Life cycle assessment of oat flake production with two end-of-life options for agro-industrial residue management

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Table S1. Average characteristics of the study farm's fields.

Clay (%)	24
Sand (%)	30
Organic matter (%)	4.8
pH	6.7
Phosphorus available - Mehlich method (kg P/ha)	96
Natural phosphorus (mg P/kg)	980
Average slope (%)	2

Table S2. Data used to replace synthetic fertilizers with industrial compost.

Nutrient	Compost	Ecoinvent data
N[a]	4,015 kg t^{-1}	Nitrogen fertiliser, as N {GLO}| market for | Cut-off, U
P[b]	6,183 kg t^{-1}	Phosphate fertiliser, as P2O5 {GLO}| market for | Cut-off, U
K[c]	8,712 kg t^{-1}	Potassium fertiliser, as K2O {GLO}| market for | Cut-off, U

[a]We consider a substitution of 1:1

[b]To convert P to $P_2 0_5$, we multiplied the amount of P by 2.29 (molar ratio)

[c]To convert k to $k_2 0$, we multiplied the amount of K by 1.21 (molar ratio)

Table S3. Features and specifications of feed grade oat pellets expressed in %.

Dry matter	90.7
Crude protein	8.1
Fat	2.9
ADF fiber	27.1
NDF fiber	50.7
Calcium	0.13
Phosphorus	0.2
Sodium	0
Potassium	0.73
Ash	3.5
Vomitoxins ppm	0.1
Zearalenone ppm	0.237

Table S4. Sources and values used to quantify nitrogen and phosphate emissions to air and water for oat grain production

Pollutants	Sources/Values
Emissions to air	
NH_3	Brentrup et al. (2000): 10.46 kg NH_3 ha $year^{-1}$
N_2O	Hergoualc'h et al. (2019): 0.011 kg NO_x-N kg N^{-1} (urea) 0.007 kg NO_x-N kg N^{-1} (Monoammonium phosphate - MAP)
NO_2 (direct)	Rochette et al. (2018): 0.0211 kg N_2O-N kg N^{-1} (synthetic fertilizer)
NO_2 (indirect)	Hergoualc'h et al. (2019): 1.0% of N contained in NH_3 and NO_x volatilizes as N_20 0.75% of N contained in leached NO_3 volatilizes as N_2O
Emissions to water	
NO_3	Roy et al. (2003): 0.134 kg NO_3-N kg N^{-1} (synthetic fertilizers)
PO_4^{3-}	Michaud et al. (2008): Oat production: 1.47 kg PO_4 ha $year^{-1}$

Table S5. LCA results of oat flakes production according to selected sensitivity scenarios.

Impact categorie	Scenario		Oat grain production	Oat flake production	Hulls end-of-life	Avoided impacts	Total
Global warming (kg CO_2 eq)	Québec	Compost	449	115	37	6.9	594
		Annimal feed (0%)	449	115	1.7	0	566
		Annimal feed (10%)	449	115	1.7	20	546
		Annimal feed (50%)	449	115	1.7	101	466
	Manitoba	Compost	449	128	37	6.9	608
		Annimal feed (0%)	449	128	5.4	0	582
		Annimal feed (10%)	449	128	5.4	20	562
		Annimal feed (50%)	449	128	5.4	101	482
	Sasketawan	Compost	449	290	49	6.9	782
		Annimal feed (0%)	449	290	54	0	794
		Annimal feed (10%)	449	290	54	20	774
		Annimal feed (50%)	449	290	54	101	693
	Alberta	Compost	449	334	52	6.9	829
		Annimal feed (0%)	449	334	68	0	852
		Annimal feed (10%)	449	334	68	20	831
		Annimal feed (50%)	449	334	68	101	751
	Québec	Compost	1.45	0.1	0.07	0.006	1.62

Fine particulate matter formation (kg PM2.5 eq)		Annimal feed (0%)	1.45	0.1	0.0012	0	1.56
		Annimal feed (10%)	1.5	0.1	0.0	0.03	1.52
		Annimal feed (50%)	1.5	0.1	0.0	0.2	1.4
	Manitoba	Compost	1.5	0.1	0.07	0.0	1.6
		Annimal feed (0%)	1.5	0.1	0.01	0.0	1.6
		Annimal feed (10%)	1.5	0.1	0.01	0.0	1.5
		Annimal feed (50%)	1.5	0.1	0.01	0.2	1.4
	Sasketawan	Compost	1.5	0.3	0.08	0.0	1.8
		Annimal feed (0%)	1.5	0.3	0.05	0.0	1.8
		Annimal feed (10%)	1.5	0.3	0.05	0.0	1.7
		Annimal feed (50%)	1.5	0.3	0.05	0.2	1.6
	Alberta	Compost	1.5	0.3	0.09	0.0	1.9
		Annimal feed (0%)	1.5	0.3	0.07	0.0	1.9
		Annimal feed (10%)	1.5	0.3	0.07	0.0	1.8
		Annimal feed (50%)	1.5	0.3	0.07	0.2	1.7
Terrestrial acidification (kg SO_2 eq)	Québec	Compost	8.9	0.25	0.23	0.015	9.4
		Annimal feed (0%)	8.9	0.25	0.003	0	9.2
		Annimal feed (10%)	9.0	0.25	0.00	0.2	9.1

		Annimal feed (50%)	9.0	0.3	0.00	0.8	8.4
	Manitoba	Compost	9.0	0.3	0.23	0.0	9.5
		Annimal feed (0%)	9.0	0.3	0.01	0.0	9.3
		Annimal feed (10%)	9.0	0.3	0.01	0.2	9.1
		Annimal feed (50%)	9.0	0.3	0.01	-0.8	8.4
	Sasketawan	Compost	9.0	0.8	0.27	0.0	10
		Annimal feed (0%)	9.0	0.8	0.17	0.0	10
		Annimal feed (10%)	9.0	0.8	0.17	0.2	9.8
		Annimal feed (50%)	9.0	0.8	0.17	0.8	9.1
	Alberta	Compost	9.0	1.0	0.28	0.0	10.2
		Annimal feed (0%)	9.0	1.0	0.22	0.0	10.2
		Annimal feed (10%)	9.0	1.0	0.22	0.2	10
		Annimal feed (50%)	9.0	1.0	0.22	0.8	9.3
Mineral resource scarcity (kg Cu eq)	Québec	Compost	0.9	0.06	0.2	0.04	1.1
		Annimal feed (0%)	0.9	0.06	0.009	0	0.97
		Annimal feed (10%)	0.9	0.06	0.009	0.05	0.92
		Annimal feed (50%)	0.9	0.1	0.01	0.3	0.7
	Manitoba	Compost	0.9	0.1	0.20	0.0	1.1
		Annimal feed (0%)	0.9	0.1	0.01	0.0	1.0

		Annimal feed (10%)	0.9	0.1	0.01	0.1	0.9
		Annimal feed (50%)	0.9	0.1	0.01	0.3	0.7
	Saskatchewan	Compost	0.9	0.1	0.20	0.0	1.1
		Annimal feed (0%)	0.9	0.1	0.02	0.0	1
		Annimal feed (10%)	0.9	0.1	0.02	0.1	1
		Annimal feed (50%)	0.9	0.1	0.02	0.3	0.8
	Alberta	Compost	0.9	0.1	0.20	0.0	1.2
		Annimal feed (0%)	0.9	0.1	0.02	0.0	1
		Annimal feed (10%)	0.9	0.1	0.02	0.1	1
		Annimal feed (50%)	0.9	0.1	0.02	0.3	0.8

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