ENVIRONMENT

RUMINANT LIVESTOCK FARMING AND SOIL QUALITY

« How does ruminant livestock play a role in soil quality? »

1

Thanks to their effluents, livestock animals fertilize the soils and allow for an increase in carbon stock.

To preserve this positive effect and avoid any pollution, farmers adhere to spreading rules and maintain an appropriate animal load.

2

Livestock farms use few phytosanitary products.

Grasslands and forage crops consume very few phytosanitary products.

3

Livestock farming limits soil erosion

thanks to livestock effluents and the presence of grasslands.

4

The combination of animal and plant production improves soil quality.

The complementary nature of livestock farming and crop cultivation helps maintain organic matter levels in the soil.

Incorporating grassland into crop rotations promotes the development of biological activity.

Including legumes in crop rotations helps capture nitrogen from the air and fertilize the soil.

INSTITUT DE L'ELEVAGE idele

Confédération Nationale de l'Elevage CNE

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WHAT ARE WE TALKING ABOUT?

The physical, chemical and biological functions of the soil are determined by the organic matter in the soil, whose dynamics are largely driven by soil microorganisms. The enzymes synthesized by these microorganisms participate in the decomposition of soil organic matter (Petitjean *et al.*, 2018), which is the process of humification.

THE CAUSES OF SOIL DEGRADATION

In France, soil degradation is mainly due to impermeabilization (particularly through urbanization), erosion, depletion of organic matter (notably due to a deficit in organic matter input to the soil), contamination and compaction (GIS Sol, 2010).

THE PROCESS OF DECOMPOSITION OF EXCREMENT

Animal waste decomposes through mineralization: nutrients such as nitrogen, phosphorus, sulfur and potassium are released into the soil, nourishing the plantss (Rieutort *et al.*, 2014). The use of livestock effluents as organic fertilizers helps to renew soil fertility by enriching it with organic matter, thereby limiting the use of chemical fertilizers.

1 Livestock effluents

The maintenance and improvement of the organic matter content in the soil through livestock effluent

Animals fertilize the soil with their effluents directly on the grassland when they are grazing or through the farmer who collects the manure and slurry produced in the barn and stored during the winter, then spreads them on the farm's crops. The high rate of humification of livestock effluents, especially manure, helps maintain or even improve the organic matter content in the soil. Animal droppings feed numerous scatophagous insects (beetles, etc.) that transform them into fertilizer and organic matter for the soil (Rieutort *et al.*, 2014). It should be noted that, compared to lands fertilized solely with mineral nitrogen, lands fertilized with livestock effluents are richer in organic matter and microorganisms beneficial to soil life (Petitjean *et al.*, 2018). However, pollution problems can be associated with excessive fertilization. The farmers comply with the rules defined by the Nitrate Directive regarding the use of effluents. These rules help prevent pollution and also provide the necessary nutrients to the plant when it needs them the most (Rieutort *et al.*, 2014). Also, the implementation of a spreading plan (mandatory for Classified Installations for Environmental Protection) specifies the areas prohibited for spreading as defined by the regulations (ICPE, RSD) and allows for the evaluation of the adequacy between the quantities of effluents to be managed and the soil's capacity to receive.

The highest rates of organic matter in permanent and temporary grasslands

The decrease in organic matter content in France is partly explained by the reduction in permanent and temporary grasslands in favour of annual crops (Petitjean *et al.*, 2018). Among agricultural soils, it is in the soils of natural grasslands that the highest organic matter contents are measured. Managing animal stocking rates on grasslands in a sustainable manner helps maintain the positive effects of organic fertilization (Dumont *et al.*, 2019). Generally speaking, organic matter levels are maintained by the input of livestock effluents. Thus, the quality of the soils is a consequence of the presence of livestock.

Increasing soil carbon stocks through livestock manure

The spreading of livestock effluents leads to high levels of organic carbon in the soil (Pellerin *et al.*, 2020). There too, rationalizing the animal load prevents subjecting the grassland to an excessively high defoliation regime due to overgrazing, which can lead to a net carbon destocking (Dumont *et al.*, 2019). Moreover, assessing the influence of practices on crops and grasslands of a farm on the carbon stock is one of the central points of the Carsolel project developed by Idele and Inrae and supported by the dairy and meat sectors (Idele, 2021).

KEY FIGURES

6.2 million hectares of field crops and grasslands are exclusively fertilized with livestock effluents (Ademe, 2018), which represents **¼** of French agricultural land (Agreste, 2020).

In France, farm fertilizers help avoid the production of **660.000 tons** of mineral nitrogen, **500.000 tons** of phosphate and **1.6 million tons** of potash, which corresponds to a saving of **1.2 million ton of CO_2** equivalent, representing a **40%** reduction in emissions related to the production of chemical fertilizers (Rieutort *et al.*, 2014).

Microbial biomass according to land use in France (average microbial DNA concentration, in µg/g of soil) (Idele, 2018):

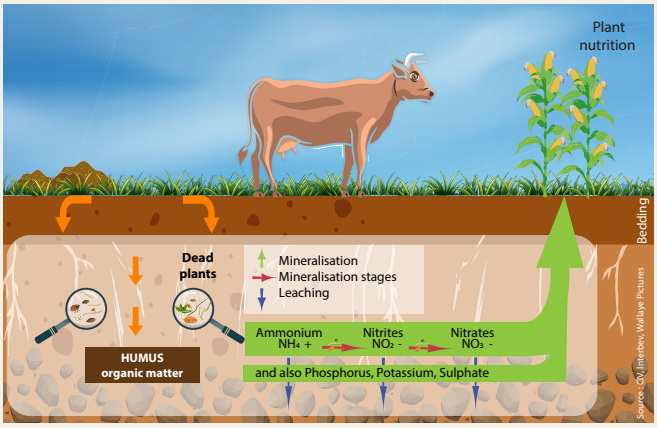
Grasslands: **11.6**
Forestry: **10.4**
Crops: **8**
Vineyards: **5.7**
Natural environment/urban parks: **7**
Medium-sized cities: **9.9**

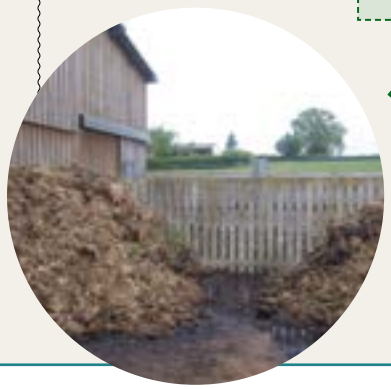
There are **22 times more** earthworms living under 1 hectare of grassland (1.1 ton) than under 1 hectare of arable land (50 kg) (Gis Avenir Élevages, 2023).

Better use of manure and slurry on livestock farms has led to a **20%** reduction in the use of mineral fertilizers over the past **20 years** years (Rieutort *et al.*, 2014).

1 Livestock effluents

SOIL FERTILIZATION WITH ANIMAL MANURE
(CIV, INTERBEV, WALLAYE PICTURES)





LEARN MORE...

...about carbon storage in grasslands

CHECK OUT THE SHEET ➡

« Ruminant livestock farming and greenhouse gases ».

LEARN MORE...

...about the role of ruminant farming on water

CHECK OUT THE SHEET ➡

« Ruminant livestock and water resources ».

2 Crop protection products

Few or no phytosanitary products on grasslands
Grasslands, areas that only ruminants can utilize, are rarely treated with pesticides (Rieutort *et al.*, 2014).

Fewer pesticides on livestock farms
Similarly, crops associated with livestock farming are forage crops and self-consumed crops: they use fewer phytosanitary products than sales crops, for example. Finally, the integration of grasslands and legumes into crop rotations reduces the risk of diseases and thus the use of phytosanitary products, as long as herbicides are not used to destroy them (Duru *et al.*, 2017).

KEY FIGURES

Cattle farming preserves 5.7 million hectares of permanent grassland with zero use of pesticides, which is equivalent to **28%** of the national UAA (excluding perennial crops) (Idele, 2018).

On livestock farms, **40%** less phytosanitary products on rotational crops (including temporary grasslands) (Idele, 2018).

The insertion of legumes in cereal rotations reduces the treatment frequency index (TFI) by **5 to 15%** (Carrouée *et al.*, 2012).

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3 Erosion

Limited erosion in livestock farming areas

Grasslands, which permanently covers the soil, limit nitrate and phosphorus losses through runoff or leaching (RMT Prairies Demain, 2018), retain particles and thus prevents erosion (Rieutort *et al.*, 2014). In addition, the organic matter provided by livestock manure increases soil stability, which limits its susceptibility to erosion (Pellerin *et al.*, 2020).

KEY FIGURES

Soil loss under grassland: **0.3 t/ha/year**

Soil loss under annual cultivation: **3.6 t/ha/year** (Idele, 2022).

4 Polyculture farming system

The improvement of soil quality through the association of animal and plant production in mixed crop farming system

The diversification and succession of crops for animal feed improves soil quality by limiting diseases, weeds and soil depletion. Moreover, thanks to the more or less deep rooting, different soil levels are explored by the roots to draw water and nutrients, allowing the soil to replenish its reserves.

In general, the complementarity between livestock farming and crop cultivation helps maintain soil organic matter levels thanks to the addition of livestock effluents and thus limits erosion (Rieutort *et al.*, 2014).

The integration of grasslands into rotations promotes the development of biological activity, particularly earthworms, whose burrows provide preferential spaces for the development of crop roots. Moreover, they also increase the soil's water and nutrient capacity (RMT Prairies Demain, 2018).

The importance of legumes for soil fertility

The inclusion of legumes in crop rotations allows for the capture of nitrogen from the air and the fertilization of the soil. These legumes can then be used in animal feed or as green manure for the soil (Rieutort *et al.*, 2014).

KEY FIGURES

120 to 130 kg of atmospheric nitrogen per hectare per year fixed by legume-rich grasslands (RMT Prairies Demain, 2018).

In a rotation, the amount of mineral nitrogen left by a grassland for a crop varies between **20 and 120 kg** of nitrogen per year (COMIFER, 2013).

LEARN MORE... ...about soil life

CHECK OUT THE SHEET ➡ « Ruminant livestock and biodiversity ».

ACTIONS AND TOOLS IMPLEMENTED BY THE SECTORS

CarSolEl Project

(Carbone Sols Elevage)

Developed by an Inrae-Idele team, Carsolel notably allows for the integration of grassland management on the farm: mowing/grazing management mode, return of organic fertilization, duration of presence in rotations and management of subsequent crops (Idele, 2021).

The calculation tool aims to:

- Estimate the average annual variation in carbon stocks over the medium term (30 years) that incorporates cropping and grassland practices on a farm;
- Be usable within the framework of climate action plans;
- Be reliable in estimating trends in carbon stocks and representative of a majority of situations without, however, being exhaustive.

Dexel and Pre-Dexel tools

The Pre-DeXeL tool is mainly used by farmers located in vulnerable areas, but it can also be used by technicians from Chambers of agriculture and advisory organizations. The tool allows for an assessment at a given moment of the farm's standard effluent storage capacities.

The DeXeL tool is historically the software that has accompanied the compliance of livestock farms since the 90s. Intended for advisors from Chambers of agriculture and consulting organizations, it helps to refine the farmer's thinking by precisely calculating the sizing of their storage facilities that applies to their livestock and practices. It also allows solutions to be tested in order to respond to a situation of under-sizing. Moreover, the tool can calculate agronomic capacities and size treatment systems for lightly loaded effluents.

DEPHY ECOPHYTO National network

The ECOPHYTO PLAN action program involves all stakeholders in the agricultural sector. Its objective is to test, promote and deploy agricultural techniques and systems that reduce the use of plant protection products while remaining economically, socially and environmentally effective.

The DEPHY FERME system is a demonstration and reference network for agricultural production using fewer phytosanitary products. Created in 2010 with 178 farms, it now has more than 2,000 farms grouped into 180 farmer groups, supported by network engineers from various organizations (Chambers of agriculture, CIVAM network, organic farmer groups, FREDON, management centers, agricultural high schools, etc.). Between 2010 and 2023, up to 3,054 farmers voluntarily committed to a process of reducing phytosanitary products. These farms are spread across the entire country, and their production may include large-scale crops, mixed farming, viticulture, arboriculture, vegetable crops, horticulture and tropical crops.

In 2023, a new study from the DEPHY FERME network was published. Farms in large-scale crops and polyculture farming systems represent 52% of all farms studied. Between the time these farms joined the network and the 2018/2019/2020 seasons, the average IFT (excluding biocontrol and seed treatments) decreased by 26% (National DEPHY Ecophyto Animation Unit, 2023).

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