Enhancing Climate-Smart Outcomes from Livestock Systems

A "How-To Guide" Following the Project Cycle

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Acknowledgements

This guidance note was prepared as part of the technical assistance provided by the Food and Agriculture Organization of the United Nations (FAO). This assistance was led by Félix Teillard, with contributions from Şeyda Ozkan, Bienvenu Somda and Phyllis Ndung'u, under the coordination of Anne Mottet.

The document benefited from a review and comments by Julien Vallet (FAO), Antonio Rota (International Fund for Agricultural Development) and Sabina Espinoza (World Bank).

The guidance note and underlying data and experience were gathered and developed in the context of the Program for Climate Smart Livestock Systems in Africa (PCSL), funded by the German Federal Ministry of Economic Cooperation and Development (BMZ), and jointly implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), the International Livestock Research Institute (ILRI), and the World Bank.

The work was led from the World Bank by Pierre Gerber and Leah Germer with support from Lee Cando, and under the guidance of Holger Kray. Colm Foy edited the report.

Financial support for the preparation of the report was provided by Food Systems 2030.

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Abbreviations

Abbreviations that are specific to World Bank projects appear in blue.

ASA	Advisory Services and Analytics
ASAL	Arid and Semi-Arid Land
ASF	Animal-Sourced Foods
AFOLU	Agriculture, Forestry and Other Land Use
CDM	Clean Development Mechanism
CIAT	International Center for Tropical Agriculture
CIRAD	Agricultural Research Centre for International Development (*Centre de coopération internationale en recherche agronomique pour le développement*) (France)
CGIAR	Consultative Group for International Agricultural Research
CSA	Climate-Smart Agriculture
CSL	Climate-Smart Livestock
ELRP	Emergency Locust Response Program
EI	Emission Intensity (GHG emissions *per* kg of animal products, e.g., kg CO2-eq/kg protein)
EX-ACT	EX-Ante Carbon-balance Tool (FAO)
FAO	Food and Agricultural Organization of the United Nations
GLEAM-i	Global Livestock Environmental Assessment Model – interactive
GHG	Greenhouse Gas
GIZ	German Agency for International Development (*Deutsche Gesellschaft für Internationale Zusammenarbeit*)
GRA	Global Research Alliance on Agricultural Greenhouse Gases
ICR	Implementation Completion Report, i.e., final project report
IGAD	Intergovernmental Authority on Development
IFI	International Financial Institution
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
ISFL	BioCarbon Fund Initiative for Sustainable Forest Landscapes
ISL	Investing in Sustainable Livestock
ISRA	Agriculture Research Institute of Senegal (*Institut Sénégalais de Recherches Agricoles*)
kg	Kilogram
KCSAP	Kenya Climate Smart Agriculture Project
LFSDP	Livestock and Fisheries Sector Development Project (Ethiopia)
LMICs	Low- and Middle-Income Countries
LSIPT	Livestock Sector Investment and Policy Toolkit
M&E	Monitoring and Evaluation
MIS	Management Information System
MRV	Measurement, Reporting and Evaluation
MTR	Mid-Term Review
NARIGP	National Agricultural and Rural Inclusive Growth Project
OFLP	Oromia Forested Landscape Program
OSILP	Orinoquía Sustainable Integrated Landscape Program
PASEC	Niger Climate Smart Agriculture Project (*Projet d'Appui à l'Agriculture Sensible aux risques Climatiques*)
PCSL	World Bank Program on Climate Smart Livestock
PDO	Project Development Objective, i.e., main impact or goal statement
PPZS	Dryland pastoralism pole (*Pôle Pastoralisme en Zones Sèches*)
PRAPS	Regional Sahel Pastoralism Support Project
PRODEL	Livestock development project (*Projet de développement de l'élevage*)
RCP	Representative Concentration Pathway
SSA	Sub-Saharan Africa
t CO_2-eq	Metric tonnes of carbon dioxide equivalent
TLU	Tropical Livestock Units
TTL	Task Team Leader, i.e., project manager
VCS	Verified Carbon Standard
WB	World Bank

Executive Summary

Rationale

Seemingly opposing questions dominate the livestock sector: how to meet increasing demand for animal proteins; and how to do so in the context of new challenges raised by climate change, while reducing the heavy contribution of the sector to the emission of greenhouse gases (GHGs) and to other adverse impacts?

The *Enhancing climate-smart outcomes from livestock systems: A Guidance Note following the development project* cycle, hereafter the "Note," attempts to address these questions[1]. The Note recognizes that increased livestock production is inevitable in many lower- and middle-income countries because demand for animal products will continue to grow with increasing population and rising prosperity. Development projects targeted at livestock can support the sector's growth, especially when it contributes to food and nutrition security. Properly conceived and managed, such projects present opportunities to steer this growth towards low-carbon development, resilience and sustainability.

The need for livestock investments and development projects to contribute to climate-change mitigation and adaptation is now well recognized. Mitigation indicators are becoming more and more important, as the international community and climate scientists strive to deliver strategies to reduce greenhouse gas (GHG) emissions and adapt to climate change. This trend is reflected in the requirements of multilateral development institutions, including the World Bank, to set mitigation targets for their operations and align themselves with the Paris Agreement[2].

The Note adopts the Climate-Smart Livestock (CSL) approach, aiming at transforming and reorienting livestock systems to support sustainable development and ensure food security, despite the challenges inherent in climate change, and addresses three objectives: (i) sustainably increasing agricultural productivity and incomes; (ii) adapting and building resilience to climate change; and (iii) reducing and/or removing GHG emissions.

The Note represents a major contribution to the enabling of teams to integrate CSL approaches and activities into development projects and to quantify contributions to CSL objectives. It follows the project cycle (preparation, implementation, evaluation) and highlights that the recognition of the importance of CSL by project teams and

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1 The Guidance and underpinning data and experience were gathered and developed in the context of the Program for Climate Smart Livestock Systems in Africa (PCSL), funded by the German Federal Ministry of Economic Cooperation and Development (BMZ), and jointly implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), the International Livestock Research Institute (ILRI), and the World Bank.

2 The Paris Agreement entered into force in 2016, it is a legally binding international treaty setting long-term goals to guide all nations: substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 degrees Celsius while pursuing efforts to limit the increase even further to 1.5 degrees. Article 2.1c of the Paris Agreement stipulates the goal to align financial flows with climate goals and in 2017, the Multilateral Development Banks (MDBs) committed comply with this goal. As of July 1, 2023, 100% of new World Bank operations align with the goals of the Paris Agreement.

clients from the onset of the project is an important success factor. The identification of several practical aspects – team composition, selection of activities and results indicators, data requirements, project monitoring and evaluation (M&E) systems – leads to conclusions about how these can contribute to better national GHG inventories and to more robust and ambitious targets in Nationally Determined Contributions (NDCs).

Indicators, data and assessment methodology

Tracking the contribution of livestock investments and development projects to CSL is not only a requirement in the context of the commitment to align financial flows with the Paris Agreement, but a condition for maximizing such contributions. The challenge is inherent in the complexity of the methodologies and their intense requirements for resources, expertise, and data. Indicators, data, and methodologies to assess adequately CSL contributions is thus an important focus of the note.

Productivity is a traditional metric for evaluating success in livestock development projects, but it needs to be monitored with sufficient accuracy and frequency, as a key component of CSL. Productivity should be measured together with total production (i.e., by ensuring productive animals and not only the total number of head are counted), and all relevant outputs should be considered (e.g., milk, meat and eggs).

To estimate the extent of adaptation, the Note describes three types of indicators based on: *actions* that improve adaptation (changes to farming practices, financing, early warning provision, knowledge and capacity . . .), *system characteristics* linked to vulnerability or resilience (information on climate and natural resources, on the type of livestock production systems, access to market, diversification, learning capacity . . .), and *results* showing evidence of resilience (reactivity, loss levels, speed of recovery . . .).

For mitigation the Guidance Note identifies the mains sources of GHG emissions and removals relevant to livestock production, both direct (e.g., enteric methane emissions and manure management) and indirect (e.g., emissions associated with feed production and soil organic carbon sequestration in grasslands). It describes methods and tools for their assessment, as well as associated data requirements and sources (sample survey questionnaires and budgets are provided).

Guidance along the project cycle and the key stages of preparation

Taking CSL concepts into consideration early in project preparation is the best way to mainstream them into activities and M&E systems, and to help to build the client's CSL capacity.

Including a livestock and climate-change expert in the project team can help to apply CSL lenses to understanding the context (e.g., current situation and trends in livestock GHG emissions hotspots, mitigation pathways and adaptation challenges), and to the selection of activities and beneficiaries.

Efforts to raise awareness of CSL with clients, stakeholders and local experts should also ideally be undertaken at the beginning of project preparation. These partners will include technical experts on livestock and environmental sciences, NGOs, private sector representatives, ministries, and government agencies in charge of climate-change policies and reporting that should provide focal points for livestock GHG inventories and NDCs to ensure a connection between the project's climate results and national climate commitments.

At the preparation stage, the CSL indicators (productivity, adaptation, and mitigation) must be included in the results framework. The collection of data relevant to their calculation can be integrated into the baseline survey and in the project's M&E system, as a cost-effective strategy to collect CSL data. Robust M&E systems at the project level open opportunities for integration with the national Measurement, Reporting and Verification (MRV) system of livestock GHG emissions, and can be conceivably used to leverage climate finance.

Implications for World Bank Operations

Agriculture – and especially livestock – has not yet attracted sizeable climate finance flows, but this could be changed by mainstreaming CSL principles, and monitoring, reporting, and verifying the mitigation contributions of CSL activities in World Bank projects. Indeed, World Bank operations targeting the agriculture sector have already been shown to generate significant climate-change adaptation and mitigation co-benefits; GHG emission reductions of the order of millions of tonnes of carbon dioxide-equivalent (CO_2-eq) have been estimated. Demonstrating and verifying these contributions to overall GHG emission reductions is crucial for the livestock sector to access climate finance at scale.

Data collection and MRV to expose the progress and eventual success of CSL initiatives are essential. However, they continue to suffer from a lack of knowledge and resources, leading to insufficient granularity and reliability. The Note contributes to improving CSL data collection and MRV. As CSL contributions are better exposed, analyzed and interpreted, the concept will highlight lessons and attract resources for MRV development, leading, ultimately, to more robust and cost-effective methodologies.

A key task is to identify and allocate resources to CSL champions who will support the implementation of CSL objectives and ensure continuity post-project. They may also be key to attracting climate finance to CSL during implementation and subsequently, which will be important for the long-term sustainability of the transitions needed to meet the CSL objectives. Ideally, CSL champions are identified both among members of the World Bank's teams and within counterpart teams, including partner institutions and national agencies.

As work on CSL progresses – and as CSL aspects are included more in livestock development projects – the guidance offered in this Note will be enhanced and will evolve, benefitting from additional experience available via the World Bank/FAO Investing in Sustainable Livestock guide.

Alignment with the Paris Agreement

"Paris Alignment" refers to the commitment of Multilateral Development Banks to guarantee that new financing flows will be consistent with the objectives of the Paris Agreement and countries' pathways towards low GHG emissions and climate-resilient development. For the World Bank, in particular, 100% of operations as of July 2023 must align with the goals of the Paris Agreement. Two main sets of methodological documents were published to guide Paris Alignment of World Bank operations: Instrument Methods[3] for different types of financing instruments and Sector Notes[4] providing guidance on sector-specific issues.

Adopting a context-specific approach. An important assumption underpinning Paris Alignment is that countries have different needs and circumstances in integrating climate and development, and therefore must have flexibility in defining their own contribution to the overarching goal of the Paris Agreement. A good understanding of the context as described in Section 3.2, including of countries' climate strategies and commitments (NDCs, Long-term Strategies, National Adaptation Plans), is a key initial step and consideration for Paris Alignment.

Assessing and managing climate risks. Climate risks need to be assessed for both adaptation (climate hazards likely to have an impact on the operation and its development objective) and mitigation (the operation's running the risk of having a negative impact on the country's low-GHG emissions development pathways). This will be particularly important for livestock, which is amongst the most GHG-emitting sectors and, at the same time, both highly vulnerable to climate change and an important tool for food system resilience (Section 2). Measures will need to be incorporated into the operation to reduce risks from climate hazards and to ensure that the development objective is achieved with lower GHG emissions and by avoiding hindering transitions to lower-carbon options.

3 https://www.worldbank.org/en/publication/paris-alignment/instrument-methods

4 https://www.worldbank.org/en/publication/paris-alignment/world-bank-group-sector-notes

The role of livestock in lower-GHG emissions options. Ensuring that project activities take the lowest GHG emission pathway to achieve the project development objective will require a careful examination of several options, including outside the livestock sector. Adopting a context-specific approach and aligning with the country's climate strategies is a prerequisite; however, projects also provide an opportunity to set more ambitious goals for the sector. A priority is to avoid carbon lock-in, i.e., investments and activities that will support persisting patterns that are carbon-intensive or hinder the transition to low-GHG emissions development pathways. For livestock, carbon lock-in risks are potentially associated with interventions at multiple levels (e.g., policy, institutional, or financial via investment in long-term assets or infrastructures), promoting persisting higher-GHG emission pathways, and with activities causing expansion or changes into areas of high carbon stocks (e.g., forests, well-managed semi-natural grasslands). Preventing such expansion needs to be ensured in the country of the operation, but also by guaranteeing sustainable sourcing of imported feed. Supporting low-carbon livestock development pathways and preventing persisting high-GHG emission options will require a good understanding of GHG emissions, mitigation potential, and temporal trends of evolution across and within sub-sectors and production systems (Section 3.2). When emission intensity is used as a result indicator to emphasize productivity and efficiency benefits, and to decouple livestock sector growth from GHG emission trends, projects should, ideally, aim at limiting the growth of absolute livestock GHG emissions below a BAU trend. Activities targeting a partial shift to lower-GHG emitting animal protein sources (e.g., poultry meat as opposed to beef), and a controlled growth in demand for animal proteins in line with food and nutrition security goals should be explored, despite challenging policy and behavioral changes.

1 Introduction

The portfolio of World Bank's (WB) lending for livestock investments has increased from an average of USD 150 million per year in 2010 to roughly USD 700 million per annum around the year 2000, mostly in sub-Saharan Africa (SSA), South Asia and Central Asia. At the same time, livestock-sector development is coming under increasing scrutiny due to its links to global climate change, health and equity agendas.

The Program on Climate Smart Livestock (PCSL), jointly implemented by the International Livestock Research Institute (ILRI), the German Agency for International Cooperation (GIZ) and the World Bank, aims to ensure that key actors in the livestock sector increasingly include climate-change adaptation and mitigation in their farming practices, sector strategies and investment projects. The World Bank implemented activities at the national and project levels, as well as at the regional level, for example supporting the preparation of a *Strategy for Sustainable and Resilient Livestock Development in View of Climate Change* in the IGAD region. The main objective of national- and project-level activities was to provide technical assistance, training and tools to Bank project teams to enhance and assess the contribution of selected country operations (the "operations") to the three CSL 'pillars': productivity, climate-change adaptation, and climate-change mitigation.

Building on lessons learned through the implementation of PCSL, the objectives of this guidance note are to: (1) enable project task teams from the World Bank and other institutions to enhance and track project contributions to climate-smart livestock outcomes; and (2) improve the capacity of project teams to leverage existing products and tools to support climate-smart livestock development. This guidance note can contribute to increasing the level of climate ambition (including through Paris Alignment[5]) and to guiding investments from the World Bank and other International Financial Institutions (IFIs) towards more sustainable livestock portfolios.

The note covers the three objectives of CSL: productivity enhancement, adaptation to climate change, and mitigation of GHG emissions and other environmental impacts. In chapter 2, each objective is described and methodological elements are provided for assessing CSL performance, including relevant indicators. In particular, the chapter offers detailed support for estimating the mitigation potential of World Bank (WB) projects. The next chapters provide guidance along the project cycle, starting with project preparation and then moving to implementation stage and evaluation. The Annexes provide practical examples and templates to assist project teams in incorporating CSL into their practices.

5 As of July 2023, all new World Bank operations will be requested to demonstrate their alignment with the Paris Agreement. This will include assessing whether lower emission pathways are available to achieve the project development objective. This Paris Alignment commitment was also adopted by other IFIs.

The note has been informed by experience gained from supporting various operations at country level[6], as well as previously published material provide complementary resources. These include: (i) Investing in Sustainable Livestock (ISL) Guide, an online tool that offers guidance needed to ensure livestock projects are sustainable according to environmental and animal health dimensions, as well as the theory and evidence that underpin the guidance; and (ii) Opportunities for Climate Finance in the Livestock Sector: Removing Obstacles and Realizing Potential, which identifies investment and institutional options to channel climate finance into the livestock sector.

Although mostly developed on the basis of activities carried out in Sub-Saharan Africa, the lessons and implications in this note are largely applicable to other regions.

6 Including in Kenya (Kenya Climate Smart Agriculture Project, National Agricultural and Rural Inclusive Growth Project, Emergency Locust Response Program), Ethiopia (Livestock and Fisheries Sector Development Project, Oromia Forested Landscape Program), Cameroon (Projet de développement de l'élevage), Niger (Projet d'Appui à l'Agriculture Sensible aux risques Climatiques), the Sahel region (Regional Sahel Pastoralism Support Project), Colombia Orinoquía Sustainable Integrated Landscape Program), see Annex 1 for an overview.

2 Climate-Smart Livestock and How It Is Assessed

What is CSL? Climate-Smart Livestock (CSL) is an approach aiming at transforming and reorienting livestock systems to support sustainable development and ensure food security under climate change (definition adapted from Climate-Smart Agriculture[7]). It addresses:

- Sustainably increasing agricultural productivity and incomes;
- Adapting and building resilience to climate change; and
- Reducing and/or removing GHG emissions.

Sections 2.1 to 2.3 provide common methodological elements for the assessment of CSL performance in these three objectives.

How to make the case that mitigation is important? Livestock is the fastest-growing agricultural sector and is set to continue robust growth. Yet, the environmental effects are potentially catastrophic without serious attention to mitigation; but this message needs to be emphasized more forcefully, despite expressions of commitment to appropriate strategies on the part of countries and IFIs. Sub-Saharan African countries, for example, have already committed to climate-change mitigation objectives; however, those may be seen as lower priorities, compared to food security and resilience, so that mitigation efforts may lack ambition and be conditional to external financial support. Several key points can be advanced by project teams to engage national counterparts in dialogue about the importance of mitigation:

- Many operations will have development objectives centred around livestock-sector development, food security and resilience. However, interventions and activities in support of these objectives can have important mitigation co-benefits. For instance, productivity gains are directly related to reductions in emission intensity (emissions *per* unit of output). Essentially, more productive livestock are more efficient from a GHG emission standpoint. Capturing these mitigation co-benefits, even if they are not the primary development objective, can allow them to be accounted for (e.g., in NDCs) and potentially leveraged to attract climate finance for livestock development.
- Many developing countries, including in Sub-Saharan Africa, include livestock among the priority sectors for mitigation in their Nationally Determined Contributions (NDCs). Some countries may even include livestock-specific

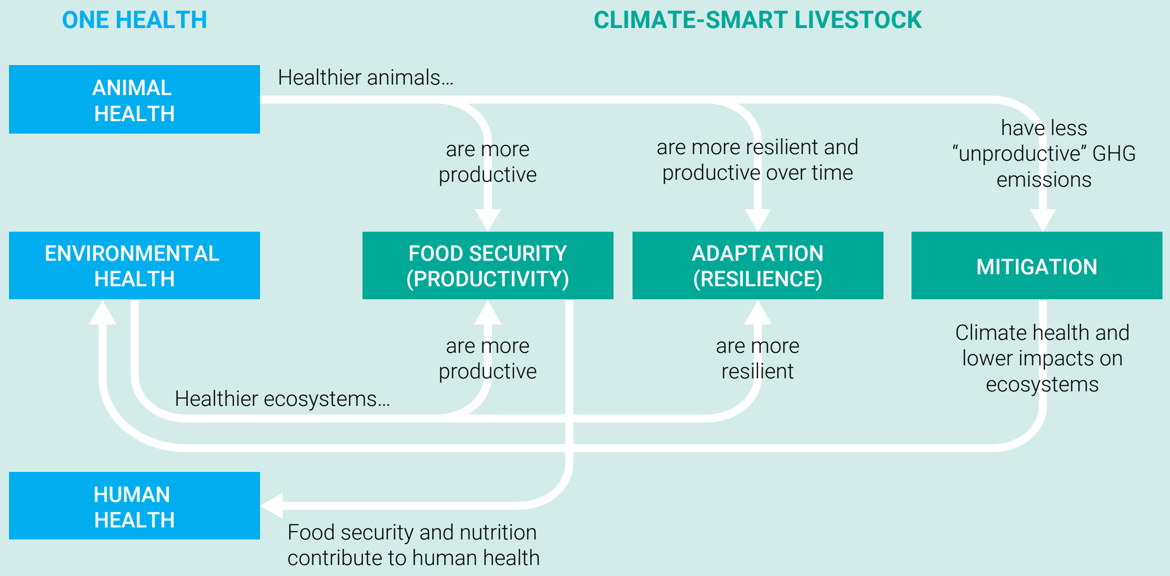
7 https://www.fao.org/documents/card/en/c/a58c2363-da18-4b55-8747-309bf1d82ccf/

mitigation targets. However, in such cases, NDCs still often lack ambition and/or remain vague regarding the concrete actions planned to achieve livestock-sector mitigation outcomes. Investments from IFIs can involve large scale and transformative changes in the livestock sector, which have the potential to make significant contributions to mitigation outcomes as well as to measure and track these outcomes as part of NDC accounting, potentially opening up further opportunities for climate finance in the future. IFI investment dialogue can thus be an entry point for action on existing NDC priorities and targets for the livestock sector, as well as for raising the ambition of the NDC itself regarding livestock sector mitigation.

- Traditional finance has long been difficult to access for livestock smallholders because of their lack of collateral, limited experience working with financial institutions, and the low interest and high risk as perceived by lenders. Climate finance can be leveraged to expand financial inclusion to smallholders, enabling them to adopt more sustainable practices, improve their livelihoods, increase their resilience, and improve their on-farm net GHG emissions. Although numbers will vary depending on investment size, type of activities and accounting methodologies, large scale operations from the World Bank and other IFIs targeting the livestock sector can generate emission reductions in the order of millions of tonnes CO2-eq (e.g., Boxes 1, 3, 4 and 5). Operations can play a key role in capitalizing on these mitigation benefits by building the dialogue and mechanisms that will allow channelling climate finance to the livestock sector. More details on climate finance are provided in Section 3.6.

Link to other approaches. CSL is not a set of pre-defined practices but, rather, an approach to integrating the climate perspective, in a context-specific manner, into existing frameworks such as sustainable agriculture, sustainable land and water management, ecosystem services, landscape approaches, and One Health, among others. **One Health**, for example, emphasizes the interlinkages between efforts to improve the health of people, animals, and ecosystems. Important synergies thus exist between the animal health pillar of One Health and the productivity and adaptation/resilience pillars of CSL, which for livestock systems often promote improved animal health as an important aspect of animal-level productivity and livestock system resilience to disease spread. Synergies are also present between the mitigation pillar of CSL and ecosystem health pillar of One Health, which can be considered to cover the health of climate systems along with other ecosystem components. Further linkages include animal health's limiting 'unproductive' GHG emissions and ecosystem health's benefitting productivity and carbon sequestration through higher quality and productivity pasture and feed in livestock systems (Figure 1).

FIGURE 1 Examples of inter-linkages among One Health and Climate-Smart Livestock.



2.1 Productivity

The first objective of CSL is to improve food security but measuring it is often translated into quantifying food production, whereas food *security* goes beyond that, to encompass aspects of nutrition, availability, access, utilization, and stability. Projects may assess these aspects, but only when adequately quantified livestock production and/or productivity already provide valuable proxies that all projects with livestock components are strongly recommended to include in their M&E activities. Furthermore, the issue of stability is closely related to the adaptation objective of CSA and can be assessed with the adaptation indicators described in Section 2.2.

Production. Livestock production can be quantified for specific animal products (i.e., litres of milk, kilograms (kg) of meat or eggs) or converted into a common unit – usually, kg of proteins. Using this measure allows the aggregation of several animal products (for example, milk and meat that are both produced by a dairy cattle herd). Quantification of livestock production is required to calculate the emission-intensity indicator under the mitigation objective (Section 2.1). Projects targeting dairy value chains often collect milk production or productivity data regularly (e.g., monthly to quarterly) as part of their M&E framework. However, it is also important for meat production to be quantified, by collecting data on the number and weight of the different categories of animals (e.g., male calves, culled cows, fattened animals) that are slaughtered and/or sold for meat production.

Productivity. For livestock, productivity is most often measured as production *per* animal. In addition to production, this involves collecting data not only on the *productive* animals but on the total number of animals to assess productivity *at herd level*. For all types of livestock production, the number of adult females should be collected in addition to the total number of animals, as it provides more useful information on production and the total population dynamics. More specifically:

- For dairy and dual-purpose (milk and meat) ruminant (cattle, sheep, goats) production, both the total number of females, the number of lactating females, and the average milk yield *per* lactating female should ideally be collected;
- For egg production (specialized layer systems or "backyard" systems), the number of laying hens and average number of eggs per hen should be collected;
- For specialized meat production, whether ruminants or monogastrics (poultry, pigs . . .), the weight at slaughter should be collected, as well as information on the fattening period including average duration and daily weight gain. Since meat is also a co-product of all other types of production, the weight of animals slaughtered or sold for meat should, thus, be collected.

2.2 Adaptation

Adaptation is likely to be the CSA objective with the highest diversity and complexity of indicators; several frameworks have been proposed to categorize them. The terms "adaptation" and "resilience" are often used interchangeably but, to be more specific, the former tends to place emphasis on adjustments in response to climate change, while the latter refers to an ability to cope with climate shocks. Adaptation refers to changes in processes, practices, and structures to moderate potential damage or to benefit from opportunities associated with climate change. Resilience can be defined as the capacity to prepare for, respond to and recover from the impact of hazardous climatic events.

The diversity of adaptation indicators also comes from the diversity of scales at which adaptation takes place and can be measured. Relevant scales from adaptation include the animals (e.g., resilient breeds), the species and production system (e.g., resilient feed supply) or the whole value chain. The value chain scale is particularly relevant to addressing adaptation in the livestock sector because, in addition to direct effects on the animals (e.g., heat stress), a large part of the impact of climate change on livestock production is indirect. Upstream, feed availability is perhaps the most critical aspect of resilience, including the ability to purchase feed in many production systems. Downstream, access to market strongly determines the ability to destock, avoiding "unproductive" losses and providing income to maintain the rest of the herd. Access to market thus contributes to robust value chains and strengthens the ability of smallholder farmers to cope with climate shocks.

Three simplified categories of indicators for both adaptation and resilience are relevant to reporting at project level and they relate to the other CSA objectives. **Indicators based on actions**. These indicators reflect the level of adoption or implementation of actions (activities) that are established by the project to promote climate-change adaptation. Such activities can be diverse — farming practices (e.g., drought resistant breeds/varieties, forage conservation), financial instruments/insurance, information (e.g., early warning systems), knowledge and capacity, and market access. Data on the implementation of these activities is most often collected because they are directly implemented by the project and it is, therefore, recommended to include them as high-level results indicator (Project Development Objectives, i.e., PDO-level for World Bank projects). The downside of such indicators is that they rely on the assumption that the identified actions do contribute to the adaptation of the system, which may not entirely be the case. Data on implementation should, thus, be complemented by information/description of the link between the activities and adaptation, which can be done through a review of literature, surveys, and other local sources of information (technical/research/extension institutions and networks.)

Indicators based on system characteristics. These indicators describe properties or characteristics of the system (e.g., household, producer organization, region, value chain) that are relevant to its adaptive capacity. For instance:

- Natural system: length of growing period, soil and water availability/quality, rainfall quantity/variability, drought/flood frequency;
- Livestock system: the animal stock per species and breed, dry matter intake and type (rangelands, hay, crop residues or other products grown on-farm, feed purchased externally);
- Access to natural resources: type of water access on rangelands, water availability, land tenure, type/degradation status of rangeland, pastoral mobility management;
- Access to markets: types of markets, access to them (distance, infrastructure), price variability, numbers of animals/volume of products sold;
- Diversification: feed sources, livestock species kept/crops grown on farm, income sources; and
- Learning capacity: accessibility to social/farmers/extension networks

These examples are only a subset of possible indicators (more thorough reviews can be found in the literature[8]), and it can be challenging to build a coherent framework

8 For instance: Alary, V., Lasseur, J., Frija, A. and Gautier, D., 2022. Assessing the sustainability of livestock socio-ecosystems in the drylands through a set of indicators. Agricultural Systems, 198, p.103389.

to assess climate-change adaption with selected indicators based on the system characteristics. However, it can be informative to couple selected action-based indicators with indicators based on system characteristics, to show how project activities do result in the targeted improvements (e.g., in terms of livelihood diversification, access to markets or natural resources).

Indicators based on results. Adaptation actions, capacity or processes should result in a more resilient system, i.e., one that is better able to cope with climate shocks and to recover from their impacts. Four theoretical indicators can be used for measuring resilience:

1. Length of time from the onset of a disturbance or shock to the loss of livestock numbers, production, and income;
2. Length of time during which livestock numbers, production, and income are compromised due to the shock or disturbance;
3. Total losses of livestock numbers, production, and income due to the shock or disturbance; and
4. Extent to which livestock numbers, production, and income recover to previous levels.

These indicators are the end results that adaptation actions aim to achieve and, thus, provide the best evidence of adaptation benefits. However, they require the collection of specific data over time and possibly on a longer term than the duration of project implementation. They can still be calculated from livestock numbers, production or income data collected regularly during the project.

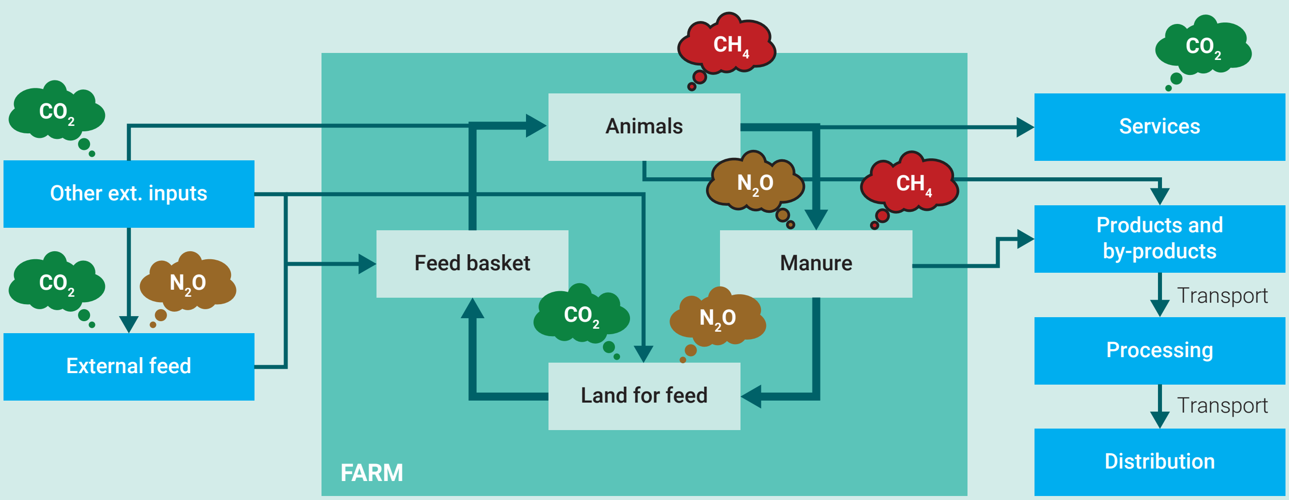
2.3 Mitigation

2.3.1 Key concepts of livestock GHG emissions and their assessment

Sources of emissions (direct and indirect). The main GHGs emitted by the livestock sector are methane (CH4), nitrous oxide (N2O), and carbon dioxide (CO2). In the Intergovernmental Panel on Climate Change (IPCC) approach used in national GHG inventories, only direct livestock emissions (e.g., enteric fermentation and manure management) are reported under the livestock sector. Another approach is to adopt a life-cycle perspective, where indirect emissions are also considered, those occurring upstream (inputs and feed production, transport) and downstream (processing, transport) from the livestock farm (Figure 2). This is the preferred approach when the project includes activities along the value chain (e.g., product transformation/ marketing in addition to production itself), and more generally when significant livestock activities are implemented by a project. This is because the life-cycle approach provides a more comprehensive and realistic picture of the changes in emissions driven by livestock along the value chain. Certain activities (e.g., intensification) can shift part of the GHG emissions from direct (e.g., better quality feed leading to lower enteric methane emissions) to indirect (more emissions from external feed production) emissions. Focusing on direct emissions is preferable when several inter-related sectors need to be considered, to avoid any risk of double counting (e.g., counting feed emissions under both crop and livestock production).

Tier 1 vs. tier 2. IPCC guidelines include a tiered approach, with typically 3 Tiers corresponding to levels of complexity in the calculation of GHG emissions. For enteric methane emissions from livestock, the simpler Tier 1 approach is less data-demanding and, hence, more frequently used. IPCC provides default emission factors by animals (by animal categories and regions). Calculating emissions only requires multiplying the number of animals by these emission factors. Consequently, the only way to account for emission reductions with this approach is if there is a reduction in animal numbers (since the emission factors are constant). The Tier 2 approach is based on a set of equations within a small biophysical model reflecting energy demand from animals, how this demand is met by feed supply, and how much methane is emitted in the process of converting this supply to energy. Such

FIGURE 2 Overview of the main sources of emissions from livestock production when considering a life-cycle perspective. A thick, black outline is used for gases/sources defined as direct livestock emissions.

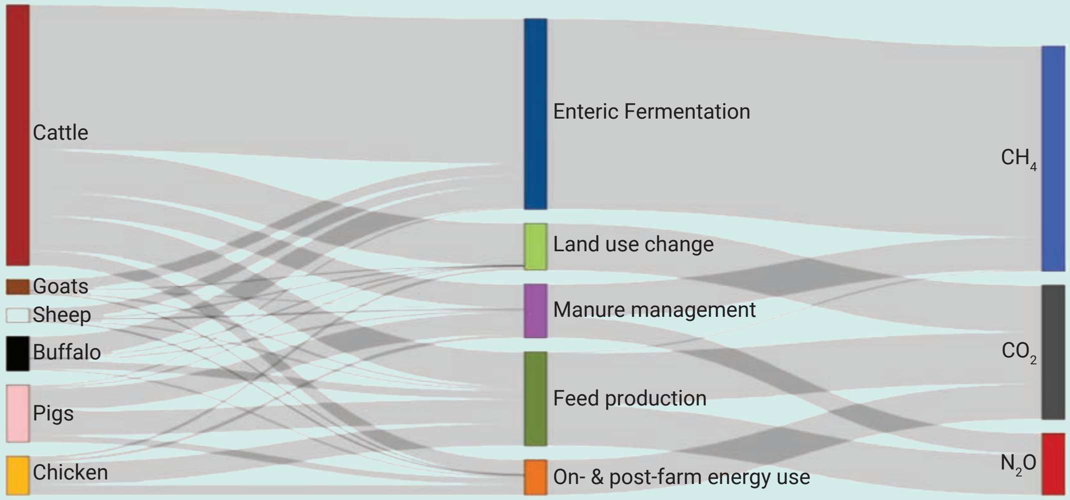


an approach can reflect and quantify the impact of improved management practices (e.g., animal health and husbandry, feeding, manure management) on changes in GHG emissions.

Projects can easily apply a Tier 1 approach by applying IPCC Tier 1 emission factors directly, or by using existing tools based on the Tier 1 approach such as FAO EX-ACT. However, if the project includes significant activities involving livestock (changes in practices, technologies, intensification/productivity improvements), using a Tier 2 approach is strongly recommended because it will be the only way to account for the impact of such activities on GHG emissions.

Methane emissions. Over 100 countries joined the Global Methane Pledge launched at COP 26 in November 2021 in Glasgow, Scotland. Participants to the Pledge agree to take voluntary actions to contribute to a collective effort to reduce global methane emissions by at least 30% from 2020 levels by 2030, and to move towards higher tier IPCC methodologies and improved transparency in their reporting, especially for key sectors. In most developing countries, the largest share of livestock emissions is in the form of methane from enteric fermentation. For Africa as a whole, for example, methane accounts for 69% of all livestock emissions, 96% of which come from enteric fermentation (Figure 3). This offers an opportunity for the livestock sector to contribute to methane-specific climate commitments, including in the context of the Global Methane Pledge. Livestock can be considered a key sector

FIGURE 3 Relative contributions of animal species, emission sources and gases to the total livestock greenhouse gas emissions in the African continent.



Source: FAO-GLEAM.

for improving GHG inventory reporting on methane, including by moving from Tier 1 to Tier 2 methodologies. The use of Tier 2 methodologies will facilitate the estimation, tracking and reporting of mitigation benefits from interventions aiming at methane emission reductions. All categories of mitigation practices targeting the animal (including husbandry, health and nutrition) and manure levels have an effect on methane (Figure 7).

2.3.2 Indicators, their calculation and reporting

For high-level (PDO-level) results indicators related to mitigation, three main types of metrics can be considered:

- **Absolute GHG emissions** from livestock, expressed in t CO_2-eq (tonnes of carbon dioxide-equivalent) should be measured with an IPCC Tier 2 approach, which models several biophysical processes leading to emissions, making it possible to quantify the impact of changes in practices (e.g., animal health, feed, management of the herd and effluents) on emissions reduction. Such an approach is in contrast to the simpler and more commonly used Tier 1 approach that uses constant emission factors multiplied by animal numbers, leaving a decrease in the animal population as the only emission-reduction option. In using a Tier 2 approach, the project should decide if only direct emissions should be reported or if a life-cycle perspective would be more appropriate (Section 2.3.1). As an indicator, absolute GHG emission is in line with National Inventory Reports to the UNFCCC, and with the GHG emission reduction targets.
- **Emission intensity** is livestock GHG emissions divided by production and expressed in kg CO2-eq/kg protein (or another production unit such as kg milk or meat). This indicator reflects productive efficiency as climate-change impact. Since emission intensity is calculated as a ratio, it can be reduced in two ways: by decreasing absolute emissions (numerator), or by increasing productivity (denominator). Most practices that increase productivity (yield) also increase GHG emissions but at a lower rate, leading to an overall reduction in emission intensity. This means that there are almost always synergies between productivity gain and emission-intensity reduction. Emission intensity can be selected as a mitigation indicator if the project needs to emphasize these synergies. It enables the measurement of the decoupling between livestock-sector growth and the related GHG emissions trend. As for absolute emissions, the scope should be defined, although including both direct and indirect emissions is the classic approach for calculating emission intensity.

Net GHG emissions considers both the emission of GHGs and their removals from the atmosphere. Net GHG emissions are commonly expressed as t CO_2-eq but with a value that can be positive (if emissions are higher than removals) or negative (if removals are higher than emissions). In the case of livestock, removals can be achieved through carbon sequestration in the soil of grasslands (through pasture and grazing management) and in the woody biomass of shrublands/silvopastoral systems. Projects may also include activities beyond livestock production and calculate more comprehensive AFOLU net GHG emissions (e.g., including forest-related activities, or soil conservation in crop farming).

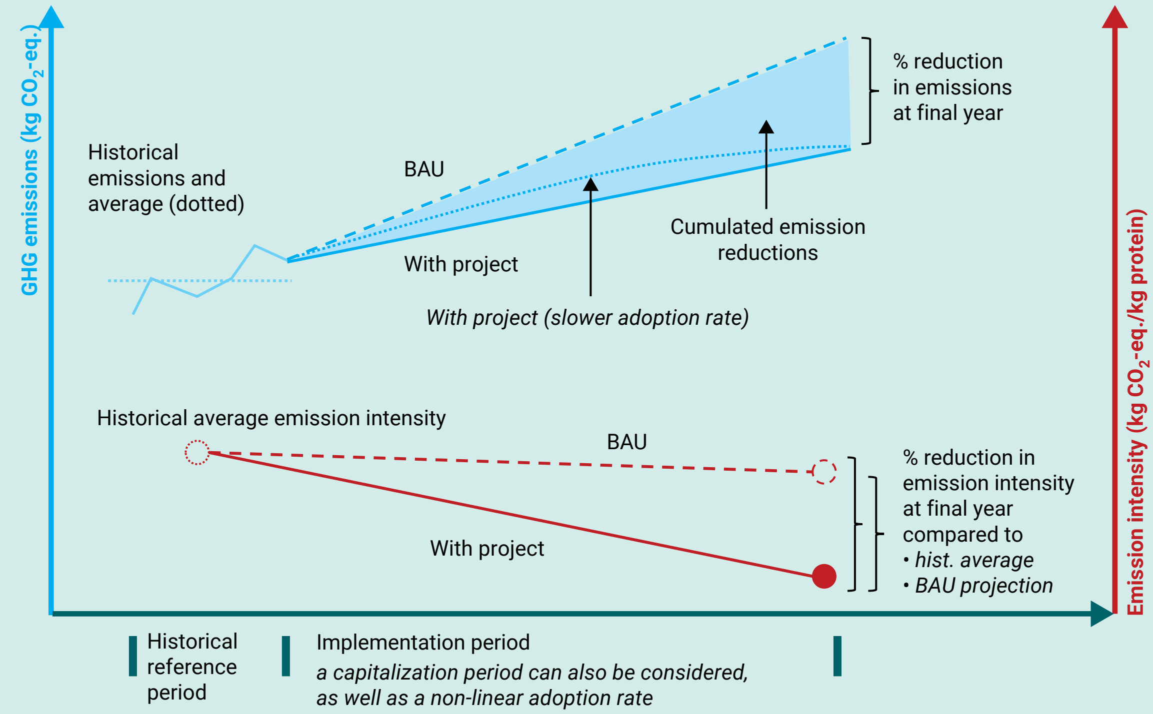
Tools. Several Tier 2 calculators are available for *absolute livestock GHG emissions*, including international tools such as the FAO GLEAM-i, the Cool Farm Tool, the Farm Carbon Calculator or the IPCC inventory software, but also national tools that can be adapted to local needs (e.g. New Zealand's Agriculture Emissions Calculator). Calculating *emission intensity* does not require much in the way of additional steps or data, compared to the computation of GHG emissions alone, except for meat production if relevant (milk production is already a required input for Tier 2 emissions calculation).

Estimating *carbon sequestration* to calculate *net GHG emissions* requires different tools and is associated with more uncertainty, although resources do exist. A Tier 1 approach can be used for exploratory assessments, with existing tools (e.g., FAO EX-ACT) or by applying Tier 1 factors from IPCC or from the literature (example Box 5). A more accurate approach is the use of process-based models such as RothC, CENTURY or DeNitrification DeComposition (DNDC), that account for most carbon flows (inputs and outputs) to the soil in order to estimate the balance (example in Box 1). These models need input data that can be retrieved from global soil property maps, but they are most accurate when calibrated and validated with direct measurements (soil samples, flux towers, portable chambers). Such direct measurements should be included in data collection plans for projects where first assessments predict significant soil-carbon sequestration potential. Research organizations at national and regional level should be considered as key partners for this.

Reference situation. Setting targets and baselines for selected indicators requires careful choice of a reference point. Situations will be relatively rare where absolute livestock GHG emissions will have decreased at the end of the project, compared to its start, because livestock is a growing sector in most developing countries, and because most intensification interventions to increase productivity will reduce emissions *per* unit of products (emission intensity) but increase absolute emissions (because of increased livestock output). Absolute emissions can only decrease if a stable level of production is reached through a combination of productivity gains and decreased animal numbers (see also Figure 6a), which is difficult to achieve in the context of low and middle-income countries (LMICs), where livestock is generally a growing sector. To reflect efforts from the sector to produce in a more emissions-efficient way, either an emission-intensity-based reference (e.g., at the start of the project, or averaged over a historical period of 5–10 years) can be used, or a Business-As-Usual (BAU) projection of emissions at the end of the intended duration of the project. The former has been adopted as part of the BioCarbon Fund Initiative for Sustainable Forest Landscapes, while the latter is used in many developing countries' NDCs.

Another type of project scenario producing absolute emissions reduction is where GHG emissions from animals, their feed and their manure are compensated for by a greater increase in carbon sequestration. This will typically concern extensive, pasture-based systems with high grassland productivity. The reference situation should be carefully defined in this case; emissions and sequestration are different in nature. While livestock production always leads to GHG emissions, sequestration only occurs if there is a change in practices (otherwise it is assumed that the carbon dynamics are at equilibrium, which is typically reached after 20, or more,

FIGURE 4 A schematic representation of different baseline options and considerations along baseline choices. There are two main types of reference: absolute emissions (blue) and emission intensity (red). A typical situation is illustrated where livestock emissions are historically growing and would already be above a (e.g., 10y) average at the start of the project. In a project scenario, absolute emissions have a slower growth than in a BAU scenario (which is based on a projection of historical emissions), and emission intensity is reduced. Several indicators can be used, e.g., the cumulated avoided emissions, compared to BAU, the percentage reduction in absolute emission or in emission intensity reached at project completion stage.



years). The reference should, therefore, be a "without project" situation, with robust assumptions for the evolution of livestock production (emissions) and grassland management practices (removals). This type of reference was used in the *ex-post* assessment of the PRODEL project in Cameroon[9].

2.4 Data sources and data management

Standardizing the calculation of mitigation potential is essential for ensuring consistency and credibility. While emissions calculations depend on contextual factors and available data, a uniform methodology ensures that targets and results are comparable across projects. Harmonizing approaches thus enables organizations to track progress, identify trends, and make informed decisions across a broad portfolio of projects. It also enhances the credibility of GHG reporting, aligning it with regulatory requirements and fulfilling auditing requirements. Additionally, a standardized approach may streamline resource allocation, as it enables teams to optimize data collection, analysis, and reporting processes. This efficiency is essential given the limited resources of project teams.

To guide CSL assessment, Table 1 provides recommendations for a minimum set of indicators (based on the indicators described in the sections above) to be included at high-level (PDO-level for World Bank project) for each CSL objective, along with indications of associated data and methodological requirements. Annex 5 contains a comprehensive list of data requirements for Tier 2 GHG emission calculations and provides recommendations on data collection type and frequency.

With- vs. without-project situations. Assessing the impact of a project will involve comparing two situations – with and without an implemented project – collecting and managing data for both. As detailed in Section 2.3.2, several counterfactuals can be used for without-project situations; for example, a historical baseline reference, a projection of the BAU trend of evolution among future project beneficiaries, or non-beneficiaries, in project areas during implementation. These options for the without-project situation will involve different types of data collection. Three main types of data that will be used to describe the with- and without-project situations are listed below in decreasing order of accuracy but also of associated collection efforts.

- **Primary data** are obtained from direct measurements, or a calculation based on a direct measurement as its original source. To the extent possible, primary data should be used to describe the project situation, i.e., all data required for

9 https://www.fao.org/3/cc1443en/cc1443en.pdf

the calculation of project's performance on CSL indicators should be directly collected by the project among project beneficiaries and integrated into the project Management Information System (MIS). Primary data can also be collected through targeted surveys of non-beneficiaries in the project area if this is the preferred option to describe the without-project situation (see also Section 4.4).

- **Secondary data** can be used to describe the without-project situation when a historical reference or BAU projection is used. Secondary data can also complement primary data to describe the project situation for variables that have a lower level of priority for calculating CSL indicators. When secondary data are used, national sources of information should be prioritized, such as national statistics from the central statistics office and/or ministry of agriculture, reports from research, extension and other technical institutions, scientific literature published on the country, etc. Consultation with local experts will be key to identifying and compiling all the available information and optimally to fill gaps with expert opinion. Secondary data will not necessarily be integrated into the project management information systems (MIS) but should be consolidated in a clean database with clear sources and references. This database can also help identify gaps and data collection improvements that could be implemented at research or national levels (e.g., to improve national GHG emission inventories, see also Section 3.2).
- **Expert opinion and assumptions.** Where neither primary nor secondary data sources are available, expert opinion and assumptions can be used to fill data gaps. These assumptions should always be documented and communicated transparently, and ideally discussed with a pool of experts and/or reviewed by additional external experts.

Data disaggregation and representativeness. Using an IPCC Tier 2 approach for livestock GHG emissions calculations requires the impact of a project on emissions to be calculated from its impact on the parameters of Tier 2 equations. Different Tier 2 calculators or tools for livestock may use slightly different input parameters. Sets of parameter values will need to be derived from the data sources for both the without- and with-project situation, and for the groups/levels of disaggregation required for results/reporting (all livestock vs. by livestock species or by production system, country average vs. by region). The set of parameter values needs to be representative of the different beneficiary groups. When primary data are used, average parameter values will need to be calculated (possibly weighted averages, by animal numbers or production volume). When secondary data are used, they need to come from similar groups and to be as close to representative as possible (e.g., values from a few experimental farms are unlikely to be representative of a given production system in the country). Assumptions will also need to be specific to each group.

2.5 Addressing potential tradeoffs between CSL and sustainability objectives

While climate-smart agriculture promotes approaches that contribute comprehensively to its pillars (production, adaptation, mitigation), tradeoffs among them can occur. For example, to increase livestock productivity, a common intervention is to improve animal nutrition through supplementing a grazing-based diet with feed based on grain concentrate. While improved animal nutrition may result in both increased productivity and reduced enteric methane emission intensity, the production and transport of concentrates is associated with considerable nitrous oxide and carbon dioxide emissions that may outweigh these emission reductions. Another example is the import of exotic (breeds neither endemic to the region, nor historically adapted to it), high-yielding breeds to increase livestock productivity. While such breeds may produce measurably more output, they often do so only under specific conditions. A tradeoff with resilience may occur if the exotic animals cannot sustain higher yields in the face of local seasonal patterns and climate change impacts.

Tradeoffs among CSA pillars may also occur over time. For example, activities to restore crop land and grazing lands are promoted as contributing to productivity (through increased feed availability), resilience (through improved soil health and fertility), and mitigation (through increased carbon sequestration). However, restoration activities may imply taking land out of production in the short term; a tradeoff thus may occur between shorter-term and longer-term productivity gains.

Tradeoffs can also exist beyond CSA pillars, with other environmental or social dimensions of sustainability. Intensification is key to increasing productivity and efficiency (including in terms of GHG emissions *per* unit of product) but can, in some cases, occur at the expenses of other environmental (e.g., pasture improvement for productivity resulting in the loss of native grassland biodiversity, animal concentration leading to nutrient pollution) or social (e.g., marginal production systems or social groups not accessing the opportunity and benefits of intensification) aspects. Avoiding such tradeoffs requires specific measures, to ensure that sustainable intensification is achieved and leaves no social group behind.

Task teams may confront such tradeoffs among CSA pillars in the design of livestock projects. In these cases, it is important to acknowledge and discuss them with counterparts, recognizing that all activities under an investment project may not be able to contribute unilaterally to all three CSA pillars. Moreover, maintaining strong environmental and social safeguards is necessary to avoid tradeoffs with other sustainability dimensions. There is no standardized approach to addressing tradeoffs, and the team should evaluate design options in the light of country specific context and development goals. An example of favoring production growth over mitigation of GHG emissions is to use an emission intensity-based indicator for GHG monitoring in the results framework.

2.6 The mitigation focus of this document

This document addresses the three CSA pillars but adopts a mitigation focus, with a higher level of information and technical details provided on this aspect. Productivity and adaptation can be measured with metrics that are generally already well understood and adopted by livestock projects (e.g., volume or yield of livestock products, percentage adoption of practices that are beneficial for adaptation). In contrast, GHG emissions accounting is based on specific methods and data, and tends to be seen as more challenging by project teams, requiring targeted support. There is increasing demand for the inclusion of ambitious mitigation targets and accurate GHG accounting methods, for instance in the context of the requirement for operations of the World Bank and other Multilateral Development Banks to be aligned with the Paris Agreement. Furthermore, there is increasing awareness of the potential to link the livestock sector to climate finance, which requires detailed Measurement Reporting and Verification[10] (MRV).

10 World Bank, 2021. *Opportunities for Climate Finance in the Livestock Sector: Removing Obstacles and Realizing Potential*. The World Bank Group, Washington DC.

3 Guidance for Project Preparation Stages

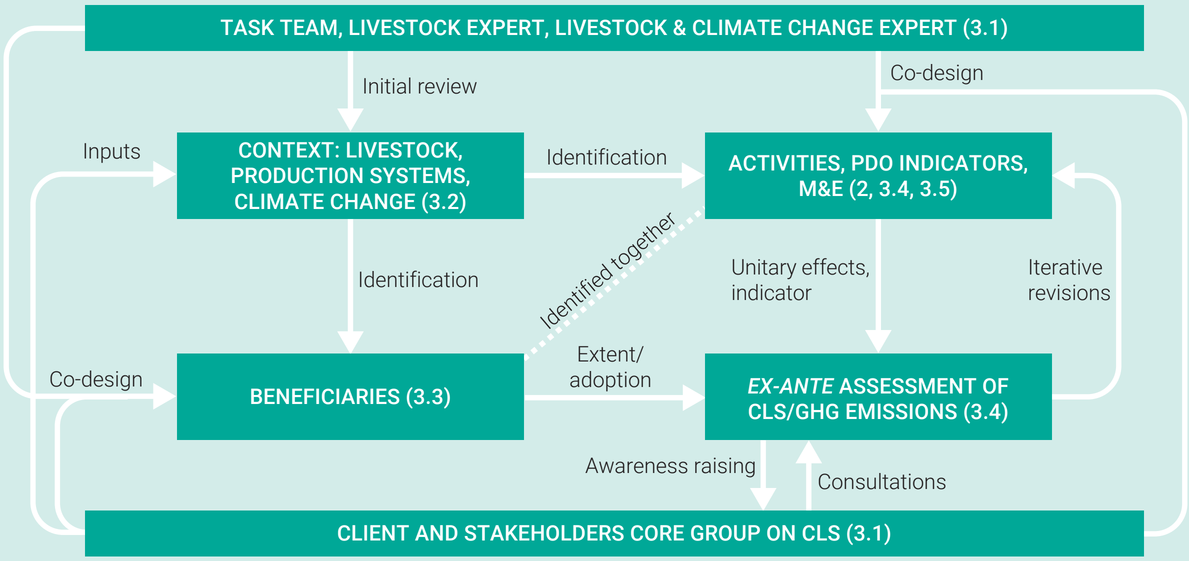
3.1 Team composition and consultations

For projects that largely support the livestock sector, the task team may be strengthened with dedicated livestock and climate change experts. Below are some suggestions in this regard.

National livestock expert. Sample ToRs are provided as Annex 2 for such a livestock expert, who could be a national consultant hired by the IFI or by the client. The expert will have an extended knowledge of the local livestock production systems and practices, livestock and climate-change issues (adaptation, in particular) and of the stakeholder landscape (producers associations, technical/extension/research institutions, key government agencies and offices). This knowledge will be used to support the description of the context, technical assessment, and project formulation (prioritizing practices and technologies in collaboration with stakeholder networks).

Livestock & climate-change expert. It is likely that the skill set of the livestock expert would need to be strengthened in specific technical aspects – the assessment of livestock and climate-change (mitigation and adaptation) impacts in particular. If these skills are also lacking in the task team, an international consultant may be contracted for a limited number of days (sample ToRs in Annex 3), to participate in the formulation mission, to contribute to the technical assessment of the project

FIGURE 5 Overview of the different steps and persons involved at project design stage. Numbers in brackets indicate corresponding sections of this document.



and to certain aspects of formulation (e.g., insights into the climate change impacts of potential activities), and M&E (e.g., baseline survey design).

Client and stakeholders. It will also be critical to identify relevant client counterparts, stakeholders and local experts who can be consulted and will contribute to project design for the CSL aspects (and possibly also be involved in implementation). These individuals/organizations will include experts from technical/extension/research institutions related to livestock and environmental science, NGOs, private sector representatives (farmers/producers/value-chain organizations/associations), ministries and government agencies in charge of climate-change policies and reporting. Among this last group, focal points for livestock GHG inventories and NDCs should be involved to ensure a connection between the project's climate results and national climate commitments.

Linking with other national projects. Linking to other operations and projects (including research projects) will be important to avoid duplication of efforts during implementation and will enhance the impact of the projects' results. Resources that can be put in common across operations include baseline data, emission factors, good practices and associated elements.

International support. International institutions and networks can be incentivized to provide advice, guidance, or technical support for strengthening the CSL aspect of the project. For instance, the Global Research Alliance on Agricultural Greenhouse Gases (GRA) brings countries together to share experience on low-carbon agriculture and livestock development, and hosts research networks to promote collaboration, knowledge sharing, use of best practices and capacity building. International institutions at the global (e.g., FAO) and regional levels (e.g. Consultative Group for International Agricultural Research [CGIAR], centers such as the International Livestock Research Institute [ILRI] in East Africa, the International Center for Tropical Agriculture [CIAT] in Latin America or national and regional institutions such as the dryland pastoralism pole [PPZS], Agriculture Research Institute of Senegal [ISRA] or France's Agricultural Research Centre for International Development [CIRAD] in West Africa) also have the capacity to provide technical support for CSL. They can also provide reference points for emissions factors and sequestration rates from their research infrastructures.

3.2 Understanding the context

The identification of mitigation and adaptation opportunities, and design of effective project activities, requires a complete understanding of the livestock production context.

Livestock species and productive orientations. The five most common livestock species across the globe are cattle, sheep, goats, swine and chickens; however, other species can be locally very important such as buffaloes, camels, horses, and various species of ruminants (deer, alpacas) and poultry (ducks, geese . . .). For certain species, different productive orientations (or value chains) exist, such as dairy or dual purpose vs. specialized meat production for cattle and ruminants, and eggs vs. meat for poultry. These species and breeds have contrasting emission profiles and adaptation issues. The relative importance and spatial distribution of the different species and productive orientation is an important part of understanding the context. In addition to national data sources, a useful resource on is the Gridded Livestock of the World (GLW)[11], that provides global maps of livestock density for the main species at a 10km resolution (see example in Figure 6a).

Livestock production systems and practices. Production systems are an important level of stratification below livestock species and productive orientations. They are important because they will be relatively homogenous in terms of practices and, hence, of practice/technology changes and innovations targeted by the project. Production systems will also reflect representative categories to collect data and calculate average CSL impacts (on productivity, adaptation, and mitigation) since they are relatively homogeneous groups of livestock production conditions and practices. Different, but often inter-related dimensions can be used to distinguish production systems. These include farm size or market orientation (e.g., smallholders vs. large commercial farms), level of intensification and feeding strategies (e.g., extensive, pastoral, grassland-based vs. mixed crop-livestock, intensive or even landless – dry- vs wet-season feed rations and feed resources), or production environment (e.g., arid, high-potential, or peri-urban areas). The type of production system classification adopted in the context of the project can depend on data availability (e.g., classification used in national/agricultural statistics) and relevance to the type of activities implemented.

Temporal trends – livestock. To complement the picture of the current situation, it is important to assess the trend of evolution of livestock numbers (by species) and production (by commodity). It can be useful to calculate an average growth rate on the time series (e.g., least-square growth rate or other method) to project livestock numbers or production at the end of the project (reflecting a BAU scenario). This is because strong growth trends will likely make it impossible for the project to achieve absolute emission reduction within the livestock sector, in which case other targets can be considered (emission intensity reduction, emission reduction compared to BAU, cf. Section 2.3.2). If time series are not available through national

11 https://www.fao.org/livestock-systems/global-distributions/en/

statistics, FAOSTAT[12] data can be used (see example in Figure 6b). The previous 5, 10 or 20 years can be taken into account to assess the temporal trend, depending on reliability for predicting future evolutions. Demographic models simulating herd growth can also be used[13].

Temporal trends – climate change. A preliminary overview of the climate-change impacts of livestock in the country, current and projected, should be part of understanding the context. This will include an understanding of the main climate/agro-ecological zones where livestock production takes place, and of the associated climate constraints. Particular attention should be paid to pastoral production systems in Arid and Semi-Arid Lands (ASALs) because they largely depend on the availability of natural biomass, which is strongly influenced by climate. Drought is a key climate risk for livestock production in these areas, so information should be collected on past droughts and their impact on animal mortality. Projections and/or assumptions should also be established regarding future trends of evolution of drought frequency and intensity and associated impact on livestock mortality (see example in Figure 6c). Raw data on the evolution of temperature and rainfall can be retrieved for various Global Circulation Models and IPCC RCP (Representative Concentration Pathways) scenarios[14]. Several map databases are also publicly available to describe current and future climate conditions, including FAO's Earth Map[15] (with a wide number of map layers for land use, agriculture, natural resources, climate etc.) and Climate Change Toolbox[16] which provides climate vulnerability maps based on climate and environment predictors.

Climate change commitments related to livestock. The national communication (or National Inventory Report [NIR]) and NDC should be reviewed to understand the climate commitments of the country. The approach used in the NIR should be identified; a Tier 1 approach is used in the NIR of most developing countries, but Tier 2 approaches have been adopted by some, especially for specific sub-sectors such as dairy. The sources of data used in the NIR should also be well identified but critically assessed for their quality, because the same data can be used to complement/contribute to the establishment of the baseline situation (before project implementation). If national sources of information are lacking, data can be complemented by default country data from international tools and databases (e.g., FAO GLEAM-i[17]).

12 https://www.fao.org/faostat/en/

13 http://livtools.cirad.fr/dynmod

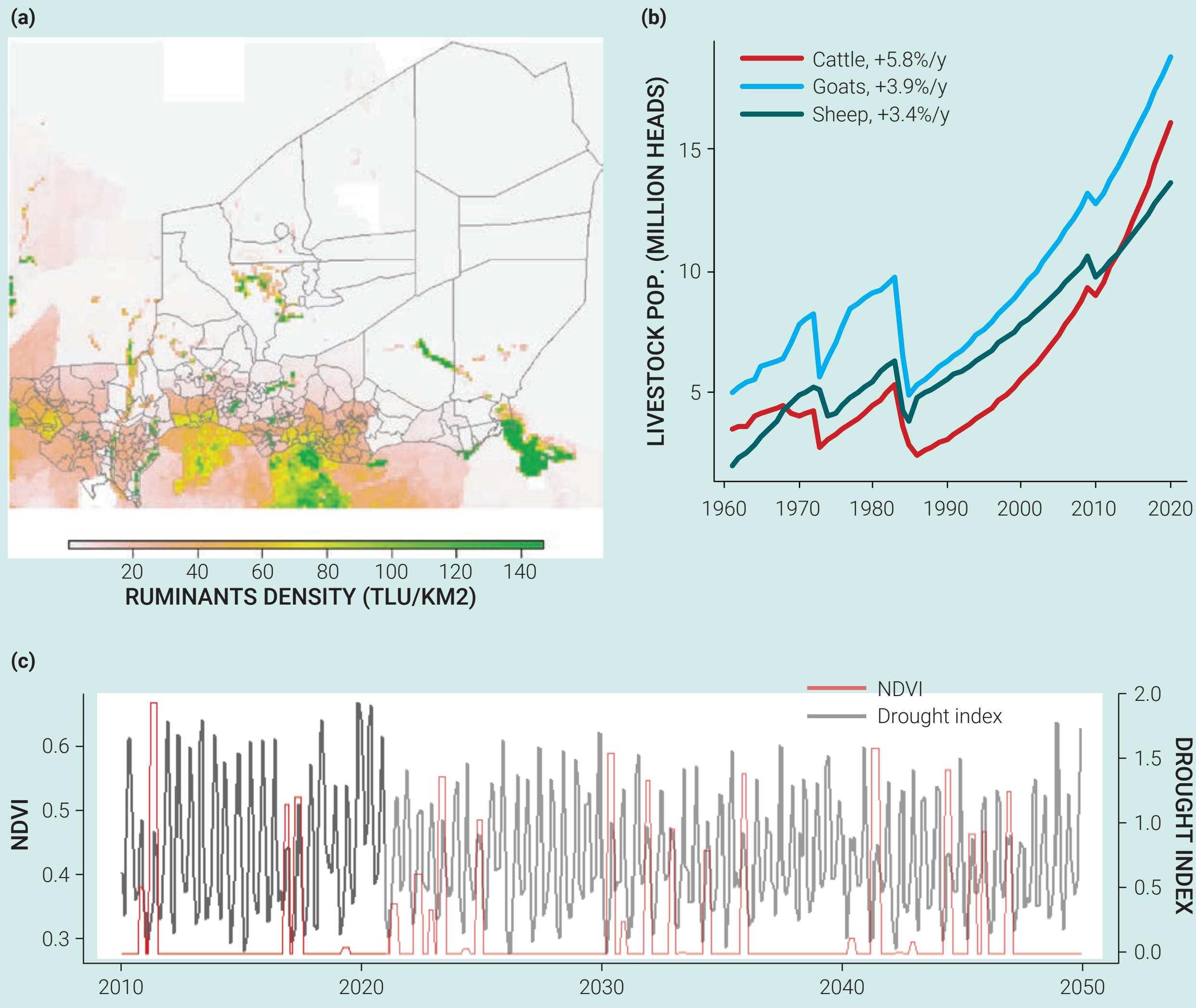
14 https://www.envidat.ch/#/metadata/chelsa_cmip5_ts

15 https://earthmap.org/

16 https://data.apps.fao.org/catalog/organization/climate-risk-toolbox-crtb

17 https://gleami.apps.fao.org/

FIGURE 6 Examples of figures useful to understand the livestock-production context, generated with publicly available global data. (a) Animal density map of Niger generated from Gridded Livestock of the World data and overlaid with the 'commune' administrative units. Ruminants considered = cattle, sheep, goats; TLU = Tropical Livestock Units. (b) Livestock population (pop.) time series in Niger from FAOSTAT along with average annual growth rates calculated on the 10 most recent years (2012–2021). (c) Monthly time series of Normalized Difference Vegetation Index (NDVI) from MODIS[18] in Oromia (Ethiopia) were used to calculate a drought index (proxy for forage availability)[19,20]. Temperature and rainfall data (historical[21] and projected with the MIROC5 model for the IPCC 8.5 Representative Concentration Pathway[11]) were correlated with NDVI to project its future evolution as well as the evolution of drought frequency and intensity.



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18 https://edcintl.cr.usgs.gov/downloads/sciweb1/shared/fews/web/africa/east/dekadal/emodis/ndvi_c6/temporallysmoothedndvi/downloads/monthly/

19 MacLeod, M., Henderson, B., Teillard, F., Kinyanjui, W., Tadesse, F., Cando, L., Halpern, C., Germer, L.A. & Gerber, P. J. (2023). Investigating the dynamics of resilience and greenhouse gas performance of pastoral cattle systems in southern Ethiopia. Agricultural Systems, 207, 103636.

20 https://documents1.worldbank.org/curated/en/099701012222213301/pdf/P17570400835c405709e490b364512ba5a1.pdf

21 https://data.isimip.org/10.5880/pik.2019.004

The schedule for updates of the NDC and/or NIR should be considered, as well as improvement opportunities from project activities and M&E efforts. Data collected by the project could indirectly or directly contribute to NIR improvement, but projects can also include the improvement of the national Measurement, Reporting and Verification (MRV) system as a specific activity. Many countries include targets related to livestock in their NDCs but they often lack a concrete description of action and measures, which means they may miss several mitigation opportunities. If the project is expected to achieve significant climate benefits from livestock production, there is a major opportunity to reflect those in the NDCs and other national climate policies and strategies.

3.3 Targeting and identification of beneficiaries

Understanding of the context (previous section) is the basis for the identification of beneficiaries, which should be done with the selection of activities (next section), because the type of actions selected will be specific to the type of systems they target.

Supporting livestock growth. Livestock is a growing economic sector in LMICs and investing in it is likely to contribute to further increases in the absolute GHG emissions associated with livestock (see also Section 2.3.2). In these conditions it is essential to lay out clearly the rationale for investment and the intended beneficiaries so that any rise in GHG emissions is weighed against development goals such as food security or poverty alleviation.

Animal-Sourced Foods (ASF) provide essential nutrients, such as proteins, but also micronutrients including vitamin A, vitamin B12, riboflavin, calcium, iron and zinc. Animal products can, thus, be key to closing nutrition gaps, in particular in South Asia and in Sub-Saharan Africa. However, livestock is also overconsumed by some sections of the population, including in LMICs, raising public-health concerns. In addition, while livestock-sector growth represents income and job opportunities for rural communities and the poor, the sector is often captured by the wealthiest members of the population who can afford to invest in it.

Hence, the task teams need to assess the overall objective of the investment, and who the investment will benefit in terms of added availability of animal products, of production growth, and of employment opportunities.

Targeted systems and changes. A scoping analysis of the relative contribution of production systems and regions for their contribution to CSL – and their potential for improvement – will be useful to identify beneficiaries. The analysis should address each of the three CSL objectives:

- **Production:** what is the relative contribution of the different production systems to the total production of ASF or to GDP? What is the contribution of livestock to employment, household revenues, food security and improved livelihoods, especially among vulnerable populations?

- **Climate-change adaptation and resilience:** how vulnerable to climate change are the regions and production systems i.e., their level of exposure (e.g., rainfall/rainfall variability, length of growing period, drought/flood frequency and intensity), sensitivity (e.g., reliance on natural rangelands as feed) and adaptive capacity (see Section 2.2)? Does climate change interact with other factors related to resilience (e.g., conflicts, access to markets and services), for which production systems such interactions are important?

- **Mitigation:** what is the relative contribution of the different production systems to total livestock GHG emissions? What are the productivity and mitigation potentials? For example, small productivity gains in systems with low productivity levels can lead to important reductions in emission intensity.

Tools can be used to aid in the CSL evaluation of livestock production systems and the identification of targeted systems and changes. For example, the Livestock Sector Investment and Policy Toolkit (LSIPT[22]) is designed to evaluate actual and potential contributions of livestock to economic growth, poverty reduction, food security and nutrition, and the reduction of GHG emissions. The LSIPT conducts prospective analysis to optimize synergies and manage trade-offs between these areas, with the objective of improving policy setting and investment decisions.

Targeted changes. Project activities can produce different types of changes, ranging from marginal technical changes (e.g., access to existing best practices and technologies), to system transformation (e.g., intensification, establishment of zero-grazing units or large-scale fattening operations). Marginal technical changes can yield important benefits within the three CSL pillars, especially in smallholder systems, and these potential benefits are relatively easy to assess *ex-ante*. System transformation has the potential to contribute to a longer-term CSL transition. Effects on all three CSL pillars should be carefully evaluated to ensure sustainable co-benefits, by strengthening resilience to climate change and other factors so that productivity (and mitigation) gains can be maintained over time. The effects of system transition will go beyond CSL, and these implications will need to be considered. They can include effects on social inclusion, economic effects across the livestock value chain and sector at the national scale (e.g., rebound effect, product displacement . . .), and environmental aspects beyond climate (e.g., pollution, land use, biodiversity).

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22 https://www.fao.org/3/ca7635en/CA7635EN.pdf

Reaching all social groups. Poorer and more marginalized social groups and production systems may hold significant shares of the national herds but will often require more investments than will larger and wealthier producers to improve on the three CSL pillars. They are typically more vulnerable and exposed to climate change, and require more efforts to reach better resilience. They can also be harder to reach by projects aiming at increasing productivity and climate change mitigation, given their relative lower access to information, technology and financial resources. Their participation in informal value chains is a further challenge. Adequate levels of resources and efforts need to be allocated to achieve gender and social inclusion. Considering the mission of IFIs and development agencies to eradicate poverty and hunger, it is crucial that all social groups are given the opportunity to reap the benefits of CSL.

3.4 Objectives, components and activities

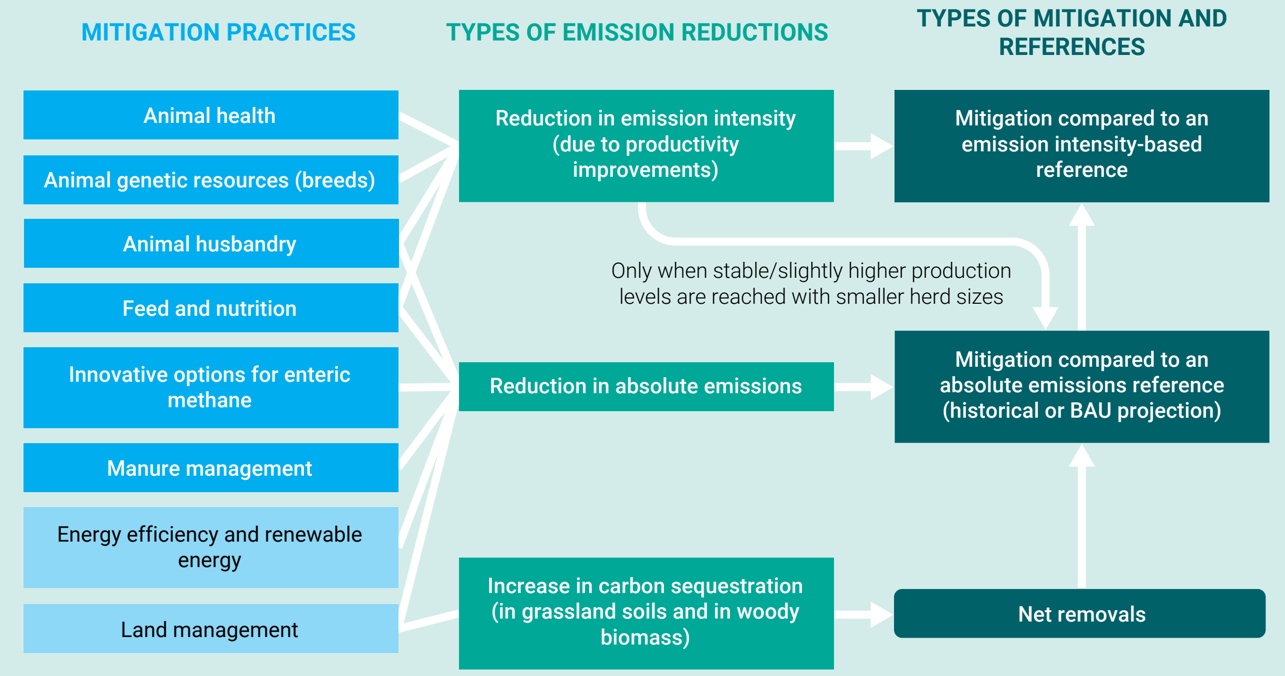
Activities. The ISL guide ("Project in Preparation" pages) can be used to identify the main objectives and interventions that the project will include based on the targeted types of livestock. 7 principles for the environment are considered in the guide:

1. Contribute to a sustainable food future;
2. Enhance carbon stocks;
3. Improve efficiency at individual animal and herd levels;
4. Source feed sustainably;
5. Couple livestock to land;
6. Minimize fossil fuel use; and
7. Foster an enabling environment.

In the ISL guide, interventions under these principles are specific to the production context. They are aligned with CSL objectives, but here and in Annex 4 we provide details on activities from a more specific climate-change mitigation perspective.

Categories of mitigation practices. Actual practices for increasing productivity and mitigating GHG emissions are context-specific; however, generic categories can be defined and are shown in Figure 7 (examples of more detailed categories of interventions can be found in Annex 4). Most projects should include at least a combination of animal health and feed/nutrition interventions, because of their strong co-benefits for all three CSL pillars, and because the health and productivity of animals are closely linked to their nutrition. Practices under the improved animal genetics and husbandry categories will lead to additional productivity gains. When

FIGURE 7 Main categories of mitigation practices and the type of emission reductions that they involve. Types of emission reductions can be seen as hierarchical: all removals contribute to reductions in absolute emissions that, in turn, contribute to emission intensity reductions. Orange boxes show mitigation practices with an effect on methane coming from enteric fermentation and manure.



possible, linking feed and nutrition practices (the demand side – what is fed to the animals) to land management (the supply side – how feed is produced) is a way of strengthening the resilience of productivity gains, and opening opportunities for carbon sequestration (i.e., GHG removals) associated with land restoration and grazing management. Land management activities are included in most projects addressing grassland-based production systems. Importantly, mitigation categories have different effects on mitigation pathways (Figure 7) and this should be considered when determining the high-level (PDO-level) indicators (Section 3.5).

Mitigation along the value chain. Livestock development projects most often include activities to develop the whole value chain, possibly feed production upstream, livestock production itself, collection/transport/processing/marketing of animal products downstream and the encompassing policy/regulatory framework. Similarly, GHG emissions occur all along the livestock value chain (Figure 2) and considering emission sources beyond the farm opens new potential mitigation opportunities. Although at the aggregate level (for all livestock species and production systems) the largest share of emissions still occurs at production level as enteric methane

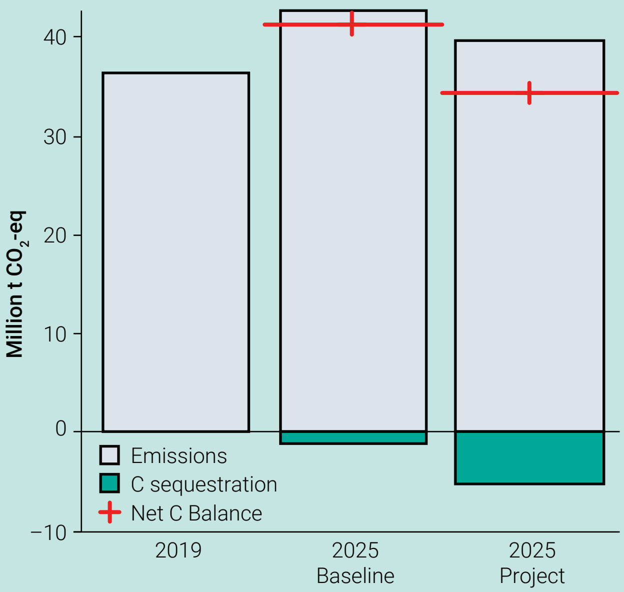
(Figure 3), other stages and sources of emissions should not be neglected. For certain species and production systems (poultry, pigs, sometimes intensive dairy production), upstream emissions related feed production is the dominant sources and should thus be targeted by specific mitigation efforts to sustainably produce or source feed products. Certain sources may represent a limited contribution to the total emissions but a target for effective and profitable mitigation efforts. For instance, proven technologies and practices exist for several energy-related aspects such as biogas production, energy efficiency, or the use of renewable energy (e.g., for processing/chilling or transport). Subsidies and carbon offset schemes specifically target these emission-related mitigation efforts and can enhance their economic viability.

***Ex-ante* assessment.** If an *ex-ante* assessment of the project impact on climate change can be conducted, it will be most useful to develop it in parallel and iteratively with the selection of project activities (and beneficiaries). The *ex-ante* assessment can provide a preliminary estimation of the potential impact of activities in different beneficiary groups/production systems and can help to prioritize them from a climate-impact perspective. The *ex-ante* assessment will typically be led by the CSL focal point in the task team (livestock & climate change expert, cf. Section 3.1) but should involve a range of staff from the project team, clients, and stakeholders. This will allow for iterative refinements in activity selection and *ex-ante* assessment results, while raising awareness among relevant staff and stakeholders on enhancing and assessing the contribution of livestock to CSA.

Two types of assumptions will need to be defined in support of an *ex-ante* assessment. The first concerns the extent or adoption of practices/activities implemented by the project (e.g., as number of farms, animals or hectares [ha]). It is generally easier to produce, as it can be derived from the project document. The second type of assumption concerns the unitary effect of the practices and activities implemented by the project, on parameters impacting GHG emissions, for example, the percentage reduction in the mortality rate from a specific vaccine, or the percentage increase in milk productivity from improved breeds or feeding practices. These assumptions of unitary effects will usually rely on country-specific studies and expert consultations.

Economic and financial analysis. The economic and financial analysis of operations can be based on cost effectiveness or cost-benefits analyses and can include a valuation of environmental externalities. The cost-benefit analysis considers the added value derived for example from higher productivity and access to markets, and the costs of interventions such as vaccinations, improved feed or animal genetic resources. For livestock operations, the economic and financial analysis can be based on herd dynamic models such as "EcoRum" of the Livestock Sector Investment Policy Toolkit (LSIPT), a software developed by FAO and CIRAD with the support of the World Bank for simulating bio-economic performances of herds of

BOX 1 Example of *Ex-ante* Assessment Conducted for a Livestock Development Operation in Kazakhstan



The technical assessment of a livestock development operation in Kazakhstan included an *ex-ante* assessment of the estimated effects of the program on net GHG emissions. Several methodological aspects described in Section 2.3 are illustrated in this *ex-ante* assessment.

- Emissions: both direct and indirect sources of Emissions were considered, and a Tier 2 approach was used (based on secondary data from national statistics and literature).
- Indicator: net GHG emissions was used to account for both emission reductions and higher carbon sequestration from project activities.
- Carbon sequestration: the sequestration potential was also estimated with a Tier 2 approach using process-based modelling to account for country-specific conditions and management practices.
- Baseline: two baselines were considered, the 2019 situation and a 2025 projection considering the country's objective to increase production mostly through an expansion of the herd.

Compared to the 2019 reference, it was estimated that cumulative emissions over the 5 years of project implementation could increase by 18.2 and 9.2 million t CO_2-eq in the baseline and project scenarios, respectively. Cumulative carbon sequestration over 5 years was estimated to reach 3.7 and 15.5 million t CO_2-eq, respectively, in the baseline and project scenario. This resulted in a net GHG removal of 6.4 million t CO_2-eq for the project compared to the 2019 reference.

In addition, a proposal of livestock emissions MRV system to track these emissions during the project was formulated. It included data requirements (existing sources and additional needs), the means of verification, and the implementation mechanism (e.g., budget, institutional arrangements). The total cost of the MRV system was estimated at around US$500,000 for the first year, and US$140,000 for the annual recurrent budget. This cost estimate focused on livestock GHG emissions (MRV for carbon sequestration assessment was not initially included) and was for a full MRV system enabling reports on emissions at both the project level and on the national scale (e.g., national GHG inventory, NDC reporting).

tropical domestic ruminants. A valuation of environmental externalities can enhance the economic justification of investments. The estimate of the GHG emissions balance provided by the *ex-ante* assessment (previous paragraph) can be valued using, for instance, the World Bank Guidance note on the shadow price of carbon in economic analysis, which recommends that projects' economic analysis should use a low and high estimate of the carbon price starting at US$40 and US$80, respectively, in 2020 and increasing to US$50 and US$100 by 2030. These ranges reflect prices consistent with achieving the core objective of the Paris Agreement of keeping temperature rise below 2 degrees, provided a supportive policy environment is in place.

3.5 Results Framework and M&E

Indicators and their calculation. Section 2 describes several indicators for all three CSL objectives and details associated data and methodological aspects that will need to be considered when setting targets for these indicators (including the scope of the indicator's calculation, assessment method and choice of a reference). As a summary, Table 1 provides recommendations for a minimum set of indicators to be included (at PDO-level for World Bank projects) for each CSL objective.

Theory of change. A sound theory of change should describe links in the results chain from activities to outcome, as well as CSL results indicators. Ideally, the CSL perspective should be included in the goal statement (PDO for World Bank projects) and the contribution of the different activities and outcomes to CSL should also be described (see also Section 3.3 on selecting beneficiaries and activities for their CSL contribution). For adaptation, the recommended indicators are action-based and the link between the related activities and positive impact for adaptation should be justified with context-specific literature (Table 1). For mitigation, the *ex-ante* assessment (Section 3.4) will be useful for generating quantitative evidence of the impact of activities on GHG emissions. Both potential synergies and trade-offs between activities and specific CSL indicators should be considered. For example, the introduction of crossbreed animals can improve productivity and productivity over time (synergy with adaptation) but can also replace local breeds that are more drought-tolerant (trade-off with adaptation). Similarly, activities to enhance productivity can have synergies with mitigation if emission intensity indicators are used but trade-offs if absolute emissions are considered.

Baseline. Data relevant to the calculation of livestock GHG emission should be collected as early as the baseline survey stage. A list of data relevant to Tier 2 calculations of livestock GHG emissions is presented in Annex 5, along with recommendations in terms of priority (which parameter should be surveyed, with what frequency, which ones can be derived from country-specific studies . . .).

M&E budget. Annex 5 shows that calculating livestock GHG emissions with a Tier 2 approach requires a substantial amount of data. Allocating adequate financial and human resources and mainstreaming GHG-emission aspects in the project M&E from the very start of the project will, therefore, facilitate estimating the climate impact of a project accurately and with a reasonable level of confidence. It is difficult to provide an indication of an isolated budget associated with CSL-related data collection if these aspects are mainstreamed into the project M&E; however, a theoretical upper cost range is reflected in Annex 7: budget indications for standalone, *ad-hoc* surveys on livestock GHG emissions (see also Box 4).

TABLE 1 Minimum Recommended Set of Indicators for Assessing Climate-Smart Livestock Objectives, Along with Data Requirements

CSL objectives	Indicators	Methodological and data requirements
Productivity	Number of animals Production volume (e.g., annual kg meat or litres of milk) Productivity (e.g., milk yield *per* animal, animal weights, daily weight gains, and number of productive animals)	Methodological point: indicators can be measured at various scales (e.g., farm, region, country) Data requirements: the collection of primary data (e.g., farm surveys or *ad-hoc* national statistics) is recommended but could be complemented with context-specific literature
Adaptation	Implementation of project activities relevant to adaptation (Action-based indicators)	A range of activities can be relevant to adaptation (e.g., farming practices, financial instruments/insurance, information, knowledge and capacity, market access). Justification of action-based indicators should rely on context-specific literature describing how the action contributes to adaptation in the specific context.
Mitigation	Absolute GHG emissions Emission intensity (CO2-eq/kg proteins) Carbon sequestration if relevant	Methodological points • Indicators can be measured at various scales (e.g., farm, region, country) • Emission calculations should be based on an IPCC Tier 2 approach • A life-cycle perspective should be adopted if relevant (e.g., including emissions from feed production occurring off-farm) Data requirements • Same data as for production/productivity to be collected regularly • Possibly data on animal health (mortality, fertility), nutrition (feed ration composition) and manure management collected at baseline, mid-term and final evaluation stages if associated activities are implemented

M&E integration at higher levels. If the project is expected to achieve significant climate benefits (on mitigation in particular), fully integrating the project M&E framework into higher-level MRV systems should be considered:

- The project can include specific activities to establish and develop a national MRV system (i.e., the system for reporting livestock emissions in the National Inventory Report or National Communication). The project M&E framework should be aligned with the national MRV framework. It is important that such a national MRV system will not only include data collection and methodological aspects, but also institutional arrangements (roles and responsibility for data collection, GHG emission calculations, verification, and reporting). More information on project and national MRV integration can be found in other document such as the FAO brief on *The role of animal health in national climate commitments*.

- If there is an opportunity for the project to leverage additional types of climate finance such as carbon markets, the project M&E framework should be aligned with the MRV requirements of carbon credit verification standards (see Section 3.6).

3.6 Financing considerations

Once the technical interventions of the project are defined, project teams need to identify the types of instruments available to support their implementation. This is particularly important in LMICs, where producers historically have difficulty accessing finance. Indeed, traditional sources of financing have long been out of reach for livestock smallholders who often have no collateral apart from their animals and have little experience of working with financial institutions. In addition, traditional lenders see the livestock sector as overly risky, with little potential for significant profits.

Expanding inclusion for climate finance can improve livelihoods, increase resilience, and help reduce GHG emissions. The World Bank report, *Opportunities for Climate Finance in the Livestock Sector: Removing Obstacles and Realizing Potential*, identifies investment opportunities for increasing climate finance in the sector and driving its sustainable transformation. Climate finance can be direct (with specific mitigation or adaptation goals) or indirect (consistent with a pathway towards low-carbon and climate-resilient development), and can come from public or private sources, with a wide diversity of actors and financial flows.

The World Bank report identifies six investment opportunities for channeling climate finance into the livestock sector (Box 2): conditioning credit lines on climate-mitigation actions; value-chain finance for native ecosystem protection; clean investment through Emissions Trading Schemes; sustainable sourcing of livestock feed; rewards for innovation in livestock climate finance through prize-based programs; and rewards for proactive policy commitments through Official Development Assistance (ODA).

Carbon markets. Operations including CSL results are, in themselves, a project-based type of climate finance, but they can also leverage additional types such as participation in carbon markets. Carbon markets allow the trading of emission units, in the form of credits or offsets that represent emission reductions. They remain the only global mechanism — whether voluntary or compliance-based — that attempts to put a value on climate-mitigation actions. Despite unclear policy signals (e.g., pending decisions on Article 6 of the Paris Agreement that includes mechanisms for voluntary cooperation) and related low carbon prices, projects and methodologies are progressively being developed, some of which are related to the livestock sector. Methodologies based on both absolute emission reductions and emission intensity reductions exist as carbon standards. One important challenge for CSL projects to access carbon markets is establishing a robust methodology with controlled implementation costs. To calculate and certify GHG emission reductions generated by a project, the M&E system would need to be aligned with verification standards (e.g., Clean Development Mechanism (CDM), GoldStandard, Verified Carbon Standard [VCS]) or other emission trading schemes (e.g., Initiative for Sustainable Forest Landscapes [ISFL] program requirements). Methodological requirements (e.g., sample size, level of uncertainty,

BOX 2 Six Investment Opportunities to Channel Climate Finance into the Livestock Sector, Identified in the WB Report *Opportunities for Climate Finance in the Livestock Sector: Removing Obstacles and Realizing Potential*[13]

1. **Condition credit lines on climate mitigation actions**. Lending through local financial intermediaries, presents opportunities for channeling climate finance into greening the livestock sector, while increasing farmers' access to financial and knowledge resources with an identified ecological impact. Climate finance can

(*continues*)

BOX 2 Six Investment Opportunities to Channel Climate Finance into the Livestock Sector, Identified in the WB Report *Opportunities for Climate Finance in the Livestock Sector: Removing Obstacles and Realizing Potential*[13] (*Continued*)

define mitigation conditions against which it enables stakeholders' access to finance through existing credit institutions, for example by de-risking investments, lowering interest rates and providing technical assistance.

2. **Encourage value-chain finance for native ecosystem protection.** With proper incentives, stakeholders along value chains will have the opportunity to adopt practices that, for example, do not rely on deforestation. This is particularly important for livestock value chains, given the number and geographical spread of actors and production steps. Linked to strong traceability systems, climate finance can support the development of virtuous value chains.
3. **Drive clean investment through Emissions Trading Schemes (ETSs).** Putting a price on emissions is another tool to bring down emissions and drive investment into cleaner options in the livestock sector. Climate finance can help overcome the obstacles in linking livestock producers to an ETS: aggregation through existing or *ad hoc* organizations to lower transaction costs, and the development of cost-effective Measurement, Reporting and Verification systems (MRV). ETS credits sales will make more funds available for further progress in both mitigation and adaptation.
4. **Reward proactive policy commitments through Official Development Assistance.** Remedying the problems of weak or unenforced legislation and a lack of proactive policy commitments to foster climate action, is essential in the transition to a lower-emission livestock sector. Programmatic Official Development Assistance and IFI funding have the capacity to drive policy changes and create the conditions for innovation and private sector investment in climate-sensitive technologies and practices.
5. **Verify sustainable sourcing of livestock feed.** Improving the feed of animals to reduce their GHG emissions can displace emissions at the level of feed production, for example by driving feed-crop expansion into forests. Verified Sourcing Area-based climate finance is an innovative solution that supports the marketing of feed that is certifiably sourced from geographical areas free of deforestation. The system offers a win-win of discouraging deforestation while enabling better quality animal feed and associated GHG mitigation benefits.
6. **Innovate in livestock climate finance through prize-based programs.** Practices and technologies to reduce GHG emissions and improve the sustainability of livestock value chains remain severely under-researched, with much of the potential gains yet to be uncovered. Prize-based programs provide incentives for research and development by encouraging researchers and entrepreneurs to compete with each other to bring innovations to market. Climate finance supporting such programs can therefore realistically push the frontier of mitigation potential in the sector in cost-effective ways.

confidence interval) in these standards are typically higher than normal for reporting the project's result indicators. The ability of the project to bear these extra MRV costs will depend on several factors including:

- Accessing technical assistance on MRV aspects through grants;
- Minimizing data collection costs, e.g. through digitalization and by developing synergies with other data-collection activities (e.g. for extension or animal health intervention purposes);
- The price of certified emission reductions; and
- The opportunity to dilute MRV costs in large amounts of emission reductions.

Co-financing and coordination. Efforts should be made to coordinate activities among the different actors involved in livestock development in each country, including the different IFIs, as well as multilateral and bilateral development agencies. Co-financing should be promoted as an advanced form of coordination. Coordination of livestock development activities goes beyond CSL objectives, although mitigation can be a specific entry point for coordination efforts because emissions reductions (t CO_2-eq) provide a common unit, are measured with a common methodology, can be totalled, and reflected at country scale in national commitments such as the NDCs. Emissions reductions can also be aggregated across projects and sectors to contribute to jurisdictional climate finance approaches. One IFI could champion CSL and mitigation, promoting a dialogue and helping raise the climate ambitions across potential partners, including other IFIs, development agencies but also private actors such as green funds with lower levels of experience on climate-smart livestock.

3.7 Achieving climate change co-benefits

“Climate co-benefits” refers to the share of development financing dedicated to climate-change adaptation or mitigation in operations financed by the World Bank or other IFIs. Climate co-benefit tracking is expected to identify the portion of a project’s financing (if any) that carries climate-mitigation or adaptation co-benefits. Mitigation co-benefits are assigned to activities that promote efforts towards the reduction, limitation, or sequestration of GHG emissions and are listed in the *List of Activities Eligible for Classification as Climate Mitigation Finance*. Adaptation co-benefits are assigned to activities that contribute to adaptation in the context of the specific vulnerabilities to climate change identified for the project.

World Bank task teams are requested to ensure during project preparation that the climate co-benefits of projects are clearly expressed in the project documents and reach minimum target levels as defined either at Global Practice level or the regional level. Guidance for demonstrating climate co-benefits in agriculture-sector projects (including livestock) is available in the WB *Guidance Note for Meeting Corporate Commitments for Climate-Smart Agriculture*.

Building on and aligning with the existing World Bank guidance on climate co-benefits, Table 2 summarizes guidance and examples that may help task teams to reflect the climate co-benefits of livestock activities in project preparation documents; Annex 8 provides a concrete example of how climate co-benefits of activities were described in the context of a World Bank project in Uzbekistan.

TABLE 2 Reflecting the Climate Co-Benefits of Livestock Activities in Project Preparation Documents (See also Annex 8 for an Example)

<table>
<tr><th>Adaptation co-benefits of livestock activities</th><th>Mitigation co-benefits of livestock activities</th></tr>
<tr><td colspan="2">Examples of project-level climate-smart livestock activities</td></tr>
<tr><td>• In contexts where livestock are directly vulnerable to acute impacts of climate change such as drought and flooding: livestock insurance mechanisms, livestock early warning systems, and livestock emergency response and preparedness programs.
• In contexts where grazing areas are vulnerable to climate change: management of grazing intensity and timing, introduction of drought-resilient varieties, grazing land restoration, and communal grazing management planning.
• In contexts where water resources are scarce or fluctuate: adoption of water-use efficiency measures, watershed restoration, and communal water-use planning.
• In contexts where soil resources are vulnerable to climate change impacts: promoting better cycling of nutrients from manure, precision application of manure and synthetic fertilizers.
• In contexts where climate change will drive the surge of emerging diseases: disease surveillance systems, control measures, traceability.</td><td>• Increasing animal-level production efficiency through improved animal health, animal nutrition, and improved breeding.
• Increasing herd-level production efficiency through herd management, increasing or maintaining output levels while holding down growth in herd size.
• Diversifying animal feed ingredients to reduce reliance on fossil-fuel-intensive concentrates and transport emissions associated with imported feeds.
• Increasing soil carbon sequestration through better management practices on grasslands, croplands used for livestock feed production, and forested land.
• Improving manure management.
• Incorporating on-farm production of clean energy (wind, solar, biogas).
• Invest in awareness raising campaigns on diets to ensure that any support to increased ASF intake targets the intended beneficiaries, i.e., those for whom it will improve diets and who may not have alternative produce with similar benefits.</td></tr>
<tr><td colspan="2">• Capacity building and training for livestock-sector actors for implementing the activities, at both beneficiary and institutional levels.
• Research and development for the tailoring of known practices to the specific project context, e.g., developing and piloting drought-resistant pasture varieties.</td></tr>
<tr><td colspan="2">Conveying CSL activities in project documents</td></tr>
<tr><td>• Clearly articulate the main vulnerabilities of livestock to climate change in the project context section: direct impact of temperature and heat waves on productivity and mortality; indirect impact through pasture productivity and quality alteration; feed costs (yield drops and input costs); and emerging diseases (link to One Health approaches).
• Include activities in the project components that address the identified vulnerabilities.
• Include an adaptation indicator(s) in the project Results Framework to monitor and evaluate the impacts of the activities.</td><td>• Explain the main sources of livestock emissions (e.g., enteric methane, feed imports . . .) expected under the project in the project context section.
• Include activities in the project components that will reduce emissions from the identified sources and activities that will offset project emissions (carbon sequestration). Explain implementation mechanisms and provide indications of budget allocation.
• Include an emissions indicator(s) in the project Results Framework to monitor and evaluate the impacts of the activities.</td></tr>
<tr><td colspan="2">• For projects that will finance sub-projects, include the adoption of climate-smart livestock practices as a condition of sub-project approval. Provide a menu of practices that will be considered climate-smart under the project and explain how each contributes to adaptation and/or mitigation.
• For projects that will improve producer access to finance, include activities to develop credit lines targeted to livestock producers that are conditional on achieving mitigation outcomes.
• For projects that will improve market access, include activities that enable farmers to utilize traceability systems and labelling schemes for deforestation-free products.</td></tr>
</table>

3.8 Alignment with the Paris Agreement

”Paris Alignment” refers to the commitment of Multilateral Development Banks to guarantee that new financing flows will be consistent with the objectives of the Paris Agreement and countries' pathways towards low GHG emissions and climate-resilient development. For the World Bank, in particular, 100% of operations as of July 2023 must align with the goals of the Paris Agreement. Two main sets of methodological documents were published to guide Paris Alignment of World Bank operations: Instrument Methods[23] for different types of financing instruments and Sector Notes[24] providing guidance on sector-specific issues.

Adopting a context-specific approach. An important assumption underpinning Paris Alignment is that countries have different needs and circumstances in integrating climate and development, and therefore have flexibility in defining their own contribution to the overarching goal of the Paris Agreement. A good understanding of the context as described in Section 3.2, including of countries' climate strategies and commitments (NDCs, Long-term Strategies, National Adaptation Plans), is a key initial step and consideration for Paris Alignment.

Assessing and managing climate risks. Climate risks need to be assessed for both adaptation (climate hazards likely to have an impact on the operation and its development objective) and mitigation (the operation's running the risk of having a negative impact on the country's low-GHG emissions development pathways). This will be particularly important for livestock, which is amongst the most GHG-emitting sectors and, at the same time, the most vulnerable to climate change (Section 2). Measures will need to be incorporated into the operation to reduce risks from climate hazards and to ensure that the development objective is achieved with lower GHG emissions and by avoiding hindering transitions to lower-carbon options.

The role of livestock in lower-GHG emissions options. Ensuring that livestock activities take the lowest GHG emission pathway to achieve the project development objective will require a careful examination of several aspects. Adopting a context-specific approach and aligning with the country's climate strategies is a prerequisite; however, projects also provide an opportunity to reach more demanding goals compared to livestock-specific targets in such strategies, which sometimes lack ambition and precision. A priority is to avoid carbon lock-in, i.e., investments and activities that will support persisting patterns that are carbon-intensive or hinder the transition to low-GHG emissions development pathways. For livestock, carbon lock-in risks are associated with interventions at multiple levels (e.g., policy, institutional, or

23 https://www.worldbank.org/en/publication/paris-alignment/instrument-methods

24 https://www.worldbank.org/en/publication/paris-alignment/world-bank-group-sector-notes

BOX 3 MRV and MRV Costs Estimated Within the ASA *Livestock Sector's Readiness to Access Climate Finance (2021 Data)*

The livestock sector's readiness to access climate finance was an ASA that included the following main activities:

- Publication of a report on Opportunities for climate finance in the livestock sector
- Development of a conceptual MRV framework for livestock intensification
- Moderation of a community of practice bringing together the livestock and climate-finance communities
- Development of two blueprints (or pilots) for livestock access to climate finance in Kenya and in Ethiopia

Some key elements of the two blueprints are summarized below, with a focus on how emission reductions could be generated and monitored:

	Credit line with mitigation conditionality for the Kenya dairy sector	Value chain finance for mitigation and native ecosystem protection in the Colombian beef sector
Scale	Around 100 producer organization and some 3,770 members	One large champion farm for sustainability with potential to replicate its model
Mitigation pathways	Productivity (improved breeds, nutrition, and herd management) leading to 50–100% increase in milk yield and 18–33% reduction in emission intensity Reduction of 0.8 Mt CO2-eq through biogas production and, renewable energy/energy efficiency (milk chilling and processing)	Productivity (improved breed with short cycle, improved pasture, and nutrition) leading to up to 200% in produced live weight and 60% reduction in emission intensity Grassland improvement resulting in net C removals of 2.6 t CO2-eq/ha/year (over 10 years)
Total mitigation outcome	Over 10 years: 1.8–3.6 Mt CO2-eq at animal level + 0.8 Mt CO2-eq upstream and downstream	198,657 t CO2-eq *per* farm
MRV costs	Total cost ~ US$693,000 Cost *per* t CO2-eq ~ 0.16-0.27 US$/t CO2-eq	Total cost ~ US$183,500 for one farm and US$1,191,750 for 100 farms Cost *per* t CO2-eq ~ 0.9 and 0.06 US$/t CO2-eq respectively for 1 and 100 farms
Key points	MRV is eventually undertaken by the financial institutions providing credit. Mitigation outcomes come from different activities; therefore, they may need to comply with different accounting standards, leading to varying figures and costing.	An important part of the mitigation potential comes from carbon sequestration. MRV would thus involve soil sampling which is costly but costs can be diluted if more farms/ emission reductions are generated

financial via investment in long-term assets or infrastructures), promoting persisting higher-GHG emission pathways, and with activities causing expansion or changes into areas of high carbon stocks (e.g., forests, well-managed semi-natural grasslands). Preventing such expansion needs to be ensured in the country of the operation, but also by guaranteeing sustainable sourcing of imported feed. Supporting low-carbon livestock development pathways and preventing persisting high-GHG emission options will require a good understanding of GHG emissions, mitigation potential, and temporal trends of evolution across and within sub-sectors and production systems (Section 3.2). When emission intensity is used as a result indicator to emphasize productivity and efficiency benefits, and to decouple livestock sector growth from GHG emission trends, projects should, ideally, aim at limiting the growth of absolute livestock GHG emissions below a BAU trend. Activities targeting a partial shift to lower-GHG emitting animal protein sources (e.g., poultry meat as opposed to beef), and a controlled growth in demand for animal proteins in line with food and nutrition security goals should be explored, despite challenging policy and behavioral changes.

4

Guidance for Project Implementation Stages (Including Mid-Term Review)

4.1 Capacity development throughout implementation

Capacity development objectives. Going from entry- to advanced-level knowledge and capacities, objectives will include:

1. Assessment of capacity needs in the project team;
2. Awareness raising of CSL and of the contribution of livestock to productivity, mitigation and adaptation (e.g., at global and national scales, what are the pathways of livestock GHG emissions and approaches to measure them, the main mitigation and adaptation interventions and indicators?);
3. Understanding the relative, potential contributions of the project activities to productivity, mitigation, and adaptation;
4. General knowledge of key data requirements for livestock GHG emissions assessments;
5. Basic knowledge and skills with tools/calculators used for livestock GHG emissions assessments;
6. Advanced knowledge on how to consolidate and use project data as inputs to for GHG emissions calculators; and
7. Advanced knowledge on how to use (and possibly combine) GHG emissions calculators to assess the project's climate impact (e.g., building baseline and project scenarios, computing different emission indicators).

Approach. Capacity development should be seen as a process, rather than a list of activities, as it depends on the national and individual context. Different methods should be considered as a package to address the nested objectives:

- Rapid online surveys to assess the level of capacity and knowledge in the project team can provide information for preparing the capacity-development program;
- E-learning materials and other resources (e.g., FAO CSL sourcebook[25] and e-learning course[26]) can be useful as an introduction or in preparation for workshops;
- Virtual workshops/webinars can reach a wide audience with limited costs and can be useful for awareness-raising purposes (i.e., objective #1 above), and possibly to initiate addressing objectives #2–4;

25 https://www.fao.org/climate-smart-agriculture-sourcebook/en/

26 https://elearning.fao.org/course/view.php?id=437

- In-person workshops are essential to train participants on the use of livestock GHG emissions calculators and for them to reach autonomy in the assessment of the project's climate impact (objectives #5–6);
- Intermediate online questionnaires/surveys can give an idea of the level of progress achieved in the team, which will not be homogeneous in most cases; and
- Continuous technical backstopping through email exchanges and *ad-hoc* calls and/or small virtual working sessions will also be needed to complement one or several in-person workshops to achieve objective #5–6 above.

Material. Annex 6 provides a list of capacity development materials relevant to CSL.

Target audience. The target audience for capacity development workshops and efforts will include:

- A core group of project staff from the IFI and government counterpart following CSL aspects, activities, and technical support throughout the project (CSL "champions" described in Section 4.5). It could include technical livestock focal point people following operations from the IFI, and project staff such as the M&E coordinator and staff, component leads of CSL-relevant components, and the environmental safeguard specialist;
- A wider group of project staff, involving sub-national levels (e.g., local M&E specialists and experts). This is important because most of the project data is often collected locally (e.g., in regions, counties and other sub-national jurisdictions). Involving local staff is, thus, key to accessing and consolidating project data, and to ensuring that capacities and skills can be transferred from the national to the local level; and
- Beyond the project, technical staff from government agencies and ministries relevant to CSL, as well as science partners and other data providers (e.g., technical/extension/research institutions/networks/projects).

Linking the project to national levels brings several important benefits: (i) filling data gaps, sharing data, aligning data/methods; (ii) reflecting climate benefits achieved by operations in national climate reporting and commitments; and (iii) ensuring the sustainability of data and acquired capacities, once the operation is over.

While a wide audience can be reached in virtual workshops, in-person training sessions on calculators require dedicating individual attention to all participants and will typically be restricted to 20-30 participants (around 10 participants *per* trainer). These participants should not be too high-level in their respective institutions but, rather, be the most likely to use the tools as part of their duties. A mix of junior and senior staff is ideal.

4.2 Mid-term review as an entry point during project implementation

Mid-term Review. Projects already in implementation that were designed without climate change in mind can still contribute to CSL. The mid-term Review (MTR) provides an important entry point to adjust the project's activities and M&E framework to enhance and track such contributions. The ISL guide ("Project in Implementation" pages) can be used to generate guidance for enhancing the sustainability of those activities commonly found in livestock development projects. The guidance also proposes indicators to incorporate into the project's M&E framework to track the results of those activities.

For projects under implementation that did not consider CSL during preparation, it will be critical to ensure that adjustments to the project design undertaken during the mid-term review are coupled with the necessary staffing and budget. In particular, the project should undertake activities to build awareness and capacity in the project implementation unit to implement and track CSL activities (Section 4.3), undertake data collection and analysis to inform M&E on the project's contributions to CSL (Section 4.4), and designate key project staff and budget (Section 4.5) to follow up on CSL aspects of implementation.

4.3 Adjusting activities and M&E

CSL mapping and assessment. A useful starting point to any improvement and assessment of a project's contribution to CSL is to elaborate a mapping of project components and activities for their contributions to the three CSL pillars. This can be done, first, through a desk review and later completed by consultations with project staff, which will aim to (i) raise awareness about the CSL contribution of the project; (ii) identify gaps and priorities in the initial mapping; and (iii) link the mapping to data availability and data gaps for a CSL assessment of the project.

If data relevant to CSL has been collected, or if it can be complemented with country-specific sources of secondary data, the CSL mapping could be further strengthened with a quantitative assessment of productivity gains and emission reductions from selected activities.

Adjusting activities. Based on the CSL mapping and possibly quantitative assessments of CSL benefits, opportunities can be identified to enhance the project's contribution to CSL. This will not necessarily involve creating new activities but, rather, prioritizing activities with the highest CSL benefits. Certain projects will have a specific component on funding matching grants/business plans/sub-projects/

community or communal investments, which will provide important flexibility to select activities based on their CSL outcomes.

Adjusting results indicators. It could be possible to adjust results indicators (including PDO-level indicators for World Bank projects), especially if the CSL perspective was not a focus at design stage. This could mean adjusting and/or adding indicators (e.g., based on the guidance provided in Section 3.5), or setting more ambitious targets (based on assessments conducted at the mid-term review stage).

4.4 Data collection and analyses

Data collection requirements at implementation stages will largely depend on the extent to which CSL and livestock GHG emission information has been mainstreamed into M&E, baseline, and planned data collection at the design stage (Section 3.5).

Data consolidation. If data related to CSL and livestock GHG emissions is regularly collected by the project team during implementation, it will be important to ensure that it is frequently consolidated. Consolidation will involve gathering scattered information/data (e.g., collected from different channels, in different regions), performing quality checks, and progressively feeding a clean database from which representative averages can be extracted to calculate several indicators (including productivity and livestock GHG emissions).

Mid-term review. The guidance provided on baseline survey (Section 3.5) is also relevant for mid-term review; CSL aspects should ideally be mainstreamed into mid-term review data collection.

Targeted surveys. Targeted surveys can be conducted during implementation to fill data gaps around the effect of the project on livestock GHG emissions. However, it will not be possible to go back in time to fill gaps in the baseline situation, making it impossible to assess the effect of the project in the absence of a reference/point of comparison. This challenge can be partially overcome during implementation by collecting data on "without projects" situations or from non-beneficiary farms or areas, but this could involve confusion of effects and will be less accurate than actual baseline data. A careful review of existing data (building on the CSL mapping of project activities mentioned in Section 4.3) should first be conducted to inform the sample structure and content of the targeted survey to be conducted. An example of survey design and budget is provided in Annex 7, along with a sample questionnaire (see also Box 4).

Data analyses. If a certain tool has been used for GHG emissions calculations at project design/*ex-ante* assessment stage (Section 3.4), the same tool can be

BOX 4 Mitigation Outcomes from an Operation in Ethiopia and Link to Climate Finance

The results framework of the Livestock and Fisheries Sector Development Project (LFSDP) in Ethiopia includes a specific indicator for GHG emission intensity, with a target of 30% reduction by the end of the project.

LFSDP was used to build a case study to inform a revision of the program requirements of the BioCarbon Fund Initiative for Sustainable Forested Landscapes (ISFL). ISFL gathers 5 jurisdictional programs that combine grant financing with payments for emission reductions, including one in Oromia Ethiopia, the Oromia Forested Landscape Program (OFLP). The case study showed that under the current rules of accounting of ISFL, efforts to decrease emission intensity in livestock would not fully compensate for the growth of the sector in Oromia. The increase in absolute livestock emissions exceeds emission reduction from other AFOLU sectors (forestry in particular), resulting in emissions increase at the landscape level. The revised requirements allow for emission-intensity-based accounting under specific conditions (growing livestock sector, recognized mitigation efforts), so the livestock sector can contribution to, rather than jeopardize, potential payments for emission reduction at the landscape level. Up to 10 million t CO2-eq of emission reductions could be purchased within OFLP, including from the livestock sector.

In parallel, efforts were undertaken to operationalize the emission intensity indicator of LFSDP after the md-term review (MTR) because of insufficient specific data collection foreseen in the project M&E framework. A contract with a vendor for ~ US$77,000 was established to conduct a dedicated survey among 600 households to provide an initial estimate of emission intensity reduction, to finalize an excel-based emission intensity calculator and to train project team to its use. Initial results showed emission reduction results ranging from around 20% to 30%, two years before the end of implementation.

adopted at the mid-term review stage. If capacity development has been undertaken before the mid-term review, it should also have included training on a specific livestock GHG emission calculator (Section 4.1). In countries with more advanced capacities in GHG inventory (e.g., where Tier 2 approaches are already adopted for specific livestock sub-sector, often dairy cattle), there should be an effort of integration with the national tools and methods already in use. Besides calculating emissions, particular openness and attention should be paid to aspects of results interpretation, scope/categories of emissions reported, indicator and reference used (see also Section 2.3).

4.5 CSL champions

Internalizing CSL skills. Projects should identify and allocate budget to key resource staff whose role will be to ensure that changes and actions are taken to mainstream CSL and CSL assessment during project implementation, in situations where this was not planned from the design stage. If such CSL champions are not designated, there is a risk that the Project Implementation Unit will not take action fully to fill CSL gaps identified during implementation/mid-term review. CSL champions will be a primary target for all capacity development efforts; they could be identified among M&E coordinators at national and regional levels, component leads on relevant components (e.g., animal health, sustainable land management), or environmental safeguard specialists.

Task team and external support. If expertise or time is lacking in the task team on CSL, contracting external consultants or firms could be considered. Assignments could include the following areas (i.e., supporting the activities described in the following sections):

- Awareness raising of CSL;
- Capacity development and technical backstopping on quantitative assessments of livestock GHG emissions and other CSL aspects; and
- Technical support to data consolidation or conducting *ad-hoc* surveys for CSL assessments.

If external consultants/firms are hired it will be important for them to follow a demand-driven approach, whereby activities are tailored to respond to the specific needs of each supported operation. This will involve an initial proposal of activities and consultations with project teams/project managers (TTLs) to select the relevant activities and develop a workplan.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5 Guidance for Final Evaluation (ICR)

Many aspects relevant to ICR preparation have been covered in previous sections of this Guide. If CSL aspects have been mainstreamed at design and/or implementation stages, ICR preparation on these aspects will be straightforward. If, however, CSL aspects have not been mainstreamed at earlier stages, it will be difficult to develop a robust and accurate CSL assessment for the ICR. The following paragraphs provide complementary information specific to ICR preparation.

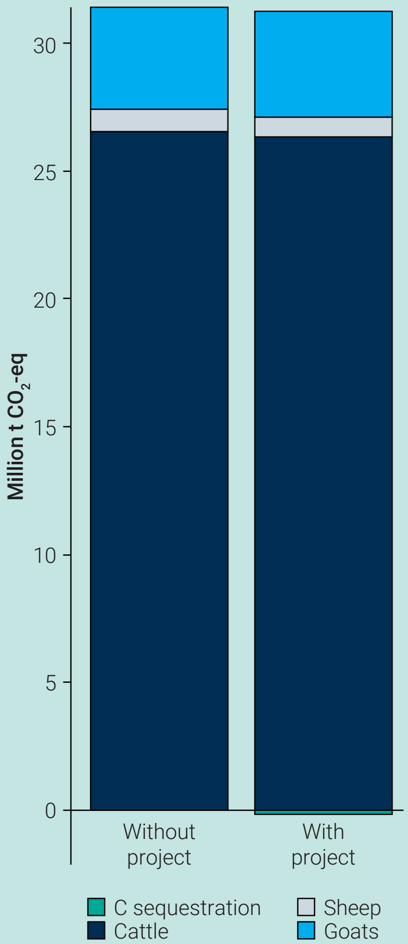
Team. The possible need to strengthen the ICR team with external CSL expertise will largely depend on the capacity development efforts and results achieved during project implementation. Ideally, the project M&E team should be virtually autonomous in the quantification of livestock GHG emissions and other CSL aspects towards the end of the project. In this case, an external livestock and climate-change expert (with a similar profile to that described in Section 3.1 and Annex 3) can be brought on board by the IFI or the client with an advisory/guidance role to provide inputs into the quantitative assessments and ICR reporting designed by the project team. However, if limited capacity development on CSL was achieved during the project, an external livestock & climate change expert will have a more active and predominant role – consolidating and analyzing most of the data, generating results and most of the corresponding ICR section itself. Only limited capacity development can be achieved if it starts at later project stages, which will represent a missed opportunity to transfer CSL capacities within the project and the country.

Data. Ideally, CSL-related data will have been collected and consolidated throughout project implementation, making analyses for the ICR relatively straightforward. There is usually limited scope to fill data gaps with new data collection efforts at the ICR stage. Conducting targeted surveys (Section 4.4) could be considered if time and resources allow. Otherwise, a consolidation of collected data, literature, proxies and other available information will need to be undertaken but will result in a less accurate assessment of climate and other CSL impacts.

If the net GHG emissions was selected as an indicator or if it needs to be reported in the ICR, data collection and calculation is likely to be easier to obtain on emissions than it would be on removals. This may result in higher uncertainty for the latter, which should be clearly stated and discussed in the ICR.

Reporting and narrative. Reporting livestock GHG emissions in the ICR will not only involve quantitative figures but also building a narrative on the project's contribution to CSL. As underlined in Section 2.3.2, few projects will result in an absolute decrease in livestock GHG emissions, compared to a historical reference, but can reduce emissions when compared to a situation without the project. Building a strong narrative for the counterfactual (e.g., faster growing, less efficient, more emission-intensive sector) will be important. The highest level of transparency and harmonization should nonetheless be sought in presenting the results and methodological approach (including indicators and references), the drivers of change should be explained, and limitations clearly identified and discussed.

BOX 5 Key Results from an *Ex-post* Assessment PRAPS-1



A Tier 2 *ex-post* assessment of the PRAPS-1 operation was conducted as part of the project ICR. Two scenarios were compared: without and with project. Total emissions from ruminants amounted to 31,434,420 CO_2-eq/year and 31,247,759 t CO_2-eq/year, respectively, in the without- and with-project scenarios, for all 6 countries and on average over the implementation period of 5 years. Cumulative emission reductions were limited, relative to total emissions, but still reached nearly 1 million (933,305) t CO_2-eq over 5 years. Emission reductions were achieved through improvements in productivity, limited growth in animal numbers and marginal improvements in the quality of feed.

In addition, factors from the literature were used to provide an estimate of carbon sequestration potential from rangeland restoration and pasture improvement activities implemented by the project. Carbon sequestration could reach 178,257 tCO_2-eq/year with the project. Although carbon sequestration was estimated with a simpler method than emission, leading to higher uncertainty and lower confidence, the net GHG emissions of the project could have reached –1.8 million t CO_2-eq (net removal) over 5 years, from both emission reductions and carbon sequestration.

6 Conclusion

This guidance note builds on lessons learned from the analytical and technical assistance work caried out in the context of PCSL. The primary goal of this work was to support operations in their attempts to mainstream the concept of climate smart agriculture in livestock development. The experience developed through these activities is however of broader relevance. It was combined with lessons learned from support provided to operations in other regions (e.g., in Colombia, Kazakhstan, Bangladesh) to prepare this document with the objective of helping task teams to enhance and assess the food security, and climate-change mitigation and adaptation outcomes of livestock operations.

Main lessons from this work include:

- The earlier in the project cycle CSL aspects are tackled, the more benefits they can achieve. Initiating the mainstreaming of CSL during project preparation (e.g., capacity development, planning for data collection, design/prioritization of activities) allows the project team to capitalize on these efforts throughout implementation;
- The highest CSL benefits come with transformational changes. This will involve setting objectives, designing activities, and identifying beneficiaries with the intention to transform, while considering social inclusiveness, food security, and poverty alleviation amongst the most vulnerable groups. "End of the pipe" solutions and systems modifications at the margin will generate lesser CSA gains;
- Identifying and allocating resources to CSL champions is an important success factor. CSL champions will be a primary target for all capacity development efforts and will ensure that all actions to mainstream CSL into the project (e.g., adjusting activities, indicators, data collection, assessment) are implemented. CSL champions should be both on the project teams and their counterparts, to promote alignment of CSL efforts across the project and on the national scale, while ensuring continuity (e.g., on data, capacity) after the project has ended;
- Assessing potential benefits from a project during preparation, and then monitoring and evaluating actual results in a robust and reliable manner requires both human and financial resources. Climate finance provides an opportunity to capitalize on such investment. Opportunities are currently still limited but show an important growth trend; and
- Data collection and M&E remain a challenge. Assessing CSL objectives should be most efficiently achieved when mainstreamed into the project M&E system, but how this is done in detail (what data to collect, at what frequency, to calculate which indicators, by whom and using which tools) is still a "learning-by-doing" exercise to be undertaken in projects.

Providing guidance on CSL mainstreaming to operations is a process of continuous improvement. It is thus intended that the guidance provided in this document will be included in the ISL web-based guide so it can be regularly updated. For example, future work may focus on the development of systematic approaches to help teams address the numerous tradeoffs and synergies between CSL objectives, taking place at various geographical and temporal scales.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Annexes

ANNEX 1

Selected Past/Ongoing Operations with Significant Application of a CSL Approach

Niger:

Title of World Bank investment project	Niger Climate Smart Agriculture Project
Status	Active
Budget	US$78.8M
Objective	(i) to enhance adaptation to climate risks, (ii) to improve agricultural productivity among the target communities and (iii) to improve the Recipient's capacity to respond promptly and effectively to an Eligible Crisis or Emergency
Main components	Investments for Scaling up Climate-smart Agriculture, Innovative practices and improved service delivery for mainstreaming CSA, Contingency Emergency Response
Target group(s)	Farmers and agro pastoralists, producer organizations, micro small and medium enterprises
Role of adaptation/mitigation in the project	The project development objective explicitly include adaptation, and project activities are intended generally to promote adoption of CSA, including both adaptation and mitigation.

Cameroon:

Title of World Bank investment project	Livestock Development Project
Status	Active
Budget	$100M
Objective	Improve the productivity of selected livestock production systems and the commercialization of their products for the targeted beneficiaries, and to provide immediate and effective response in the event of an Eligible Crisis or Emergency.
Main components	Improvement of Livestock Services Access and Delivery Improvement of Pastoral Productivity, Access to Markets, and Resilience of Pastoral Communities Support to livestock value chains development
Target group(s)	Livestock-rearing households, including pastoralists, livestock farmer's organizations, small and medium scale private livestock operators and enterprises
Role of adaptation/mitigation in the project	Includes a component explicitly devoted to resilience to climate change

Kenya:

Title of WB investment project	(1) Kenya Climate Smart Agriculture Project (KCSAP) (2) National Agricultural and Rural Inclusive Growth Project (NARIGP)
Status	(1) active (2) active
Budget	(1) US$250M (2) US$200M
Objective	(1) Increase agricultural productivity and build resilience to climate-change risks in the targeted smallholder farming and pastoral communities in Kenya, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response. (2) Increase agricultural productivity and profitability of target rural communities in selected Counties, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response.
Main components	(1) Upscaling Climate-Smart Agricultural Practices, Strengthening Climate-Smart Agricultural Research and Seed Systems, Supporting Agro-weather, Market, Climate, and Advisory Services (2) Supporting Community-Driven Development, Strengthening Producer Organizations and Value Chain Development, Supporting County Community-Led Development
Target group(s)	(1) Smallholder farmers, agro-pastoralists, and pastoralists (2) Producers and communities in select rural areas
Role of adaptation/mitigation in the project	(1) The project development objective explicitly aims to implement CSA, including both mitigation and adaptation. (2) Addresses resilience as an aspect of agricultural productivity in project activities

Ethiopia:

Title of WB investment project	(1) Livestock and Fisheries Sector Development Project (2) Ethiopia Oromia Forested Landscape Program
Status	(1) active (2) in preparation
Budget	(1) US$170M (2) US$50M
Objective	(1) Increase productivity and commercialization of producers and processors in selected value chains, strengthen service delivery systems in the livestock and fisheries sectors, and respond promptly and effectively to an eligible crisis or emergency. (2) Improve the enabling environment for sustainable forest management and investment in the regional state of Oromia.
Main components	(1) Linking More Productive Farmers to Markets, Strengthening National Institutions and Programs (2) Preparation an Emission Reduction Purchasing Agreement
Target group(s)	(1) Smallholder livestock and fisheries producers and processors (2) All economic activities in the jurisdiction
Role of adaptation/mitigation in the project	(1) At more subsistence levels, the focus will be on adaptation and increased productivity (resulting in lower emission intensities). For more commercial producers, the focus may also include specific mitigation options such as covered manure storage, biogas and energy-saving devices. (2) Focus on mitigation, across all AFOLU sectors

PRAPS II (Sahel):

Title of WB investment project	Regional Sahel Pastoralism Support Project II
Status	In preparation
Budget	US$335M
Objective	To improve the resilience of pastoralists and agro-pastoralists in selected areas in the Sahel region, and respond promptly to pastoral crises or emergencies.
Main components	Animal health improvement and veterinary medicines control Sustainable landscape management and governance enhancement Livestock value-chain improvement Social and economic inclusion of women and youth improvement
Target group(s)	Pastoral and agro-pastoral households
Role of adaptation/mitigation in the project	“Resilience” is an explicit project development objective. For example, the project will work to improve access to and use of feed and forage (through specific value-chain development along the main regional agropastoral livestock corridors – i.e., production, storage, processing, and commercialization), and to complement scarce natural resources during the lean season to improve pastoralist and agro-pastoralist resilience.

Bangladesh:

Title of WB investment project	Livestock and Dairy Development Project (LDDP)
Status	Active
Budget	US$500M
Objective	To improve productivity, market access, and resilience of smallholder farmers and agro-entrepreneurs operating in selected livestock value chains in target areas
Main components	Productivity Improvement Market Linkages and Value Chain Development Improving Risk Management and Climate Resilience of Livestock Production Systems
Target group(s)	Small and medium-scale livestock producers
Role of adaptation/mitigation in the project	Productivity and resilience are targeted by dedicated components with GHG emission reduction included as a PDO-level indicator. In addition, a related crediting program was developed to support the measurement of mitigation outcomes from LDDP and their use in NDC reporting or trading schemes under Article 6 of Paris Agreement.

Uzbekistan:

Title of WB investment project	Second Livestock Sector Development Project
Status	Active
Budget	US$150M
Objective	To support the development of a productive, market-oriented, sustainable, and inclusive livestock subsector in Uzbekistan
Main components	Public livestock support services Market and value addition infrastructure, trade Green and resilient livestock value chains
Target group(s)	Smallholder farmers, large-scale commercial farmers, agribusinesses, and other livestock value chain actors such as service providers, input suppliers, aggregators, and off takers
Role of adaptation/mitigation in the project	Productivity, as well as technologies and practices controlling GHG emissions and enhancing resilience to climate change are included as PDO-level indicators. The project will improve access to finance, including through the establishment of a credit line to finance climate change mitigation and/or adaptation activities.

ANNEX 2

Sample ToRs for a Country Livestock Expert

Background

Objective

The main objective should be to support project preparation by building a comprehensive understanding of livestock production, evolution, and constraints, and by identifying/organizing consultations with relevant stakeholders.

Tasks

Specific tasks may include:

- Support the understanding of the context for livestock-related aspects, including:
  - Defining the main value chains and production systems, their relative importance and distribution across the country;
  - Describing the recent and projected evolution of the sector and its underlying drivers (demand, economic attractivity, relative growth of the different sub-sectors);
  - Identifying the main constraints faced by the livestock sector, particularly those related to climate change;
  - Reviewing national policies and strategies for agricultural/livestock development and climate-change mitigation/adaptation.
- Facilitate the identification and dialogue with local stakeholders on livestock and climate change:
  - Mapping national stakeholders from technical/extension/research institutions related to livestock, NGOs, private sector representatives (farmers/producers/value-chain organizations/associations), government agencies and climate-change and technical staff from ministries (livestock, environment, agriculture);
  - Collecting information in support of project design and CSL assessments (in coordination with the livestock & climate-change expert), especially country-specific information generated by local institutions and not easily accessible online;
  - Organizing consultation with stakeholders, during the design mission and remotely during the design phase.

Deliverables

Deliverables should include:

- Initial report on the description of the context and stakeholder mapping;
- Contribution to the project document.

Qualifications

- Advanced degree in Agricultural or Livestock Science (including livestock production, animal health etc.), or any other topic relevant to the project;
- A minimum of 10–15 years of relevant professional experience is generally sought;
- Established knowledge and network among the national stakeholders in livestock production and climate change; and
- Proven and recognized experience in organizing stakeholder consultations.

ANNEX 3

Sample ToRs for a Livestock & Climate-Change Expert in Support of Project Design

Background

In addition to general background about the project, this section could include an initial overview of livestock & climate change issues.

If activities or (PDO-level) results indicators related to CSL have been preliminarily identified, they should also be mentioned.

Objective

The main objective may be to support project preparation from the CSL perspective, by contributing to technical assessments on livestock & climate change, and by supporting project design on CSL aspects (mitigation & adaptation measures, [PDO-level] results indicators, M&E considerations).

Tasks

Specific tasks may include:

- Review and refine GHG emission estimates at the national level (from livestock species relevant to the project). This may involve:
  - Reviewing the national communication/GHG inventory and other relevant studies on livestock GHG emissions in the country;
  - Collecting information and secondary data on parameters required for a Tier 2 (and possibly life cycle) assessment of livestock GHG emissions;
  - Proposing a refined estimate of national livestock GHG emissions and discussing potential differences with the national communication/GHG inventory (e.g., Tier 1 vs. Tier 2).
- Identify and advise on mitigation interventions to improve the climate impact of the project. This may involve:
  - Identifying the main categories of interventions relevant to the scope of the project and local livestock production context;
  - Proposing and developing a preliminary assessment of mitigation potential and discussing specific mitigation measures with the task team and local stakeholders.

- Participate in the design mission, which will provide an opportunity for the consultant to:
  - Strengthen their understanding of the project context, critical issues, existing practices;
  - Meet and consult local stakeholders to gather information and secondary data (from local research/technical institutes, etc.);
  - Consult local stakeholders on latest developments in the livestock sector and relevance/feasibility of different mitigation interventions;
  - Raise awareness among local stakeholders on climate-smart livestock and the calculation of GHG emissions from the sector.
- Develop an initial assessment of the potential GHG emission impact of the project. This may involve:
  - Consolidating baseline data obtained from the desk review and consultation with the task team and local stakeholders performed remotely or during the design mission;
  - Proposing a tool for the calculation of Tier 2 livestock GHG emissions;
  - Elaborating assumptions on the adoption rate and individual effect of project activities;
  - Estimating GHG emissions for the baseline and under different project scenarios (e.g., by categories of activities, considering conservative/optimistic assumptions).
- Provide recommendations on M&E aspects related to livestock GHG emissions, including:
  - Data collection at baseline and implementation stage;
  - (PDO-level) results indicators;
  - Link to national data (institutionalization) and MRV systems for GHG emissions;
  - Capacity development plan for M&E teams on livestock GHG emissions aspects.

Deliverables

Deliverables may include:

- Short report on the design mission from the livestock GHG emission aspect and contribution to the *Aide memoire*;
- Final report summarizing data, approach, findings, and recommendations;
- Contribution to the technical assessment of the project (section on climate impact).

Qualifications

Specific qualifications may include:

- Advanced degree in Agricultural Science, Environmental Science, or any other topic relevant to the project;
- A minimum of 5–10 years of relevant professional experience is generally sought;
- Proven and recognized experience in analyzing livestock value chains, GHG emissions along livestock value chains, natural resource management and mitigation potential thereof;
- Proven ability to work with a multi-disciplinary team, undertake stakeholder consultations, provide guidance, and recommend actions;
- Experience in supporting capacity development on CSL and livestock GHG emission assessments to national stakeholders.

ANNEX 4

Examples of GHG Emission Mitigation Interventions from Livestock

Figure 7 describes the main categories of mitigation intervention and their effect on emission intensity, emission reduction, and removals. The three sections below provide:

- A list of more specific categories of mitigation interventions;
- Additional references to learn more about mitigation interventions;
- An example taken from FAO studies that aimed to quantify the mitigation potential of animal health and feed/nutrition interventions in various countries.

List of interventions (see also: www.sustainablelivestockguide.org/)

Animal health – Decreasing mortality and increasing fertility leads to improved productivity over the lifetime of individual animals and at herd level. Emission intensity is decreased through higher productivity and by cutting 'unproductive' emissions that are associated with dead or sick animals.

- Vaccination (e.g., Rift Valley Fever, PPR, CBPP, Blue Tongue);
- Control/treatment (e.g., surveillance and diagnosis, treatment, quarantining);
- Prevention (e.g., sourcing, hygiene, monitoring, disposal, keeping records);
- Deworming;
- Heat stress management (temperature regulation in building and pastures [shade]).

Animal husbandry – Similar to animal health measures, good animal husbandry practices can increase productivity at herd level by optimizing the number of productive animals (e.g., lactating cows through early age at first calving, short calving interval and optimal age at culling).

- Artificial insemination;
- Culling (rate) optimization;
- Reducing age at first calving/calving intervals;
- Strategic destocking.

Animal genetic resources (breeds) – Breeding to maximize desirable traits can strongly increase productivity by improving traits such as live-weight gain, milk yield, or fertility, with, in turn, an effect on emission-intensity reduction. Adaptation traits can also be sought to reduce mortality in challenging climate or disease contexts.

- Introducing improved breeds/cross breeding.

Feed and nutrition – Poor nutrition is one of the main factors of low productivity; therefore, improving feed availability, quality and balancing the feed ration to animals' requirements offers important leverage for productivity gains and emission-intensity reduction. Using feed of higher quality and digestibility can also lead to absolute emission reductions.

- Feed conservation is a way of ensuring feed availability in periods when the growth of natural biomass is limited (e.g., dry seasons) and to increase feed quality/digestibility (e.g., silage);
- Fodder introduction/cultivation can make available new feed ingredients with high nutritional value (e.g., grass and legumes sown in pastures or inter-cropped, tree forages);
- Feed supplementation aims to provide certain nutrients (N in particular) and to balance rations for macro- and micro-nutrients, especially when the availability and quality of natural biomass is low. For instance, legumes can be used for their high N digestibility (due to their tannin concentration), as well as multi-nutrient blocks;
- Feed transformation/processing can be used to improve the digestibility of feed, through physical (e.g., chopping) or chemical (e.g., urea-treated straws/crop residues);
- Introducing small amounts of feed concentrates has a strong effect on productivity and GHG emission intensity reduction. Feed concentrates are highly digestible and are intended to be diluted/mixed in the diet to provide specific nutrients, often proteins (proteinaceous concentrates, mostly from legumes and oilseed cakes), energy (carbonaceous concentrates, mostly from grains), and/or minerals;
- Balancing feed rations to meet the specific nutritional needs of different categories of animals (lactating cows in particular) increases productivity as well as feed conversion efficiency, resulting in both emission intensity and absolute emission reductions.

Innovative options for enteric methane – As enteric methane emissions represent the most significant emission source from the global livestock sector, important science and research efforts focus on methods to mitigate them. Most options are still in development and include, for instance, methane inhibitors, vaccines against methanogen micro-organisms of the rumen or selection of the rumen microbiome to favor low-methane producing animals.

Manure management – Manure generates CH_4 and N_2O emissions that can be reduced by adapting the diet of the animals, transforming the manure and using good manure management practices.

- Diet has an impact on the composition of faeces and urine and on emissions related to manure management. Matching protein intake from feed with animal requirements can potentially limit nitrogen concentration in manure and to reduce N_2O emissions;
- Biogas digesters can capture up to 60–80 percent of the CH_4 from manure that would otherwise be emitted into the atmosphere;
- Composting can reduce CH_4 emissions but can increase N_2O emissions. It can have a positive climate impact if compost is used to replace synthetic fertilizers;
- Proper manure collection/storage.

Energy efficiency and use/production of renewable energy – There is scope for mitigation in greater reliance on renewable energy and adopting energy-efficient technology for livestock production, especially in more industrialized production systems and at energy-intensive stages of the animal protein life cycle (transport, animal housing, processing of feed and animal products).

- Production/use of renewable energy at farm stage;
- Energy efficiency at transport stages;
- Energy efficiency/use of renewable energy at processing stages (e.g., milk cooling, pasteurization, and processing).

Land management – Agro-ecosystems not only emit GHGs but also have the potential to sequester carbon, by enhancing soil organic carbon below ground through improved pasture management, and above ground in systems where trees can be included. Carbon sequestration potential is highly variable across geographies and systems; however, a high potential and co-benefits for productivity lie in the restoration of degraded pastures, that can have had their soil carbon stock reduced up to 95 percent.

- Grazing management (timing and intensity): fencing/rotational grazing, restorative grazing;
- Participatory rangeland management for grassland restoration and avoiding overgrazing;
- Nutrient management to favor productivity and carbon sequestration;
- Fire management;

- Invasive species control (an important cause of grassland degradation);
- Pasture improvement (e.g., fertilization, seeding, irrigation);
- Species introduction (fodder grass, legumes, trees).

References and resources

Gerber, P. J., H. Steinfeld, B. Henderson, A. Mottet, C. Opio, J. Dijkman, A. Falcucci, and G. Tempio. 2013. Tackling Climate Change through Livestock – A Global Assessment of Emissions and Mitigation Opportunities. Rome: FAO.

GRA (Global Research Alliance On Agricultural Greenhouse Gases) and SAI (Sustainable Agriculture Initiative) Platform from LRG (Livestock Research Group). 2015. Reducing greenhouse gas emissions from livestock: Best practice and emerging options.

Hristov, A.N., Oh, J., Lee, C., Meinen, R., Montes, F., Ott, T., Firkins, J., Rotz, A., Dell, C., Adesogan, A., Yang, W., Tricarico, J., Kebreab, E., Waghorn, G., Dijkstra, J. & Oosting, S. 2013. Mitigation of greenhouse gas emissions in livestock production – A review of technical options for non-CO2 emissions. Edited by Pierre J. Gerber, Benjamin Henderson and Harinder P.S. Makkar. FAO Animal Production and Health Paper No. 177. FAO, Rome, Italy.

Mottet, A., Henderson, B., Opio, C., Falcucci, A., Tempio, G., Silvestri, S., . . . & Gerber, P. J. (2017). "Climate change mitigation and productivity gains in livestock supply chains: insights from regional case studies". Regional Environmental Change, 17(1), 129–141.

Puri, M., Rincon, L. and Maltsoglou, I. 2021. Renewable energy for agrifood chains – Investing in solar energy in Rwanda. Rome, FAO.

Özkan, Ş., Teillard, F., Lindsay, B., Montgomery, H., Rota, A., Gerber P., Dhingra M. and Mottet, A. 2022. The role of animal health in national climate commitments. Rome, FAO.

Example of quantification of the mitigation potential of animal health and feed/nutrition interventions

The table below provides an overview of nine FAO studies (click country names to access publications or visit https://www.fao.org/in-action/enteric-methane/resources/publications/en to see the list) conducted in various regions and countries to identify and evaluate low-cost strategies to improve productivity while reducing livestock GHG emissions. Country experts and stakeholders were consulted to pre-select potential mitigation interventions. The table focuses on animal health (blue rows) and feed/nutrition (green rows) mitigation interventions and shows their effects on productivity gains ('prod.') and emission intensity reductions ('EI') in the context of the studies.

Interventions	Uruguay	Argentina	Ethiopia	Kenya	Uganda	Tanzania	West Africa[a]	Bangladesh	Sri Lanka
Vaccination/ control		Tricomoniasis control +21–31% prod. –15–22% EI	Trypanosomosis control –30–31% EI	East Coast Fever vaccination +25% prod. –14–19% EI		East Coast Fever vaccination +12–23% prod. –20–29% EI	Vaccination +15–21% prod. –13–19% EI		
Other				Deworming +12–27% prod. –8–20% EI	Technologies & services +8–40% prod. –2–27% EI			Mastitis prevention +5–14% prod. –3–12% EI	Heat stress management +6% prod. –3–6% EI
Urea-treated crop residues/ straws			–17–44% EI	+20–35% prod. –13–26% EI	+2–4% prod. –1–4% EI	+5–6% prod. –3–8% EI	+26–43% prod. –19–30% EI	+8% prod. –27–36% EI	
Feed supplementation	With legumes (interseeding) –21% EI	With deferred forage +31–65% prod. –23–39% EI	With leguminous shrubs –20–28% EI With UMMB[b] –20–28% EI	With legumes +8–33% prod. –7–25% EI With UMMB –11% EI +13% prod.	With legumes (intercropping) +3–19% prod. –1–12% EI	With legumes (intercropping) +21–38% prod. –12–29% EI	With ration blocks +14–19% –13–19% With legumes +26–35% prod. –21–26%	Balanced feed rations +15% prod. –23–28%EI	With gliciridia blocks +102–109% prod. –46–50% EI Balanced ration +48% prod. –20% EI
Feed concentrates	–20–33% EI		–15–43% EI	+4–12% prod. –7–12% EI					+41–47% prod –36–39% EI
Feed conservation		Silage +3–4% prod. –3–5% EI		Silage +8–10% prod. –9–10% EI	+4–21% prod. –3–16% EI		Silage +24–32% prod. –20–24% EI		
Establishment of fodder grasses and legumes	–56% EI	Pasture improvement +7–17% prod. –3–9% EI		+6–25% prod –8–18%EI		+22–44% prod. –13–30% EI	Fodder banks +17–24% prod. –17–23% EI	+4–5% prod. –5–12% EI	

[a] Benin, Burkina Faso, Mali, Niger, Senegal. [b] Urea-molasses multi-nutrient blocks.

ANNEX 5

Parameters Required for Tier 2 Calculation of (Direct and Indirect) Livestock GHG Emissions

TABLE A.1 Indicative List of Data/Parameters Required for Tier 2 Calculation of (Direct and Indirect) Livestock GHG Emissions. Recommendations are Provided in Terms of Priority (Surveyed > Surveyed if Related Activities are Implemented by the Project > Country-Specific Studies Can be Used > International Literature Can be Used) and Collection Frequency ('Regularly' = Embedded Into Regular Data Collection by the Project, Typically Monthly to Annually)

Stock	
Animal numbers by representative animal categories (based on age, sex and reproductive status).	Ideally surveyed regularly and at all stages. Instead of numbers in all animal categories, the total number of animals, number of adult females and bull to cow ratio can be used.
Herd parameters	
• Mortality rate of calves (%) • Mortality rate of animals other than calves (>1 year) (%) • Fertility rate of adult females (%)	At baseline stage, existing, country-specific data from literature and reports could be used. If animal health measures are implemented, these should ideally be surveyed during implementation (regularly or at least at mid-term and final evaluation [MTR and ICR] stages).
• Replacement rate of adult females (%) • Age at first calving (months) • Age at weaning (months)	Existing, country-specific data from literature and reports can be used.
Productivity	
• Milk yield (average daily milk yield during lactation) (litres / day)	Ideally surveyed regularly and at all stages (when dairy production is in the scope of the project).
• Live weight (kg): – at birth – of adult females – of adult males – at slaughter	Existing, country-specific data from literature and reports can be used. If meat production is in the scope of the project, slaughter weight should be validated at least on a sub-sample (e.g., at mid-term and final evaluation [MTR and ICR] stages).
• Daily weight gain of "growing" categories (i.e., excluding breeding cows and bulls)	Can be calculated from the parameters above, or country-specific data from literature and reports could also be used.
Production (for each farm category)	
Total milk production (number of milking animals * average milk yield per animal) (kg)	Ideally surveyed at all stages. If milk yield is already surveyed.
Total meat production (number of slaughtered animals * average slaughter weight) (kg)	Ideally surveyed at all stages. The dressing percentage (carcass weight/live weight at slaughter) and protein content of meat can be derived from the literature.
Other animal energy requirements (for each animal category, farm category, and possibly season)	
• Feeding situation (daily number of hours on pastures) • Work hours per day	Could be surveyed or derived from country-specific data from literature and reports.

Feed ration (for each animal category, and possibly farm category, and season)	
Composition of the feed ration (description of feed items and their proportion in the total dry matter intake)	Ideally surveyed at all stages. Country-specific studies could be used to fill gaps, but this parameter has a strong influence on emissions, it should thus be surveyed although it can represent a non-negligible section of the surveys.
• Digestible energy of each feed item (or average for the whole ration) (%) • Crude protein content of each feed item (or average for the whole ration) (kg N/kg dry matter)	Can be derived from international literature although country-specific data should be preferred.
Manure management (for each farm category)	
Proportion (%) of manure managed in each manure management system. Indicative manure management systems: • Deposited on pastures • Daily collected and spread over pastures of fields • Used in biodigesters • Stored in open lagoons • Stored as liquid slurry • Stored as solid manure (in combination with bedding material) • Stored as dried material • Burnt for fuel	Country-specific studies can be used except if manure management measures are part of the project (e.g., biogas, composing), in which case this should be surveyed during implementation.
Feed production practices (for feed crops corresponding to each feed item in the feed rations of the animals)	
• Yield – Crop yield (kg/ha) – Straw/co-products yield (kg/ha) – Storage losses (kg/ha) • Manure application – Application rate (kg manure/ha) – Nitrogen content (kg N/tonne) • Synthetic fertilizer application (kg N/ha) • Urea application (kg/ha) • Lime application (kg CaCO3/ha)	Country-specific studies can be used except if specific measures are part of the project activities.
Energy consumption (for each feed crop or each farm category)	
• Fossil fuel use for feed cultivation and transport (type of fuel, litres/ha) • Fossil fuel use for feed transformation and preparation (type of fuel, litres/ha) • Energy use in the form of electricity taken from the grid (kilowatt-hours)	Country-specific studies can be used except if specific measures are part of the project activities.
Land use change	
• Type (in particular, forest to grassland or cropland, cropland to grassland) and area (ha) of land use change having occurred in the past 20 years	Country-specific studies can be used except where specific measures are part of the project activities.

ANNEX 6

Capacity Development Material

1. **Useful links**

- FAO e-learning course[27] on CSL
- GLEAM-i tool
  - The online tool[28]
  - Manuals: of the online tool[29] and of the full model[30]
  - Video demonstrations, including guided exercises, part 1[31], part 2[32], parts 3 and 4[33]
- Example of trainings provided with national funding institutions[34]
- Example of training provided at regional level: in Asia[35] and in Mediterranean countries[36]
- Policy briefs based on technical assistance at country level
  - The role of animal health in national climate commitments[37]
  - Cameroon moves towards low-carbon livestock systems[38]

2. **Example of agenda outline for an awareness raising workshop/webinar on CSL**

The objective of the workshop is to raise awareness of the contributions of livestock to all three pillars of CSA and to introduce tools and methods that can be used to measure these contributions.

27 https://elearning.fao.org/course/view.php?id=437

28 http://gleami.org/

29 https://www.fao.org/3/cb2249en/cb2249en.pdf

30 https://www.fao.org/fileadmin/user_upload/gleam/docs/GLEAM_2.0_Model_description.pdf

31 https://youtu.be/iIKfIVbw1aE

32 https://youtu.be/OU4MRLjCUSM

33 https://youtu.be/iVK6l2GXtI0

34 https://www.fao.org/support-to-investment/news/detail/en/c/1298227/

35 https://www.fao.org/asiapacific/news/detail-events/en/c/1261179/

36 https://edu.iamz.ciheam.org/LivestockClimateChange/en/

37 https://www.fao.org/3/cc0431en/cc0431en.pdf

38 https://www.fao.org/3/cc1443en/cc1443en.pdf

Participants should acquire the following skills:

- Understanding of livestock contributions to the three CSA pillars, in general, and within the project
- Knowledge of key data requirements for GHG emissions assessment
- Basic-level skills with the use of GHG emissions calculators (GLEAM-i)

Agenda outline

	Morning	Afternoon
Day 1	Introduction (of the participants, workshop objectives, overview of CSL)	Updates from project activities/relevant local research on CSL
Day 2	Presentation of CSL mapping of project activities Group work to complement CSL mapping	Group work to identify data availability and gaps Groups reporting in plenary
Day 3	Introduction to the calculation of livestock GHG emission Presentation and demonstration of the GLEAM-i tool	Group exercises with GLEAM-I Plenary discussion Closing

3. Example of agenda outline for training workshop on the calculation of livestock GHG emissions and emission reductions from a project

The objective of the workshop is to provide advanced training on the GLEAM-i tool for calculating livestock GHG emissions. Several aspects will be addressed, from data collection and preparation to GHG emissions calculations and preparation to results interpretation and reporting.

The workshop is intended for participants to acquire the following knowledge/skills:

- Be autonomous in the use of GLEAM-I;
- Understand data requirements, how to input data, how to identify and address data gaps;
- Be able to apply GLEAM-i to their own projects, by revising input data;
- Be able to develop and compare baseline and project scenarios; and
- Know how to interpret GHG emission results and how to use them for reporting purposes.

Agenda outline

	Morning	Afternoon
Day 1	Introduction (of the participants, workshop objectives, reminder of CSL concepts)	GLEAM-i reminders and exercise
Day 2	Group work (by projects or project components): data consolidation for the baseline situation: data inventory and consolidation, revision of GLEAM-i input parameters	Group work: data consolidation for the project situation, preliminary calculations of project impacts on GHG emissions
Day 3	Finalization of GHG emissions results in groups Results interpretation	Reporting in plenary Roadmap for filling data gaps

ANNEX 7

Example of Structure Budget for *Ad-hoc* Survey on Livestock GHG Emissions

Structure

In this example, a sample size of 30 households per combination of *treatments* was adopted (typically the very minimum sample size). Combinations of treatments were the following:

- With c/w without project households
- 3 regions
- 3 value chains (dairy, red meat, poultry)

Resulting in a total sample size of 30 × 2 × 3 × 3 = 540 households.

The households are typically randomly chosen in villages/small administrative units (municipalities) that can be randomly sampled or not (based on expert knowledge of representative areas within project/non-project zones).

Time for one survey is typically around one hour but an average of two surveys/day/enumerator is considered to account for time for transportation and data entry.

Budget

The example of budget below amounts to an average of around US$46 per household surveyed (540 in total). This figure will vary, depending on real-life experience and on inflation (the example of budget is based on activities undertaken in South Asia and East Africa between 2017 and 2022).

Item	Unit cost (US$)	Units	Total cost
Initial training			
International travel for trainer (survey coordinator)	1500	1	2,500
Trainer daily rate + per diems for conducting training	700	3 days	2,100
Trainees (supervisors) payment during training	100	9 (3 supervisors, 3 days)	900
Training organization	1000	1	1,000

Item	Unit cost (US$)	Units	Total cost
Data collection			
Local travel to regions for supervisors	400	3	1,200
Supervisor payments	100	30 (3 supervisors, 10 days)	3,000
Enumerator payment (2 surveys/day/enumerator on average)	20	270 (3 regions, 9 enumerators, 10 days)	5,400
Logistics (transportation, local guides)	150	30 (3 regions, 10 days)	4,500
Farmers’ payment	1	540	540
Printing/utilities	500	1	500
Data consolidation/quality control/preliminary analyses			
Supervisor payments (data consolidation and quality control)	100	9 (3 supervisors, 3 days)	900
Coordinator payment (overall coordination, preliminary analysis)	500	5	2,500
TOTAL			25,040

ANNEX 8

Example of a Summary of Climate Co-Benefits Per Activity, for the World Bank Second Livestock Sector Development Project for Uzbekistan

Activity	Adaptation	Mitigation
	Subcomponent 1.1: Improve the enabling environment (US$0.5 million)	
Review of policies and legislation (100% F)	Increased awareness and information dissemination on how to adapt to climate change impacts on the livestock sector for government at all administrative levels. National objectives of climate change adaptation and mitigation identified in the Green Economy Development Strategy 2019 will be mainstreamed into policies and regulations developed with support of the project. Examples include the repurposing of public support to the sector for greater adaptation and mitigation results; support to sustainable pasture management and restoration of degraded pastures; introduction of organic livestock farming methods; support to the development the area under forage crops and diversification of forage crops i.e., expansion of the area under perennial forage trees and perennial grasses; incentives for green investments in livestock production, processing and marketing; incentives and regulations for proper storage/processing of organic animal waste; monitoring of GHG emissions in the livestock sector and linkages with National Inventory Reports to UNFCCC; support to breeding highly productive animals and developing forage crop varieties resistant to salinity, drought and other hazards and risks; programs for the preservation of the gene pool of local animal breeds and forage crop varieties.	
	Subcomponent 1.2: Strengthen the CVLD (US$13.0 million)	
Capacity building Developing systems, including VIS (15% F) Infrastructure capacity building (goods and works) (70% F) Human capacity building (15% F)	A strengthened CVLD will be able to design and implement veterinary and livestock policies, strategies and regulations that enhance resilience of the sector. This specific sub-component will help CLVD to support adaptation to climate change impacts on the livestock sector through training, capacity building, and improved information dissemination (by developing a veterinary information system). The VIS will include the collection and management of information relevant to adaptation activities, (e.g., monitoring of progress in improving the drivers of resilience to climate change). The integration of the One Health approach will contribute to climate adaptation. The vulnerability context of the livestock subsector with regard to climate related zoonotic diseases and follow-on impacts call for an integrated system-based approach such as One Health.	Energy efficiency consideration will be incorporated in civil works and equipment purchase. A strengthened CVLD will be able to support the sector in developing and adopting practices that improve animal production efficiency (health, feed, reproduction management), and thus reduce emission intensity. The VIS will include the collection and management of information relevant to mitigation activities (e.g., monitoring and reporting of GHG emissions in livestock value chains and their reduction).
	Subcomponent 1.3: Strengthen public livestock extension and advisory services (US$6.0 million)	
Capacity building and extension	All resources in this subcomponent will support farmers and institutions (extension providers) in the development, adaptation and adoption of climate smart	All resources in this subcomponent will support farmers and institutions (extension providers) in the development, adaptation and adoption of climate

ANNEX 9

Questionnaire Form for an *Ex-ante* Analysis Survey on GHG Emissions Reductions Associated with a Livestock Project (Example from Bangladesh)

Bangladesh *ex-ante* analysis survey on GHG emission reductions associated with the Livestock and Dairy Development Project

Enumerator: Each time a household has been selected for interview, go to the household and:

(1) Make a brief introduction:

Good morning/afternoon. My name is __________. We are working for the Bangladesh Livestock Research Institute and we are doing a survey about dairy cows and dairy production. Your household was chosen randomly from a list of households in the village. Is this the household of [name of household head from the list]? [If No, ask where the farm of that person is. If yes, ask:]

Does your household keep dairy cows? [If No, say "thank you" and get another household from the list. If Yes:]

(2) Explain in more detail about the survey:

The survey we are doing will provide information to help the Bangladesh Livestock Research Institute and the Department of Livestock Services to design programmes of support to dairy farmers. The survey asks questions about the dairy cows that you keep, how you apply feed and other management on the farm, and the services that you use. Are you the person responsible for looking after cattle? [If No, ask to speak to someone, e.g. household head, spouse or another adult household member, who is responsible for dairy cattle on the farm. If Yes, continue:]

(3) Check if the person is willing to be interviewed:

The survey will take about 1 hour. Can you spare some time to talk now? [If No, try to rearrange for later today. If yes, begin the survey]

1. Household identification

Only fill in if you have confirmed the household has dairy cattle and a suitable respondent is available.

Date of survey (DD/MM/YYYY):	/ /				
Enumerator name:					
Head of household name:*					
Mobile number:*					
Time interview started:	HH:		MM:		
Division name:		District (Zila) name:			
Upazila name:		Village name:			
Name of survey respondent:					
Relationship of survey respondent to household head (code a):					
Gender of survey respondent (tick correct box):		Male [_____]		Female: [____]	
Household GPS Coordinates:	Latitude (N/S):		Longitude (E/W):		
HH ID System: (to be filled in at data entry, not by enumerator)					
Household Code (ABCDE):					
A = Division, B = District, C = Upazila, D = Village, E = Household number					
a) Respondent relationship					
1 = household head, 2 = spouse, 3 = other family member, 4 = Other non-family member					

Enumerator: explain that we will not share details about their name or phone number with anyone else, but we may need to contact them again to cross-check some of the information. That is why we ask for the name and phone number. If they are not willing to give their phone number, that is OK.

Quality Assurance Aspects – not for enumerator, to be filled by supervisor upon questionnaire inspection

DATE OF QUESTIONNAIRE INSPECTION BY SUPERVISOR (dd/mm/yyyy):	/ /
Review of questionnaire:	
Enumerator assessment: Fill this in AFTER you have administered the questionnaire	
Assessment of quality of information: (1 = reliable, 2 = unreliable)	
Explain or add any relevant comments:	
Supervisor: Enter your comments here AFTER you have inspected the WHOLE questionnaire	

2. Livestock and Cattle: Herd Structures and Dynamics

2.1 Keeping and Ownership of Dairy Cattle

How many local and cross-bred/exotic are cattle kept and owned by the household? (Include calves, heifers or steers, and mature animals, male and female).

Cattle type		A = Number kept by the household	B = Number owned but kept by other households	C = Number not owned but kept by the household for others
Cattle	Local			
	Cross/exotic*			

* “Cross” refers to a cross-bred animal which is part-exotic.

2.2 Cattle Herd Inventory

List all cattle kept on the farm and their characteristics. **Include only cattle kept by the household**, no matter whether it is owned by the household or by others. To take heart girth measurements, select **one animal of each type**, and use a chest girth tape to measure.

						For animals sampled for measurement		
Cattle ID		Animal type (code a)	Breed (code b)	Age (years)	Number of animals of this type, age and breed	Farmer weight estimate (kg)	Heart girth (cm)	Is body condition 'poor'? (N = 0, Y = 1)*
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

a) Animal type	b) Breeds
1 = Bulls (>3 yrs)	1 = Holstein-Friesian X local
2 = Castrated adult males (oxen>3 yrs)	2 = Shahiwalx local
3 = Immature males (< 3 yrs)	3 = Jersey xlocal
4 = Cows (calved at least once not lactating)	4 = Pabna
5 = Cows (lactating)	5 = Red Chittagong cattle (RCC)
6 = In-calf (cow lactating)	6 = Munshigonj
7 = Female calves (between 8 wks & <1yr)	7 = Indigenous
8 = Male calves (between 8 wks & <1yr)	8 = North Bengal Grey
9 = Heifers (female ≥1 yr, have not calved)	
10 = Female calves (<8 wks)	
11 = Male calves (<8 wks)	
12 = in-calf heifer	

* 'Poor' body condition is indicated by very prominent pin bones with a deep V shape cavity below the tailhead and no fatty tissue under the skin.

2.3 Have any cattle (including calves, heifers, cows or bulls) exited the herd kept on the farm during the past 12 months? No_____ (=0) or Yes _____(=1). **If No, go to 2.4.**

Animal type [use codes from 2.2.a]	Month exited (MM/YY)	Breed [use codes from 2.3.e]	Age at exit (years)	Was it lactating? (N = 0, Y = 1)	How did it exit? (code c)	If died of disease
						What was the disease? (code e)

c) How exited	e) Disease cause of death
1 = Sale (live animals)	0 = I don't know
2 = Barter exchange	1 = Tick-borne disease (eg. East coast fever)
3 = Slaughter for sale	2 = Other vector-borne disease (Trypanosomosis)
4 = Slaughter – household needs	3 = Notifiable diseases (eg. Foot & mouth disease)
5 = Slaughter because sick	4 = Routine management related (foot rot, worms)
6 = Given away (e.g. dowry)	5 = Nutrition diseases and complications (eg. Milk fever)
7 = Stolen	6 = General infections (pneumonia, diarrhea)
8 = Old age/natural death	7 = Skin problems
9 = Died due to disease	8 = Other specify
10 = Died due to injury, accidents	
11 = Died due to poisoning (acaricide, snake bite)	
12 = Other (specify) ______	

2.4 Have any new cattle joined the herd on the farm or were any calves born in the last 12 months?

No_____ (=0) or Yes _____(=1). **If No, go to 3. (If Yes, give individual details on all cattle that were born, purchased or obtained)**

Animal type [use codes from 2.2.a]	Breed [use codes from 2.2.e]	No. of animals	How it entered (code b)	Date of entry (MM/YY)
a) How it entered				
1 = Bought from smallholder farm 2 = Bought from individual trader/broker 3 = Loan from project 4 = Gift from relatives/ others 5 = Obtained as dowry 6 = Birth/born on farm 7 = Barter 8 = Other (specify) ______				

3. Cows, cow milk production and milk sales

In this section **do not include** any information on goat milk or milk of other animals. **Only dairy cows and cow milk** are considered.

3.1 Dairy cow profiles

For each cow kept on the farm fill in each column.

Cattle ID (copy from Section 2.2)	Age at first calving (months)	Number of parity (live and/or still-births)	Currently lactating (=1) or dry (=0)	If dry, date dried (MM/YY)	Date of last calving (DD/MM/YY)	In current or last lactation, * total milk yield per day (morning plus evening) in litres		If this is not the first calving, number of months dry between last lactation and calving date	If this is not the first calving, calving interval before last calving (in months)	Age of calf at weaning (i.e. calf stopped suckling). If weaned, enter age in months, if still suckling enter [STILL]
						Height yield (e.g. peak yield after calving)	Lowest yield since calving			

* If currently lactating, ask for maximum and minimum yield of current lactation; if dry, ask for maximum and minimum yield of previous lactation.

4. Feeding

4.1 Defining the seasons

In your area, which months are considered 'dry season' and which months are considered 'wet season'? (Enumerator: put a tick in the appropriate box for each season. If there are long rains and short rains, both are wet season. Dry seasons are any months between the rainy seasons)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry												
Wet												

4.2 How do you keep your cattle in the dry and the rainy season?

	Rainy season (code a)		Dry season (code a)	
	Hours spent grazing	Hours spent stall fed or tethered in village	Hours spent grazing	Hours spent stall fed or tethered in village
1. Bulls				
2. Castrated adult males (oxen >3 yrs)				
3. Immature males (<3 yrs)				
4. Cows (calved at least once not lactating)				
5. Cows (lactating)				
6. In-calf (cow lactating)				
7. Heifers (female ≥1yr,have not calved)				
8. In-calf heifer				
9. Female calves (between 8 wks & <1yr)				
10. Male calves (between 8 wks & <1yr)				
11. Pre-weaning calves (<8 wks)				

4.3 If grazing or semi-grazing

	Rainy season	Dry season
When grazing, are the cattle tethered? (No = 0, Yes = 1)		
Is the pasture grazed natural pasture (=1) or improved pasture (=2)?		
How much distance to get to where they graze? (km)		

4.4 What fodder and crop residues do you feed to your cattle? (include both grazing and roughages)

a) Main fodder and crop residue fed during the wet season

Feed type (Code a)	Source (grown on farm = 1, purchased = 2)	1 = Fresh or 2 = dry	Any treatment? (Code d)	Cattle type (Code b)	Unit of feed (Code c)	Frequency (code e)	Number of units fed*	Number of months of the year fed	If grown on farm:	If purchased:	
									total area (ha)	Distance transported (km)	How transported (Code f)

b) Main fodder and residue fed during the dry season

Feed type (Code a)	Source (grown on farm = 1, purchased = 2)	1 = Fresh or 2 = dry	Any treatment? (Code d)	Cattle type (Code b)	Unit of feed (Code c)	Frequency (code e)	Number of units fed*	Number of months of the year fed	If grown on farm:	If purchased:	
									Area (ha)	Distance transported (km)	How transported (Code f)

* Considering the two previous columns, for instance if unit is kg and frequency is day, this column should be the number of kg/day fed

a) Feed type	b) Cattle type	c) Unit of feed
1 = Napier bazra 2 = Maize fodder 3 = Sugarcane tops 4 = Sugarcane leaf 5 = Dry rice straw 6 = Tritical green 7 = Baksha 8 = Arial 9 = Chaila 10 = Shama 11 = Water hyacinth 12 = Khasari grass 13 = Matikalai grass 14 = Ipil ipil 15 = Road side grass (mixed) 16 = Natural grassland 17 = German 18 = Para 17 = Banana pseudostem and leaves xx = Other residue (specify)	1 = Calves 2 = Heifers 3 = Lactating females 4 = Non lactating females 5 = Males 6 = Fattened animals	1 = Kg 2 = Hours grazed If the farmers has the information in another unit (for instance, number of bales or baskets), the enumerator should estimate the corresponding weight in kg
d) Treatment	**e) Frequency**	**f) Transport**
0 = No treatment 1 = Turned into hay 2 = Chopped using panga 3 = Hand chopped using chaff cutter 4 = Motorized chopping using a pulveriser 5 = Pit silage without additives 6 = Tube silage without additives 7 = Pit silage with additives (urea, molasses etc.) 8 = Tube silage with additives (urea, molasses etc.) 9 = Grazed 10 = Other, specify	1 = Year 2 = Month 3 = Week 4 = Days 5 = Hours per day	1 = on foot 2 = donkey or donkey cart 3 = bicycle 4 = motorbike 5 = rickshaw 6 = car 7 = small truck (≤1 tonne) 8 = large truck (1–5 tonne)

4.5 Do you feed cattle concentrate feeds, by-products and/or mineral supplements? *No_____ (=0) or Yes _____ (=1)*. If No go to Section 4.7

What is fed? (Code b)	Which animal types are fed with it? (Code a)	How many months of the year do you feed these?	Kg fed per animal per day		Made on-farm (=1) or purchased (=2)?	If purchased	
			Wet season	Dry season		Distance transported (km)	How transported (Code f)

a) Cattle type	b) Feed type		f) transport
1 = Calves 2 = Heifers 3 = Lactating females 4 = Non lactating females 5 = Males 6 = Fattened animals	1 = Sugarcane by product 2 = Coconut by product 3 = Kheshari (Lathyrus) grain 4 = Molasses 5 = Coconut oil cake 6 = Cotton seed cake 7 = Crushed Kheshari 8 = Maize (whole seeds) 9 = Mustard oil cake 10 = Rice meal feed (husks, bran)	11 = Rice polish 12 = Soyabean oil cakes 13 = Til oil cakes 14 = Wheat bran (coarse bran) 15 = Wheat bran (fine bran) 16 = Broken rice 17 = Crushed wheat 18 = Mixed Concentrate 19 = Silage (maize) 20 = Silage (other grass) 21 = Other specify	1 = on foot 2 = bicycle 3 = motorbike 4 = small truck (≤1 tonne) 5 = large truck (1–5 tonne)

5. About cropping on the farm

5.1 Area of fodder crops planted

List areas of land used by the household to grow fodder crops

Fodder type (code a)	Size of the plot (ha)	Total harvest in last 12 months (number of units)	Organic fertilizer used		Inorganic fertilizer used		Harvest		
			Type (code b)	Amount (kg/plot)	Type (code b)	Amount (kg/plot)	Method (by hand = 0, by machine = 1)	Fuel type (code c)	Quantity (l/plot)

a) Fodder crop type		b) Fertilizer type	c) Fuel type
1 = Napier bazra 2 = Maize fodder 6 = Tritical green 7 = Baksha 8 = Arial 9 = Chaila 10 = Shama	12 = Khasari grass 13 = Matikalai grass 14 = Ipil ipil 15 = other (specify)	1 = Cattle manure (slurry) 2 = Cattle manure (wet) 3 = Cattle manure (dry) 4 = Poultry manure 5 = CAN 6 = DAP 7 = TSP 8 = SSP 9 = other (specify)	1 = diesel 2 = electricity 3 = LPG/kerosene 4 = other (specify)

6.1 Manure management

Please tell us what % of cattle manure is used in different ways in the dry and wet seasons (999 if respondent refuses)

	Dry season (enter % for each use)	Wet season (enter % for each use)
Left where deposited on pasture		
Collected and spread on pastures or crops		
Left in the area where cows are kept		
Stored as solid manure (including in combination with bedding material)		
Composted		
Stored as a liquid or slurry		
Stored in open lagoon		
Biodigester		
Burnt for fuel		
Wastage sold		
	Total should be 100%	**Total should be 100%**

6.2 Draft animal utilization

Indicate what tasks your household uses draft animals for and how much they work in the year.

Tasks that use draft animals	Animal type used (code a)	Use own animal (=1) or animal rented or borrowed from others (=2)?	Number of days used in the year	Number of hours working per day
1 = Ox 2 = Donkey 3 = other (specify)				

7. To be answered privately by the enumerator immediately following the interview

1. In your opinion, how did you establish rapport with this respondent [___]

   1 = with ease

   2 = with some persuasion

   3 = with difficulty

   4 = it was impossible

2. Overall, how did the respondent give answers to your questions? [___]

   1 = willingly

   2 = reluctantly

   3 = with persuasion

   4 = it was hard to get answers

3. How often do you think the respondent was telling the truth? [___]

   1 = rarely

   2 = sometimes

   3 = most of the times

   4 = all the time

I certify that I have checked the questionnaire two times to be sure that all the questions have been answered, and that the answers are legible.

Signed: ___________________ Date ___/___/___


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