

Soil biodiversity under threat



Manure in the EU



- > 1.4 billion t y–1 of manure are generated in the EU and UK
- 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)



Soil Biodiversity and Manure Management



Research Protocol

Research Question (RQ)	Aim	Method	Keywords in the Search
RQ1: Which factors	To identify the factors	To perform a	Manure management
regulate the direct and	determining the impact of	systematic literature	and/or animal faeces
indirect effects of farm	manure on soil biodiversity	review on the effects of	and/or animal dung
manures on soil	including benefits and	manure on soil	and/or animal urine,
biodiversity and their	threats to soil biodiversity	biodiversity and vice	benefit and/or harm,
implications on the fate of	as well as the effects of soil	versa	soil biodiversity
manure additions?	biodiversity on the fate of		
(Section 3.1)	manure		
RQ2: Which practices help	Recommend best practices	To examine	Manure management
to achieve sustainable	for integrating soil	sustainable farming	and/or sustainable
manure management in	biodiversity in manure	practices for the role	agriculture, and
the EU? (Section 3.2)	management to enhance	and integration of	European Union
	benefits of manure for soil	manure	-
	biodiversity		
RQ3: What role and	To investigate the extent to	To examine the	Manure management
importance, if any, is	which European policy	integration of manure	and/or soil
attributed to soil	instruments integrate soil	management and soil	biodiversity, and/or
biodiversity in current	biodiversity and manure	biodiversity in legal	policy instruments,
European legislation on	management	frameworks	and/or European
manure management?			Union
(Section 3.3)			
RQ4: Which shortcomings	To determine knowledge	To evaluate and	Manure management
in regulations and	gaps and limitations in	combine/match the	shortcomings and/or
practices, if any, currently	current manure	findings derived from	limitations, and/or
prevent sustainable	management practices and	the two previous	sustainable
manure management in	regulations to recommend	methods	agriculture, and
the EU? (Section 3.4)	sustainable manure		European Union
			-

Effects of manure on soil biodiversity

Sustainable manure management practices

Soil biodiversity in EU legislation on manure management

Shortcomings in current legislations



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Review

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

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Effects on soil biodiversity are often not assessed
The interaction between manure and soil

biodiversity have not been reviewed



Table 2

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- 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.

Manure Treatments	Enviro	imentai impact	cts with focus on soils (see supplementary text in Appendix A Soil Biodiversity for more details)							
	NH3 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	++

 \rightarrow The higher the soil biodiversity, the better threats of manure contaminants can be prevented:

Table 3

The impact of soil biodiversity on the environmental threats caused by manure application: ++ 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 not available studies. Techniques separating manure into solid and liquid fraction allowing their separate management is not covered in the table since the impact on the environment and biodiversity depends on the fraction and the technique.

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

BENEFICIAL MANURE PRACTICES

MANURE QUALITY	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.					
	Respect animal welfare (space, stress,)					
	When animals have been treated with antibiotics, hormones or heavy metals, adding organic matter (e.g. plant residues) reduces the toxic effect of manure					
MANURE STORAGE	Combining storing and composting manure reduces antibiotics more efficiently					
MANURE TREATMENT	Manure from ill animals containing pathogens require treatment (e.g. composting or anaerobic digestion)					
	To prevent the leaching of N, high amounts of manure should be composted before application					
	Fermenting manure enhances benefits to soil biota (compost-tea preparations)					
MANURE QUANTITY	Application amount below 25t/ha -1. If manure contains toxic pollutants, the quantity should be reduced, see the threshold for heavy metals)					
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SUSTAINABLE MANURE MANAGEMENT

CHECKLIST: MANURE MANAGEMENT <> SOIL BIODIVERSITY

Soil Biodiversity in EU Manure Policies:

		Neglected:	
-	Animal By-Products and Derived Products Regulation 1069/2009		Quality of manure
-	The Common Agricultural Policy (CAP) Regulation (EU) No 1306/2013		
-	Air Quality and National Emission Ceilings Directive 2016/2284		Counciling with practicos
-	EU Nitrates Directive 91/676/EEC		beneficial for soil
-	Organic Production Schemes Council Regulation (EEC) No 2092/91		biodiversity
-	Fertilising Products Regulation (EC) No 2003/2003 replaced by Regulation (EU) 2019/1009		D
-	Veterinary Medicinal Directive 2001/82/EC replaced by Regulation EU/2019/6		Raw manure
-	Industrial Emissions Directive (2010/75/EU)		
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Conclusion



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LEGISLATION ON MANURE MANAGEMENT

- Is scattered across different policy areas and legislations
- Ignores effects on soil biodiversity

CONCLUSION & RECOMMENDATIONS

- Manure quality is currently neglected though crucial for soil biodiversity
- Soil biodiversity plays a crucial role in reducing pollution risks
- Pollution risks could be reduced by protecting and enhancing soil biodiversity
- Radical changes in philosophies and practices of intensive animal farming needed to protect soil biota and to reduce environmental risks and costs

Thanks!

@Andy Murray





Nematode, South Devon





A Platanurida species of springtail

A Temeritas species of springtail

Dicyrtomina novazealandae