

Supplementary Material

1 Supplementary Tables

Supplementary Table S1: Available information for the emission factors included in group 1, considering its values, 95 % confidence intervals, references used, and probability distributions fitted for the simulation processes carried out in the present study.

Process	Source	Available Information			Fitted probability distribution
		Value	95 % C. I.	Reference	
Enteric Fermentation kg/(head year)	Buffalo*	68			
	Sheep	5			
	Goats	5	± 50 %	(IPCC, 2019b)	Normal
	Horses	18			
	Swine	1			
Manure Management kg/(head year)	Cattle	1			
	Horses	1.64			
	Goats	0.17	± 30 %	(IPCC, 2006d)	Normal
	Swine	1			
	Poultry	0.02			
Bio. Treat. of Solid Waste g/kg	Composting (CH ₄)	4	[0.03, 8.00]		
	Composting (N ₂ O)*	0.24	[0.06, 0.60]	(IPCC, 2006f)	(Asymmetric) Triangular
	Anaerobic digestion	2	[0.0, 20.0]		

*Values were updated according to 2019 IPCC guidelines, causing differences between estimated and official emission factors.
C. I.: Confidence Interval.

Supplementary Table S2. Available information for the input quantities used to estimate the emission factors included in group 2, considering its values, 95 % confidence intervals, references used, and probability distributions fitted for the Monte Carlo simulation method carried out in the present study.

Process	Source	Input Quantity	Available Information			Fitted probability distribution
			Value	95 % C. I.	Reference	
Industrial Wastewater Treatment	Anaerobic reactor	B_o (kg/kg)	0.25	$\pm 30 \%$	(IPCC, 2006g) and (IPCC, 2019d)	Normal
		MCF (1)	0.8	$\pm 10 \%^s$		
	Anaerobic shallow lagoon	B_o (kg/kg)	0.25	$\pm 30 \%$		
		MCF (1)	0.8	$\pm 10 \%^s$		
	Anaerobic deep lagoon	B_o (kg/kg)	0.25	$\pm 30 \%$		
		MCF (1)	0.2	$\pm 30 \%^s$		
	River discharge	B_o (kg/kg)	0.25	$\pm 30 \%$		
		MCF^* (1)	0.11	$\pm 50 \%^s$		
Domestic Wastewater Treatment	(Anaerobic shallow) Lagoon	B_o (kg/kg)	0.6	$\pm 30 \%$	(IPCC, 2006g) and (IPCC, 2019d)	Normal
		MCF (1)	0.2	$\pm 30 \%$		
		BOD (g/(person day))	40	$\pm 30 \%$		
	Septic tank	B_o (kg/kg)	0.6	$\pm 30 \%$		
		MCF (1)	0.5	$\pm 10 \%$		
		BOD (g/(person day))	40	$\pm 30 \%$		
	River discharge	B_o (kg/kg)	0.6	$\pm 30 \%$		
		MCF (1)	0.11	$\pm 50 \%$		
		BOD (g/(person day))	40	$\pm 30 \%$		

C. I.: Confidence Interval.

*Values were updated according to 2019 IPCC guidelines, causing differences between estimated and official emission factors.

^sIntervals were taken from domestic wastewater values according to expert judgement from three technical experts.

Supplementary Table S3: Available information for the input quantities used to estimate the emission factors included in group 3, considering its values, 95 % confidence intervals, references used, and probability distributions fitted for the Monte Carlo simulation method carried out in the present study.

Process	Source	Input Quantity	Available Information			Fitted probability distribution
			Value	95 % C. I.	Reference	
Non-Energy Products Use	Lubricants	AW_C^* (g/mol)	12.0106	[12.0096, 12.0116] [#]	(CIAAW, 2020)	Uniform
		AW_O^* (g/mol)	15.9994	[15.999 03, 15.999 77] [#]		
		ODU (1)	0.2	± 50 %	(IPCC, 2006c)	Normal
		CC (kg/GJ)	20	[-2.0 %, +2.5 %]	(IPCC, 2006b)	Log-normal
		NCV (TJ/Gg)	40.2	[-16.7 %, +5.2 %]		
		$\rho_{r\ lub}^*$ (1)	0.8807 [‡]	[0.8744, 0.8873] [‡]	(Morales, 2016)	t -distribution (df = 20)
		ρ_{H_2O} (kg/L)	0.999 103	[0.997 843, 1.000 363] [§]	(ASTM, 2019)	Normal
Solid Waste Disposal	Landfill	AW_C^* (g/mol)	12.0106	[12.0096, 12.0116] [#]	(CIAAW, 2020)	Uniform
		AW_H^* (g/mol)	1.007 975	[1.007 84, 1.008 11] [#]		
		MCF (1)	1	[-10 %, +0 %]	(IPCC, 2019c)	(Asymm.) Triangular
		DOC_1 [food] (kg/kg)	0.15	± 20 %	(IPCC, 2006e) and (IPCC, 2019c)	Normal
		DOC_2 [paper] (kg/kg)	0.4	± 20 %		
		W_1 [food] (1)	0.529	± 30 %	(FEDEMUR, 2002) and (IPCC, 2019c)	Normal
		W_2 [paper] (1)	0.19	± 30 %		
		DOC_l^* (1)	0.5	± 20 %	(IPCC, 2019c)	Normal
		F^* (1)	0.5	± 5 %		

C. I.: Confidence Interval.

[§]Interval was estimated based on the precision and bias of the method.

[‡]Value and interval were estimated from raw data.

[#]Intervals corresponds to 100 % confidence intervals.

^{*}Values were updated causing differences between estimated and official emission factors.

Supplementary Table S4: Estimated values, relative standard uncertainties, and 95 % relative confidence intervals for the emission factors using the Monte Carlo simulation method. Updated values are suggested for emission factors marked with an asterisk (*).

Process / Sources	Gas	Estimated Emission Factor	Estimated Std. Uncertainty (u)	Estimated 95 % C. I.
<u>Enteric Fermentation</u>		Units: kg/(head year)		
Buffalo*	CH ₄	68	25 %	[-50 %, +50 %]
Sheep	CH ₄	5.00	25 %	[-50 %, +50 %]
Goats	CH ₄	5.00	25 %	[-50 %, +50 %]
Horses	CH ₄	18.0	25 %	[-50 %, +50 %]
Swine	CH ₄	1.00	25 %	[-50 %, +50 %]
<u>Manure Management</u>		Units: kg/(head year)		
Cattle	CH ₄	1.00	15 %	[-30 %, +30 %]
Horses	CH ₄	1.640	15 %	[-30 %, +30 %]
Goats	CH ₄	0.170	15 %	[-30 %, +30 %]
Swine	CH ₄	1.00	15 %	[-30 %, +30 %]
Poultry	CH ₄	0.020	15 %	[-30 %, +30 %]
<u>Biological Treatment of Solid Waste</u>		Units: g/kg		
Composting	CH ₄	4.00	49.33 %	[-99.25 %, +100 %]
Composting*	N ₂ O	0.24	58.75 %	[-75 %, +150 %]
Anaerobic digestion	CH ₄	2.00	289 %	[-100 %, 900 %]
<u>Industrial Wastewater Treatment</u>		Units: kg/kg		
Anaerobic reactor	CH ₄	0.200	15.85 %	[-31 %, +31 %]
Anaerobic shallow lagoon	CH ₄	0.200	15.85 %	[-31 %, +31 %]
Anaerobic deep lagoon	CH ₄	0.050	21.40 %	[-39 %, +45 %]
River discharge*	CH ₄	0.028	28.93 %	[-54 %, +59 %]
<u>Domestic Wastewater Treatment</u>		Units: kg/(person year)		
(Anaerobic shallow) Lagoon	CH ₄	1.752	26.26 %	[-45 %, +58 %]
Septic tank	CH ₄	4.380	21.92 %	[-39 %, +47 %]
River discharge	CH ₄	0.964	33.30 %	[-56 %, +74 %]
<u>Non-Energy Products Use</u>		Units: kg/L		
Lubricants*	CO ₂	0.5184	25.79 %	[-50 %, +52 %]
<u>Solid Waste Disposal</u>		Units: kg/kg		
Landfill*	CH ₄	0.0519	16.57 %	[-34 %, +31 %]

C. I.: Confidence Interval.

*Emission factors and their uncertainties were estimated with updated reference data.