



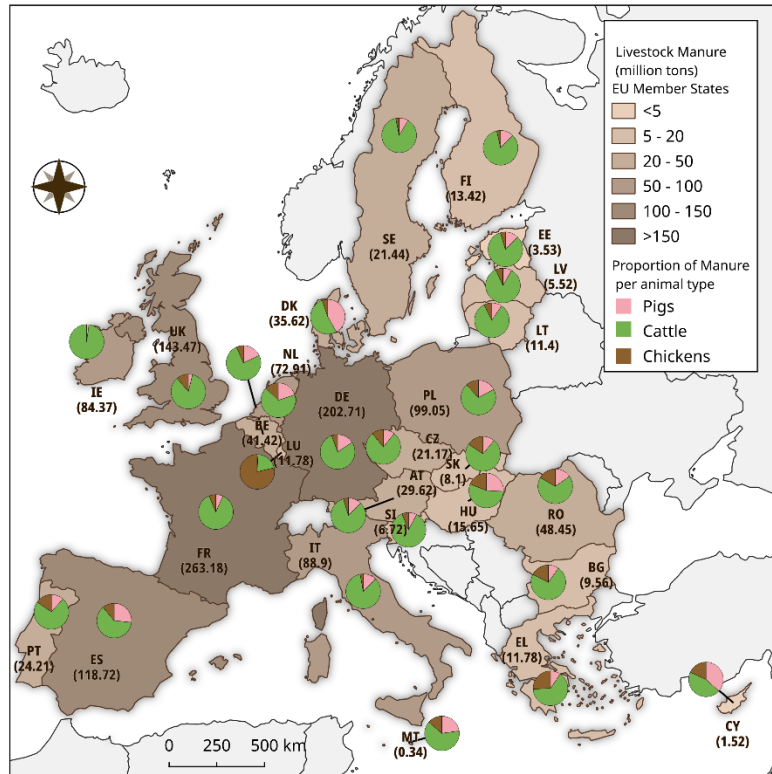
Manure management & soil biodiversity

Julia Köninger

Global Symposium on Soils for Nutrition | 26-29 July 2022



Manure in the European Union



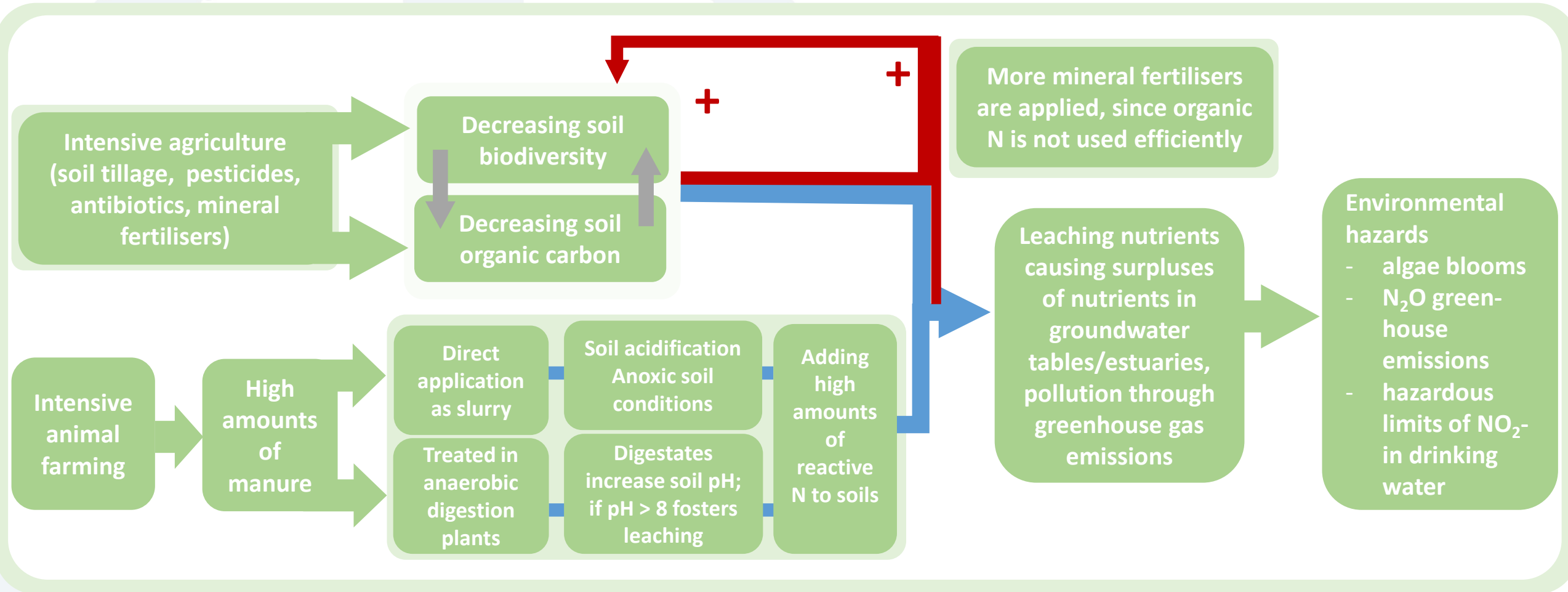
Köninger et al., *Agricultural Systems*, 2021

- > 1.4 billion tons of manure are generated in the EU and UK yearly
- Between 2010 and 2018: pigs +25% and poultry/broilers + 3% (Eurostat, 2019)
- Manure is increasingly generated in highly intensive farming systems (Bernal et al., 2015)
- 4% of European farms produced 80% of the total amounts of manure in 2018 (Amann et al., 2018)

Global Symposium on Soils for Nutrition | 26-29 July 2022



Manure & the environment



Manure & soil biodiversity



+



A Platanuridae species of springtail



Dicytomonina novaezealandae



A Tenebrionidae species of springtail



- Effects on soil biodiversity are often not assessed
- The interaction between manure and soil biodiversity has not been reviewed



REVIEW OF 406 PAPERS & EUROPEAN LEGISLATION

Relationship between manure and soil biodiversity

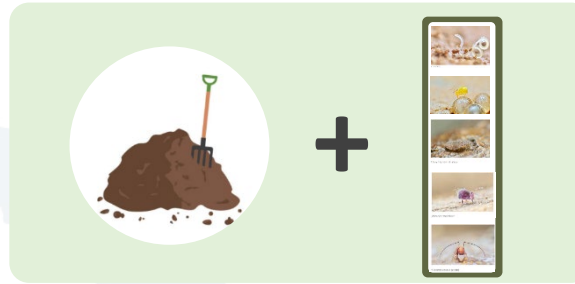
Soil biodiversity in manure legislation

Practices considering soil biodiversity in manure management

Global Symposium on Soils for Nutrition | 26-29 July 2022

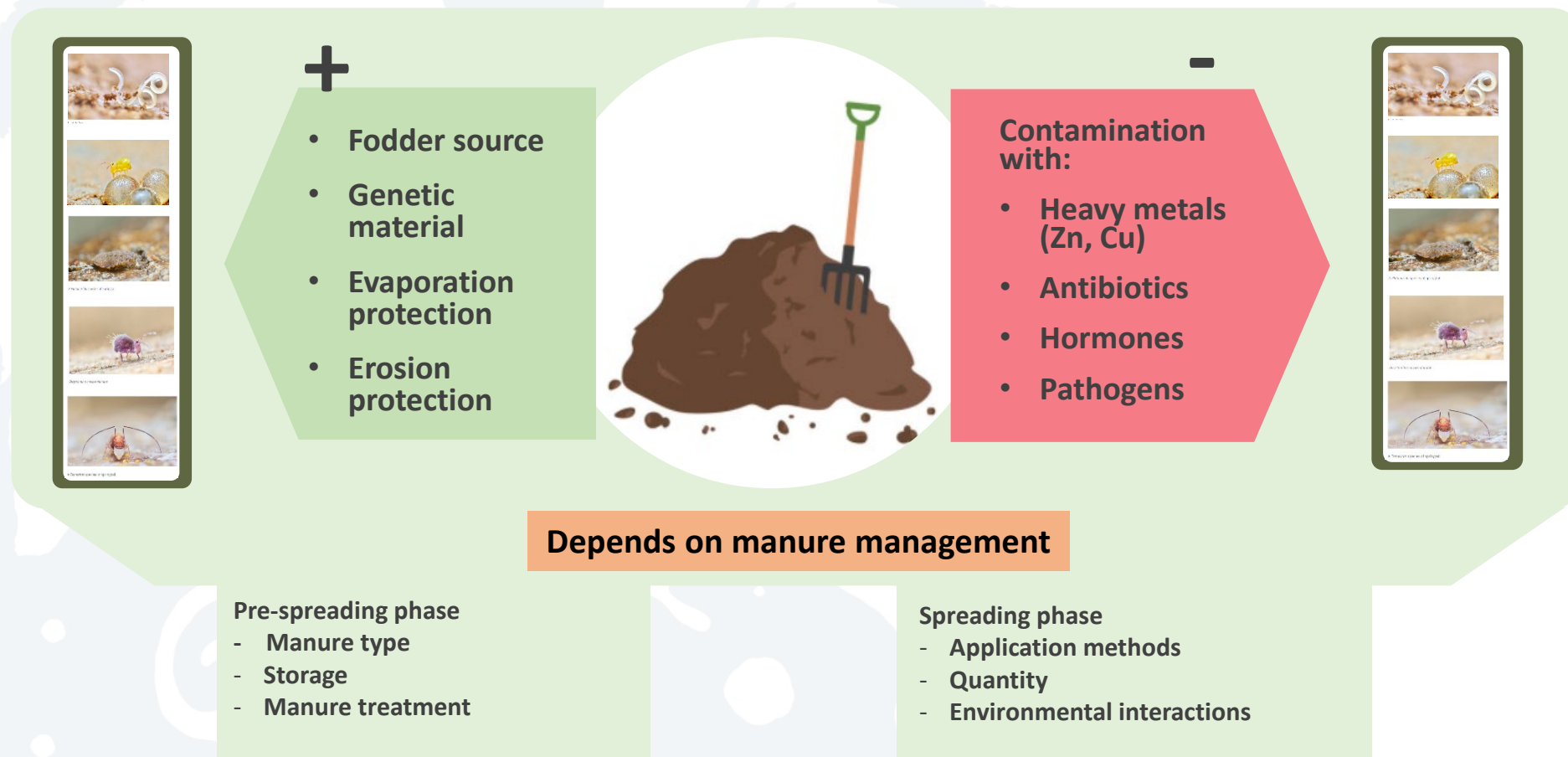


Research questions



1. Which variables affect farm manure's impact on soil biodiversity?
2. Which practices help to achieve sustainable manure management in the EU?
3. What role and importance, if any, is attributed to soil biodiversity in current European legislation on manure management?
4. Which shortcomings in regulations and practices, if any, currently prevent sustainable manure management in the EU?

Effect of manure on soil biodiversity



Global Symposium on Soils for Nutrition | 26-29 July 2022

BENEFICIAL MANURE PRACTICES

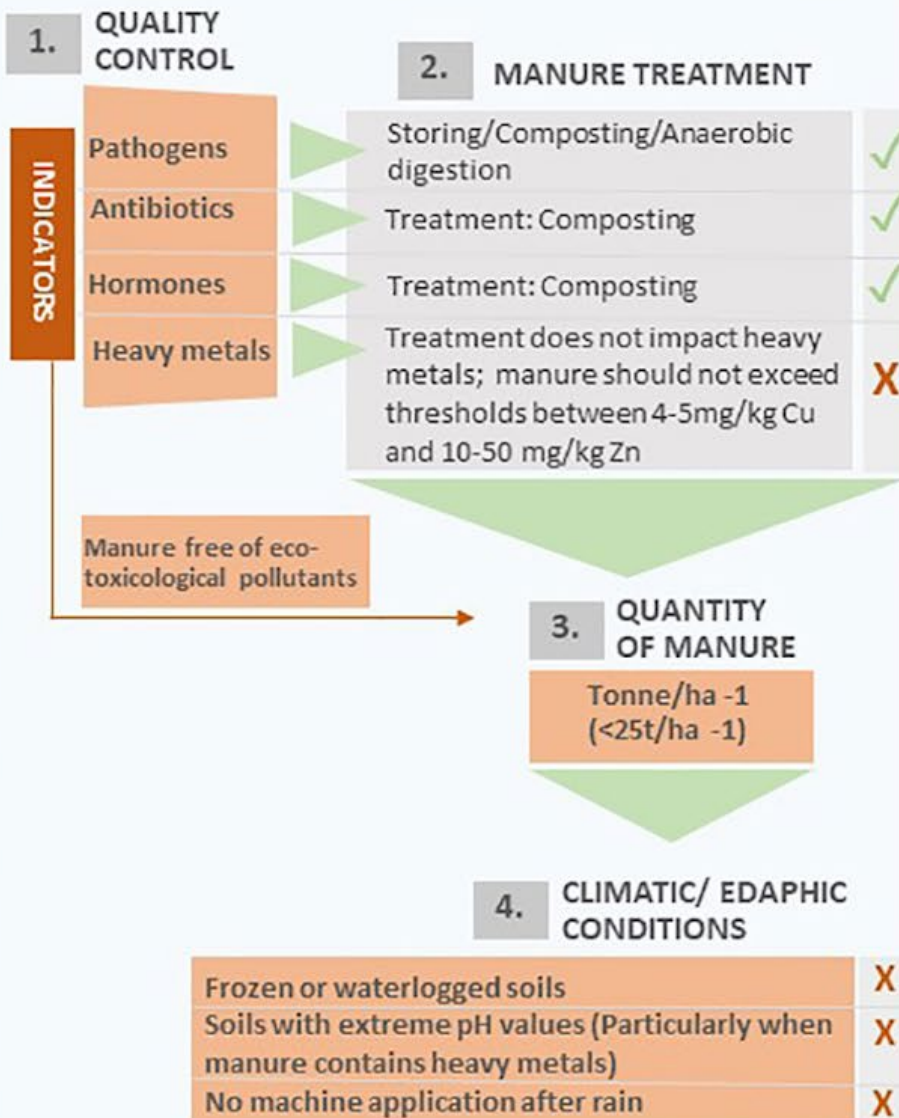
MANURE QUALITY	<p>Limit/prevent food supplements such as hormones, antibiotics and heavy metals. Replace mineral zinc with organic zinc. No usage of manure as organic fertiliser when both copper and antibiotic oxytetracycline were fed simultaneously.</p> <p>Respect animal welfare (space, stress,...)</p> <p>When animals have been treated with antibiotics, hormones or heavy metals, adding organic matter (e.g. plant residues) reduces the toxic effect of manure</p>
MANURE STORAGE	Combining storing and composting manure reduces antibiotics more efficiently
MANURE TREATMENT	<p>Manure from ill animals containing pathogens require treatment (e.g. composting or anaerobic digestion)</p> <p>To prevent the leaching of N, high amounts of manure should be composted before application</p> <p>Fermenting manure enhances benefits to soil biota (compost-tea preparations)</p>
MANURE QUANTITY	Application amount below 25t/ha-1. If manure contains toxic pollutants, the quantity should be reduced, see the threshold for heavy metals)

HARMFUL MANURE PRACTICES

MANURE QUALITY	<p>Usage of antibiotics in animal farming</p> <p>When heavy metals are fed as additives in animal farming: thresholds should be considered for applying manure from animals that received heavy metal supplements: 4-5 mg/kg Cu and 10-50mg/kg Zn depending on animal size</p> <p>Usage of hormones as additives in animal farming</p>
MANURE STORAGE	Storing manure does not adequately reduce antibiotic resistance genes
MANURE TREATMENT	To prevent the leaching of N, the quantity of digestates applied to alkaline soils must be limited or coupled to further treatments (e.g. N recovery by separation)
MANURE QUANTITY	Manure quantity exceeding 25t/ha-1 (if manure contains toxic pollutants, the quantity should be reduced, see the threshold for heavy metals)
CLIMATIC/ EDAPHIC CONDITIONS	No application to frozen or waterlogged soils or soils with extreme pH values, no machine application after rain since earthworms are more likely being harmed

SUSTAINABLE MANURE MANAGEMENT

CHECKLIST: MANURE MANAGEMENT <> SOIL BIODIVERSITY



Impact of manure on the environment

Table 2

The impact of manure treatment on the environment (with focus on soils) and biodiversity (for low to medium amounts of manure, not exceeding 25 t ha^{-1}): ++ large positive impact; + positive impact; – negative impact; -- large negative impact; 0 neutral (neither positive nor negative impact); + – No clear position in literature; NA refers to no available studies. Techniques separating manure into solid and liquid fraction allowing their separate management are not covered in the table since the impact on the environment and biodiversity depends on the fraction and the technique.

Impact Manure Treatments	Environmental impacts with focus on soils (see supplementary text in Appendix A for more details)						Soil Biodiversity			
	NH ₃ Loss	Heavy metal soil pollution	Salinisation	Antibiotics	Pathogens	Soil organic Carbon content	Microbial biomass	Genetic diversity	Soil fauna	Plant- parasitic nematodes
Raw application (from animals farmed in stables, excluding untreated manure by grazing animals)	–	–	–	–	–	+	+–	+–	–	+
Aerobic composting of the solid fractions (Aerobic microorganisms decompose organic matter, occurring naturally when manure is stored in heaps)	–	+	++	+	+	++	+	++	++	+–
Biostimulant Fermentation (Naturally-occurring acidification e.g., compost teas)	NA	–	+	+	++	++	++	++	++	++
Anaerobic digestion (Microbial degradation of organic matter to biogas, as methane and carbon dioxide)	–	–	++	–	–	+	0	+–	–	+
Additives and other pre/treatments (e.g., acidification through the addition of chemical compounds such as sulfuric acid)	+	NA	NA	NA	–	NA	NA	NA	0	++

Impact of soil biodiversity on the environment

Impact of biodiversity	Environmental Threats (relevant to soils)					
	Emissions	NH ₃ Leaching	Heavy Metal soil contamination	Pathogens (<i>Salmonella</i>)	Antibiotic resistance genes	Carbon losses
Microbial biomass	+–	++	++	++	++	+–
Genetic diversity	+	+	+	++	++	++
Soil fauna	+	+	+	++	++	++

→ The higher soil biodiversity, the better environmental threats, which were introduced by manure and its contaminants, can be prevented

Köninger et al., *Agricultural Systems*, 2021

Global Symposium on Soils for Nutrition | 26-29 July 2022



Manure in European policy instruments

Soil Biodiversity in EU Manure Policies:

- Animal By-Products and Derived Products Regulation 1069/2009
- The Common Agricultural Policy (CAP) Regulation (EU) No 1306/2013
- Air Quality and National Emission Ceilings Directive 2016/ 2284
- EU Nitrates Directive 91/676/EEC
- Organic Production Schemes Council Regulation (EEC) No 2092/91
- Fertilising Products Regulation (EC) No 2003/2003 replaced by Regulation (EU) 2019/1009
- Veterinary Medicinal Directive 2001/82/EC replaced by Regulation EU/2019/6
- Industrial Emissions Directive (2010/75/EU)

Neglected:

- Quality of manure
- Coupling with practices beneficial for soil biodiversity
- Raw manure

Conclusions

- Manure quality is currently neglected though crucial for soil biodiversity
- Radical changes in philosophies and practices of intensive animal farming needed to protect soil biota and to reduce environmental risks and costs

This approach will:

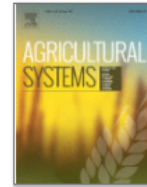
- Reinforce the European Member States' commitment to embrace soil protection in national legislation
- Enable the implementation of strategic goals for sustainable food systems in EU

Want to know more? Check our paper!



Agricultural Systems

Volume 194, December 2021, 103251



Review

Manure management and soil biodiversity: Towards more sustainable food systems in the EU

Julia Köninger ^{a, b}✉, Emanuele Lugato ^b✉, Panos Panagos ^b✉, Mrinalini Kochupillai ^c✉, Alberto Orgiazzi ^b✉, Maria J.I. Briones ^a✉

Global Symposium on Soils for Nutrition | 26-29 July 2022





Thank you!

Keep in touch: julia.koeninger@ec.europa.eu

Global Symposium on Soils for Nutrition | 26-29 July 2022

