FOOD FORWARD NDCs

Reducing emissions from livestock through sustainable management practices

Overview

Globally, livestock production accounts for more than 25% (3.8 gigatons of CO_2e) of the greenhouse gas (GHG) emissions from food systems. Most livestock emissions come from enteric fermentation and livestock manure. Sustainable livestock management practices and measures not only help to mitigate climate change, but also build the sector's resilience to climate change impacts and contribute to food security and health, economic and environmental wellbeing, and the sociocultural lives of local communities.

Concrete measures to implement

Reducing emissions from livestock production requires a mixture of strategies and practices based on local contexts that improve animal diets and manure handling. FAO has identified the following measures for farmers to take:

- **Improve feeding strategies:** One of the most promising options for limiting emissions within livestock management is improving animal production through dietary changes. This process can include integrating different diet additives (e.g. certain oils) to feed or improving the digestibility of low-quality forage, which ruminant animals have difficulties breaking down and which therefore increases the process of enteric fermentation.
- **Adopt anaerobic manure management system:** Anaerobic manure management is a process through which microorganisms break down manure in the absence of oxygen and produce a mixture of biogas (mainly

methane – CH_4 and carbon dioxide – CO_2) and digestate. Where production is carried out on a large, intensive scale and manure is stored under anaerobic conditions, methane can be captured with biogas collectors. The captured methane can be flared or used as a source of energy for electric generators, heating or lighting.

- **Separate solid-liquid manure content**: Manure processing technology can partially separate solid and liquid manure using gravity or mechanical systems such as centrifuges or filter presses. This process aerates manure storage conditions, which then limits the potential of emitted methane.
- **Dry manure:** Manure drying involves any of a variety of methods to reduce the liquid content of manure to achieve a solids content of 13% or more. Manure drying is commonly used to facilitate the transport or storage of manure. Solid manure is typically stored for several months in unconfined piles or stacks in open areas or in dedicated storage facilities that confine the dried manure, where the manure is confined within the walls of the facility. Drying manure reduces the amount of manure entering uncovered anaerobic manure lagoons and thereby reduces the volume of methane emissions from lagoons.
- **Compost manure:** Composting is the aerobic decomposition of manure or other organic material by microorganisms in a managed system. Composting requires air, moisture and high-nitrogen and high-carbon organic material. The process generally takes several weeks to months depending on the level of turning or aeration management. Composting manure produces fewer methane emissions than uncovered anaerobic lagoon or liquid/slurry manure management systems.
- **Decrease manure storage time:** The time manure is stored in anaerobic conditions can be reduced by processing it, or transporting it out of a storage facility using methods like slatted floor pit storage or spreading it on land consistently during periods of good weather and soil conditions. Daily spreading of manure results in the greatest reductions in methane production but reducing storage time from months to weeks can also have a significant effect. In a daily spread management practice, manure is removed from a barn and is applied to cropland or pasture daily.
- **Improve pasture management:** Adjusting grazing pressure can restore the quality of pastures and increase soil carbon. Adjustments to improve pasture management include: balancing the spatial and temporal presence of livestock (e.g. with new technologies like solar-powered electrical fences), improving fertilization and nutrient management, introducing

species (e.g. legumes), inoculating plants, improving the mobility of animals in pastoral and agropastoral systems, and integrating trees and pastures. Also see ***Implementing agroforestry practices*** and ***Implementing integrated crop-livestock management systems*** for more information about these measures.

- **Adopt rotational grazing:** Rotational grazing divides a large pasture into smaller fields and moves livestock between the smaller fields over time. This system allows livestock to get the nutrients they need and maintains the health of the grass and soil over the long term, all while keeping carbon in the ground instead of releasing it into the atmosphere. Additionally, rotational grazing provides higher forage quality which is easier for livestock to digest, which may **result in fewer emissions**.
- **Improve animal health and husbandry:** Improving reproductive efficiency and extending the reproductive life of animals can extend the lifetime performance of individual animals and reduce GHG emission intensities. Reducing the incidence and impact of diseases, parasites and insect burdens results in higher productivity and efficiency with fewer losses and fewer unproductive animals that emit GHGs. Genetic improvements generate gains in productivity and decreases in emission intensity.
- **Avoid conversion of rangelands and grasslands** into cropland or other land uses. Grass and soils store a large amount of organic carbon that, if exposed to the atmosphere (e.g. through tillage), would be mostly released in form of CO_2 emissions. Avoid the selection of grasslands as sites for afforestation without careful consideration of the ecosystem services, carbon sequestration, biodiversity, economic, and cultural benefits that grasslands provide. See ***Implementing improvement management practices in grasslands*** for more information about these measures.

Enabling governance measures

A transition to sustainable livestock management at the farm level requires several governance measures to enable farmers adopt improved practices, including:

- Promoting payment for ecosystem services (PES) for sustainable livestock and feed through public-private partnerships, conservation programmes that provide landowners incentive payments, and technical assistance for grassland restoration. Benefits should be equitable and focused on ensuring support for low income and marginalized communities.

- Implementing agricultural subsidies that shift finance from unsustainable practices to sustainable livestock and feed production that use less intensive, regenerative agricultural practices and recognize the rights of Indigenous Peoples and Local Communities.
- Increasing funds channeled to research and innovation in reducing enteric fermentation.
- Providing incentives for innovative feed, feed management and alternative feeds that reduce enteric emissions from livestock.
- Providing resources for training and technical assistance to ensure adequate capacity to provide support and education in sustainable grazing, feed management and feed innovations by producers. Incorporate behavioural insights into the policymaking and programming process.
- Promoting product certification and labelling schemes for nature-positive agricultural management practices in the production of sustainable livestock and feed.
- Addressing drivers of grassland loss and conversion by prohibiting subsidies for crops grown on recently converted grasslands, making biofuels crops from recently converted grasslands ineligible for biofuels programmes and ensuring risk mitigation policies between crop production and grazing/livestock do not create economic imbalances that drive conversion. See guidance ***Implementing improvement management practices in grasslands*.**

Tools and MRV systems to monitor progress

Calculators and Trackers

GLEAM-i

Global Livestock Environmental Assessment Model – Available as an interactive platform by FAO

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

EX-ACT

EX-Ante Carbon-balance Tool by FAO

Link: https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/ex-act/en/

Guides and handbooks

Storing Manure on Small Horse and Livestock Farms

Rutgers University

Link: https://njaes.rutgers.edu/fs1192/

Manure timing

University of Minnesota Extension

Link: https://extension.umn.edu/manure-management/manure-timing

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Land Application Considerations for Animal Manure

University of Missouri Extension

Link: https://extension.missouri.edu/publications/eq202

Building Soils for Better Crops – Chapter 12: Integrating Crops and Livestock

Sustainable Agriculture Research and Education

Link: https://www.sare.org/publications/building-soils-for-better-crops/integrating-crops-and-livestock/

Grazing and pasture management best practices for cattle

University of Minnesota Extension

Link: https://extension.umn.edu/pasture-based-dairy/grazing-and-pasture-management-cattle

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Evaluating greenhouse gas emissions from dairy manure management practices using survey data and lifecycle tools

Journal of Cleaner Production

Link: https://www.sciencedirect.com/science/article/pii/S0959652616321953

AgSTAR Project Development Handbook

U.S. EPA

Link: https://www.epa.gov/agstar/agstar-project-development-handbook

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Manure Storage: Small Scale Solutions for Your Farm

USDA NRCS

Link: https://www.nrcs.usda.gov/sites/default/files/2022-11/Solutions-for-Small-Scale-Farms-Manure-Storage-NRCS.pdf

Mitigation benefits

FAO found that sustainable livestock management practices reduces CH_4 generated during digestion as well as the amount of CH_4 and nitrous oxide (N_2O) and CO_2 released by decomposing manure. FAO also identified the following examples of emissions reduction potentials associated with sustainable livestock management practices:

- In **South Asian** mixed dairy farming systems, GHG emissions could be reduced by 38% of the baseline emissions (120 million tonnes CO_2eq).
- In industrial pig production systems in **East and Southeast Asia**, emissions could be reduced by 16 to 25 percent of baseline emissions for these systems (21 to 33 million tonnes CO_2eq).
- In specialized beef production in **South America**, emissions could be reduced by 19 to 30 percent of baseline emissions (190 to 310 million tonnes CO_2eq).
- In the **West African** small ruminant sector, emissions could be reduced by 27 to 41 percent of total annual baseline emissions (7.7 to 12 million tonnes CO_2eq).

Other environmental benefits

Several livestock mitigation options also help reduce ammonia (NH_3) emissions, which contribute significantly to air pollution and eutrophication.

Adaptation benefits

- Multiple reviews show that, compared to simplified farming systems, diversification of fields and farms can improve biodiversity and ecosystem services such as pollination and water regulation.
- Improved pasture management also offers other benefits such as:

    - Enhanced soil drainage
    - Reduced soil erosion
    - Reduced invasions of noxious and poisonous weeds

- Manure management with **anaerobic digestion** can also conserve agricultural land as it:
    - Improves soil health by converting manure nutrients into a plant-friendly form
    - Safeguards local water resources by reducing nutrient runoff and eliminating pathogen
- For more information about common benefits, see ***Implementing agroforestry practices*** and ***Implementing integrated crop-livestock management systems***.

Other sustainable development benefits

The Global Agenda for Sustainable Livestock (**GASL**) has identified nine SDGs with strong direct links to the livestock sector (SDGs 1, 2, 3, 5, 8, 12, 13, 15 and 17). According to GASL, **sustainable livestock management** can:

- SDG 1 (No poverty) & SDG 5 (Gender equality): Increase employment opportunities (e.g. keeping anaerobic digestors running at optimal levels once operational).
- SDG 2 (Zero hunger), SDG 8 (Decent work and economic growth), & SDG 12 (Responsible consumption and production): Increase crop productivity and yield when nutrients in manure are converted to a plant-friendly forms.
- SDG 2 (Zero hunger), SDG 3 (Good health and well-being), & SDG 12 (Responsible consumption and production): Recycle nutrients on farms, creating economically sustainable food production systems.
- SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), & SDG 13 (Climate action): Produce heat, electricity or fuel from biogas (using anaerobic digestors), reducing the dependence on fossil fuels.

Main implementation challenges and potential negative externalities and trade-offs

- Changes in livestock diets and management approaches are often costly and demand high skill levels by farmers.
- Many high-technology mitigation options (like dietary manipulation) may be limited by their high economic costs and their difficulties for use in non-intensive systems.

- Installing anaerobic digesters can be expensive and require substantial upfront funding. Operating and maintenance costs are also high, posing challenges for farmers. Moreover, anaerobic digesters are only practical for larger farms.
- Certain manure management measures like solid-liquid separation can increase ammonia production, resulting in the possibility of indirect nitrous oxide emissions.
- Shorter manure storage times provide less time for the manure to break down and produce methane emissions, but nitrous oxide emissions may increase.
- The implementation of several techniques and technologies may require in-depth knowledge and skills by farmers.

Measures to minimize challenges and potential negative externalities and trade-offs

- Continuous and inclusive dialogue with farmers, scientific organisations, and both government and civic leaders to:
    - increase capacity building (e.g. through workshops with farmers)
    - access to technology at lower costs

- Lifecycle analysis may be necessary to estimate net GHG emission reductions.

Implementation costs

- An example from the NRCS shows the costs for implementing rotational grazing in a 40-acre pasture can include:
    - A 40 acre pasture divided into 4 pastures: $200 for single strand fencing.
    - Water distribution: about $.50/foot of water line.
    - Portable watering trough: about $100 to $160.

Another study shows that reducing grass maturity as a feeding strategy is more cost-effective (€57/t of CO2e) when compared to €241/t of CO2e for nitrate supplementation and €2,594/t of CO2e for linseed supplementation

Intervention in practice

A study showed that Jalisco, Mexico could produce 5.5% of its electricity needs by processing all its livestock waste in centralized anaerobic digestion units. This could also yield 49.2 Gg of nitrogen and 31.2 Gg of phosphorus, while reducing carbon dioxide emissions by 3012.6 Gg.

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