



Applicazione del metodo PROMETHEE per la valutazione multicriteriale della sostenibilità di nuovi prototipi alimentari

Michele Zoli, Jacopo Bacenetti

Dipartimento di Scienze e Politiche Ambientali - Università degli Studi di Milano

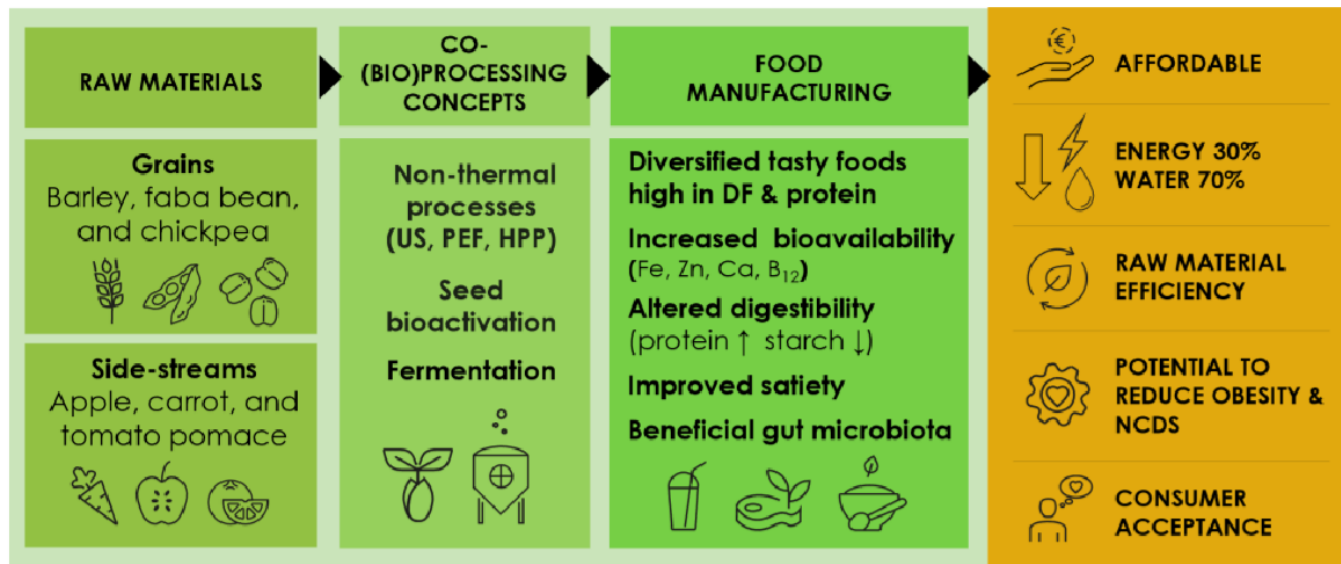


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Sustain-a-Bite has the ambition to develop innovative, affordable, raw material, energy and water efficient minimal processing solutions for nutrient-rich plant-based ingredient and food production, propelling both health and sustainability.



Aim of the study

Provide an early overall assessment of potential ingredients for the future novel food prototypes;



Dimensions covered:

- Environmental (carbon footprint, energy demand, water use);
- Techno-economic (€/kg ingredient, availability index);
- Nutritional (protein, micronutrient index, fiber).



Final goal: support the selection of promising processing routes for future prototypes

Screening of the methods and scientific articles.

According to:

- Goal;
- Applicability;
- Complexity;
- Previous study;
- Pairwise comparison of alternatives;
- Flexible preference functions and weighting;
- Clear outputs: positive / negative / net flows, ranking.



PROMETHEE Method



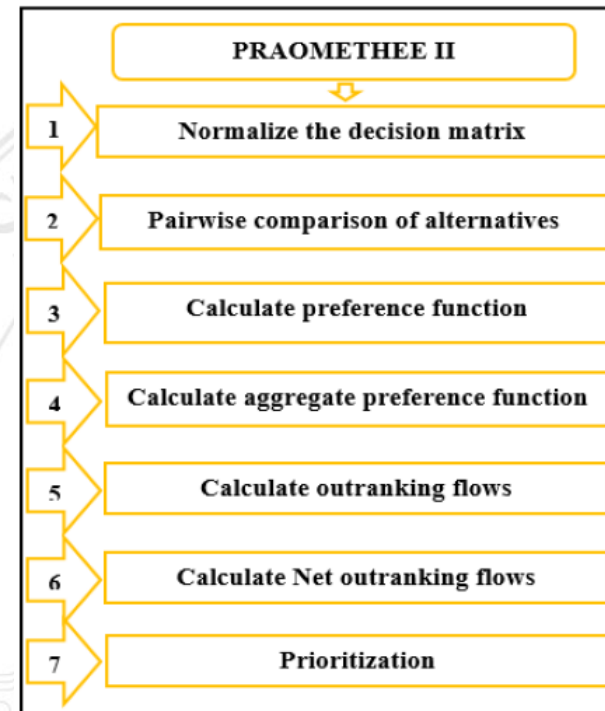
Review

Multi-Criteria Decision Analysis (MCDA) for sustainability assessment in food sector: A systematic literature review on methods, indicators and tools

Giulio Ferla^{a,*}, Benedetta Mura^a, Silvia Falasco^a, Paola Caputo^a, Agata Matarazzo^b

^a Politecnico di Milano, Department of Architecture, Built Environment and Construction Engineering, Piazza Leonardo da Vinci, 32, Milan 20133, Italy

^b Department of Economics and Business, University of Catania, Corso Italia, 55, 95129 Catania, Italy



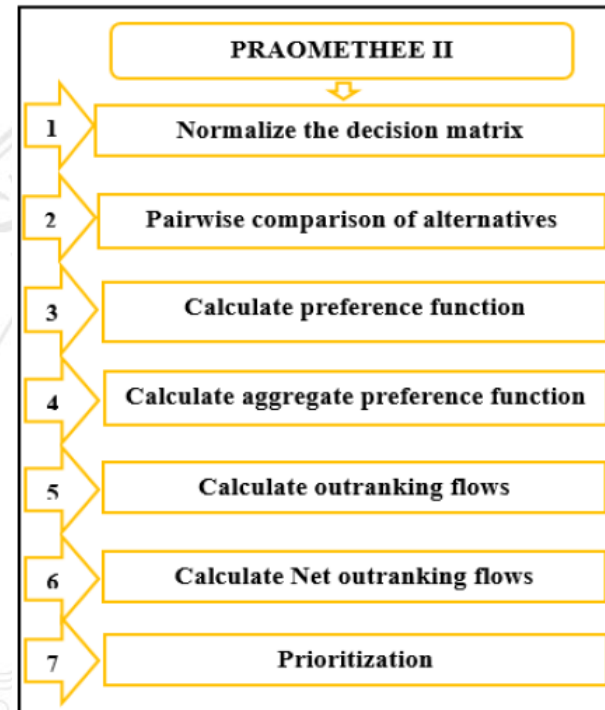
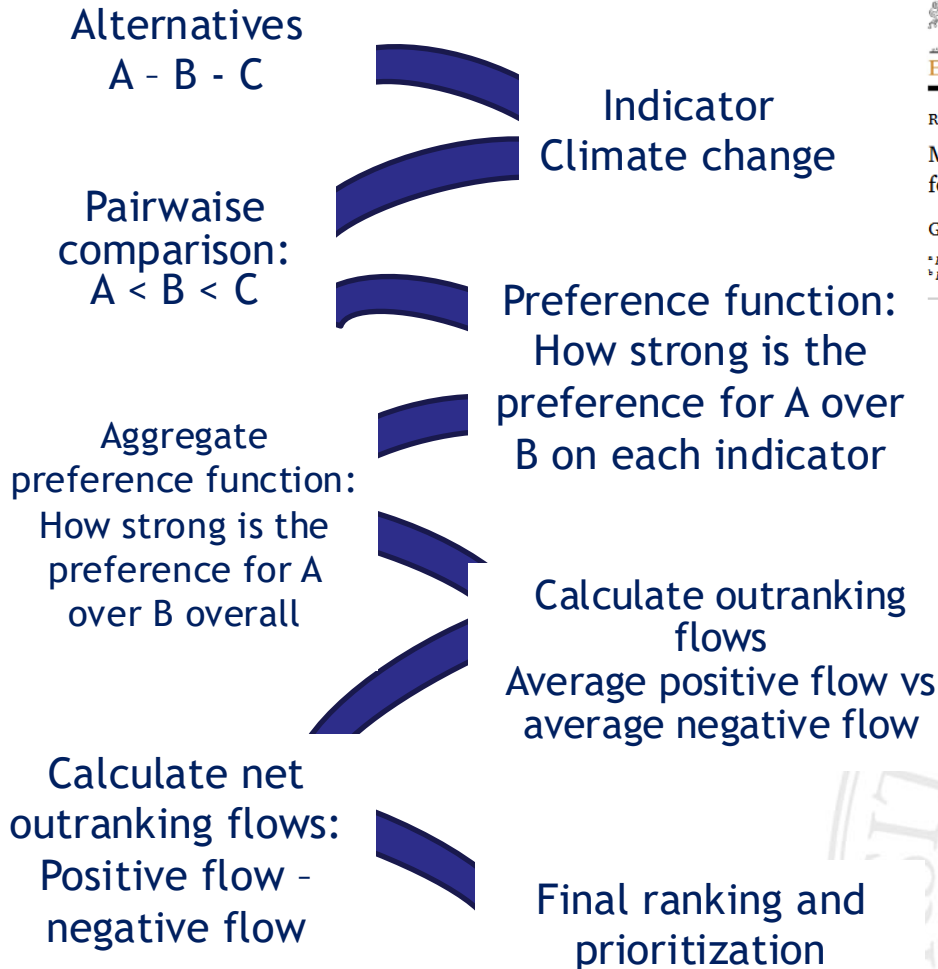


Review

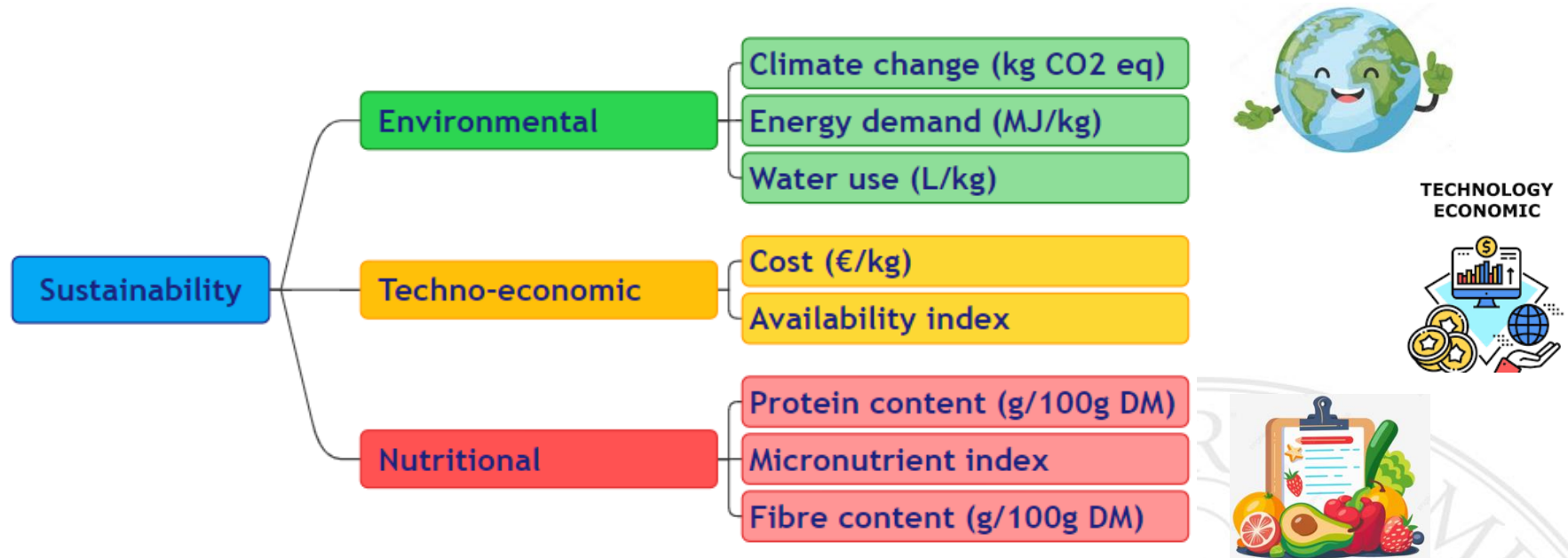
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Indicators



Barley (BA) →

Fava Bean (FA) →

Chickpea (CH) →

Apple pomaces (AP) →

Carrot pomaces (CA) →

Tomato pomaces (TO) →

Pea Protein Isolate (PPI) →

Germination + Fermentation

Germination only

Fermentation only (1,2,3)

Acid fermentation + drying

Benchmark



Indicators values

	Environmental dimension			Techno-economic dimension		Nutritional dimension			
Ingredient Acronym	Climate_change (kg CO ₂ eq/kg)	Total energy demand (MJ/kg)	Water_use (l/kg)	Cost (€/kg)	Availability index	Protein_content (g/100g DM)	Micronutrients (Fe, Ca, Zn) - index	Fiber content (g/100g DM)	dry weight
BA1	2.33	36	268	0.7	0.7	16	0.8	29	94%
BA2	2.27	35	264	0.6	0.7	16	0.8	29	94%
BA3	1.98	35	266	0.6	0.7	16	0.8	29	94%
CH1	1.48	33	630	0.8	0.6	34	1.0	23	94%
CH2	1.44	33	627	0.7	0.6	34	1.0	23	94%
CH3	1.32	33	629	0.7	0.6	34	1.0	23	94%
FA1	1.23	24	5	1.0	0.6	28	0.8	21	94%
FA2	1.15	23	2	0.9	0.6	28	0.8	21	94%
FA3	1.12	24	4	0.8	0.6	28	0.8	21	94%
AP1	1.98	32	4	1.1	0.7	4	0.1	53	94%
CA1	2.00	33	7	1.3	0.6	8	0.1	35	94%
TO1	1.98	32	4	1.2	0.6	15	0.1	53.5	94%
PPI1	3.49	50	96	4.0	0.8	68	0.5	4	94%



Input from Procestimotor

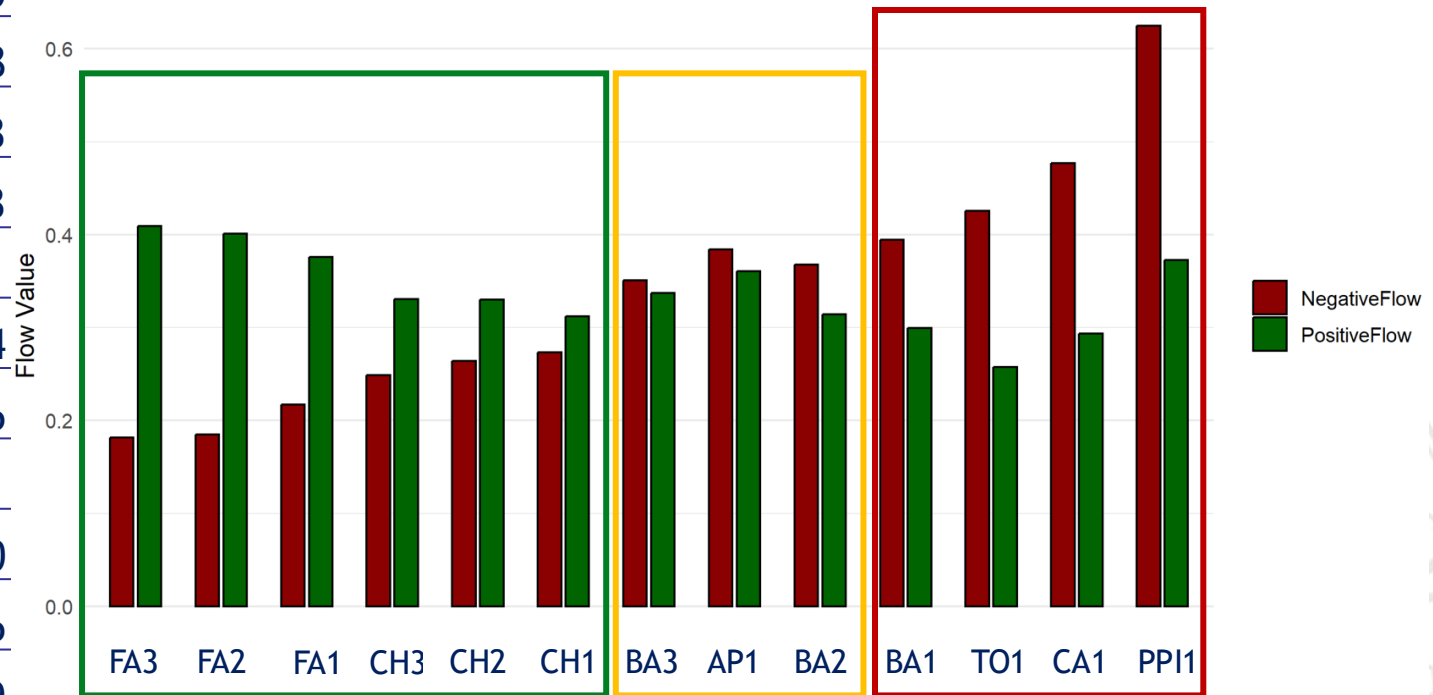
Expert opinion, lab. analysis, literature data



Indicators values

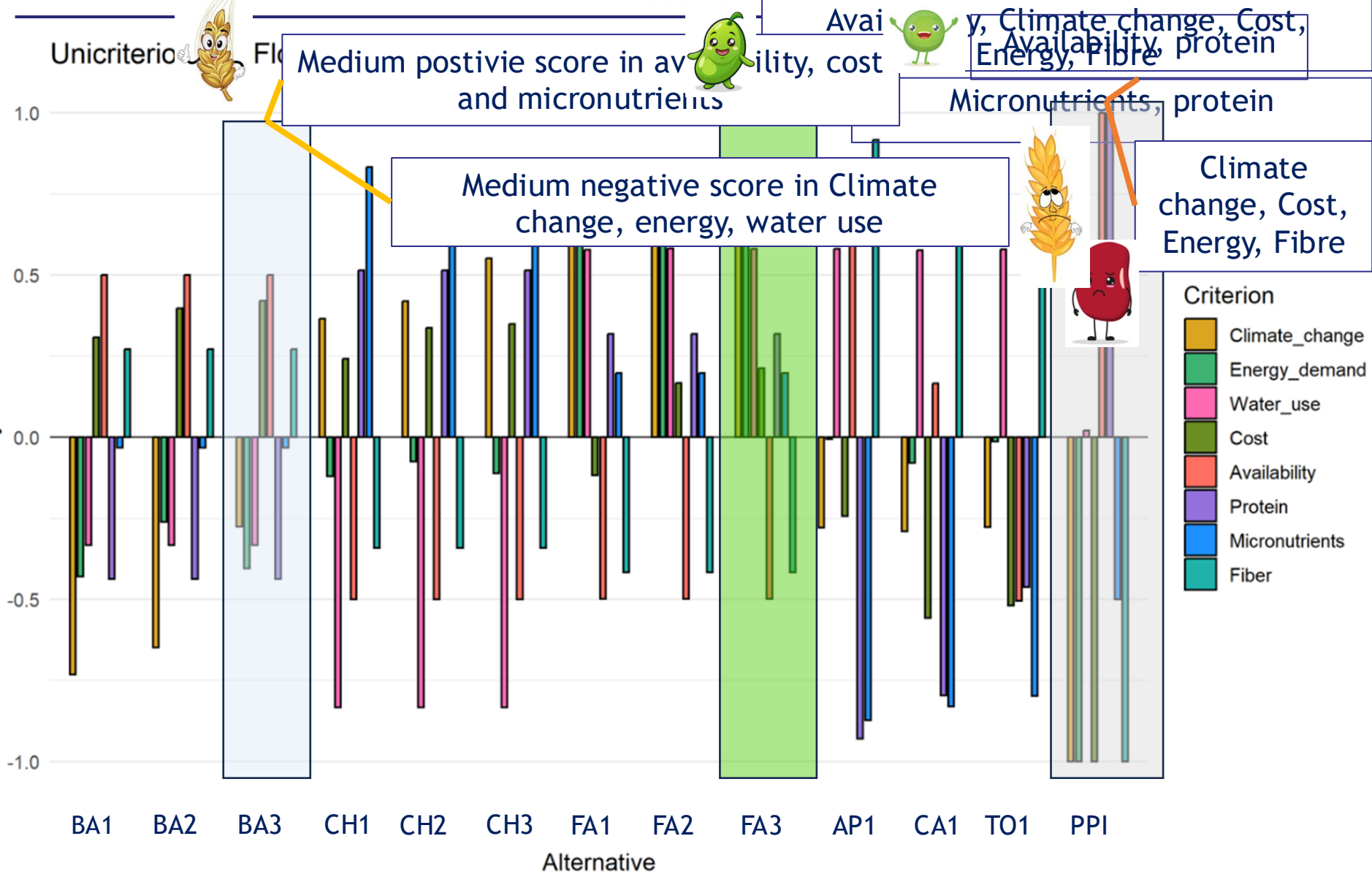
Rank	Alternative	Positive Flow	Negative Flow	NetFlow
1	FA3	0.41	0.18	0.23
2	FA2	0.40		
3	FA1	0.38		
4	CH3	0.33		
5	CH2	0.33		
6	CH1	0.31		
7	BA3	0.34		
8	AP1	0.36		
9	BA2	0.31		
10	BA1	0.30		
11	TO1	0.26		
12	CA1	0.29		
13	PPI1	0.37	0.63	-0.25

Positive vs Negative Flow



Results

Net Flow by Criterion



Fava bean showed the best overall performance → environmental indicators and good trade-off

All alternatives performed better than PPI → PPI showed very high net flows for availability and protein content, but low score in other indicators

Apple pomace showed intermediate performance → characterized by low cost, higher fiber content, and good water-use performance.



Other considerations



Allocation sensitivity: Economic allocation for pomaces;

Strengths: Integrated view across environment, techno-economics and nutrition;

Limitations: Need for robustness checks (allocation, weights, thresholds), user choices;

Next steps: Refine datasets, sensitivity analysis, other flow scheme.

My first time with PROMETHEE, any suggestion are welcome 😊

I thought it was simpler, but actually there is some complexity behind.





THANK YOU FOR YOUR ATTENTION

michele.zoli@unimi.it



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