Supporting Information (SI)

Energy and environmental performance of Nile tilapia processing methods for a circular economy in the fish industry

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Table S.1 Characterization of the foreground inventory quality and background inventory source for Nile tilapia processing and distribution.

Parameter			Basic uncertainty	Pedigree score	Background data
Processing	Input	Infrastruture	3.00	5,1,1,1,4	Chemical factory, organics {GLO} - market for - Cut-off, S
		Electricity	1.05	2,1,1,1,1	Electricity, low voltage {BR} - market group for electricity, low voltage - Cut-off, S
		Potable water	1.05	2,1,1,1,1	Tap water {BR} - market for tap water - Cut-off, S
		Harvested Nile tilapia	1.05	1,1,1,1,1	Petroski et al. (2024)
		Transport, pick-up truck	2.00	2,1,1,1,1	Transport, freight, light commercial vehicle {RoW} - market for transport, freight, light commercial vehicle - Cut-off, S
		Ice	1.05	2,1,1,1,1	Tap water {BR} - market for tap water - Cut-off, S; Electricity, low voltage {BR} - market group for electricity, low voltage - Cut-off, S
	Output	Wastewater, treament	1.05	2,1,1,1,1	Wastewater, average {RoW} - treatment of, capacity 1E9l/year - Cut-off, S
Distribution	Input	Transport, refrigerated truck	2.00	2,1,1,1,1	Transport, freight, lorry with refrigeration machine, freezing {GLO} - market for - Cut-off, S
		Electricity	1.05	2,1,1,1,1	Electricity, low voltage {BR} - market group for electricity, low voltage - Cut-off, S
		Infrastructure	3.00	4,1,1,1,2	Fish freezing plant {RoW} - fish freezing plant construction and maintenance - Cut-off, S

Table S.2 Characterization of the foreground inventory quality and background inventory source of fishmeal and fish oil production.

Parameter		Basic uncertainty	Pedigree score	Background data
Input	Infrastruture	3.00	4,2,1,1,2	Fishmeal plant {GLO} - market for fishmeal plant - Cut-off, S
	Electricity	1.05	2,1,1,1,1	Electricity, low voltage {BR} - market group for electricity, low voltage - Cut-off, S
	Water, groundwater	1.05	2,1,1,1,1	Water, well, BR
	Co-products of Nile tilapia	1.05	2,1,1,1,1	Table S.1
	Transport, refrigerated truck	2.00	2,1,1,1,1	Transport, freight, lorry with refrigeration machine, freezing {GLO}| market for | Cut-off, S
	Antioxidant	1.05	2,1,1,1,1	Chemical, organic {GLO} - market for - Cut-off, S
	Heat, wood, burned	1.05	2,1,1,1,1	Heat, district or industrial, other than natural gas {RoW}- heat production, hardwood chips from forest, at furnace 1000kW - Cut-off, S
Output	Evaporated water	1.05	2,1,1,1,1	Water/m^3
	Wastewater, treatment	1.05	2,1,1,1,1	Wastewater, average {RoW} - treatment of, capacity 1E9l/year - Cut-off, S

Table S.3 Sensitivity analysis of the energy and environmental performance for 1 t of Nile tilapia processed and distributed per cut type, 1 t of fish meal and 1 t of fish oil with the allocation procedures of cutoff criteria (process subdivision) (CC), economic allocation (EA) and mass allocation (MA).

Processing and distribution stages		AO / m^2.year			WC / m^3			ED / MJ			GW / kg CO_2eq			AC / kg SO_2eq			EU / kg PO_4^{3-}eq		
Allocation procedure for the co-products in the processing stage (first allocation) considering only Nile tilapia cuts (main product)	CC, TE [a]	17 682			68			113 504			14 664			135			124		
	CC, TS [a]	32 752			117			205 004			26 893			249			229		
	CC, TF [a]	40 684			143			253 181			33 332			309			284		
	EA, TE	17 649			68			113 299			14 637			135			123		
	EA, TS	32 532			117			203 672			26 715			248			227		
	EA, TF	40 411			142			251 522			33 110			307			283		
	MA, TE	13 446			54			87 780			11 226			103			94		
	MA, TS	13 446			54			87 780			11 226			103			94		
	MA, TF	13 446			54			87 783			11 226			103			94		
Fish meal and oil production stage [b]		CC	EA	MA	CC	EA	MA	CC	EA	MA	CC	EA	MA	CC	EA	MA	CC	EA	MA
Allocation procedure for the co-products in the processing stage (columns: first allocation), which were used for fish meal and oil production (rows: second allocation)	EA, TF, Fish meal	2 502	2 832	-	3	4	-	20 474	22 477	-	158	426	-	2	5	-	1	3	-
	EA, TF [b], Fish oil	7 730	8 749	-	10	14	-	63 251	69 439	-	489	1 316	-	7	15	-	2	10	-
	MA, TF [a,b], Fish meal	4 641	-	65 622	6	-	206	37 974	-	408 268	294	-	49 784	4	-	466	1	-	428
	MA, TF [a,b], Fish oil	4 641	-	65 622	6	-	206	37 974	-	408 268	294	-	49 784	4	-	466	1	-	428

Area occupation (AO); water consumption (WC); energy demand (ED); global warming (GW); acidification (AC); and eutrophication (EU). [a] Base scenario; [b] The distribution stage for the fish cuts (main product) of the processing stage and the other products (fish meal and oil) were disregarded.

References

Petroski LPS, Medeiros DL, Vidal LVO (2024) The fish weight at slaughter influences energy and environmental performance of fish farming: The case of Nile tilapia production in cages. Aquaculture, 586, 740757. https://doi.org/10.1016/j.aquaculture.2024.740757.