Data Article

Life cycle inventory data on French organic waste treatments yielding organic amendments and fertilisers

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ABSTRACT

To inform the modelling of organic waste treatments yielding organic amendments and fertilisers in France, published as "Screening LCA of French organic amendments and fertilisers" [1], we compiled data pertaining to the chemical characteristics of both raw and treated organic residues, as well as inventory data on the most common organic waste treatments. The majority of these life cycle inventory data was obtained from reports and other literature, but primary data was also compiled, notably for commercial organic fertiliser production. The data presented here can be used by future life cycle assessment studies on organic waste treatments, as well as to inform agricultural modelling.

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Specifications Table

Subject	Environmental Science
Specific subject area	Life cycle modelling of treatment activities on organic waste streams yielding organic amendments and fertilisers.
Type of data	Table
How data were acquired	The vast majority of the data was obtained from grey and scientific literature, as well as directly from researchers (unpublished data). The data pertaining the commercial production of organic amendments and fertilisers was obtained by means of direct questioning of technical responsible of the concerned processes in the context of field visits. The interviews relied on structured questionnaires. The two commercial organic fertilisers producers preferred to remain anonymous.
Data format	Raw Analysed Filtered
Parameters for data collection	Secondary data was collected only from reputable sources: scientific literature or project/expertise reports by recognised French institutions (technical institutes, national research institutions and researchers from said institutions, national and regional statistics, national standards). Primary data consisted of recalls from technical personnel of commercial organic production firms, which were confirmed *in situ* by consulting internal corporate reports. Data quality was assessed based on expert opinion (see list of consulted experts in Acknowledgements).
Description of data collection	Secondary data collection was based on literature review (followed by data treatment) and interviews with experts. Primary data collection was carried out by means of interviews involving fact-checking. Data quality (pedigree) was determined based on expert opinion, following a common practice regarding life cycle inventory databases.
Data source location	Institution: ADEME, AFAÏA, ARVALIS, CIRAD, IDELE, IFIP, INRA, Irstea City/Town/Region: National presence Country: France
Data accessibility	With the article
Related research article	Angel Avadí Screening LCA of French organic amendments and fertilisers The International Journal of Life Cycle Assessment DOI: to be assigned (submission JLCA-D-19-00175R1 under final review by editor)

Value of the Data
- The data may be useful to inform studies using life cycle approaches to describe organic waste treatments.
- The data may be useful to inform featuring the modelling of agricultural systems that include organic fertilisers as inputs.
- The data has European relevance, and originates mainly from France.
- Any life cycle or agricultural modeller may benefit from these data.
- The data is intended to be used as default references in the absence of primary data, or to fill data gaps.
- The aggregation and consolidation of disperse data informing life cycle inventories on key treatment processes, adds value by centralising it and providing reference values.

1. Data

To inform the modelling of organic waste treatments yielding organic amendments and fertilisers in France, published as "Screening LCA of French organic amendments and fertilisers" [1], we compiled data pertaining to the chemical characteristics of both raw and treated organic residues, as well as inventory data on the most common organic waste treatments.

Table 1 presents the criteria currently applied in France for the classification of products from organic residues treatments as amendments or fertilisers. These criteria are related to the products' composition.

The data (see the Supplementary Material), consists of tables presenting the mean composition of a large list of organic waste treatment products, as well as the life cycle inventories for the concerned organic waste treatments.

Composition data is presented per general product category, and includes uncertainty data (e.g. a range of values). For each parameter, three values are presented: the first value of each table cell is the

Table 1
Criteria, relative to composition, for the classification of products from organic residues treatments as amendments or fertilisers, in France.

Products explicitly classified in French standards	French standard	N (%)	Organic N (%)	NO$_3$ + NH$_4$ + ureaic N (%)	P$_2$O$_5$ (%)	K$_2$O (%)	N + P$_2$O$_5$ + K$_2$O (%)	C/N	Organic matter (%)	Dry matter (%)
Organic amendments		Conditions to be met								
Manure (solid)	NFU 44-051	<3	–	<33 of N	<3	<3	<7	>8	>20	>30
Composted manure and litter (except poultry litter)	NFU 44-051	<3	–	<33 of N	<3	<3	<7	>8	>20	>30
Composted green waste	NFU 44-051	<3	–	<33 of N	<3	<3	<7	>8	>20	>30
Composted biowaste	NFU 44-051	<3	–	<33 of N	<3	<3	<7	>8	>20	>30
Composted animal and/or vegetal matter	NFU 44-051	<3	–	<33 of N	<3	<3	<7	>8	>20	>30
Vegetal and/or animal materials, raw or treated	NFU 44-051	<3	–	<33 of N	<3	<3	<7	>8	>25	>30
Composts and digestates containing dewatered sewage sludge[1]	NFU 44-095	<3	–	–	<3	<3	<7	–	–	–
Organic fertilisers		Conditions to be met								
Press cakes	NFU 42-001	>3	–	<1	–	–	–	–	–	–
N organic fertiliser of animal and/or vegetal origin	NFU 42-001	>3	–	<1	–	–	–	–	–	–
Poultry droppings (dried)	NFU 42-001	>3	>1	–	>2.5	–	>7	–		>75
Slurry-based products (phase separated, composted, digested)	NFU 42-001	>1.5	>1	–	>3	–	>6	–		>40
Composted poultry litter	NFU 42-001	>2	>1	–	>2	>2	>7	–		>50
NPK organic fertiliser of animal and/or vegetal origin	NFU 42-001	–	>1	–	–	–	>7	–		–
N organo-mineral fertiliser	NFU 42-001	>3	>1	–	–	–	–	–		–
NPK organo-mineral fertiliser	NFU 42-001	>2	>1	–	>2	>2	>7	–		–

Source [2–4].[1]

Table 2
Headers of data tables in the Supplementary Material.

Table numbering	Title	Fields
Table A	Composition of organic fertilisers	Residual organic amendments and fertilisers, C/N, DM (%), NTK (g/kg), N−NH4 (g/kg), P (g/kg), K (g/kg), C (g/kg), MFE, KeqN, Sources
Table B	Trace elements in organic fertilisers	Residual organic amendments and fertilisers, Cd (mg/kg), Cr (mg/kg), Cu (mg/kg), Hg (mg/kg), Ni (mg/kg), Pb (mg/kg), Zn (mg/kg), As (mg/kg), Se (mg/kg)
Table C	Composition of French commercial organic fertilisers	6 ingredients (expressed as percentages of the total product mass) for 7 products: 1 organic amendment, 3 organic fertilisers and 3 organo-mineral fertilisers
Table D	Abridged life cycle inventories for stocking of organic residues, per 1 t fresh mass input	Infrastructure, energy, chemicals and emission factors associated with 10 systems: • Liquid sewage sludge, in silo • Solid sewage sludge, in concreted area • Swine slurry, in silo • Swine slurry, in concrete pit • Cattle slurry, in silo • Cattle slurry, in concrete pit • Cattle manure, in concreted area or pit • Poultry manure, in concreted area or pit • Swine manure, in heap • Digestate, agricultural, stocked in silo
Table E	Abridged life cycle inventories for dewatering/phase separation of organic residues, per 1 t of dry matter in input	Infrastructure, energy, chemicals and emission factors associated with 5 systems: • Digestate, by centrifugal decanter • Swine slurry, by centrifugal decanter • Sewage sludge, by centrifugation • Sewage sludge, by belt filter • Sewage sludge, by filter press
Table F	Abridged life cycle inventories for composting organic residues, per 1 t fresh mass input	Infrastructure, energy, chemicals and emission factors associated with 8 systems: • Sewage sludge + green waste • Green waste • Biowaste + green waste • Biowaste • Solid fraction of agricultural digestate • Solid fraction of mixed slurry • Swine slurry + straw • Cattle manure + wool + press cakes
Table G	Abridged life cycle inventories for anaerobic digestion of organic residues, per 1 t fresh mass input	Infrastructure, energy, chemicals and emission factors associated with 8 systems: • Sewage sludge • Swine slurry + solid fraction of swine slurry • Cattle slurry • Mixed manure + swine slurry • Maize silage • Maize silage (5%) + swine slurry (95%) • Maize silage (19%) + swine slurry (81%) • Biowaste
Table H	Life cycle inventories for processed agricultural residues (in fresh mass)	Raw materials, energy and water associated with 7 systems, including mass and economic allocation keys for coproducts: • Coffee processing • Cocoa processing • Olive processing • Pomace processing • Greasy wool scouring • Greasy wool skirting • Rendering of animal by-products
Table I	Emission factors for composting processes (per 1 t fresh mass input)	Emission factors for CO2, CH4, N2O, NH3, and VOC associated with the composting systems listed in Table F. Uncertainty data is provided as a recommended value plus a minimum and maximum values.

Table 3
Life cycle inventory questionnaire for commercial amendment and fertilisers producers.

Guiding questions	Expected response type
What products and types/categories of products are produced in your facility?	Narrative numeric data (production volumes and proportions)
Please describe the site's infrastructure, including built area, main equipment and machinery, installed capacity, life span of all items, etc.	Narrative with a list of items and numeric data
Please describe the characteristic processes resulting in the main product types.	Narrative, flow diagram including numeric data (masses, durations)
Do you measure any direct emissions? If so, please provide historic or representative measurements.	Narrative with numeric data
Please provide detailed data per process and per product type, including raw materials, waste streams including wastewater, products, energy consumption, water consumption, chemicals consumption, transported distances of all inputs.	Tables of numeric data, assumption on allocation of energy and water, formulation of multi-input product types
Please describe the wastewater and waste treatment pathways	Narrative with numeric data
Please describe frequency and interventions associated with site maintenance.	Narrative with numeric data

recommended value, the second the minimum reported and the third the maximum reported. Missing values are indicated by a dash (−). Parameters presented include those of agricultural relevance (e.g. nutrients) as well as trace elements.

Composition and trace element content data is expressed (except for certain indicated exceptions) per unit of fresh mass. We chose to express all data in terms of fresh mass to prevent bias and uncertainty associated with expressing composition data in terms of dry matter, because the water content of organic amendments and fertilisers is distributed along a wide range.

The composition (in terms of ingredients) of commercial organic fertilisers is presented. These compositions are representative of French practices, simpler cattle manure composts were also used to compute the minimum range of KeqN values in the composition data.

Life cycle inventories of specific treatment processes, namely i) stocking of organic residues, solid and liquid, ii) dewatering/phase separation of liquid organic residues, iii) composting of organic residues, including substrate mixtures, iv) anaerobic digestion of organic residues, including substrate mixtures, v) processing of agricultural residues into inputs to organic fertilisers, and vi) additional emission factors for composting processes, including uncertainty data; are presented.

Life cycle inventory data is predominantly presented per unit of fresh mass input to a process, except for certain cases in which data is presented per unit of dry mass (i.e. dewatering/phase separation processes on substrates such as sludge and slurries). In all cases, the relevant functional/reference unit is indicated.

All data table headers are presented in Table 2. All background data was sourced from ecoinvent v.3.5.

2. Experimental design, materials, and methods

The data on the criteria currently applied in France for the classification of products from organic residues treatments as amendments or fertilisers was obtained via literature review, where a handful of sources [2,4,5] contributed the bulk of up to date data.

The data on commercial organic amendments and fertilisers were obtained by means of interviews with two anonymous French producers (two of the largest organic producers among ~50 producers

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[1] Technically "materials of agronomic interest from wastewater treatment", referred to among French institutions and researchers as "matières d'intérêt agronomique issus du traitement des eaux" (MIATE).

Table 4

Quality assessment of collected secondary data for life cycle inventories.

Data	Pedigree score	Key sources[a]	Comments
Product composition data	2-2-3-2-1	[6,7,9–11]	The majority of sources were published after 2010. The majority of sources are specific to the French context, but a few present data of European validity.
Dominant treatment routes	1-2-3-1-2	[7,9,11–14]	Routes are France-specific, but undoubtedly also common in Europe
Treatment processes: Substrate stocking	2-2-3-2-2	[14,15]	The majority of emission factors were sourced from Ref. [15], which is a recent collection of emission factors from organic waste stoking, in France and Europe.
Treatment processes: Dewatering/phase separation of substrates	2-2-3-2-2	[9,11,14]	Data is representative of the French context.
Treatment processes: Composting of substrates	2-3-3-3-2	Processes [14,16]: Emissions [17,18]:	Some process and emission data represent European conditions.
Treatment processes: Anaerobic digestion of substrates	2-3-3-3-2	Processes [14,19]: Emissions: expertise IRSTEA[b]	Some process and emission data represent European conditions.
Substrate processes: Processing of agricultural residues	2-3-3-3-2	[20]	Data represent European conditions.

[a] The full list of data sources is presented in the Supplementary Material.
[b] https://www.irstea.fr/fr/recherche/unites-de-recherche/opaale.

associated with the Union of Fertilisation Industries - UNIFA, https://www.unifa.fr/qui-sommes-nous/les-adherents-de-lunifa), based on the structured questionnaire depicted in Table 3. The annual output of one of the two surveyed producers represents ~18% of the total French production of commercial organic amendments and fertilisers.

Data on composition of treatment products and on treatment processes were sought and obtained, predominantly representing French conditions, yet generally valid at the European level. When specific French data was not found for specific processes, other central European data were retained.

The product composition data was also obtained via literature review, and occasionally adjusted to harmonise units. Sources for basic composition included technical, research and commercial product reports, as well as theses and scientific publications. Two detailed reports associated with large research projects provided all data for trace element contents [6,7]. Data sources for informing life cycle inventories were also retrieved from grey and scientific literature.

Table 4 presents a quality assessment of the collected secondary data, following the ecoinvent pedigree approach, consisting of a decreasing 1–5 ranking of data reliability, completeness, temporal correlation, geographical correlation and further technological correlation [8].

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.105000.

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