainable livestock development and climate impacts and adaptation (https://bit.ly/3ocL1FQ, https://bit.ly/3udNXTm, https://bit.ly/3uec3NQ).
J. Arango (h-index=20) has extensive experience in sustainable livestock systems, with over 20 peer-reviewed papers in the last 2 years alone around mitigation of livestock emissions (e.g., https://bit.ly/3m5uq3N, https://bit.ly/2WiYccI, https://bit.ly/2WlHklG), and sustainable intensification of livestock systems (e.g., https://bit.ly/2Y4bhY3).
T. Rosenstock (h-index=32) is a global expert on climate adaptation and mitigation, covering both crops, agroforestry, and livestock systems (e.g., https://bit.ly/3zLM41A, https://bit.ly/39Gtld7, https://go.nature.com/3zG6pVP, https://bit.ly/3CPl1nP). Todd has led the development of the largest meta-analysis on resilient agriculture worldwide (https://era.ccafs.cgiar.org), and currently leads a global team with on evidence synthesis, modeling of climate-resilient agricultural options, and M&E for adaptation.
A. Notenbaert (h-index=28) is an expert on climate change impacts and adaptation for livestock systems with emphasis in Africa, who has been involved in the development of many of the existing datasets and modeling tools (e.g., heat stress modeling, https://bit.ly/3iaz3sy, published in Nature Food) underpinning our current understanding of livestock systems under climate change. Her research extends a variety of scales from local (e.g., https://bit.ly/39DmUYp) through to national (e.g., https://bit.ly/3EVz1OR) and global (e.g., https://bit.ly/3zLp1np).
J. Ramirez-Villegas (h-index=42) leads global research on agricultural climate impacts and adaptation, using predictive approaches to understand both impacts and adaptation options. Julian is also a Professor at Wageningen University (WUR) (see https://bit.ly/3iv6INN). He has published more than 60 peer-reviewed papers including several in high impact journals (e.g., https://bit.ly/3iaFdc1, https://bit.ly/3zKrcI1, https://bit.ly/3CRjKww, https://bit.ly/3ugJxv8). He has led the development of the largest database of downscaled climate change projections for agriculture (https://bit.ly/3idPJiy).
G. Pacillo is a senior economist and evaluator researching on food and agricultural systems resilience, sustainability, and transformation considering interconnected global and regional challenges, in primis, the climate security crisis (e.g. https://bit.ly/3zLtkz5, https://bit.ly/3oaXR7n, https://bit.ly/3zR7Z7G).
M. Louhaichi (h-index=19) is an expert on rangeland ecology and management, including climate change impacts especially in the CWANA region (e.g., https://bit.ly/3EXJvgL, https://bit.ly/3iaRZY4, https://bit.ly/39LsoA4, https://bit.ly/3kI9VL3).
F. Flintan is a senior scientist dedicated to rangelands and pastoral systems, particularly on governance, tenure, and land use planning. Her research focuses on improving the policy environment for these issues and has produced a number of related manuals with government partners in East Africa (e.g., https://bit.ly/3zMDDTH, https://bit.ly/3m7ASYa, https://bit.ly/39GDJ4L). She has also published on participatory rangeland and community-based natural resource management (https://bit.ly/3m6Pebb, https://bit.ly/3oippHZ), pastoralism and nutrition (https://bit.ly/2XYYtSI, https://bit.ly/2ZrWPJN), and gender and pastoralism (e.g., https://bit.ly/3EV86Tf). Most recently Fiona led the development of the innovative Rangelands Atlas (https://hdl.handle.net/10568/114064).
T. Crane (h-index=19) is an anthropologist with ~15 years of experience in agricultural development, and in sustainable intensification and climate change adaptation in livestock systems. Todd's work explores the set of socio-technical interventions to resilient, low-emissions livestock systems (e.g., https://bit.ly/2XPnEqz, https://bit.ly/3CT1UcO, https://bit.ly/3ibFKdJ), and the constraints to their adoption, including gender dynamics (e.g., https://bit.ly/39JWwfr).
R. Bullock (h-index=9) is an expert on gender and livestock systems with more than 25 peer-reviewed papers on sustainable intensification and land management, and gender in livestock systems (e.g., https://bit.ly/39JWwfr), with a explicit emphasis on climate adaptation and innovation (e.g., https://bit.ly/2WeDgn2, https://bit.ly/3EYTuCf).

[xlv] Several outcome stories clearly illustrate the impacts resulting from work led by IDT members around climate change adaptation and mitigation for agricultural and food systems: https://bit.ly/3ojJoG6, https://bit.ly/3ob0mXi, https://bit.ly/3zJoItl, https://bit.ly/3ANUIOb, https://bit.ly/3zKKjSf, https://bit.ly/3iaNQU3.

[xlvi] See folder of evidence: https://www.dropbox.com/sh/m7jeadx6j9wgf68/AADKAYyoliLvQEUuFuq0UldEa

[xlvii] https://mazingira.ilri.org.
[xlviii] Two key examples of big data analytics include the Smallholder Adaptation Atlas (MVP available at https://bit.ly/2Y5tvIS, Rosenstock, Ramirez-Villegas, Notenbaert, Ericksen), and the CCAFS-Climate portal –the largest downscaled climate projections database for agriculture (http://ccafs-climate.org).
[xlix] Stakeholder consultation for the CGIAR 2030 strategy. TAG-2. CGIAR System. Available at https://drive.google.com/file/d/1fu4XYaEDOOVBAHCWaHufIF3cHWble_CW/view
[l] For letters of support see https://bit.ly/2Wgo352
[li] Regional 2DI workshops: The 2DI convened over 1,000 stakeholders during 2020 at the request of donors. In ESA the discussions focused on food system resilience in the Horn of Africa, where livestock are extremely important. In Latin America 2DI consultations were around greening livestock, household resilience and low-emissions livestock sector (https://hdl.handle.net/10568/110560). In West Africa the role of both food system resilience and OneHealth approach were addressed. Six thematic areas emerged, all of which directly map onto LCSR's Work Packages.
[lii] Colombia's CSICAP program is a 100m project with the Green Climate Fund (GCF) in Colombia that includes the livestock sector. The three target areas are all targeted by LCSR.
[liii] http://www.fao.org/americas/eventos/ver/es/c/1415469
[liv] The AICCRA project (2021–2023) is a US$60 million investment by the World Bank. AICCRA is centered around the scaling of climate information services and climate-smart agriculture options, both addressed by LCSR. AICCRA directly involves more than 50 partners in its actions across Africa. Design documents, experiences to date, and informal consultations with CGIAR and non-CGIAR staff were all used to inform LCSR design. AICCRA project description available at the World Bank website https://projects.worldbank.org/en/projects-operations/project-detail/P173398
[lv]https://documents1.worldbank.org/curated/pt/631541558922443947/pdf/Ethiopia-Lowlands-Livelihood-Resilience-Project.pdf
[lvi] https://pdf.usaid.gov/pdf_docs/PA00X2TV.pdf
[lvii]https://documents.worldbank.org/en/publication/documents-reports/documentdetail/803721589594576936/senegal-agriculture-and-livestock-competitiveness-program-for-results-project
[lviii]https://www.dropbox.com/scl/fi/m6vqu54fjbmbmnmxike0o/IFAD-loans-current-in-countries-of-planned-operation.docx?dl=0&rlkey=p2f7uzla6p205sdnh00gdrzmh
[lix] https://bit.ly/3CEw6bo
[lx] https://cgspace.cgiar.org/handle/10568/114255
[lxi] https://unfccc.int/topics/mitigation/workstreams/nationally-appropriate-mitigation-actions
[lxii]https://www.tralac.org/documents/resources/by-country/kenya/665-kenya-climate-smart-agriculture-strategy-2017-2026/file.html and https://www4.unfccc.int/sites/NAPC/Documents/Parties/Final%20Ethiopia-national-adaptation-plan%20%281%29.pdf
[lxiii] https://www.cifor.org/knowledge/project/PMO-1128
[lxiv] https://ccafs.cgiar.org/research/projects/programme-climate-smart-livestock-systems-pcsl
[lxv] For other strategy documents consulted, see: https://bit.ly/2XKZoWC
[lxvi] https://www.dropbox.com/s/pzwxzxzvjpm6d4c/WB.pdf?dl=0
[lxvii] https://www.dropbox.com/sh/mdyon20rqn2fx5n/AADwv4k77SfRldsLw2dH8nkFa?dl=0
[lxviii]https://www.dropbox.com/scl/fi/814g65yz4jfvmryqnihkx/Africa-LED-Livestock-CoP-CN.docx?dl=0&rlkey=ahpbb9okx4r14uzmgzzv28ydu
[lxix] Webinar 1: https://hdl.handle.net/10568/109926, Webinar 2: https://hdl.handle.net/10568/111339, Webinar 3: https://cgspace.cgiar.org/handle/10568/113492
[lxx] https://www.dropbox.com/s/1mannzhuivg1410/SNV%20Agreement.pdf?dl=0
[lxxi] https://www.dropbox.com/s/tima4y5qsm0q80z/DedictedCreditLineCC_Dairy.pdf?dl=0
[lxxii] https://cgspace.cgiar.org/handle/10568/114662
[lxxiii] https://www.dropbox.com/s/xdpr0dns1r07l4e/Letter%20of%20Support_MinervaFoods_LAC.pdf?dl=0
[lxxiv] https://www.dropbox.com/s/tima4y5qsm0q80z/DedictedCreditLineCC_Dairy.pdf?dl=0
[lxxv] https://www.dropbox.com/sh/4j0jzmea21qwya5/AABLEFO0k9GgACAZ_rqDKhAca?dl=0
[lxxvi] Rosenstock, T.S., et al.. 2021. Projected benefits for the Livestock, Climate and System Resilience (LCSR) One CGIAR global Initiative. Working draft paper. Nairobi: ILRI, Alliance of Bioversity and CIAT, ICARDA, ICRAF and WUR. https://hdl.handle.net/10568/115179
[lxxvii] Depth is defined based on the CGIAR Projected Benefits Guidance as follows:
• For Impact Area 1: (i) Life-saving = avoiding a death; (ii) Transformative = 100% permanent impact on income or in case of health preventing a severe disability; (iii) Substantial = 500% of annual income, 50% permanent impact on income, or if health benefit one disability-adjusted life year averted; (iv) Significant = 100% annual income or 10%

permanent impact on income; and (v) Perceptible = 10–50% of annual income or 1–5% permanent impact on income.
• For Impact Area 2: (i) Transformative = 100% permanent impact on income; (ii) Substantial = 500% of annual income, 50% permanent impact on income; (iii) Significant = 100% annual income or 10% permanent impact on income; and (iv) Perceptible = 10–50% of annual income or 1–5% permanent impact on income.
• For Impact area 3: (i) Transformative = Constraining gender norms and dynamics are shifted and reduced, and norms and dynamics which support gender equality are strengthened, leading to greater gender equality; and (ii) Substantial = the different needs of men and women are identified and differentially met (but the underlying process by which these differing needs are generated are not affected)
• For Impact Area 4: Same as for Impact Area 1
• For Impact Area 5: (i) Transformative = Improved management delivers improvements in soil health and fertility (A), delivers biodiversity gains (B), and provides additional ecosystem service improvements (C); (ii) Substantial = Improved management delivers improvements in two of A, B, and C; (iii) Significant = Where improved management delivers in one of A, B, and C.

[lxxviii] Probability is defined using the current level of certainty that the projected impacts will be achieved by 2030 (see Guidance document): (i) Very high: >80% expectation of achieving these impacts by 2030; (ii) High: 50–80% expectation; (iii) Medium: 30–50% expectation; (iv) Low: 10–30% expectation; and (v) Very low: <10% expectation.

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