

CONTEXT 4

MIXED CROP-LIVESTOCK, DRY (RUMINANTS) SYSTEMS



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This brief provides an overview of the Investing in Sustainable Livestock (ISL) Guide and the full application of the accompanying ISL Tool to mixed crop-livestock, dry (ruminants) systems (referred to below as Context 4).

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INTRODUCTION TO THE ISL GUIDE

The online ISL Guide (www.sustainablelivestockguide.org) is an information resource for designing and implementing environmentally sound livestock development projects. The guide has an interactive tool that provides context-specific guidance, suggested activities, and indicators to help livestock projects contribute to environmental sustainability; it also includes references for further investigation.

The ISL Guide is grounded in tested theory and evidence organized in seven principles for sustainability in the livestock sector. The World Bank and the Food and Agriculture Organization of the United Nations (FAO) specifically developed the following principles for the guide:

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

Because the ISL Tool understands “sustainability” in a broad sense, it will eventually comprise elements not only of the environment but also of animal health and welfare, public health, and equity issues such as gender and inclusion. Thus, in due course, the World Bank and FAO will expand the scope of the tool to include guidance for addressing these issues in livestock projects.

STRUCTURE OF THE ISL TOOL

The ISL tool provides guidance for improving the environmental outcomes of livestock projects in the following 6 contexts, which cover the different livestock farming systems found worldwide

- Context 1: Grazing dry - Pastoral (ruminants)
- Context 2: Grazing temperate (ruminants)
- Context 3: Grazing sub-humid (ruminants)
- Context 4: Mixed crop-livestock, dry (ruminants)
- Context 5: Mixed crop-livestock, humid (monogastrics)
- Context 6: Intensive (ruminants and monogastrics)

The guidance provided for each of these contexts is organized according to objectives and interventions that are typically found in livestock investment projects. A broad review of projects funded by the World Bank Group and other Financial Institutions allowed to identify :

- Five broad objectives that livestock sector development commonly seeks to achieve: (i) improved productivity of livestock, (ii) improved market access and development of value chains, (iii) improved input and services delivery, (iv) climate change resilience and emergency response, and (v) strengthened policies, knowledge, and information.
- For each of these five objectives, a series of project interventions typically implemented (e.g. “improve animal health and welfare” for the objective “ improved productivity of livestock”), as well as more specific project activities that might be implemented under each intervention (e.g. “undertake vaccination campaigns”). For each objective, the identified interventions and activities differ according to the context of the project.

For every combination of context and intervention, the ISL Tool provides -specific guidance for improving the environmental outcomes, as well as suggested indicators for project monitoring and evaluation. The guidance integrates the trade-offs that may occur between environmental objectives where relevant and considers compromises among these trade-offs that can lead to submaximal environmental outcomes.

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OVERVIEW OF CONTEXT 4: MIXED CROP-LIVESTOCK, DRY (RUMINANTS) SYSTEMS

Context 4 covers mixed crop-livestock systems found in regions with seasonal rainfall, generally subsistence-oriented, and low productivity. Livestock play an important role by providing a range of goods and services such as food, manure for crop production, draft power, and capital assets.

Description of typical situation

This context describes mixed crop-livestock systems with small (sheep and goats) and/or large (cattle and buffalo) ruminants, as well as horses and donkeys, on smallholder farms that are mostly found in regions with seasonal rainfall, i.e., with dry and rainy seasons. Examples are found in Sub-Saharan Africa (Ethiopia, Kenya), South and East Asia, and Latin America (Andean region). The precipitation in the rainy season, in combination with an adequate level of soil fertility, typically supports sufficient food production to sustain the needs of farm households. Because of the relatively favorable conditions, human population and farm density are often relatively high, setting specific constraints for farm development. Farms are small, labor is predominantly provided by household members, land for farm extension is limited, and food crop production for household consumption is traditionally the major farming objective. Farms tend to become smaller over time, by inheritance to the next generation, though a recent study showed that pressure on farmland was slightly decreasing in Tanzania.

Livestock is important on such farms to support crop production through supply manure, providing traction for plowing, tilling and transport, and being a capital stock. The quantity of meat and milk sold is limited, but milk sales, even of small quantities, are important since they provide daily cash income. Though subsistence, i.e., support of the livelihood of the farm household is the traditional objective, these farming systems can be increasingly market-oriented. This often takes place in the vicinity of urban locations, where market-oriented production is often associated with specialization and intensification of farming systems. Where such specialization and intensification take place, crossbreeding of local breeds with exotic ones may occur, but, in general, crossbreeding is limited.

Globally, in many regions with mixed crop-livestock systems, the market orientation of farming has just started, and this process is constrained by limited access to the market for inputs and outputs which can be caused by remoteness and/or suboptimal infrastructure. However, where conditions are favorable, geographical clusters of smallholder farming have turned almost fully to market-oriented production, driven by market demand, infrastructure development, input and service supply, marketing channels, extension, and education. Such clusters are often found in peri-urban areas but not necessarily. The integration between crops and livestock may become less prominent or even absent in such clusters, and production tends to intensify. As animal productivity rises and as farm rearing focuses on the delivery of edible products (nonfood production functions of livestock are replaced by alternatives, such as mechanization, banking, and insurances), the number of livestock with nonfood production functions decreases. Some of the principles relevant to smallholder systems will be less important in such market-oriented systems, where the principles applying to the intensive production systems may become more relevant.

Common environmental issues

The greenhouse gas (GHG) emission intensity of meat and dairy production in mixed crop-livestock systems tends to be high, due to the low productivity at animal and herd levels, and poor quality of the feed ration. GHG emissions are mainly due to enteric fermentation; land use change and fossil fuel emissions are generally low. (Principles 2 and 3)

Communal grazing lands in regions with smallholder mixed crop livestock farming are often at risk of ecosystem degradation due to overstocking, especially in times of prolonged droughts. Grassland degradation is observed as vegetation cover is altered (reduced or even entirely eliminated, or evolving from grass to shrub), and signs of soil erosion appear. Such degradation reduces production potential, but also biodiversity, the amount of carbon stored in soils, and replenishment of aquifers. Communal grazing lands in regions with smallholder mixed crop livestock farming are also being converted into cropland, contributing to GHG emissions and biodiversity loss. (Principles 2 and 5)

Land shortage and increasing population pressure on land result in diminishing farm sizes, forcing farmers to intensify their land use. For example, in Ethiopia, cultivation of Khat and market-oriented dairy production are land use activities generating high returns. The derived income is used to safeguard household food security. In the absence of balanced fertilizer application, intensification can cause soil nutrient mining, which leads

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to a decrease in soil quality and eventually degradation (Principles 4 and 5). Low productivity, increasing pressures on land, increasing consumer demands for food and water, climate change, and environmental degradation are all drivers of aggravating water scarcity in these types of dry to temperate systems (Principles 3 and 4).

ISL TOOL GUIDANCE: CONTEXT 4: MIXED CROP-LIVESTOCK, DRY (RUMINANTS) SYSTEMS

The section below includes guidance for improving the environmental outcomes of five broad objectives that livestock development projects commonly seek to achieve. Typical interventions and specific activities are suggested under each objective, as well as guidance and indicators for improving environmental outcomes and monitoring and evaluating progress toward these outcomes. The guidance also references relevant Principles of Investment in Sustainable Livestock (Principles 1 – 7 or “P1” through “P7”) for further reading.

OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

INTERVENTION: EXPAND FEED RESOURCES AND BALANCE FEED RATIONS

ACTIVITIES

- Develop on-farm feed resources.
- Source (ingredients for) concentrate feed.
- Improve feed ration balancing.
- Extend stall-feeding.

GUIDANCE

- P3 Adequate feed ration balancing already contributes to reducing greenhouse gas (GHG) intensities by improving the efficiency of the digestive process and the productivity of animals. [Feedipedia](#).
- P4, P7 Raise awareness among stakeholders and provide technical assistance, financing options, and knowledge-sharing mechanisms for sustainable feed production in mixed crop-livestock systems. Assess local availability of high-quality roughages and of concentrate feed ingredients, as well as potential impacts of improving and/or increasing feed production on water and land resources. [FAO 2012a](#), [FAO 2012b](#), [FAO 2014a](#). Consider the effect of this intervention on GHG emissions and the resilience of the system to deal with short- and long-term perturbations, such as droughts, floods, warfare, and climate change. Adopt feed budgeting approaches and feed conservation to ensure a stable feed supply throughout each season.
- P4, P7 Source sustainably any imported feed, considering the fossil fuel emissions generated by feed production and transport, as well as the use of heavy metals and other environmental impacts on land and water resources. Include the environmental impacts associated with imported feed in project environmental impact assessments. [LEAP 2016b](#). Explore the feasibility of a livestock feed certification and labeling scheme.
- P3 Improved feed availability and quality may not only increase animal productivity but also incentivize herd growth. Evaluate the potential implications of any foreseen increase in animal numbers on water and land resources. [LEAP 2018a](#), [LEAP 2016f](#).

INDICATORS

Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

- Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number. This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental

OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

Irrigation water used in feed production — Cubic meter per unit of feed. This indicator measures the amount of irrigation water used for feed production (e.g., expressed in cubic meter per unit of dry matter or cubic meter per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains.](#)

Pesticides used in feed production — Amount per unit of feed. This indicator measures the amount of pesticides used for feed production (e.g., expressed per unit of dry matter or per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains.](#)

Competition with food production — Share. This indicator reports the change in the portion of feed consumed by livestock in the project that is not directly human-edible or is produced on land not suited for crop production.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: IMPROVE ANIMAL HEALTH AND WELFARE

ACTIVITIES

- Undertake vaccination campaigns.
- Improve disease prevention and control.
- Avoid antimicrobial resistance (AMR).
- Improve animal welfare.

GUIDANCE

- P3 Animal health and welfare improvements already contribute to reducing GHG emissions and pressure on natural resources. [FAO 2011](#), [FAWC 2009](#), [FAO 2013b](#). Reduced morbidity, mortality, and stress increase productivity and may diminish incentives to increase the herd size to compensate for animal losses.
- P7 Raise awareness among producers and health service providers about the environmental benefits of improving animal health and welfare.
- P3 Animal productivity improvements may incentivize herd growth and increase overall demand for feed. Evaluate the potential implications of any foreseen increase in animal numbers on water and land resources. [LEAP 2018a](#), [LEAP 2016f](#).

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Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

→ Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

→ Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: IMPROVE ANIMAL GENETICS

ACTIVITIES

- Import animals/animal semen with improved genetics for cross-breeding.
- Select for improved genetics within the existing herd.
- Develop artificial insemination.

GUIDANCE

- P3 Improving animal genetics already contributes to sustainability by avoiding the GHG emissions and other environmental impacts associated with less-productive animals and the presence of nonproductive animals in the herd, i.e., the breeding overhead. [FAO 2010](#), [ILRI 2017b](#), [IAEA 2007](#).
- P3 Consider the effect of this intervention on the resilience of animals and the system as a whole to deal with short- and long-term perturbations, such as droughts, floods, warfare, and climate change.
- P4 Cross-breeding with high-productivity breeds may require more and higher-quality feeds, potentially increasing the environmental impacts of feed production. Ensure that any increased demand for higher-quality feed is met sustainably. [LEAP 2016b](#).

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OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

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Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [IPCC 2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

- Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

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OBJECTIVE 2: IMPROVE MARKET ACCESS AND DEVELOP VALUE CHAINS

INTERVENTION: DEVELOP PRODUCER ORGANIZATIONS AND PRODUCTIVE ALLIANCES

ACTIVITIES

- Establish and/or build the capacity of new/existing producer organizations.
- Provide financing for subprojects under productive alliances.

GUIDANCE

- P7 Raise awareness among smallholders, increase capacity through the development of cooperatives or other types of organizations, and develop educational programs about sustainability issues related to livestock production.
- P7 Provide smallholders or organizations with technical assistance to develop environmental programs and gain access to related funds (e.g., for ecosystem management or renewable energy development).
- P7 Include environmental criteria in subproject selection (e.g., presence of waste management plan; absence of activities leading to deforestation or natural habitat loss). Establish a line of credit for activities with additional environmental benefits (e.g., renewable energy generation; maintenance of live fences and trees in open pasture).

INDICATORS

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: CONSTRUCT/UPGRADE POST-FARM-GATE FACILITIES

ACTIVITIES

- Improve transport and storage capacity.
- Improve/build processing plants, slaughterhouses, dairy processing, and wet markets.

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OBJECTIVE 2: IMPROVE MARKET ACCESS AND DEVELOP VALUE CHAINS

GUIDANCE

- P6 Improve access to energy-efficient technology for storage, processing, transportation, and refrigeration equipment to minimize loss and waste as well as improve food safety. [IEE 2007](#), [LEAP 2016c](#), [LEAP 2016d](#).
- P6 Integrate energy-efficient machinery and equipment into technical design and financial analysis. [IEE 2007](#).
- P6 Support investment in renewable energy production: technical assistance, subsidies (e.g., matching grants, soft loans) and energy pricing.
- P5 Develop comprehensive waste management plans: waste stream minimization, waste collection, storage, processing, and discharge/recycling. [SNV Biogas](#), [GMI 2013](#), [Teenstra et al. 2014](#), [CCAC 2015](#), [FAO 2013a](#).

INDICATORS

Processing plants and markets that have adopted a waste management plan — Number or percentage. This indicator measures the number of slaughterhouses, dairies and other processing units, animal gathering points, and markets that have received project support to develop and implement liquid and solid waste management plans. At a minimum, plans should address the reduction of waste streams, waste collection, storage, and treatment.

→ Quantification may be reported annually using project advancement reports.

Energy-saving and renewable energy production devices and plans supported by the project — Number. This indicator measures the number of energy-saving and renewable energy production devices installed by the project, either directly or indirectly (through policies and energy pricing). Energy-saving investments may include systems for energy recovery in milk cooling; upgraded thermic insulation; efficient burners; and energy use efficiency plans at the company level. Renewable energy production includes solar panels, biodigesters, solar panels, wind power, and micro-hydropower.

→ Quantification may be undertaken annually or at project start, mid-term, and terminal evaluation, using dedicated surveys.

Reduction of pollution discharge into waterways — Percentage. This indicator measures the reduction in nitrate, phosphates, and BOD and E. Coli discharge (a) at the end of the pipe of the individual farms or community and (b) at critical downstream locations to be defined in the monitoring and evaluation (M&E) plan.

→ Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

INTERVENTION: CREATE OPPORTUNITIES ALONG THE VALUE CHAIN

ACTIVITIES

- Develop a market demand for the products produced under the project.
- ^a Establish and promote a segmented livestock market.

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OBJECTIVE 2: IMPROVE MARKET ACCESS AND DEVELOP VALUE CHAINS

GUIDANCE

- P7 Mixed-crop livestock production systems can be a strong market entry point for sustainably produced products. Establish and promote labeling and/or certification schemes for niche products that are environmentally sustainable.
- P7 Raise awareness among consumers about the sustainability of livestock products produced under the project and about their relative nutritional values.

INDICATORS

Amount of animal source food in diet — Grams per capita per day — variation in percentage. This indicator measures the increase or decrease in animal source food in human diets, within a beneficiary population (kilogram intake per capita per year). It distinguishes populations having low or high baseline consumption, for instance, by using national dietary recommendations as a reference.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

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OBJECTIVE 3: IMPROVE INPUT AND SERVICES DELIVERY

INTERVENTION: DEVELOP PUBLIC AND PRIVATE EXTENSION SERVICES

ACTIVITIES

- Provide extension agents with training and capacity building.
- Develop extension manuals and curricula.

GUIDANCE

- P7 Include environmental issues and options in training programs and manuals. Embed environmental management in production practices.
- P7 Train extension agents to collect data on environmental performance along the supply chain.
- P7 Build capacity through knowledge-sharing mechanisms, for instance, between producers and among producers and producer associations.

INDICATORS

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: IMPROVE PUBLIC AND PRIVATE ANIMAL HEALTH SERVICES

ACTIVITIES

- Provide veterinarians and animal health workers with training and capacity building.
- Develop veterinary and animal health manuals and curricula.

GUIDANCE

- P7 Raise awareness among veterinarians and animal health workers about environmental issues and their links to animal health and welfare.
- P7 Introduce links to natural resource management issues and options in animal health manuals and curricula.

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OBJECTIVE 3: IMPROVE INPUT AND SERVICES DELIVERY

INDICATORS

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: STRENGTHEN PROVISION OF INPUT AND SERVICES

ACTIVITIES

- Provide private service and input providers with training and seed financing.
- Foster the development of new services where gaps exist.
- Provide financing options for new and innovative models for service delivery.

GUIDANCE

P4, P5 Assess the demand and provide seed financing for services that contribute to sustainability: green economy (renewable P7 energy installation construction and maintenance). [IEE 2007](#), [SNV Biogas](#).

P7 Develop markets for sustainable inputs, such as sustainably sourced feed, organic fertilizers, and organic pesticides.

P7 Provide financing options or selection criteria for piloting innovative approaches to service delivery that contribute to environmental sustainability.

INDICATORS

Energy-saving and renewable energy production devices and plans supported by the project — Number. This indicator measures the number of energy-saving and renewable energy production devices installed by the project, either directly or indirectly (through policies and energy pricing). Energy-saving investments may include systems for energy recovery in milk cooling; upgraded thermic insulation; efficient burners; and energy use efficiency plans at the company level. Renewable energy production includes solar panels, biodigesters, solar panels, wind power, and micro-hydropower.

- Quantification may be undertaken annually or at project start, mid-term, and terminal evaluation, using dedicated surveys.

Proportion of surplus nutrients sold for use as organic fertilizer. For those farms with nutrient surpluses that are greater than 10-20%, this indicator measures the proportion of the surplus nutrients that is sold for use as organic fertilizer. This indicator is quantified by calculating the total surplus, the amount of that surplus that is applied to crop production on the farm, and the proportion of the remaining surplus that is sold for use as organic fertilizer.

OBJECTIVE 3: IMPROVE INPUT AND SERVICES DELIVERY

- Quantification may be reported annually based on the production unit management data or surveys. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number. This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

Irrigation water used in feed production — Cubic meter per unit of feed. This indicator measures the amount of irrigation water used for feed production (e.g., expressed in cubic meter per unit of dry matter or cubic meter per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains.](#)

Pesticides used in feed production — Amount per unit of feed. This indicator measures the amount of pesticides used for feed production (e.g., expressed per unit of dry matter or per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains.](#)

Competition with food production — Share. This indicator reports the change in the portion of feed consumed by livestock in the project that is not directly human-edible or is produced on land not suited for crop production.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys

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OBJECTIVE 4: CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

INTERVENTION: IMPROVE MANURE, NUTRIENTS, AND WASTE MANAGEMENT

ACTIVITIES

- Improve integrated manure management on farms.
- Develop territorial approaches to improving the nutrient balance.

GUIDANCE

- P5 Stall-feeding can lead to the concentration of manure in the production unit. Ensure that manure is collected, safely stored (concrete floor and roof), and processed (e.g. composted, used in anaerobic digestion, dried and converted into organic fertilizer), or applied to crop and pasture land, with the timing and dosing being in line with crop/grass requirements. [Teenstra et al. 2014](#), [CCAC 2015](#), [FAO 2013a](#), [Chambers et al. 2001a](#), [Chambers et al. 2001c](#).
- P7 Provide technical assistance for the valuation of manure as an organic fertilizer. [Chambers et al. 2001d](#), [FAO 2015b](#).

INDICATORS

Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains](#) and in [large ruminant supply chains](#).

- ➔ Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

Processing plants and markets that have adopted a waste management plan — Number or percentage. This indicator measures the number of slaughterhouses, dairies and other processing units, animal gathering points, and markets that have received project support to develop and implement liquid and solid waste management plans. At a minimum, plans should address the reduction of waste streams, waste collection, storage, and treatment.

- ➔ Quantification may be reported annually using project advancement reports.

Energy-saving and renewable energy production devices and plans supported by the project — Number. This indicator measures the number of energy-saving and renewable energy production devices installed by the project, either directly or indirectly (through policies and energy pricing). Energy-saving investments may include systems for energy recovery in milk cooling; upgraded thermic insulation; efficient burners; and energy use efficiency plans at the company level. Renewable energy production includes solar panels, biogas, solar panels, wind power, and micro-hydropower.

- ➔ Quantification may be undertaken annually or at project start, mid-term, and terminal evaluation, using dedicated surveys.

OBJECTIVE 4: CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

Livestock production units that have adopted a manure management plan — Number. This indicator measures the number of production units that have received project support to develop and implement manure management plans. Improved manure management practices and plans should be defined in the project document and address, at a minimum, manure collection, storage, and the recycling schedule. Manure processing and recording of manure transfer may also be included, if relevant.

→ Quantification may be undertaken annually, using project advancement reports.

Proportion of production units for which nutrient flows are balanced — Percentage. This indicator measures simple nitrogen and phosphorus balances at the production unit level, as the difference between inputs (e.g., fertilizer, feed) and outputs (e.g., animal and crop products, manure exports). Nutrient flows are considered when the difference between inputs and outputs does not exceed 10-20%.

→ Quantification may be reported annually based on the production unit management data or surveys. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

Proportion of surplus nutrients sold for use as organic fertilizer. For those farms with nutrient surpluses that are greater than 10-20%, this indicator measures the proportion of the surplus nutrients that is sold for use as organic fertilizer. This indicator is quantified by calculating the total surplus, the amount of that surplus that is applied to crop production on the farm, and the proportion of the remaining surplus that is sold for use as organic fertilizer.

→ Quantification may be reported annually based on the production unit management data or surveys. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

Reduction of manure and waste discharge — Percentage. This indicator measures the reduction percentage of production units that discharge waste, manure, and slurry into waterways or unmanaged/unlined lagoons.

→ Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

Reduction of pollution discharge into waterways — Percentage. This indicator measures the reduction in nitrate, phosphates, and BOD and E. Coli discharge (a) at the end of the pipe of the individual farms or community and (b) at critical downstream locations to be defined in the monitoring and evaluation (M&E) plan.

→ Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

INTERVENTION: DEVELOP EARLY WARNING INFORMATION SYSTEMS AND FEED BUDGETING

ACTIVITIES

- Strengthen early warning systems and communication to areas with mixed crop-livestock systems.
- Develop industrywide crisis response plans.
- Develop seasonal assessments to forecast potential crises.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5

OBJECTIVE 4: CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

GUIDANCE

- P7 Harmonize early warning information systems with information systems on livestock, climate, and weather. Harmonizing livestock, climate, weather, and early warning information systems can improve food system resilience by enabling destocking, redistribution, or other actions to avoid loss in livestock value in anticipation of crises.
- P7 Embed basic environmental management practices in training and capacity-building programs on crisis response. [LEGS](#).

INDICATORS

Contingency fund for livestock emergencies created and operational — Yes/no. This indicator measures the creation and funding of a contingency fund for livestock emergencies related to drought, disease, and other hazards.

- Quantification may be reported annually using project advancement reports.

INTERVENTION: DEVELOP RISK MANAGEMENT PROGRAMS AND PRODUCTS

ACTIVITIES

- Develop livestock insurance and credit schemes.
- Establish an emergency contingency fund.

GUIDANCE

- P3 In risk management strategies, include incentives to control the herd size and de-incentivize keeping large herds for risk mitigation, where appropriate. [LEGS](#), [FAO 2016](#).

INDICATORS

Contingency fund for livestock emergencies created and operational — Yes/no. This indicator measures the creation and funding of a contingency fund for livestock emergencies related to drought, disease, and other hazards.

- Quantification may be reported annually using project advancement reports.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5

OBJECTIVE 5: STRENGTHEN POLICIES, KNOWLEDGE, AND INFORMATION

INTERVENTION: DEVELOP AND HARMONIZE LIVESTOCK POLICIES, PLANS, REGULATIONS, AND PROGRAMS

ACTIVITIES

- Introduce new policies and regulations or update current ones.
- Develop a national livestock master plan.

GUIDANCE

- P7 Introduce programs directly targeted at achieving environmental benefits in livestock production (e.g., payments for environmental services [IIED 2013](#), carbon offsets, linking livestock production to nationally determined contributions under the Paris Agreement). Make provision for targeting the areas and type of producers where progress toward environmental sustainability can be established most cost-effectively. Develop timelines for the progressive introduction of environmental policies. [FAO 2017a](#).
- P7 Ensure that natural resource management, pollution, and climate change are adequately addressed in the sector's policies and strategies; ensure resources are available for adequate expertise during policy formulation.
- P7 Include regulations to ensure consideration of natural resources in the zoning of livestock production. [LEAP 2016a](#).

INTERVENTION: DEVELOP LIVESTOCK INFORMATION SYSTEMS

ACTIVITIES

- Develop animal identification and performance recording.
- Include livestock data in the agriculture census.
- Develop a database on livestock production at the central level.

GUIDANCE

- P7 Include data on environmental performance in livestock information systems (e.g., GHG emissions, manure management practices, water use, nutrient balances).
- P7 Include training and resources for the collection of census data that can enable environmental performance assessment.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5

OBJECTIVE 5: STRENGTHEN POLICIES, KNOWLEDGE, AND INFORMATION

INTERVENTION: IMPROVE CAPACITIES AT CENTRAL AND LOCAL GOVERNMENT LEVELS

ACTIVITIES

- Assess and fill capacity gaps in relevant government ministries.

GUIDANCE

- P7 Support the establishment of a livestock and environment unit within the ministry of agriculture/livestock. Provide technical assistance and capacity building for developing an environmental planning and monitoring mechanism for livestock production. [WB 2009](#).
- P7 Provide relevant government ministries (e.g. agriculture, livestock, water, environment, rural development, finance, energy) with capacity building on livestock and environment issues.

INDICATORS

Environment (or natural resource) management unit created within the ministry (department) of livestock — Yes/No. This indicator measures the creation, staffing, and funding of a unit dedicated to environmental management. Its functions may include environmental monitoring, assessments, awareness raising, capacity development among public servants and private sector, administration of environmental funds, and development of policies and regulations.

- Quantification may be reported annually using project advancement reports.

INTERVENTION: ESTABLISH RESEARCH GRANTS AND EDUCATIONAL PROGRAMS

ACTIVITIES

- Provide financing options for research and education in livestock development issues

GUIDANCE

- P7 Include calls for science and policy research proposals on, for example, natural resource management, climate-smart agriculture, or indicators and policies for environmental sustainability.
- P7 In local universities and professional schools, develop educational programs on livestock and the environment.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5