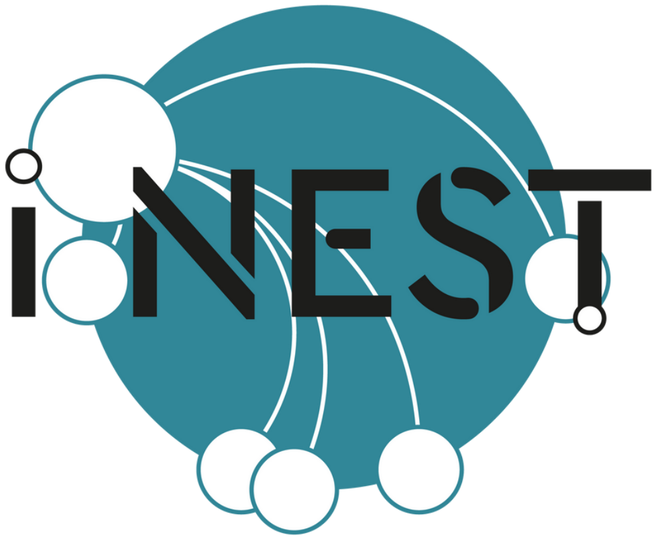
Interconnected
Nord-Est Innovation
Ecosystem



Spoke 1
Ecosystems for Mountain Innovations

Finanziato dall'Unione europea
NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

unibz
Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

iNEST - AMC

Presenter: Pasqualina Sacco - unibz

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The decision-making context

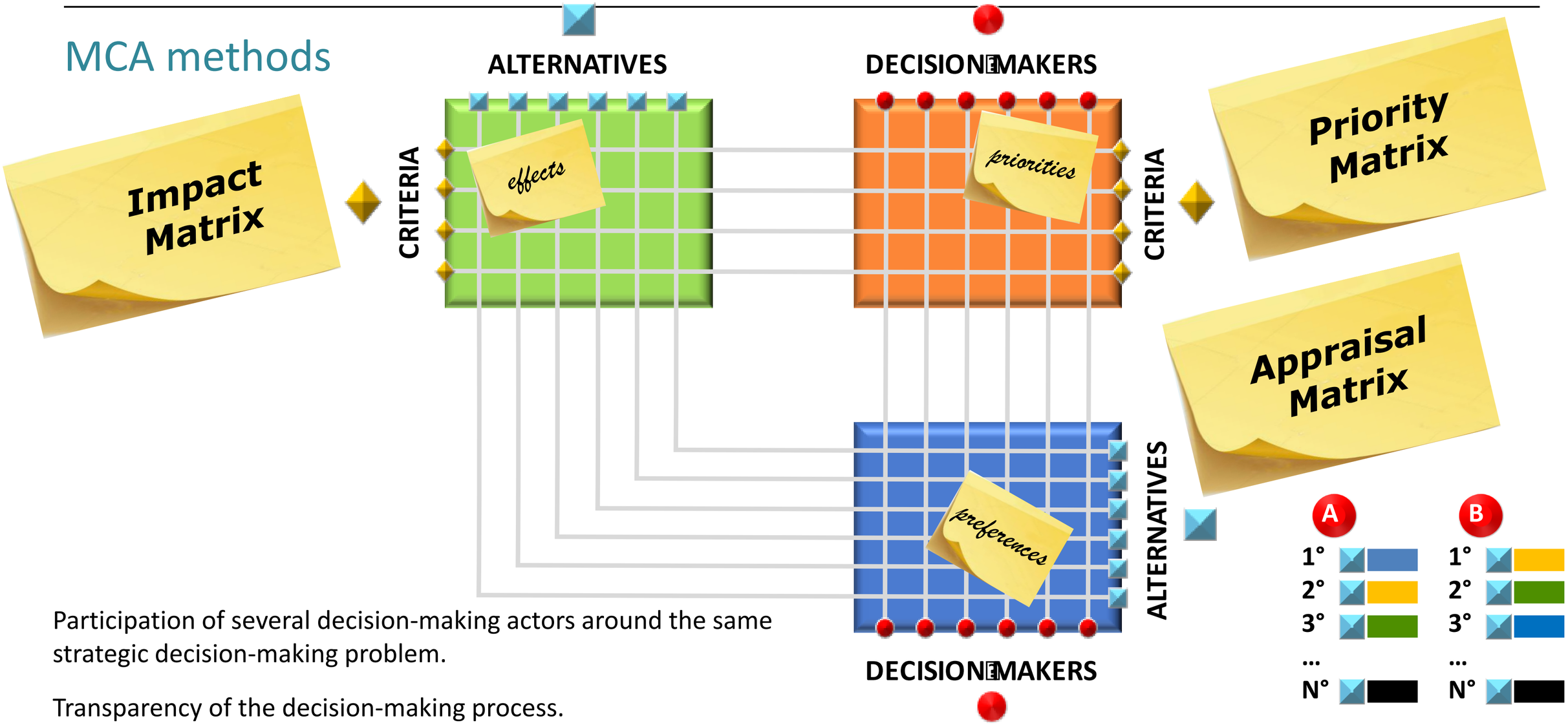
Decision-making process: the ability to use judgments in making decisions based on the information available.

Given the inherently subjective nature of decision-making, when a decision-maker is tasked with making a choice impacting the community, issues of objectivity and transparency in the decision-making process emerge.

Mountain systems are complex by nature:

- Ecological and human components coexist, each with their own specific “interests” (multi-criteria).
- Impacts affect various people directly and indirectly (multi-actor).
- Multiple stakeholders need to come together to reach a shared decision (compromise).

MCA methods



Participation of several decision-making actors around the same strategic decision-making problem.

Transparency of the decision-making process.

MCA for…

Describing the decision-making problem objectively and based on reliable data (impact matrix).

Considering different perspectives (priority matrix).

Assessing the convergence margins towards a shared solution (preference matrix and sensitivity analysis).

Electre based methodology, sysntetic index, min-max normalisation

Impact matrix

Criteria	C/B	Rye bread	Barley beer	Cow cheese	Goat cheese	Domain
Revenue	B	0,05	1,00	0,00	0,04	ECO
Investment	C	1,00	0,56	0,00	0,27	ECO
Difficulty in preserving the primary product	C	1,00	1,00	0,00	0,00	OPE
Difficulty in preserving the final product	C	0,00	1,00	0,86	0,86	OPE
Production loss risk	C	0,00	0,17	1,00	1,00	ECO
Labour for primary production	C	0,83	0,00	1,00	1,00	OPE
Labour for intermediate product	C	1,00	0,53	0,17	0,00	OPE
Labour for final product	C	1,00	0,00	0,68	0,40	OPE
Landscape and territorial stewardship	B	0,67	0,67	1,00	0,00	ENV
By-products valorisation potential	B	0,00	0,67	1,00	1,00	ECO
Land occupation	C	0,84	0,00	1,00	1,00	ENV
Climate change	C	1,00	0,00	0,72	0,69	ENV
Fossil depletion	C	1,00	0,00	0,96	0,95	ENV
Particulate matter formation	C	1,00	0,09	0,06	0,00	ENV

Priority matrix

		Farmer S_ECO (Virtual)	Farmer S_ENV (Virtual)	Farmer S_OPE (Virtual)	Community (Virtual)	Policy maker Traditional (Virtual)	Policy maker Innovative (Virtual)	Farmer no risk (Virtual)	Balanced (Virtual)
ECO	By-products	2,1%	21,2%	1,4%	13,3%	3,5%	10,9%	0,3%	7,1%
OPE	Preserving FP	14,5%	2,7%	8,4%	2,4%	3,7%	9,2%	12,8%	7,1%
OPE	Preserving PP	14,5%	2,9%	12,3%	1,9%	3,9%	8,6%	10,4%	7,1%
ECO	Product loss	14,5%	3,4%	5,0%	3,8%	12,0%	5,0%	47,8%	7,1%
ECO	Revenue	18,1%	15,8%	6,5%	2,8%	17,7%	5,2%	14,6%	7,1%
ENV	Climate	0,4%	11,9%	1,4%	12,9%	2,7%	9,2%	0,5%	7,1%
ENV	Fossil	0,4%	3,3%	1,4%	11,7%	3,4%	9,3%	0,8%	7,1%
ECO	Investment	32,1%	20,8%	4,4%	4,1%	8,4%	9,7%	2,6%	7,1%
OPE	Labour FP	0,7%	2,4%	15,4%	4,0%	3,1%	4,6%	2,0%	7,1%
OPE	Labour PP	0,7%	2,3%	18,7%	3,4%	3,5%	4,7%	1,7%	7,1%
OPE	Labout IP	0,7%	2,4%	17,7%	3,6%	3,8%	4,7%	1,3%	7,1%
ENV	Land	0,4%	1,3%	0,2%	12,0%	14,6%	6,3%	0,6%	7,1%
ENV	Landscape	0,7%	6,3%	3,4%	18,3%	15,9%	5,9%	1,5%	7,1%
ENV	Particulate	0,4%	3,2%	4,0%	5,9%	3,8%	6,7%	3,1%	7,1%

Preference matrix

Normalization Algorithm Min-Max — Best | Worst | Negative | Positive | Zero

Syntetic | Winner: Rye wholemeal bread (4 / 8)

	Farmer S_ECO (Virtual)	Farmer S_ENV (Virtual)	Farmer S_OPE (Virtual)	Community (Virtual)	Policy maker Traditional (Virtual)	Policy maker Innovative (Virtual)	Farmer no risk (Virtual)	Balanced (Virtual)
Rye wholemeal bread	0.6097	0.7447	1.5216	0.8322	0.3376	1.0998	-1.4357	1.4690
Barley craft beer	1.6551	0.0239	-0.4549	-1.7798	-0.2295	-0.8777	0.4399	-1.3082
Cow mature cheese	-1.6406	-0.2965	-0.0301	1.6933	0.6648	0.4444	0.4577	0.6923
Goat mature cheese	-0.6242	-0.4721	-1.0366	-0.7458	-0.7729	-0.6665	0.5381	-0.8531

Credits for the data: Sacco et al., 2025

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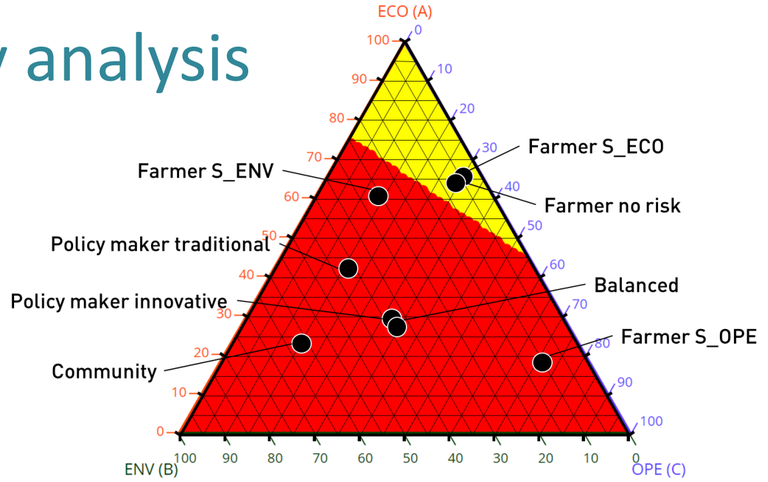
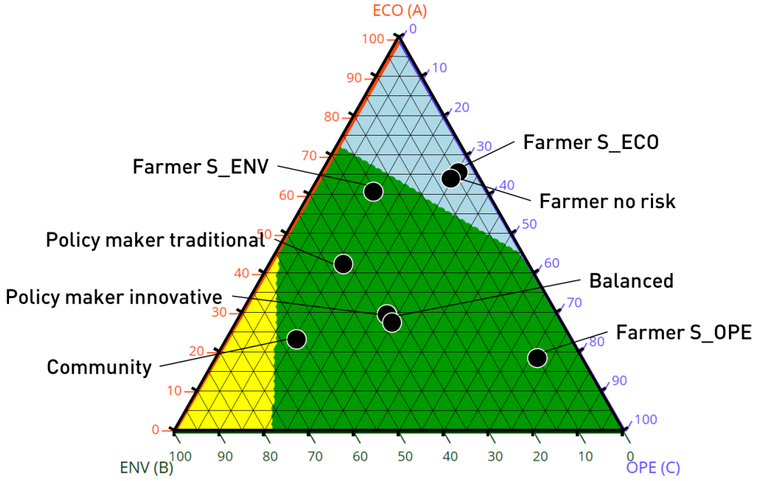
Sensitivity analysis

Best alternatives

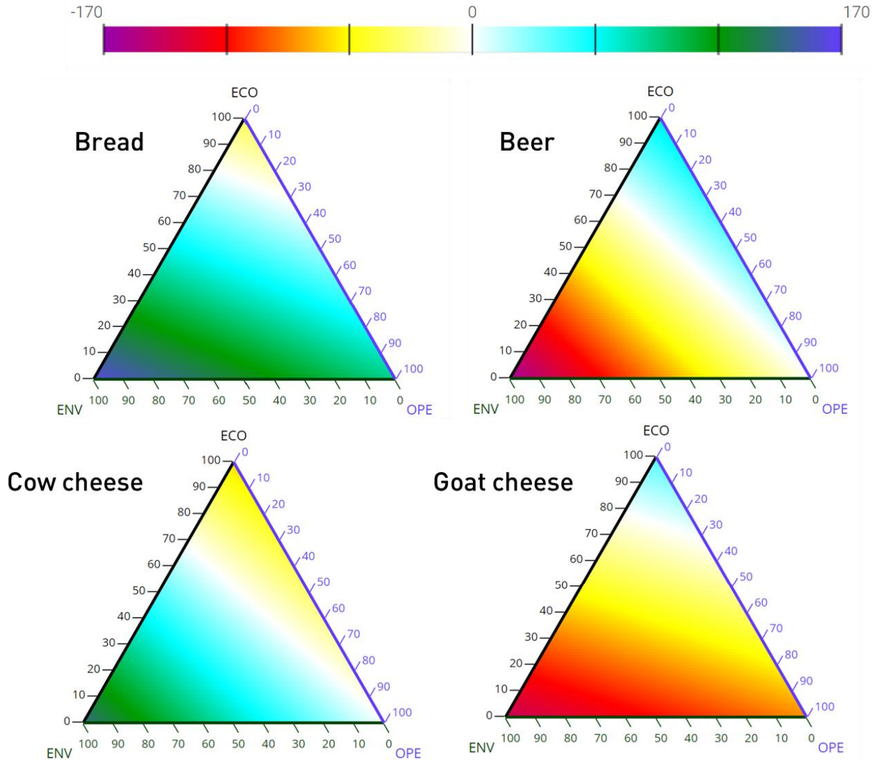


Barley beer Cow cheese Goat cheese Rye bread

Worst alternatives



- Cereals-based production systems represents a good alternative for a wide range of actors.
- Bread and cow cheese range in a positive value set and could be a satisfactory choice for most decision-makers.



3-group sensitivity , based on balanced profile, unibz proprietary software

Credits for the data: Sacco et al., 2025

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Before moving to the software tool …

- MCA methodologies offer a common platform in which to integrate the different criteria (= types of impact) to be considered.
- For the transparency and sharing of the decision-making process, it is essential to have tools in which several decision-makers can express their priorities autonomously, *once the list of criteria to be assessed has been shared and accepted*.
- MCA **is not** an optimisation method, but an approach by which a decision-making convergence on a reasonable compromise is aimed at.
- For stability in the choices of final alternatives, it is useful to use sensitivity analyses on decision profiles.

MCA tool online

iNEST-AMC

Evaluation Sessions
Scientific Network South Tyrol

Profile
Scientific Network South Tyrol

This is a freeware web application that allows decision-making processes to be set up and managed according to multi-criteria approaches. It is a multi-criteria tool derived from the ELECTRE methods and ca
criteria of different nature, unanimously agreed upon by all the actors involved in the process. Each session deals with a single decision-making problem comparing different alternatives to choose from, apply
elements of the problem (the impacts of each alternative) from the subjective ones (priorities of the different decision-makers). The result of the session is a ranking of preferences of the alternatives subject
better assess the stability of the results, the calculation platform also allows sensitivity analyses to be carried out on the priorities of the decision-makers, after grouping the criteria into homogeneous catego

The application was developed by the Free University of Bozen-Bolzano and adapted to the needs of the decision-making processes foreseen within the activities of the Consortium iNEST Interconnected Nort
Generation EU (funds of the PNRR iNEST project, promoted by the European Union NextGenerationEU (National Recovery and Resilience Plan - Mission 4 Component 2, Investment 1.5 - D.D. 1058 23/06/2022,

A quick overview of the use of the application can be found here. For a general description of the structure of the application, with examples on how to use it within the issues addressed in the iNEST Project,

Optimized for Chrome.

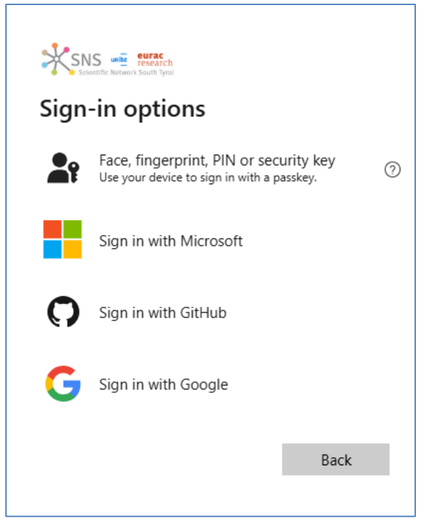
Version

14.1.2

Authors

Fabrizio Mazzetto, Pasqualina Sacco
Software Development of ICT Unibz and Eurac

https://my.scientificnet.org/inest-amc/

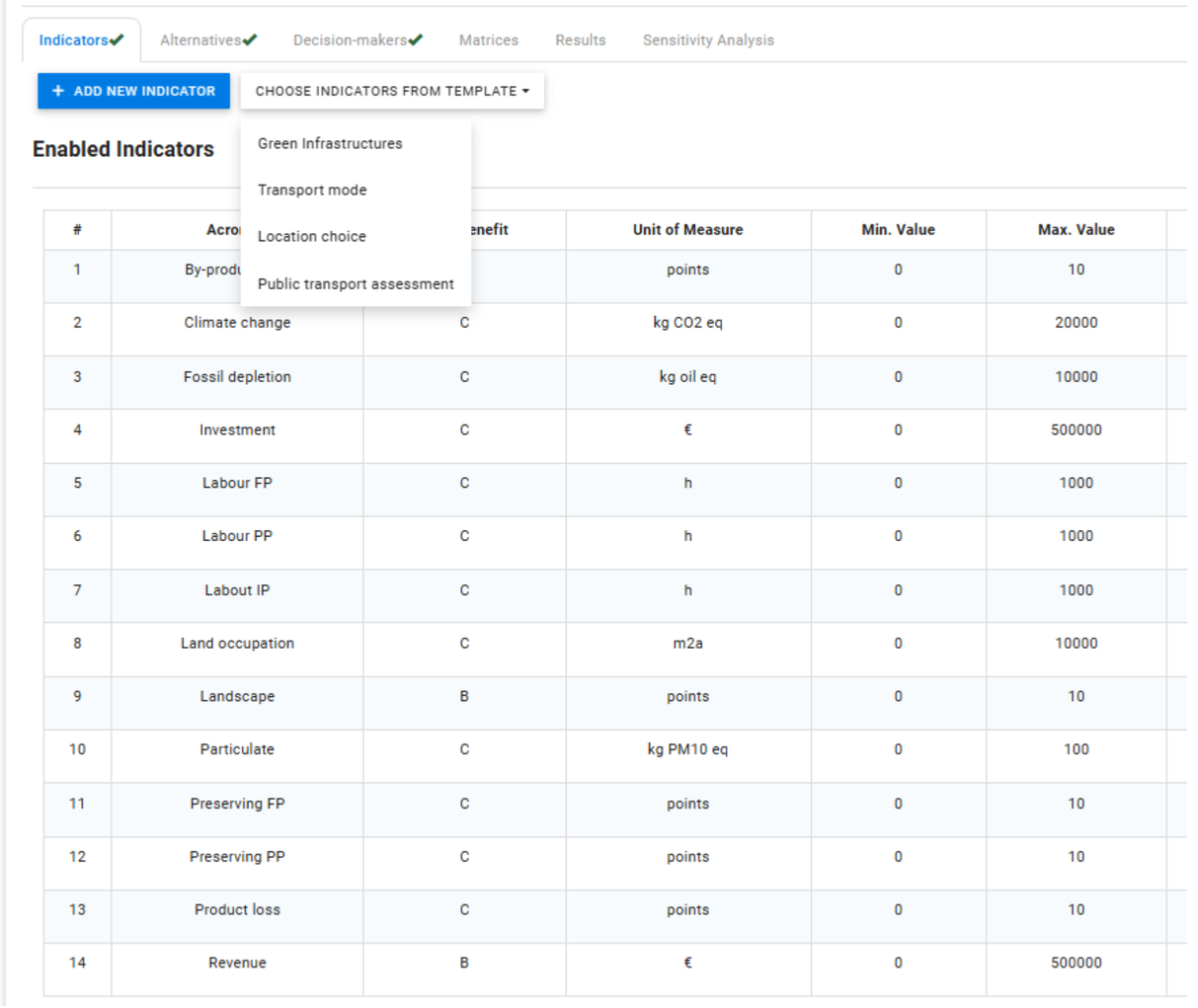


MCA tool online

1st step

Add indicators to be used into the impact matrix.

Indicators can also be added from a list.



#	Acro	enefit	Unit of Measure	Min. Value	Max. Value
1	By-produ		points	0	10
2	Climate change	C	kg CO2 eq	0	20000
3	Fossil depletion	C	kg oil eq	0	10000
4	Investment	C	€	0	500000
5	Labour FP	C	h	0	1000
6	Labour PP	C	h	0	1000
7	Labout IP	C	h	0	1000
8	Land occupation	C	m2a	0	10000
9	Landscape	B	points	0	10
10	Particulate	C	kg PM10 eq	0	100
11	Preserving FP	C	points	0	10
12	Preserving PP	C	points	0	10
13	Product loss	C	points	0	10
14	Revenue	B	€	0	500000

Credits for the data: Sacco et al., 2025

MCA tool online

2nd step

For each alternative valorize all the chosen criteria

Rye wholemeal bread (Rye bread) ✔

Description:
Rye bread

Impacts's actions

CHANGE

#	Acronym	Cost/Benefit	Unit of Measure	Min. Value	Max. Value	Threshold Enabled	Threshold Min. Value	Threshold Max. Value	Impact Value
1	By-products val	B	points	0	10	NO	-	-	3
2	Climate change	C	kg CO2 eq	0	20000	NO	-	-	1313
3	Fossil depletion	C	kg oil eq	0	10000	NO	-	-	215.6
4	Investment	C	€	0	500000	NO	-	-	17687.5
5	Labour FP	C	h	0	1000	NO	-	-	79.6
6	Labour PP	C	h	0	1000	NO	-	-	90.9
7	Labout IP	C	h	0	1000	NO	-	-	8.6
8	Land occupation	C	m2a	0	10000	NO	-	-	685.7
9	Landscape	B	points	0	10	NO	-	-	7.5
10	Particulate	C	kg PM10 eq	0	100	NO	-	-	3.3
11	Preserving FP	C	points	0	10	NO	-	-	8
12	Preserving PP	C	points	0	10	NO	-	-	3
13	Product loss	C	points	0	10	NO	-	-	9
14	Revenue	B	€	0	500000	NO	-	-	16760

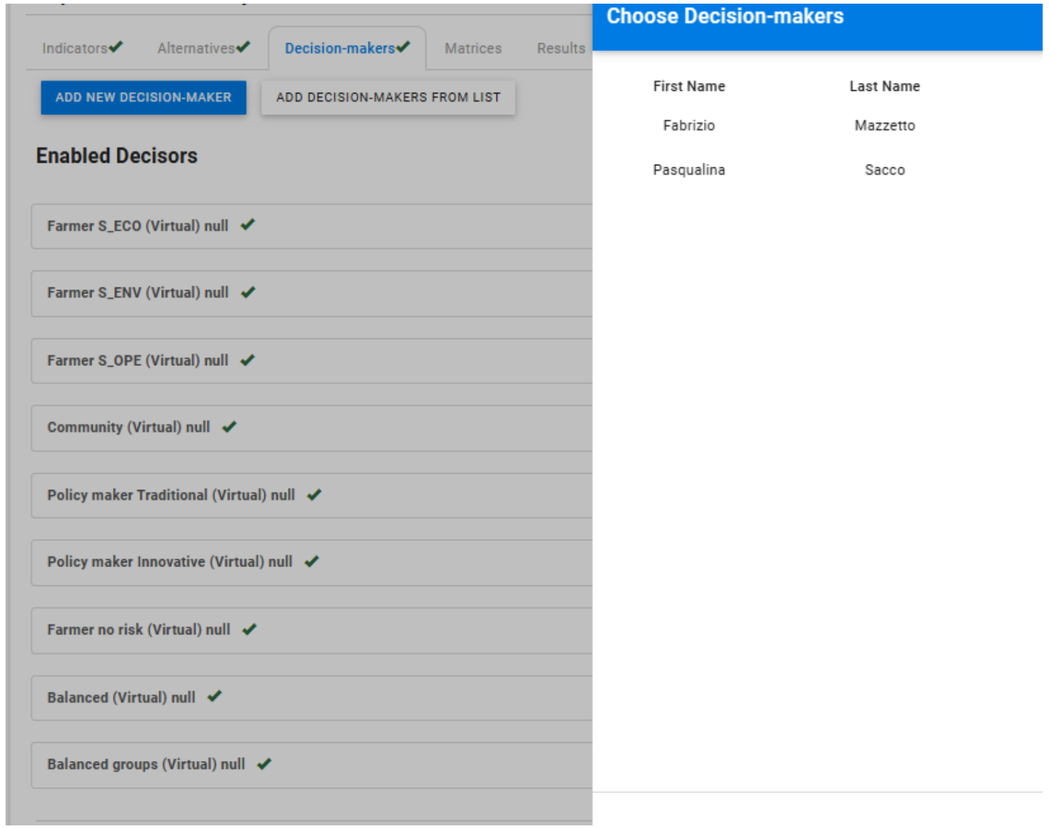
Barley craft beer (Barley beer) ✔

Credits for the data: Sacco et al., 2025

MCA tool online

3rd step

Add virtual decision makers profiles or invite people as decision maker in the evaluation session



Each decision maker sets priorities for each criterion

Farmer S_ECO (Virtual) null

CHANGE

#	Acronym	Cost/Benefit	Priority Value
1	Revenue	B	18.13
2	Investment	C	32.08
3	Preserving PP	C	14.47
4	Preserving FP	C	14.47
5	Product loss	C	14.47
6	Labour PP	C	0.72
7	Labout IP	C	0.72
8	Labour FP	C	0.72
9	Landscape	B	0.72
10	By-products val	B	2.06
11	Land occupation	C	0.36
12	Climate change	C	0.36
13	Fossil depletion	C	0.36
14	Particulate	C	0.36

Credits for the data: Sacco et al., 2025

MCA tool online

4th step

Impact matrix and priority matrix are composed

Impact Matrix

NORMALIZED VALUES

#	Acronym	C/B	Unit of Measure	Rye wholemeal bread	Barley craft beer	Cow mature cheese	Goat mature cheese
1	Revenue	B	€	16760	153600	10086.47	15474.64
2	Land occupation	C	m2a	685.7	3271.9	195	204.7
3	Climate change	C	kg CO2 eq	1313	9735	3687.6	3890
4	Fossil depletion	C	kg oil eq	215.6	2967.1	334.5	352.8
5	Particulate	C	kg PM10 eq	3.3	22.3	22.9	24.2
6	Investment	C	€	17687.5	19750	22375	21125
7	Preserving PP	C	points	3	3	10	10
8	Preserving FP	C	points	8	1	2	2
9	Product loss	C	points	9	8	3	3
10	Labour PP	C	h	90.9	148.4	79.1	79.1
11	Labout IP	C	h	8.6	82.8	139.1	165.3
12	Labour FP	C	h	79.6	193	116.3	147.8
13	Landscape	B	points	7.5	7.5	8	7
14	By-products val	B	points	3	7	9	9

Priorities Matrix

Indicator	Farmer S_ECO (Virtual)	Farmer S_ENV (Virtual)	Farmer S_OPE (Virtual)	Community (Virtual)	Policy maker Traditional (Virtual)	Policy maker Innovative (Virtual)	Farmer no risk (Virtual)	Balanced (Virtual)	Balanced groups (Virtual)
Revenue	18.13	15.76	6.51	2.75	17.67	5.24	14.59	7.18	8.46
Land occupation	0.36	1.25	0.19	11.99	14.62	6.27	0.6	7.14	6.6
Climate change	0.36	11.93	1.37	12.85	2.72	9.22	0.47	7.14	6.6

Credits for the data: Sacco et al., 2025

MCA tool online

5th step

Choose methods and run calculation

Indicators ✔ Alternatives ✔ Decision-makers ✔ Matrices **Results** Sensitivity Analysis

CHANGE SETTINGS | RUN CALCULATIONS

Best Worst Negative Positive Zero

Normalization Algorithm: Min-Max

Syntetic | Winner: Rye wholemeal bread (5 / 9)

	Farmer S_ECO (Virtual)	Farmer S_ENV (Virtual)	Farmer S_OPE (Virtual)	Community (Virtual)	Policy maker Traditional (Virtual)	Policy maker Innovative (Virtual)	Farmer no risk (Virtual)	Balanced (Virtual)	Balanced groups (Virtual)
Rye wholemeal bread	0.6089	0.7337	1.5149	0.7952	0.3042	1.0798	-1.4368	1.4321	1.1042
Barley craft beer	1.6543	0.0129	-0.4615	-1.8168	-0.2629	-0.8977	0.4387	-1.3450	-1.0359
Cow mature cheese	-1.6398	-0.2855	-0.0235	1.7304	0.6982	0.4644	0.4589	0.7291	0.5914
Goat mature cheese	-0.6234	-0.4611	-1.0299	-0.7088	-0.7395	-0.6465	0.5392	-0.8163	-0.6597

Credits for the data: Sacco et al., 2025

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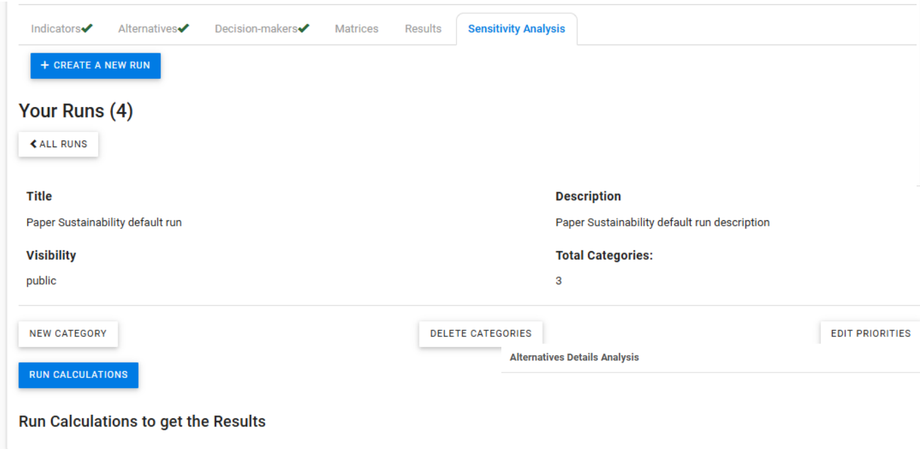
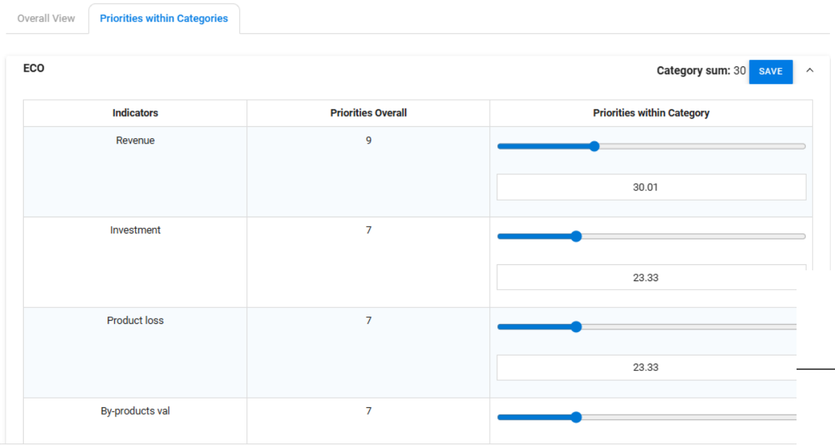
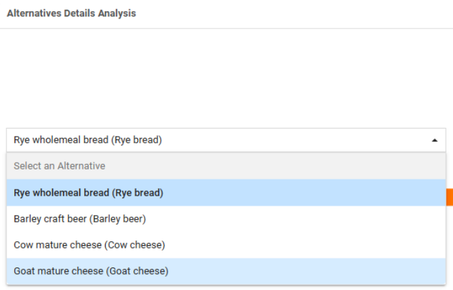
MCA tool online

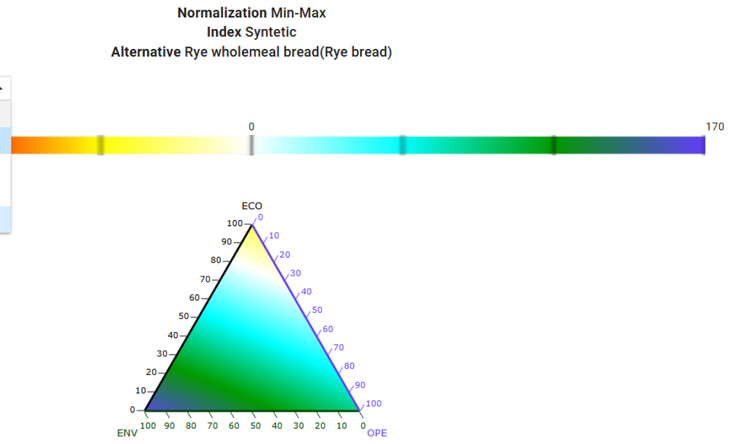
6th step

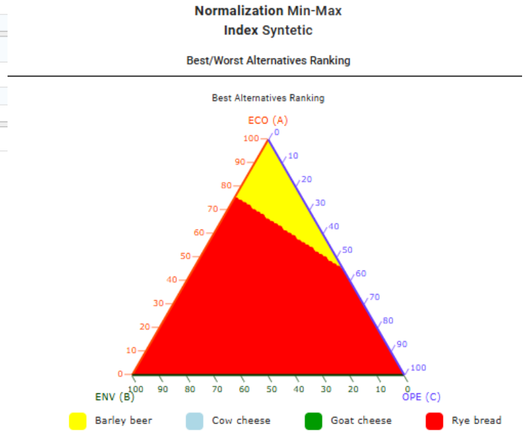
Perform sensitivity analysis

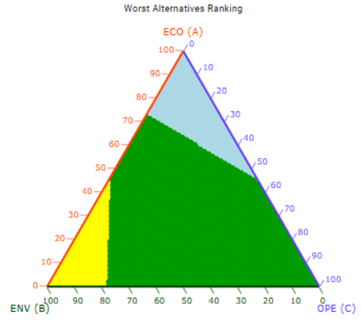












Credits for the data: Sacco et al., 2025

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Thank you

More info: psacco@unibz.it

Credits for the data: Sacco, P.; Don, D.; Mandler, A.; Mazzetto, F. Integrating LCA and Multi-Criteria Tools for Eco-Design Approaches: A Case Study of Mountain Farming Systems. Sustainability 2025, 17, 6240. https://doi.org/10.3390/su17146240

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iNEST Interconnected Nord-Est Innovation Ecosystem

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