# SINGLE-IMPACT FICHE
## MANURE PROCESSING TECHNIQUES

## IMPACT: PUBLIC HEALTH RISK

Data extracted in July 2021

**Note to the reader**: This fiche summarises the impact of manure processing techniques on PUBLIC HEALTH RISK. It is based on 1 peer-reviewed synthesis research paper[1], including 98 individual studies.

## 1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  Different manure processing techniques showed different effects on public health risk, at the stage of land application of treated manure, as compared to raw manure (see **Table 1**). The number of synthesis papers reporting positive, negative or no effect is based on the statistical comparison of the intervention and the control. The number of synthesis papers reporting relevant results, but without statistical test of the effects is labelled as "uncertain".
  Either manure drying, composting, or anaerobic digestion, have positive effects on public health risk (i.e. decrease of public health risk, measured as the concentration of antibiotic resistant microbes and genes in environmental compartments after treated vs untreated manure land application) according to the 1 available synthesis paper.
  Other techniques, namely pasteurization, anaerobic lagoon, storage, aerobic lagoon storage and (solid manure) pile storage showed no significant effect on public health risk.
  The reviewed synthesis paper include data collected in Europe (see **Table 2**).

**Table 1.** Summary of effects. The effect with the higher score is marked in bold and the cell coloured. The numbers between parenthesis indicate the number of synthesis papers with a quality score of at least 50%. Details on quality criteria can be found in the next section.

| Impact | Metric | Intervention (Technique) | Positive | Negative | No effect | Uncertain* |
|---|---|---|---|---|---|---|
| Decrease public health risk | Antibiotic resistant microbes/genes | Drying | **1 (1)** | 0 | 0 | 0 |
| | | Composting | **1 (1)** | 0 | 0 | 0 |
| | | Anaerobic digestion | **1 (1)** | 0 | 0 | 0 |
| | | Pasteurization | 0 | 0 | **1 (1)** | 0 |
| | | Anaerobic lagoon storage | 0 | 0 | **1 (1)** | 0 |
| | | Aerobic lagoon storage | 0 | 0 | **1 (1)** | 0 |
| | | Pile storage | 0 | 0 | **1 (1)** | 0 |

* Number of synthesis papers that report relevant results but without statistical test comparison of the intervention and the control.

- QUALITY OF THE SYNTHESIS PAPERS: *The quality score summarises 16 criteria assessing the quality of three main aspects of the synthesis papers: 1) the literature search strategy and studies selection; 2) the statistical analysis; 3) the potential bias. Details on quality criteria can be found in this document* →.

As shown in the "Quality score" in **Table 2**, the quality level of the synthesis paper was of 100%.

[1] Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results

## 2. IMPACTS

The main characteristics and results of the synthesis papers are summarized in **Table 2**. Detailed results of each synthesis study are reported in the summary reports .

**Table 2.** Main characteristics of the synthesis papers reporting impacts of manure processing techniques on public health risk. The references are ordered chronologically with the most recent publication date first.

| Reference | Population | Scale | Num. papers | Intervention (technique) | Comparator | Metric | Conclusion | Quality score |
|---|---|---|---|---|---|---|---|---|
| Goulas, A; Belhadi, D; Descamps, A; Andremont, A; Benoit, P; Courtois, S; Dagot, C; Grall, N; Makowski, D; Nazaret, S; Nelieu, S; Patureau, D; Petit, F; Roose-Amsaleg, C; Vittecoq, M; Livoreil, B; Laouenan, C 2020 | Livestock waste and sewage sludge | Global | 98 | Six types of treatments were considered: aerobic and anaerobic digestion, aerobic and anaerobic lagoon storage, composting, drying, pasteurization and pile storage. | No treatment | Relative abundance of antibiotic resistance markers (ARG/MGE, e.g., number of antibiotic resistance genes copies in total microbial biomass estimated by number of 16S rRNA copies in environmental sample). | The authors obtained significant results for composting, drying and a (non-significant) trend for anaerobic digestion in reducing ARG/MGE relative abundance, when organic waste treatments were compared together in the same model. Thermophilic treatments showed greater reductions in ARG/MGE relative abundance than mesophilic ones after anaerobic digestion. Consequently, treatments with thermophilic phases should be implemented before the application of organic waste products on agricultural soils. Pasteurization resulted in non-significant effect, due to a large variability and low number of observations (N=4). Anaerobic or aerobic lagoon storage and solid manure pile storage have no significant effect on antibiotic resistance genes. | 100% |

## 3. KNOWLEDGE GAPS

| | |
|---|---|
| Goulas et al. | Variability of confidence intervals across studies could be explained at least by the diversity of substrates (manure, sludge, milk or mixtures), the abundances of antibiotic-resistant bacteria before treatment, the diversity of microbial community, and/or the diversity and concentrations of antibiotics tested. To address those hypotheses, more replicates of studies are needed and deeper chemical and microbial characterization of the environmental matrices is needed. The authors also identified a knowledge gap on possible other manure processing techniques. |

## 4. SYSTEMATIC REVIEW SEARCH STRATEGY

| | |
|---|---|
| Keywords | TOPIC: (manure OR slurry OR digestate OR (digested near/3 manure)) AND TOPIC: (management OR storage OR lagoon* OR "anaerobic digest*" OR tank* OR treatment OR process* OR technolog* OR techni* OR (soil near/3 application) OR (soil near/3 distribution) OR (soil near/3 amend*) OR biogas OR precision) AND TOPIC: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis")<br><br>or<br><br>TITLE-ABS-KEY: (manure OR slurry OR digestate OR (digested W/3 manure)) AND TITLE-ABS-KEY: (management OR storage OR lagoon* OR "anaerobic digest*" OR tank* OR treatment OR process* OR technolog* OR techni* OR (soil W/3 application) OR (soil W/3 distribution) OR (soil W/3 amend*) OR biogas OR precision) AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") |
| Search dates | No time restrictions |
| Databases | Web of Science and Scopus, run in July 2021 |
| Selection criteria | The main criteria that led to the exclusion of a synthesis paper were if the paper: (1) was out of the scope; (2) did not deal with manure processing techniques or dealt with other stages of manure management (e.g. storage, land application, animal housing techniques); (3) reported studies with absolute values of emission factors, without comparing processing techniques with a reference management scenario; (4) did not clearly state the intervention and comparator; (5) was not either a systematic review or a meta-analysis; (6) was not written in English. Synthesis papers that passed the relevance criteria were subject to critical appraisal carried out on paper-by-paper basis.<br><br>The search returned 269 synthesis papers potentially relevant for the practice object of our fiche. Searches for other farming practices added another 8 potentially relevant synthesis papers. From the 277 potentially relevant synthesis papers, 207 were excluded after reading the title and abstract, and 53 after reading the full text according to the above-mentioned criteria. Finally, 17 synthesis papers were selected for manure processing techniques, from which 1 was relevant for this impact. |