



energy life cycle inputs in food systems: a comparison of local versus conventional cases

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Introduction

objective:

local food systems (LFS)



energy uses

CO₂-emissions

conventional food systems (CFS)

claim: LFS **are** more sustainable?



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Methodology

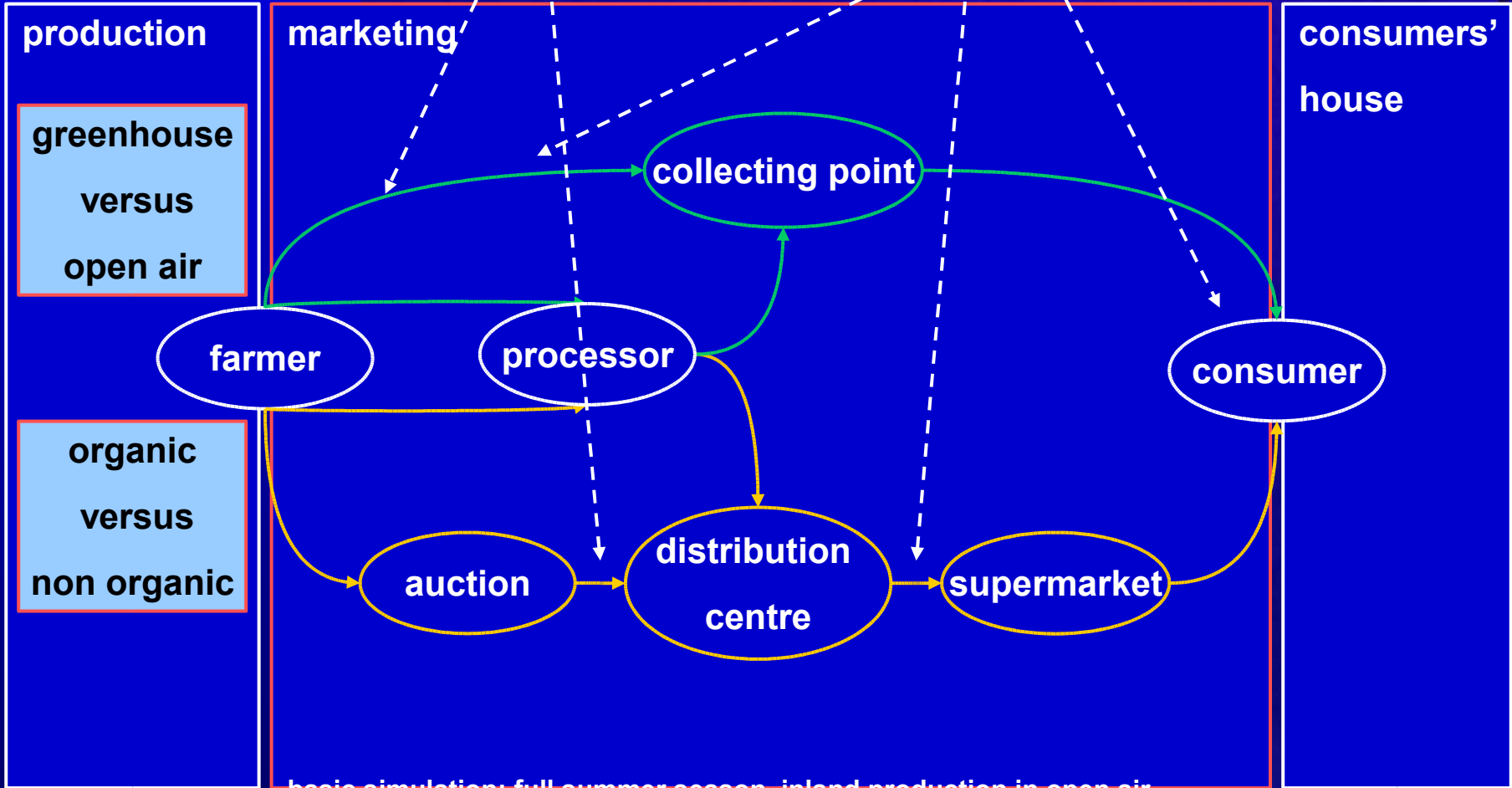
- **selection of case studies**

- cooperation of farmers selling organic vegetables through box schemes
- fruit growers selling apples through farmers' markets
- cooperative association of cattle breeders selling directly to the consumer or through food teams
- cooperative association producing organic cheese and marketing it through their shop and delis
- a Belgian supermarket chain
- definition of system boundaries
- calculations



in season
versus
off-season

efficient
versus
non efficient transport



basic simulation: full summer season, inland production in open air



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Methodology

- selection of case studies
- definition of system boundaries
- **calculations**
 - energy in MJ
 - emissions in g CO₂
 - expressed per kg or per portion



Results

in g CO₂/kg

Food item	Local food systems			Conventional food systems		
	transport	processing & storage	total	transport	processing & storage	total
	g CO ₂ /kg	g CO ₂ /kg	g CO ₂ /kg	g CO ₂ /kg	g CO ₂ /kg	g CO ₂ /kg
Beef	285.73	56.74	342.47	25.01	56.74	81.75
Potatoes	200.05	0.00	200.05	78.53	negligible	78.53
Cabbage lettuce	177.33	21.79	199.12	78.53	22.08	100.61
Tomatoes	198.70	5.19	203.89	78.53	4.73	83.26
Carrots	233.40	11.33	244.73	78.53	10.09	88.62
Apples	36.69	40.72	77.41	39.77	27.02	66.79
Gouda cheese	1557.14	841.71	2398.85	443.56	1389.10	1832.66
Average	384.15	139.64	523.79	117.49	215.68	333.17
Average fruit and vegetables	169.23	15.81	185.04	70.78	15.98	83.56



Results

in g CO₂/portion

Food item	Local food systems			Conventional food systems		
	transport	processing & storage	total	transport	processing & storage	total
	g CO ₂ /port	g CO ₂ /port	g CO ₂ /port	g CO ₂ /port	g CO ₂ /port	g CO ₂ /port
Beef	34.288	6.809	41.096	3.001	6.809	9.810
Potatoes	40.010	0.000	40.010	15.706	negligible	15.706
Cab. lettuce	12.413	1.525	13.938	5.497	1.546	7.043
Tomatoes	13.909	0.363	14.272	5.497	0.331	5.828
Carrots	16.338	0.793	17.131	5.497	0.706	6.203
Apples	4.586	5.090	9.676	4.971	3.378	8.349
Gouda cheese	23.357	12.626	35.983	6.653	20.837	27.490
Total meal	144.901	27.206	172.107	46.823	33.606	80.429
Total fruit & vegetables	87.256	7.772	95.028	37.169	5.961	43.129



Additional calculations

- **transport efficiency of the consumer**

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Transport mode and transport distance	g CO ₂ /trip
Consumer on foot	0.00
Consumer by bicycle	0.00
Consumer by car, specifically for shopping	
5 km single trip	4034.87
10 km single trip	8069.73
15 km single trip	12104.60
Consumer by car, combining shopping with other activities	
5 km single trip	2521.79
10 km single trip	5043.58
15 km single trip	7565.38

depending on the amount purchased by the consumer (LFS or CFS)

comparison with average of basic simulation:
524 g CO₂/kg for LFS & 333 g CO₂ /kg for CFS



Additional calculations

- transport efficiency of the consumer
- **transport efficiency for import**

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Transport mode and transport distance	g CO ₂ /kg
Short distance (400 km)	
Truck (ALC 27 ton)	54.66
Electric freight train (ALC 1705 ton)	69.15
Inland vessel (ALC 1250 ton)	
Bulk	29.77
Non-bulk	79.72
Continental transport (1500 km)	
Truck (ALC 27 ton)	204.98
Electric freight train (ALC 1705 ton)	259.32
Freight aircraft (ALC 83.3 ton)	2149.20
Sea vessel (ALC 16000 ton)	
Bulk	599.82
Non-bulk	1605.98
Intercontinental transport (6000km)	
Freight aircraft (ALC 83.3)	8509.68
Sea vessel (ALC 16000 ton)	
Bulk	2399.29
Non-bulk	6423.90



Additional calculations

- transport efficiency of the consumer
- transport efficiency for import
- **production in heated greenhouses**

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Food item	g CO ₂ /kg
Tomatoes	1459.41
Cabbage lettuce	1250.21



Additional calculations

- transport efficiency of the consumer
- transport efficiency for import
- production in heated greenhouses
- **organic versus non-organic (ICM)**

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Agricultural practice	g CO ₂ /kg
Organic	11.49
Non organic	18.60



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Combination of additional calculations

- results
 - transport efficiency of the consumer
 - transport efficiency for import
 - production in heated greenhouses
-  **combination of the additional calculations**



Combination of additional calculations

4 scenarios

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3. LFS selling organic inland tomatoes produced in an unheated greenhouse, purchased by a consumer on foot

➔ $204 + 11 + 0.00 + 0.00 + 0.00 = 215$

6. LFS selling non-organic inland tomatoes produced in an unheated greenhouse, purchased by a consumer by car (10 km single trip, combined shopping), buying 10kg in total

➔ $204 + 19 + 0.00 + 0.00 + 504 = 727$

9. supermarket selling non-organic inland tomatoes produced in a heated greenhouse, purchased by bicycle

➔ $83 + 19 + 0.00 + 1459 + 0.00 = 1561$

12. supermarket selling organic tomatoes produced in Spain in open air, transported by truck over 1500 km purchased by a consumer by car (5 km single trip, specific shopping), buying 10kg in total

➔ $83 + 11 + 205 + 0.00 + 404 = 703$

(in g CO₂/kg)



Combination of additional calculations

extreme scenarios

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3. LFS selling imported non-organic tomatoes from France (400 km by truck) produced in a heated greenhouse, purchased by a consumer by car (10 km single trip, specific shopping), buying 10kg in total



$$204 + 19 + 55 + 1459 + 807 = 2544$$

7. supermarket selling imported organic tomatoes from Kenya (6000 km by aircraft) produced in open air, purchased by a consumer by car (15 km single trip, combined shopping), buying 10kg in total



$$83 + 11 + 8510 + 0.00 + 757 = 9361$$

Compared to smallest energy use

12. supermarket selling organic inland tomatoes produced in an unheated greenhouse, purchased by a consumer on foot



$$83 + 11 + 0.00 + 0.00 + 0.00 = 94$$

(in g CO₂/kg)



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Conclusions

- claim: LFS **are** more sustainable?
- **results** show that:
 - basic simulation: energy uses are higher in LFS than in CFS, but in the same range
 - additional calculations: off-season, imported, greenhouse production: much larger range
 - intrinsic characteristics of LFS and CFS
- both LFS and CFS **can** be much more sustainable
 - optimisation of LFS: minimize distance & increase quantities
 - optimisation of CFS: minimize distance & shorten storage time
 - consumers' purchasing behaviour