SINGLE-IMPACT FICHE
MANURE PROCESSING TECHNIQUES

IMPACT: GLOBAL WARMING POTENTIAL (LCA)

Data extracted in July 2021
Fiche created in February 2024

Note to the reader: This fiche summarises the effects of Manure processing techniques on GLOBAL WARMING POTENTIAL (LCA). It is based on 2 synthesis papers[1], including 23 and 30 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effects of manure processing techniques (namely anaerobic digestion), as compared to untreated manure, on global warming potential (as calculated in LCA-modelling studies) are reported in **Table 1**.

The table below shows the number of synthesis papers with statistical tests reporting i) a significant difference between the Intervention and the Comparator, that is to say, a significant statistical effect, which can be positive or negative; or ii) a non-statistically significant difference between the Intervention and the Comparator. In addition, we include, if any, the number of synthesis papers reporting relevant results but without statistical test of the effects. Details on the quality assessment of the synthesis papers can be found in the methodology section of this WIKI.

- Positive effects (i.e. decrease of global warming potential, as CO_2-equivalents) was reported in 2 synthesis papers comparing farms performing anaerobic digestion processes (mono-digestion of manure with/without post-treatments such as filtration, reverse osmosis, microalgae, drying, stripping) to farms storing and managing raw manure.
- One synthesis paper reported non-statistically tested results on co-digestion of manure with other biomass feedstocks.

All selected synthesis papers included studies conducted in Europe (see **Table 2**).

Table 1: Summary of effects. Number of synthesis papers reporting positive, negative or non-statistically significant effects on environmental and climate impacts. The number of synthesis papers reporting relevant results but without statistical test of the effects are also provided. When not all the synthesis papers reporting an effect are of high quality, the number of synthesis papers with a quality score of at least 50% is indicated in parentheses. The reference numbers of the synthesis papers reporting each of the effects are provided in **Table 3**. Some synthesis papers may report effects for more than one impact or more than one effect for the same impact.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Decrease global warming potential (lca)	Global warming potential (CO_2-eq)	Anaerobic digestion	Conventional management	2	0	0	1

QUALITY OF THE SYNTHESIS PAPERS

The quality of each synthesis paper was assessed based on 16 criteria regarding three main aspects: 1) the literature search strategy and primary studies selection; 2) the statistical analysis conducted; and 3) the evaluation of potential bias. We assessed whether authors addressed and reported these criteria. Then, a quality score was calculated as the percentage of these 16 criteria properly addressed and reported in each synthesis paper. Details on quality criteria can be found in the methodology section of this WIKI.

2. IMPACTS

The main characteristics and results of the 2 synthesis papers are reported in **Table 2** with the terminology used in those papers, while **Table 3** shows the reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**. Comprehensive information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices, are provided in the **summaries of the synthesis papers** available in this WIKI.

Table 2: Main characteristics of the synthesis papers reporting effects on Global warming potential (LCA). The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref1	Dairy farm manure	Global	23	1) Anaerobic digestion (general); 2) Anaerobic monodigestion (only manure); 3) Anaerobic mono-digestion (only manure) + integrated treatment techniques (including filtration, reverse osmosis, microalgae, drying, stripping);	No treatment	Global warming potential	All types of waste-to-energy (anaerobic digestion) pathways could have a consensus on reducing global warming. However, anaerobic co-digestion did not show significant effects, for lack of data.	62%

[1] Synthesis research papers include either meta-analysis or systematic reviews with quantitative results. Details can be found in the methodology section of the WIKI.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
				4) Anaerobic co-digestion (manure + other substrates)				
Ref16	Dairy farms slurry manures	Global	30	Anaerobic digestion of manure only.	Raw slurry	The selected articles report emissions of different GHGs per functional unit [f.u.] (GHGi, i = CH_4, N_2O, or CO_2). To standardize the emissions, these are expressed as carbon dioxide equivalents (CO_2e).	The median reductions in emissions from the baseline scenarios, according to operation units, are −43.2% (n.s.) for storage, −6.3% for field application of slurries, −11.0% for offset of energy from fossil fuel, and +0.4% (n.s.) for offset of inorganic fertilizers. The leaks from digesters are found to significantly increase the emissions from baseline scenarios (median = +1.4%).	56%

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Decrease global warming potential (lca)	Global warming potential (CO_2-eq)	Anaerobic digestion	Conventional management	Ref1 and Ref16			Ref1

3. FACTORS INFLUENCING THE EFFECTS ON GLOBAL WARMING POTENTIAL (LCA)

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on Global warming potential (LCA), according to the synthesis papers reviewed.

Factor	Reference number
NA	Ref1, Ref1, Ref1, Ref1, Ref1, Ref1, Ref1, Ref1, Ref16, Ref16, Ref16, Ref16, Ref16, Ref16, Ref16 and Ref16

4. KNOWLEDGE GAPS

Table 5: Knowledge gap(s) reported by the authors of the synthesis papers included in this review.

Ref Num	Gap
Ref1	It was not possible for the present study on account of huge differences among publications and the lack of key information.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

Table 6: List of synthesis papers included in this review. More details can be found in the summaries of the meta-analyses.

Ref Num	Author(s)	Year	Title	Journal	DOI
Ref1	Zhang J., Wang M., Yin C., Dogot T.	2021	The potential of dairy manure and sewage management pathways towards a circular economy: A meta-analysis from the life cycle perspective	Sci. Total Environ. 779, 146396.	10.1016/j.scitotenv.2021.146396
Ref16	Miranda, ND; Tuomisto, HL; McCulloch, MD	2015	Meta-Analysis of Greenhouse Gas Emissions from Anaerobic Digestion Processes in Dairy Farms	Environ. Sci. Technol. 49, 5211–5219	10.1021/acs.est.5b00018

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