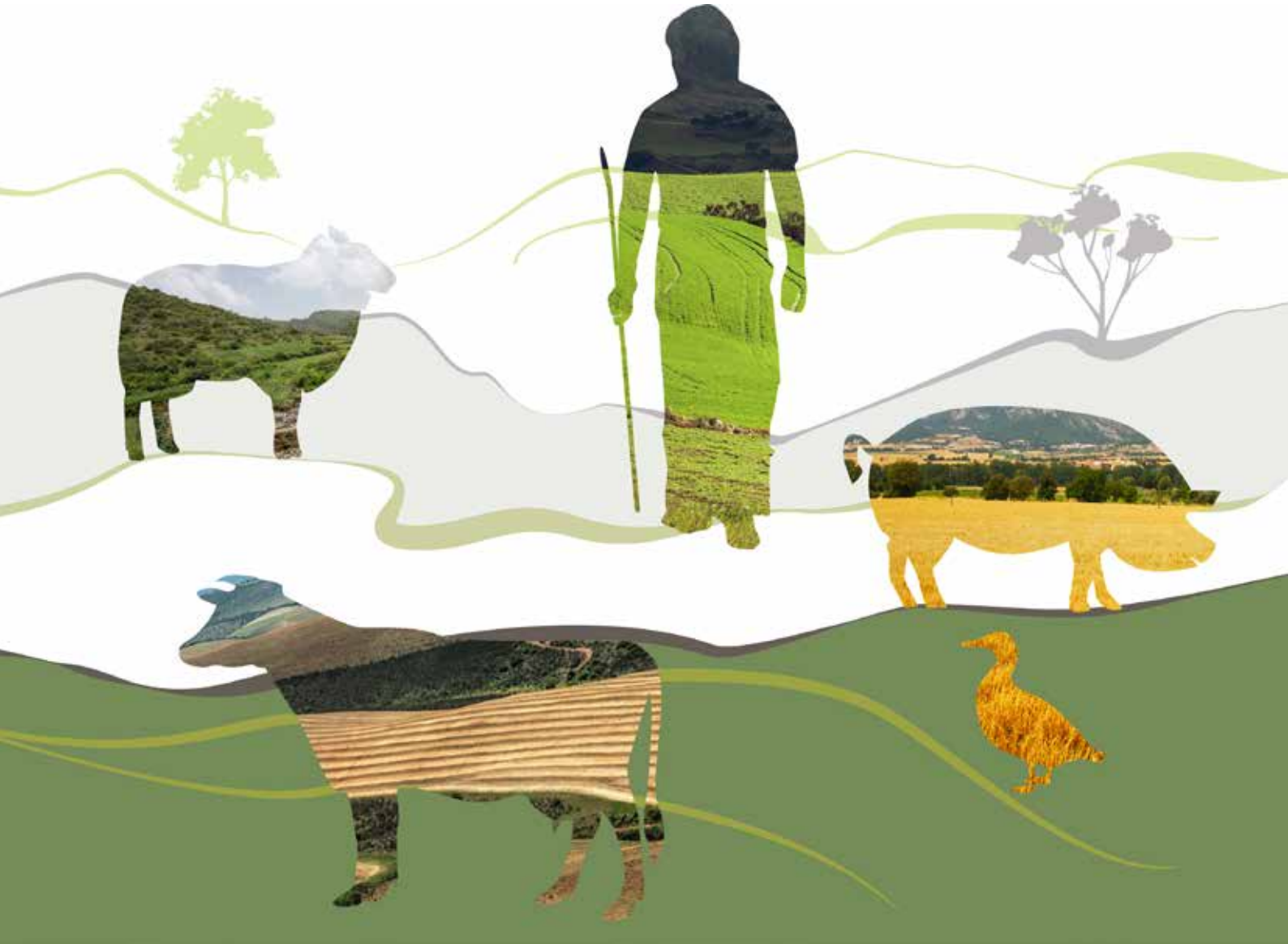
Food and Agriculture Organization of the United Nations

Livestock and agroecology

How they can support the transition towards sustainable food and agriculture



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Introduction

Livestock are found in all regions of the world and supply a wide range of products and services such as meat, milk, eggs, fibre, hides and skins, natural fertilizers, fuel, transport and drought power. They are kept by more than half of rural households and are essential to livelihoods, nutrition and food security. If managed sustainably, they can contribute to important ecosystem functions such as nutrient cycling, soil carbon sequestration and the conservation of agricultural landscapes. They can also improve livelihoods and incomes.

However, the rapid development of the livestock sector in response to growing demand has given rise to a number of risks. Most of this development has taken place in large-scale and intensive systems, with relatively little contribution from small-scale producers or pastoralists. Intensive systems account for about 60 percent of global pork or chicken meat, although they still provide less than 15 percent of beef or milk production. Concerns are also growing over the impact of the livestock sector on the climate and the environment, the role of livestock in global food security and nutrition, as well as in sustainable and healthy diets, animal health and particularly the impact of zoonotic diseases on public health, and animal welfare.

Many means of addressing these risks involve optimizing interactions between animals, plants, humans and the environment and hence are relevant to agroecology, an approach based on applying ecological concepts and principles to agriculture while taking into consideration the social aspects that need to be addressed for sustainable and fair food systems. From pastoralists to small-scale crop-livestock farmers, many livestock keepers already practice agroecology. But the transition will be more challenging for some production systems than others.

This brief reviews opportunities and challenges related to livestock's potential to contribute to agroecological transition, focusing on four main themes, which rely on different elements of agroecology: supporting better livelihoods and creating added value; conserving and using diversity; recycling for better efficiency and finally climate change mitigation and adaptation. It presents recommendations for a better inclusion of livestock in international efforts to transition to sustainable food and agriculture through upscaling and wider adoption of agroecology.

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Summary: key opportunities for livestock to contribute to the agroecological transition

- Livestock are found in all agroecosystems and include a diverse range of species and breeds raised in a variety of production systems.
- Livestock play an important role in enhancing food security and nutrition of the public at large and the rural and urban poor in particular by providing access to nutrient dense food (meat, milk and eggs)
- Livestock are key to the livelihoods of small-scale farmers, particularly women, providing them with income, capital, fertilizer, fuel, draught power, fibres and hides.
- Agricultural productivity, income and resilience can be increased by integrating livestock with other production system components such as trees and crop plants.
- By eating fibrous feeds (e.g. grass and straw) and waste (e.g. swill), livestock make use of biomass that humans cannot eat and increase natural resource use efficiency.
- Animal mobility within and between agroecosystems and landscapes transfers nutrients, biomass and water in the form of animal manure, and moves people's assets in times of disasters such as floods or drought.
- Manure is rich in nutrients and organic matter, which are key to the physical, chemical and biological properties of healthy soils
- Good livestock management practices increase plant biodiversity in grasslands, which in turn enhances productivity, resilience, and other ecosystem services
- Livestock are part of climate solutions, through reducing enteric methane emissions and deploying diverse livestock resources to increase resilience on farm.

1

Supporting better livelihoods and creating added value

Challenges

- Concentration/industrialization of livestock production excludes small holders and pastoralists from participating in the growth of the sector
- Youth unemployment can be significant, particularly in pastoralist systems

Opportunities

The livestock sector currently accounts for about 40 percent of value addition in global agriculture, reaching sometimes more than 80 percent like in Mauritania and New Zealand. Five of the ten biggest agricultural commodities in value terms are animal products, with milk occupying first position. Animal products are mostly consumed locally, with less than 15 percent of global meat, milk and eggs production being traded internationally.

Of the 770 million people surviving on less than USD 1.90 per day, about half depend directly on livestock for their livelihoods. Livestock are owned by more than half of the world's rural households; for example, 78 percent in Zambia, 82 percent in Viet Nam and 61 percent in Panama. A wide variety of products, ranging from milk, meat and eggs to fibres, feathers, hides and skins can be sold by smallholders and pastoralists to generate cash. In Africa for example, rural family poultry accounts for about 80 percent of the total flock and small-scale family poultry generates about 35 percent of household income in the Niger Delta. The **diversity** of animal products and their relative short conservation periods call for local markets and short value chains.

The value that animals add to agroecosystems goes beyond their direct products. They are also flexible assets that can be sold in times of crisis or moved to escape disasters or local social instabilities. In mixed systems, livestock also increase total farm and land productivity by providing draught power and fertilizer and by converting crop residues into valuable protein. In the pastoralist Sahel, donkeys very often accompany herders on their transhumant migrations and provide their main vehicle/mean of transporting water from boreholes to camps.

Employment in livestock agri-food systems, for example in dairy and meat processing operations, stimulates demand for goods and services, and promotes economic transformation by contributing to human and financial capital that serves the development of other sectors of the economy. They often contribute to the **circular economy**.

Policies and investments are needed to support market access for pastoralists and small livestock keepers and to develop inclusive value chains. Securing livestock keepers' access to resources, including land, is also key to poverty reduction and food security, especially for women.

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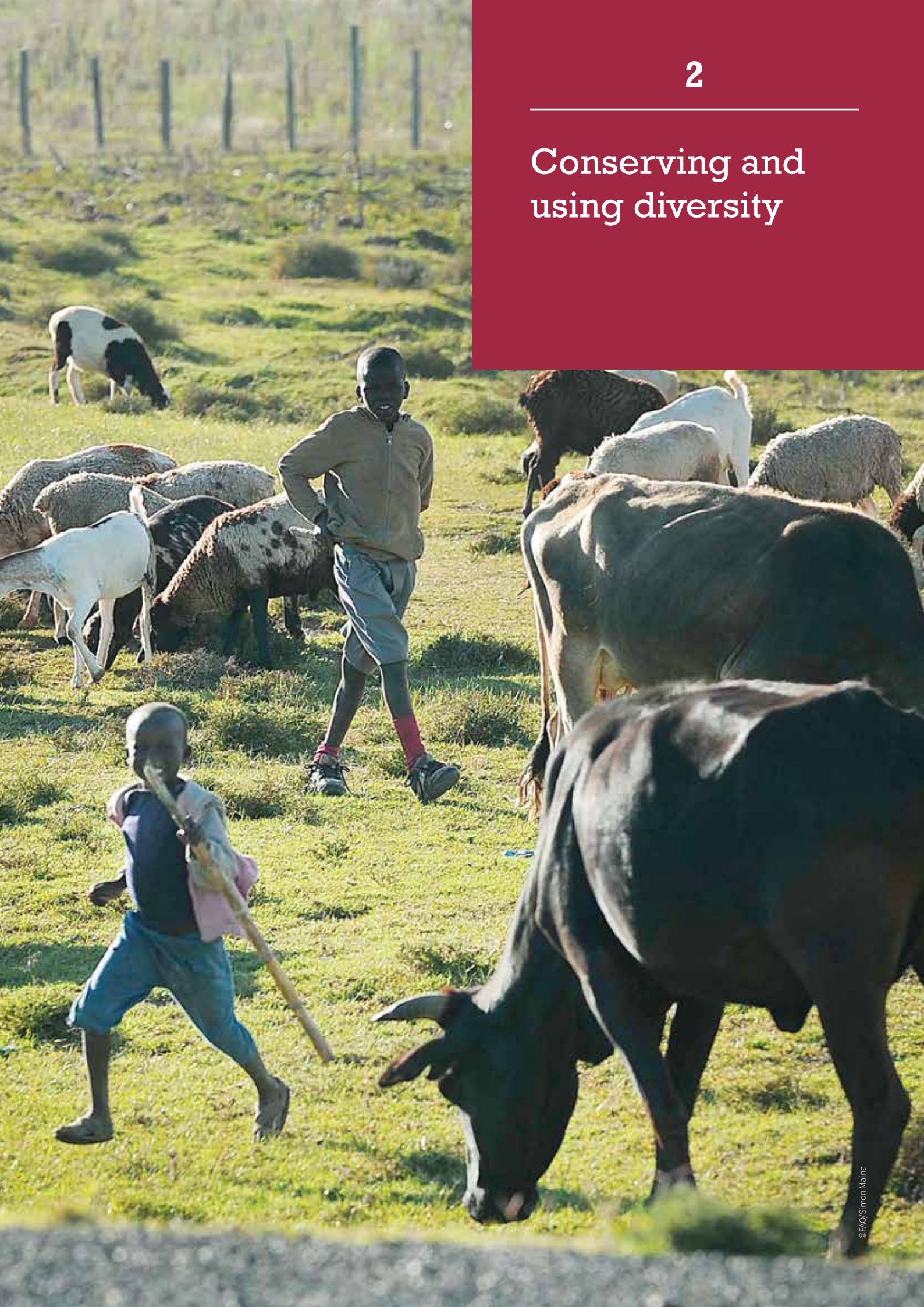
Conserving and using diversity



Challenges

- Recent development of the livestock sector has resulted in greater specialisation and concentration of production, reducing the diversity of production systems
- Urbanisation, rising incomes and changing lifestyles are driving growth in demand for standardized products at low prices
- Intensification and specialisation tend to rely on a limited number of high-producing breeds
- Intensification is associated with greater use of feed crops and improved grasslands which host less biodiversity
- Intensification causes the emergence and transmission of pathogens to occur at greater frequency and speed.

Opportunities

Farmers in mixed crop-livestock systems produce about half of the world's food. They farm in a very diverse range of environments and rely on a variety of production systems, often mixing species, crop varieties and breeds. Livestock include about 40 domesticated species and 9,000 breeds- products of natural selection and human-controlled selection and cross-breeding. The **diversity** of livestock species and breeds and their specific adaptations is the underlying reason why humans can produce food in all types of agroecosystems, including arid areas, steppes, tropics or mountainous peaks.

In all agroecosystems, locally adapted livestock breeds have characteristics that help them cope with local feed resources, climates, elevations, practices (e.g. mobility), parasites and diseases. This is key to **resilience**. Such breeds also make significant contributions to **cultural identity** and traditional knowledge and practices. Combining livestock species that have complementary grazing behaviour can increase overall biomass harvesting and productivity, while reducing health risks related to animal parasitism.

Genetic improvement programmes focus on a limited number of breeds and for a long time concentrated on production traits leading to a certain level of standardization. Traits such as robustness, **efficiency** and adaptability are difficult to translate into measurable selection criteria. In recent years, however, a number of breeding traits relevant to agroecology have been targeted, including reproductive capacities, functional longevity, and health and behavioural traits. Efforts should focus on the co-creation of knowledge and on how farmers and researchers can work together to select the best breeds for particular circumstances. As opposed to centralized national breeding schemes, community based breeding programs can help improving locally adapted genetic resources.

Biodiversity usually decreases along a gradient of land use intensity. Extensively managed, semi-natural grasslands support a wide **diversity** of plant species and provide a high-quality habitat for many species of insects, bird and mammals. In many regions, biodiversity levels in semi-natural grasslands are comparable to those in forests. Grassland intensification and monoculture of feed crops result in lower species richness. However, some production systems, such as crop-livestock systems that rely on a variety of feed and forages, trees, edges and riverbanks, can create mosaic landscapes that include a range of habitats and supply many ecosystem services.

The rapid development of specialised and intensive livestock production is a threat to the conservation of animal genetic diversity and contributes to other risks and concerns, including the overuse of antimicrobial medicines, public and animal health hazards, animal welfare vulnerabilities, soil erosion and pollution. Agroecological transition is a real challenge for these systems.

Conserving the **diversity** of production systems, species and breeds is essential to improve food security and increase **resilience**. Agricultural producers who rely on different sources of income, including a variety of crops and animals, are less vulnerable in case of droughts, floods or market shocks. They often generate a variety of products adapted to local **cultural values and food traditions**. Specific markets for such products – some of which may become more popular with consumers as incomes rise – provide an opportunity to add value and improve livelihoods, and to conserve animal genetic resources by keeping them in profitable use.

Case study 1 Pastoralism

Pastoralism is based on strong interactions between animals, humans and their environment. In arid and sub-arid environments where no crops can grow, pastoralists use heterogeneous, highly seasonal and scarce resources to produce economic, ecological and social services. To do so, they rely on diverse species and locally adapted breeds, and on multiple forms of mobility (seasonal, commercial, labour) at scales ranging from local to transboundary. Their land-use practices involve the use of shared resources based on bundles of rights and customary land-tenure governance arrangements that have evolved along with infrastructure such as wells, dams and roads.

Extensive livestock production, such as pastoralism, requires alternative indicators of performance: while productivity per hectare is usually low, protein output per input of dry matter inedible for humans is high. Pastoralist production systems make a net positive contribution to global protein balance.

Pastoralist systems are now facing a number of challenges as the traditional balance between animals, people and the environment is threatened by constraints on mobility resulting from drivers such as population growth, globalization, climate change, conflicts over land use, inappropriate legislation and political instability.

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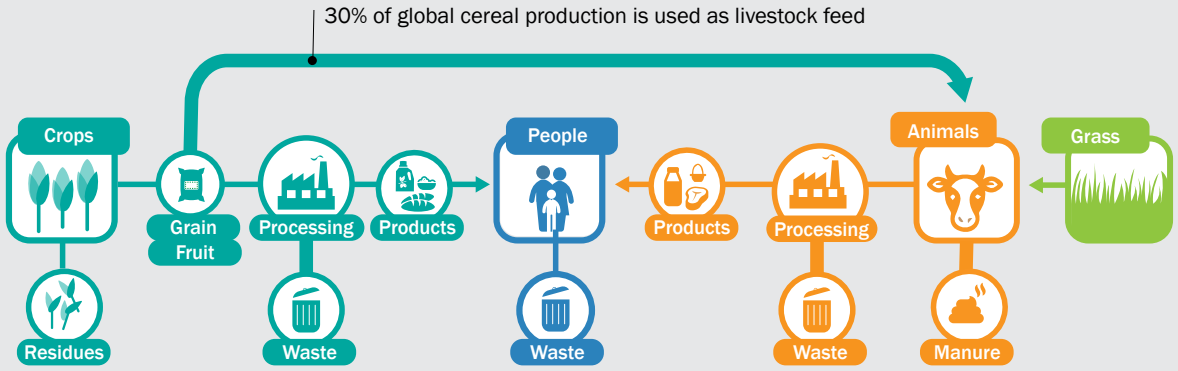
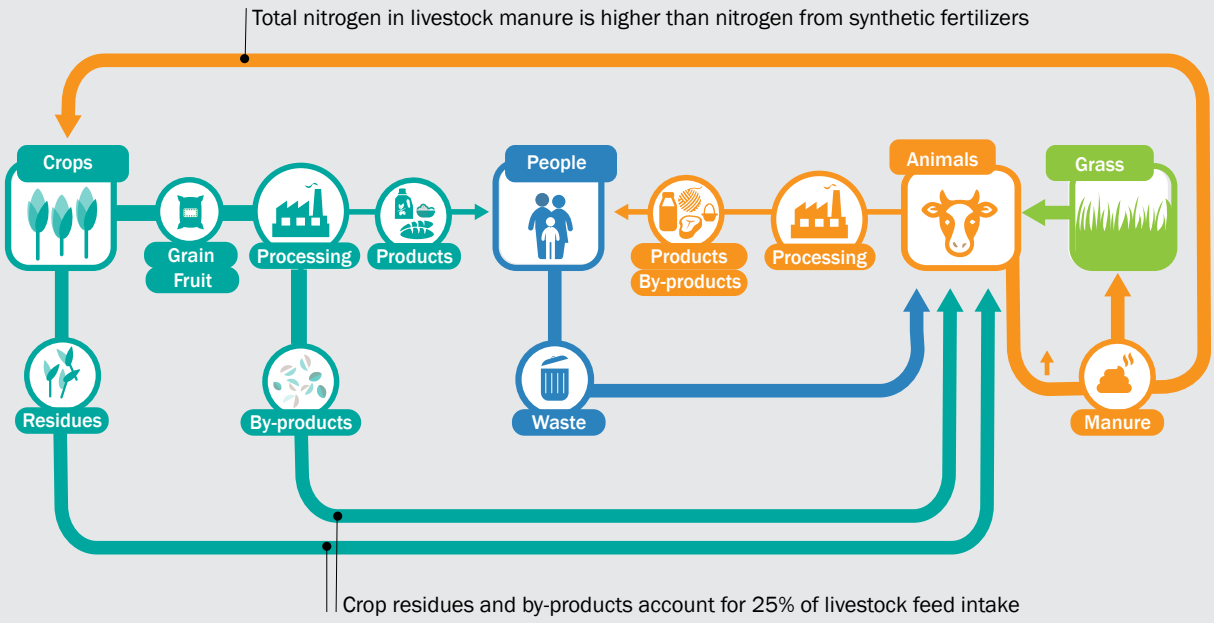
3

Recycling and using synergies for better integration

LINEAR



CIRCULAR



The current role of livestock in the bio-economy is between linear and circular

Challenges

- A lot of residues and by-products from the agrifood industry are wasted while livestock use one third of global cereal production
- A substantial proportion of livestock manure is wasted or discharged in the environment

Opportunities

Humans harvest about 25 percent of the total biomass produced on Earth each year. The annual feed intake of livestock represents about 6 billion tonnes of dry matter per year, or 20 percent of this global human appropriation of biomass.

Permanent pastures and meadows cover about 3.3 billion ha worldwide, representing one quarter of the Earth's land area and a diverse range of agroecosystems. A large share of this area cannot be cropped because of slope, elevation, type of soil or climate. The specialized digestive track of ruminants allows them to convert grass and similar feeds into high quality protein. Grass and leaves represent nearly half of the dry matter ingested by livestock at global level. Grazing livestock systems, including pastoralism, are essential for these agroecosystems and the people whose livelihood depend on them. When manage sustainably, they are also key to soil carbon conservation and other ecosystem services.

Crop residues and agro-industrial by-products such as bran, molasses and oilseed cakes, represent close to 30 percent of the livestock feed intake. They will be produced in larger amounts as the human population grows and consumes ever more processed food, and could become an environmental burden. Livestock play a critical role in adding value to these products, as well as to intercrops used to cover soils in agroecological mixed crop-livestock systems.

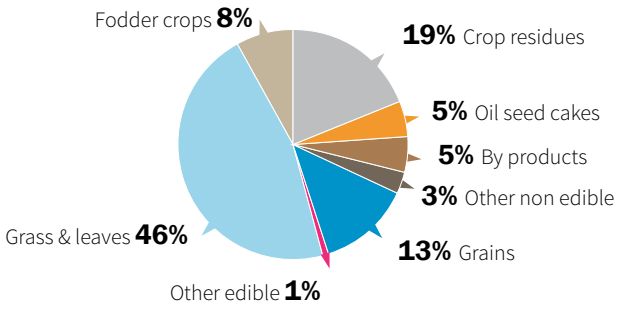
Livestock also contribute to the overall food output by increasing crop productivity through the provision of manure. They are a mean of moving organic matter and water within agroecosystems, for example from grasslands to crop fields, in the form of manure, which makes them key to nutrient cycles and associated ecological processes. Total nutrients available from livestock manure exceeds nutrients from synthetic fertilizers. However, globally, manure supplies only about 13 percent of gross nitrogen input for cropping

This is mainly due to the specialization and mechanization of production, but also to subsidies to farm inputs.

Synergies in integrated crop-livestock or livestock-fish production are key to the agroecological transition. Integration reduces the need for inputs such as land, water and nutrients and improves overall **efficiency**. Better integration can be achieved by increasing the share of grass, crop residues, by-products and waste that humans cannot eat in the livestock feed ration and by **recycling** and recovering nutrients and energy from animal waste (e.g. manure management and application, composting, and anaerobic digestion for biogas production). Integration can also be achieved at landscape or supply chain level. For example, large scale specialized crop and livestock productions can link two agroecosystems via trade in feed or manure. Use of whey from dairy production as feed in piggeries or and use of crop by-products to feed urban livestock are also examples. However, other dimensions of the agroecological transition can be difficult to achieve in these systems.

Assessing the amount of biomass that can be potentially recycled as livestock feed and the impact this would have on productivity, taking into account the **diversity** of species and production systems, still remains to be done. Regulatory frameworks need to consider the sanitary and technical requirements for better integration of non-edible products into livestock feed rations. Other issues that need to be addressed include disregard of externalities and existing subsidies on inputs (e.g. fossil fuel or fertilizers), difficulties in the adaptation of technical solutions to location-specific constraints and lack of access to knowledge and technologies. In Japan, 52 percent of waste from the food industry is now used as livestock feed, thanks to adequate policies and a certification system.

Global livestock feed rations



Case study 2 Integrated livestock-fish farming systems in East and Southeast Asia

Large-scale specialized monogastrics and fish production systems are developing fast in East and Southeast Asia. However, traditionnal integrated livestock-fish systems continue to exist and are relevant to agroecology. These systems rely on synergies between livestock and fish through the use and reuse of nutrients, particularly recycling livestock wastes (manure, urine and spilled feed) for fish production. In the case of fish species that have high demand for animal protein, livestock wastes can also be processed through worms or larvae before being fed to fish. Nutrient losses are reduced and overall resource efficiency is improved. Farmers' income is higher and more regular because of the greater diversity of the products supplied.

4

Mitigating and adapting to climate change

Challenges

- Poor livestock keepers are among the most vulnerable people to climate change, via its direct and indirect impacts on livestock and the resources used to feed them.
- There can be a trade-off between productivity in optimal conditions and resilience, i.e. productivity when exposed to changing conditions and shocks.
- Livestock products are responsible for more greenhouse gas emissions than most other food sources.

Opportunities

Because of the very large **diversity** of production systems, species and breeds and because of animals' abilities to adapt to marginal conditions and withstand climate shocks, livestock support **resilience** to climate change at farm and community levels.

However, in pastoral areas, where climate shocks have been more frequent recently, populations are suffering from the effects of droughts, a situation that is being exacerbated by reduced mobility of people and animals due to legislations and conflicts and by the relative absence of organized feed supply chains to compensate for reduced rangeland productivity.

To date, agroecological studies have paid more attention to climate change adaptation than mitigation. While livestock production is affected by the effect of climate change, it also contributes to climate change via greenhouse gas emissions from feed production, enteric fermentation, animal waste and land-use change. Livestock supply chains account for 14.5 percent of global anthropogenic greenhouse gas emissions. However, low carbon livestock production is possible. Solutions are already available. They illustrate how agroecology can contribute to climate change mitigation. Solutions fall into three main categories: improving **efficiency**; improving pasture management; and **recycling**.

Improved efficiency reduces greenhouse gas emissions per unit of product and increase farmers' income. Practices such as better animal feeding and nutrition, better grassland management, improving and diversifying pastures and forage (e.g. mixes of grasses and legumes) are relevant to agroecology and mitigation of climate change. Better animal health and husbandry, but also better animal welfare, can increase reproductive **efficiency** and extend reproductive life of the animal. It also reduces losses and the number of unproductive animals.

Improved pasture management supports soil carbon sequestration. This can be achieved by adjusting grazing pressure – through **balancing** the spatial and temporal presence of livestock (e.g. through participatory land use planning), nutrient management, diversifying pasture species mixes (e.g. with legumes), improving the mobility of animals in pastoral and agropastoral systems and integrating trees and pastures (silvopastoralism). These changes require adequate **governance** and working with farmers and pastoralists to identify best practices and lift barriers to adoption.

Considerable reduction in nitrous oxide and methane emission, as well as better economic return for producers, can also be achieved by **recycling** and better integration (manure and by-products).

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Case study 3 Mixed crop-livestock farms in Zambia and climate change solutions

78 percent of farms in Zambia raise at least one form of livestock. Economic analysis shows that in drought years households with livestock have higher and more stable income than those without livestock. While traditional systems took advantage of the integration of crop and livestock at farm and village level, policies targeting crop inputs have resulted in waste of crop residues as well as pasture degradation, which is making mixed farmers more vulnerable to climate change. At the same time, large-scale intensive beef fattening is developing in the country. FAO has shown that improved practices on small-scale farms, including better management of forages and crop residues and better use and application of manure, can result in reduced vulnerability, improved productivity and reduced greenhouse gas emission intensities.

FAO's work on sustainable livestock relevant to agroecology

- **Generating evidence and knowledge.** In order to measure impacts of agricultural practices and progress towards sustainability, FAO produces baselines and inventories of natural resource use, greenhouse gas emissions and animal genetic diversity, for example in the reports *Tackling Climate Change Through Livestock and The State of the World's Animal Genetic Resources.*

- **Identifying and promoting best practices.** FAO is piloting technical and policy options for a diverse range of production systems and providing technical guidance, for example via the project *Reducing Enteric Methane for Improving Food Security and Livelihoods* that operates in 13 countries or via implementing the Voluntary *Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests:* improving governance of pastoral lands

- **Developing tools and methodologies.** To monitor progress in the transition towards sustainable food and agriculture, FAO has developed tools such as the Global Livestock Environmental Assessment Model (GLEAM) and the Domestic Animal Diversity Information System (DAD-IS) as well as metrics and methodologies such as the guidelines from the Livestock Environment Assessment and Performance (LEAP) partnership.

- **Facilitating intergovernmental processes.** FAO provides policy support to its member countries for processes that require aligned policies and joint efforts, for example through the Commission on Genetic Resources for Food and Agriculture and the *Global Plan of Action for Animal Genetic Resources.*

- **Facilitating multi stakeholder partnerships and dialog.** To improve adoption of sustainability principles and best practices by all actors along supply chains and to ensure that different actors are heard, FAO supports multistakeholder initiatives such as the Global Agenda for Sustainable Livestock and its various Action Networks, including the Global Network on Silvopastoral Systems and Restoring Value to Grasslands.

- **Promoting producer organizations and partnerships** with focus on small-scale livestock keepers and pastoral organizations, for example through the Pastoralist Knowledge Hub.

- **Developing capacity.** FAO is working at local and governmental level to enhance technical and institutional capacities for the adoption of best practices using, for example, the Livestock Farmer Field Schools approach and the Pastoral Field Schools manual.

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Livestock and the **2030 Agenda for Sustainable Development**

In 2016, the United Nations launched the 2030 Agenda for Sustainable Development with 17 Sustainable Development Goals (SDGs). The 2030 Agenda recognizes that poverty and hunger are the greatest global challenges, but that their eradication requires a real transformative plan of action. The 17 SDGs are relevant for all countries and address all dimensions of sustainability. Livestock represent key opportunities for achieving the SDGs but also un number of challenges. They can contribute to an agroecological transition in support of the 2030 Agenda.

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