Sustainability Impact Of Children's School Lunch Plate Waste In Two Italian Case Studies

Inside from the Strength2Food Project

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Outline

Aim

Case study characterisation

Methodology

Results

Conclusion and recommendations

Problem

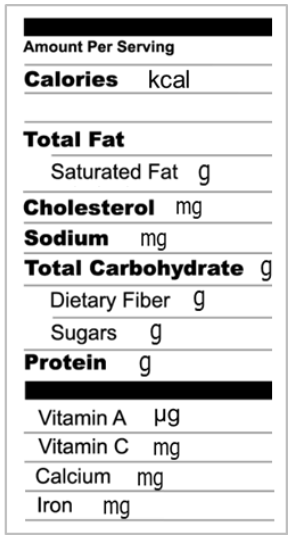
How much food is lost during distribution to school children?

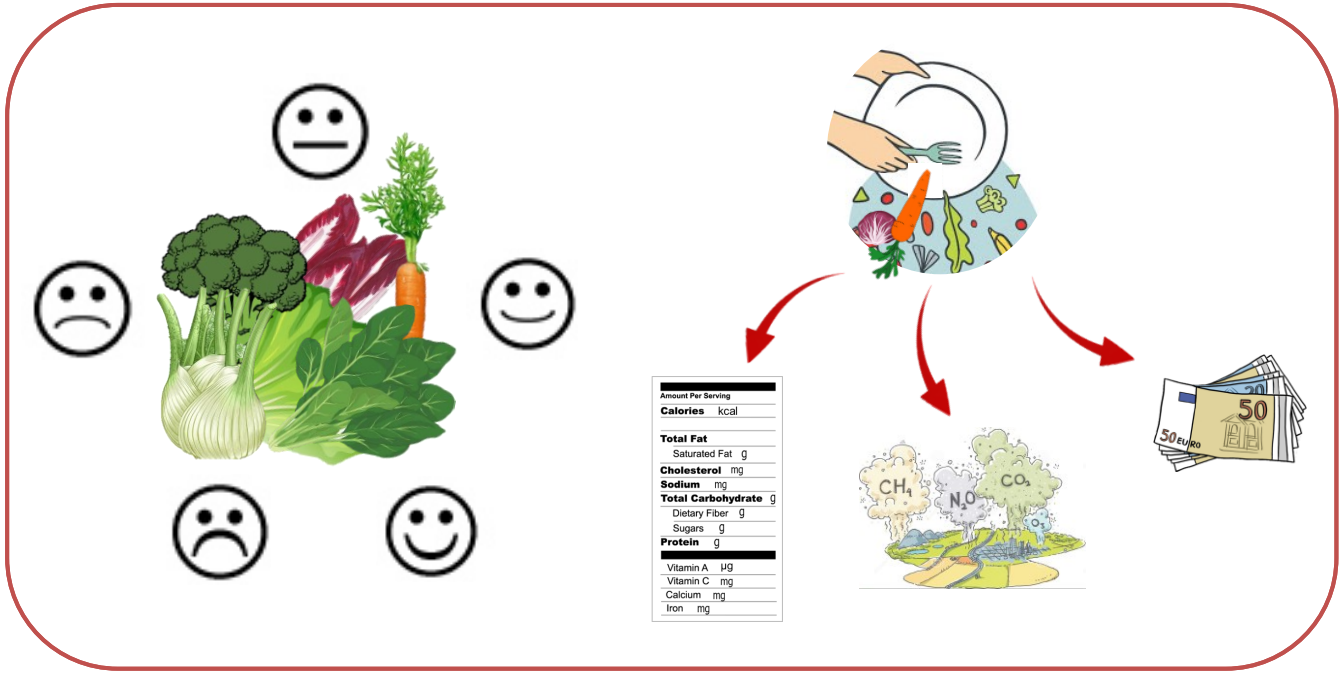
What type of food is thrown away the most? And why?

What does this imply in terms of social, environmental and economic sustainability?

Aim

To compare two Italian case studies (≠ food procurement model) in relation to:





Local-organic procurement model (Loc-Org)

- ✓ School menu has a **rotatory structure based on 4 weeks** and it is **differentiated according to the 4 seasons**

Organic procurement model (Org)

- ✓ School menu has a **rotatory structure based on 7/8 weeks** and it is differentiated in **2 periods** (autumn-winter; spring summer)

- ✓ The menus do not contain GMO, deep fried food, palm oil and palm kernel, stock cubes, soft and energy drinks

Preference is given to:

- ➢ Healthy cooking methods (baking, steaming, stewed cooking)
- ➢ Fresh and seasonal products obtained with eco-friendly production methods
- ➢ Products regulated by EU legislation (**certified GIs, organic**)
- ➢ Traditional regional food

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Loc-Org school 1:

- ✓ Town centre
- ✓ 215 pupils
- ✓ School kitchen

Loc-Org school 2:

- ✓ 16.7 km from the cooking centre
- ✓ 239 pupils
- ✓ Central kitchen

Org school 1:

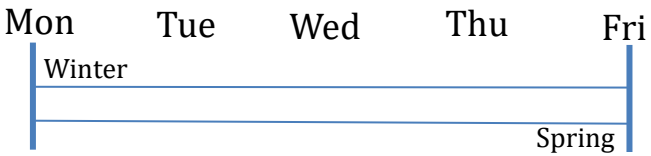
- ✓ 8.2 km from the cooking centre
- ✓ 168 pupils
- ✓ Cooking centre

Org school 2:

- ✓ 3.7 km from the cooking centre
- ✓ 212 pupils
- ✓ Cooking centre

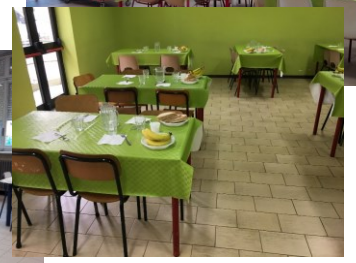
Plate waste and vegetable liking assessment

- Data collection/school



39 days

1. Starchy food
2. Bread
3. Protein-based dish
4. Vegetables
5. Fruit
6. Dessert
7. Other

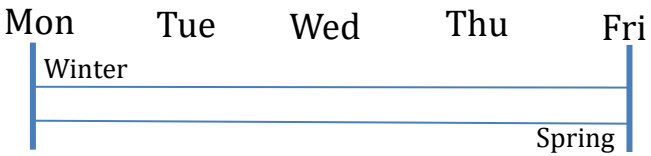


- Standard menus

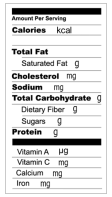
- Vegetable liking as multiple choice answer

Plate waste impact assessment

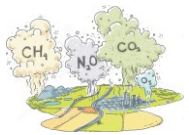
- Data collection/school



39 days



- **Energy and nutritive values** for planned meals and plate waste



- **LCA** approach in estimating **GHGe**
- **Emission factors** (Moult et al., 2018) from several **sources**:
  - ✓ BCFN Double Pyramid DB
  - ✓ Environmental Product Declaration DB (EPD International AB, 2019)
  - ✓ LCA-Food DB (Nielsen & Rikke, 2007)
  - ✓ Ecoinvent DB (Ecoinvent, 2019)

- **The average cost per kg** for each food was based on the **national agri-food market price**

Plate waste

	Total meals (n)		Total served food (kg)		Total waste (kg)	
	LOC-ORG	ORG	LOC-ORG	ORG	LOC-ORG	ORG
Starch-based dish	3526	3331	813.2	603.4	162.6	191.5
Bread	3988	2677	144.0	81.7	53.6	34.1
Protein-based dish	3471	2523	223.4	176.2	39.5	60.2
Vegetables	3979	1453	267.9	131.1	98.7	68.1
Fruit	4134	2304	539.3	338.8	163.6	1[illegible]
Other	387	311	115.5	28.2	22.6	3.3
Dessert	Not served	690	Not served	76.7	Not served	13.7
All food categories	19485	13289	2103.2	1436.2	540.6	551.8

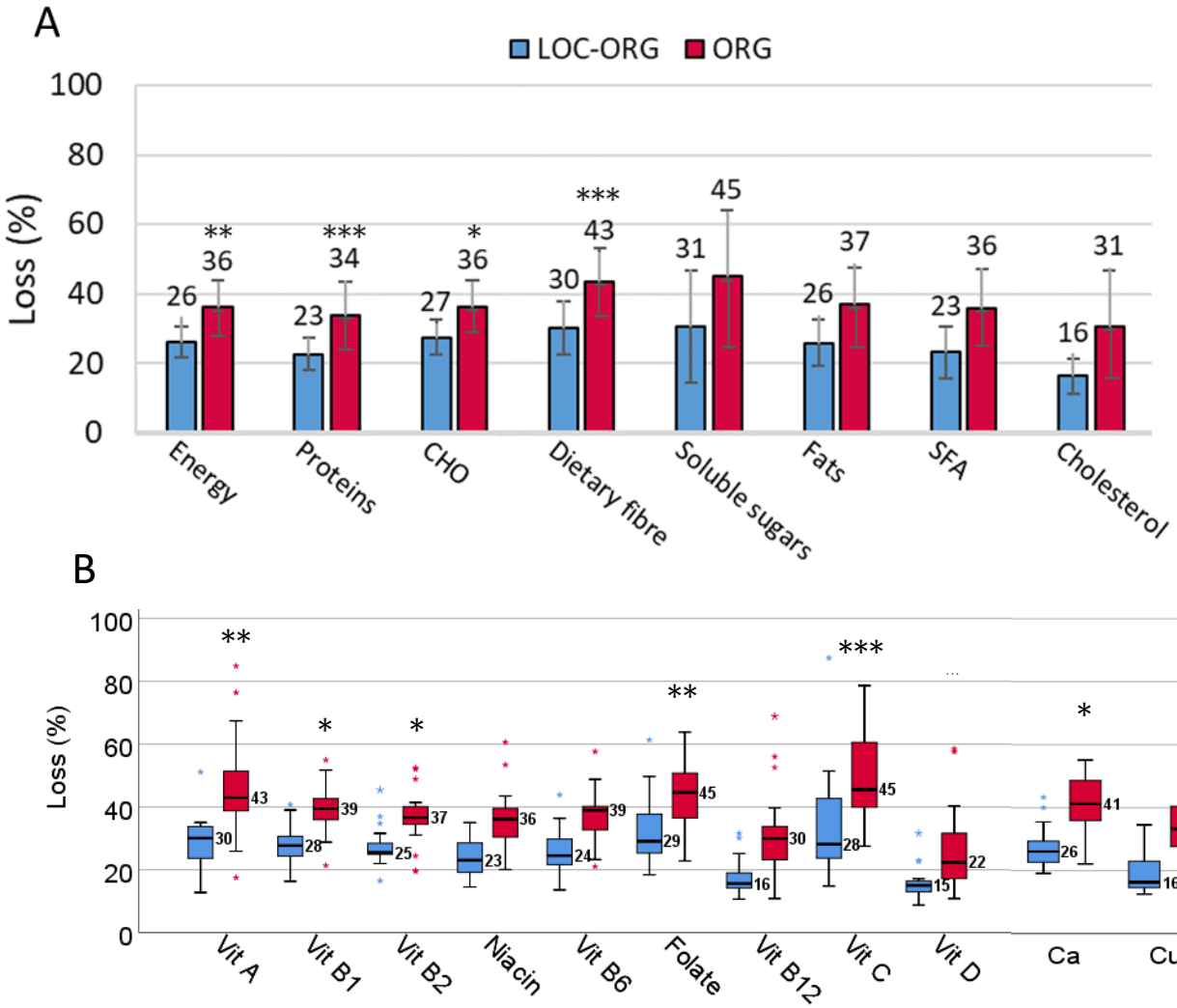
27 kg/day

29 kg/day

	Serving size (g)		Waste (%)		Waste per child (g)	
	LOC - ORG	ORG	LOC - ORG	ORG	LOC-ORG	ORG
Starch-based dish	240.9 (194.7 - 265.4)	211 (192.5 - 225.9)	16.5 (13.5 - 24.7)	32.5 (25.3 - 40.2)***	40.1 (28.1 - 64.7)	64.9 (45.4 - 85.9)*
Bread	40.6 (25.3 - 48.5)	30.2 (26.3 - 32.3)	35.7 (32.5 - 40.5)	44.8 (35.3 - 53.5)	11.3 (8.8 - 18.1)	12.3 (9.8 - 15.1)
Protein- based dish	55.7 (40.0 - 93.0)	60.8 (51.3 - 76.3)	14.5 (12.4 - 18.1)	33.5 (22.1 - 43.3)***	9.4 (5.1 - 15.9)	19.1 (13.5 - 35.5)**
Vegetable - side dish	52.9 (43.9 - 86.1)	57.5 (50.2 - 78.2)	34.9 (32.0 - 50.7)	52.9 (41.5 - 70.1)**	24.3 (20.8 - 31.3)	28.5 (23.4 - 44.7)
Fruit	125.9 (120.0 - 133.9)	151.8 (128.0 - 175.0)*	26.2 (15.8 - 40.0)	55.5 (41.8 - 59.3)**	32.9 (20.5 - 51.2)	75.4 (50.4 - 105.5) **
Other	293.7 (261.0 - 326.4)	93.0 (80.6 - 105.4)	22.3 (17.7 - 27.0)	11.8 (11.3 - 12.3)	59.4 (53.0- 65.8)	10.7 (9.7 - 11.7)
Dessert	Not served	100.0 (100.0 - 125.0)	Not served	14.9 (13.2 - 19.0)	Not served	14.9 (13.2 - 23.8)
All food categories	506.0 (460.5 - 599.2)	498.6 (456.3 - 520.5)	24.6 (21.8 - 27.3)	41.4 (33.2 - 42.6)***	139.5 (110.6 - 155.4)	196.2 (163.5 - 223.7)***

Note: Data are presented as median (IR) given the non-normal distributions. *p* values refer to between group comparison (LOC-ORG vs. ORG), Mann-Whitney non-parametric test. *, **, *** significant differences at $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively.

Nutritional loss



Losses of energy (A), macronutrients (A), micronutrients (B) of school lunches in the LOC-ORG (n=20) and ORG model (n=19).

Data are expressed as mean ± SD for A, and median (IR) for B given their non-normal distributions. *p* values refer to between group comparison (LOC-ORG vs. ORG), Mann-Whitney non-parametric test. *, **, *** significant differences at $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively.

Environmental loss

	Waste (kg)		Waste (%)		GHG emissions ($kgCO_2eq$)		Average EF ($kgCO_2eq/kg$)	
	LOC-ORG	ORG	LOC-ORG	ORG	LOC-ORG	ORG	LOC-ORG	ORG
Starchy food	216.2	225.7	40.0	40.9	414.4	402.1	1.92	1.78
Protein-based dish	39.5	60.2	7.3	10.9	139.5	265.3	3.54	4.41
Vegetables	98.7	68.1	18.3	12.3	60.9	23.4	0.62	0.34
Fruit	163.6	180.8	30.3	32.8	95.6	62.9	0.58	0.35
Dessert	-	13.7	-	2.5	-	35.9	-	2.61
Other	22.6	3.3	4.2	0.6	51.6	3.0	2.28	0.92
CO2 burden (food production)	540.6	551.8	100.0	100.0	761.9	792.5	1.41	1.44
Transportation [a]					15.5	38.4	0.03	0.07
Waste handling					25.9	27.4	0.05	0.05
Total Waste CO_2 Burden					803.3	858.3	1.49	1.56

Note: [a] This step refers to the distance between the central kitchen and the schools.

No differences ($p < 0.05$) have been found by comparing the two case studies for the Average EF data (Mann-Whitney non parametric test).

EF: emission factor.

- ✓ Food production accounts for 95% (LOC-ORG case) and 92% (ORG case) of the total GHG emissions linked to plate waste, with modest inputs form transportation and waste management.
- ✓ Overall, the highest emissions are due to starchy food, however protein-based dishes present the greater average EF.

Economic loss

	Waste (kg)		Waste (%)		Cost (€)		Average cost (€/kg)	
	LOC-ORG	ORG	LOC-ORG	ORG	LOC-ORG	ORG	LOC-ORG	ORG
Starchy food	216.2	225.7	40.0	40.9	426.9	652.8	1.98	2.89
Protein-based dish	39.5	60.2	7.3	10.9	236.7	370.1	6.00	6.15
Vegetables	98.7	68.1	18.3	12.3	133.9	77.2	1.36	1.13*
Fruit	163.6	180.8	30.3	32.8	156.5	217.9	0.96	1.21
Dessert	-	13.7	-	2.5	-	90.2	-	6.57
Other	22.6	3.3	4.2	0.6	24.2	21.5	1.07	6.57
Total	540.6	551.8	100.0	100.0	978.3	1429.8	1.81	2.59

Note: *p* values refer to between group comparison (LOC-ORG vs. ORG), Mann-Whitney non-parametric test.
* significant differences at $p < 0.05$

- ✓ Although the total food waste was comparable (540.6 kg vs 551.8 kg) in the two case studies, the average cost per kg of food waste was € 1.81 for the LOC-ORG case and € 2.59 for the ORG case.

- ✓ The plate waste cost has been estimated to be 0.32 €/meal, i.e., 5.2% of the full price paid by parents (6.11 €/ meal) for the LOC-ORG case and 0.70 €/meal, i.e., 14.0% of the full price paid by parents (5.00 €/ meal) for the ORG case.

Conclusion and recommendations

Need to minimise plate waste (experimental sessions to test suitable solutions are recommended)

- Menu composition, plate waste patterns and food waste management strongly affect the nutritional profile and the environmental performance of the school menus.
- To minimise plate waste among primary school children several strategies are recommended:

  - Supporting food educational programs
  - Defining school governance for healthy and sustainable eating behaviours
  - Addressing teachers' attitude during school lunch
  - Optimising school catering management in serving lunch menus
  - Monitoring children's plate waste over time

Open question for improving the sustainability of the School canteens

What is the composition of meals in your canteen in terms of carbohydrates (pasta), proteins (meat, fish, dairy products) and vegetables (fresh, cooked)?

How are they prepared in the kitchen? Cooked, fresh, cold cuts, cheese, and desserts?

How are they distributed?

Served by staff at the table, served by staff on trays, or self-service with shaped trays, with free self-service available.

Do you think there is a relationship between the way meals are distributed and the amount of food discarded? How are your meals currently distributed, and how would you like to see this process changed?

Many thanks

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