SUSINCHAIN Final Symposium
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Wageningen University & Research

Maximizing sustainability in insect production: a multi-objective optimization approach

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SUSINCHAIN

SUSTAINABLE INSECT CHAIN

SUStainable INsect CHAIN (SUSINCHAIN) aims to contribute to novel protein provision for feed and food in Europe by overcoming the remaining barriers for increasing the economic viability of the insect value chain and opening markets by combining forces in a comprehensive multi-actor consortium.

Factsheet

✓ Project Name	SUStainable INsect CHAIN
✓ Project Acronym	SUSINCHAIN
✓ Grant Agreement Number	861976
✓ Funding	European Union's Horizon 2020 Research and Innovation programme
✓ Topic	LC-SFS-17-2019 - Alternative proteins for food and feed
✓ Total Budget	8,68 Million €
✓ Start Date	1 October 2019
✓ End Date	30 September 2023
✓ Coordination	Stichting Wageningen Research, Netherlands

SUSINCHAIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement nº 861976.

Methodological insights: LCA

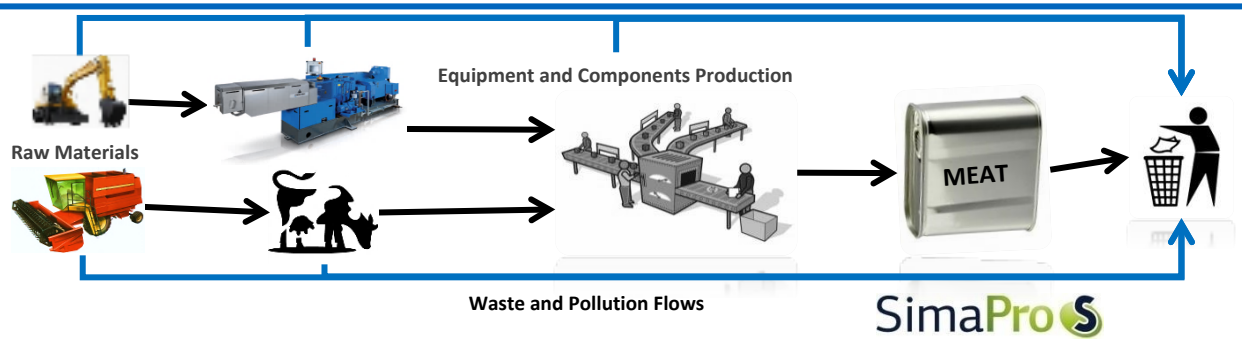
Main Objective

Estimate environmental impact of technologies and products

Basis

Life Cycle Thinking

ISO DN 14040-14044

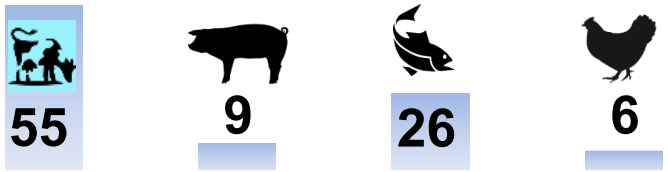


Results

Inventory and Analysis

1 annual = 1 kPt

Technologies and Products
Comparative Possibilities



Impact Categories
- Climate Change
- Human Health
- Resource Depletion
- Ecosystem Quality
- Land Use
- Water Use
- Acidification
- Eutrophication
- Minerals Use
- Fossil Fuel Use
- Carcinogens …

Outcomes

Quantified Data

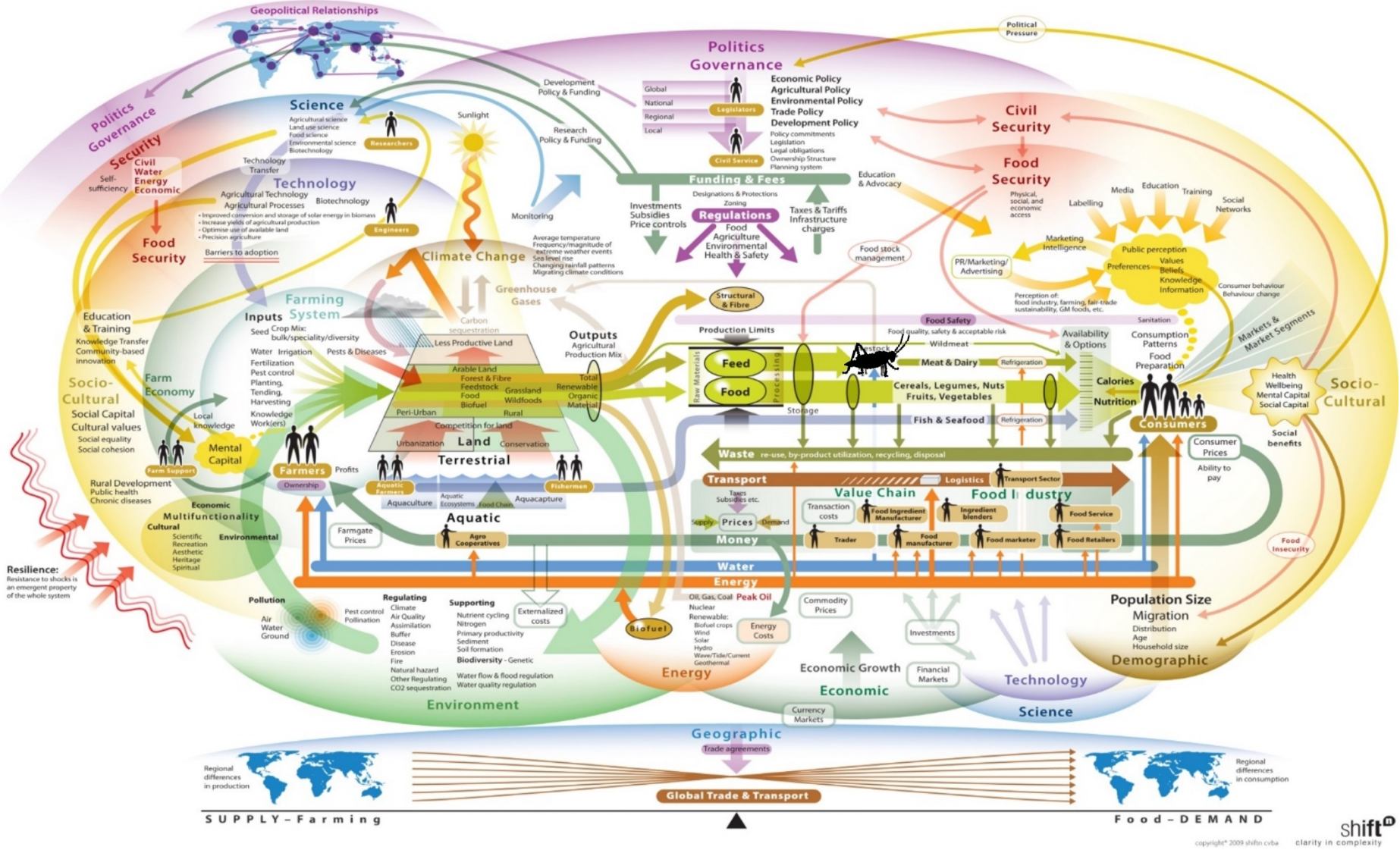
More Sustainable Equipment Selection
Product Sustainability Determination
Environmental Labeling
Technologies Improvement
Food Innovation

PEF
European Commission

More efficient, less harmful and less resource consuming products

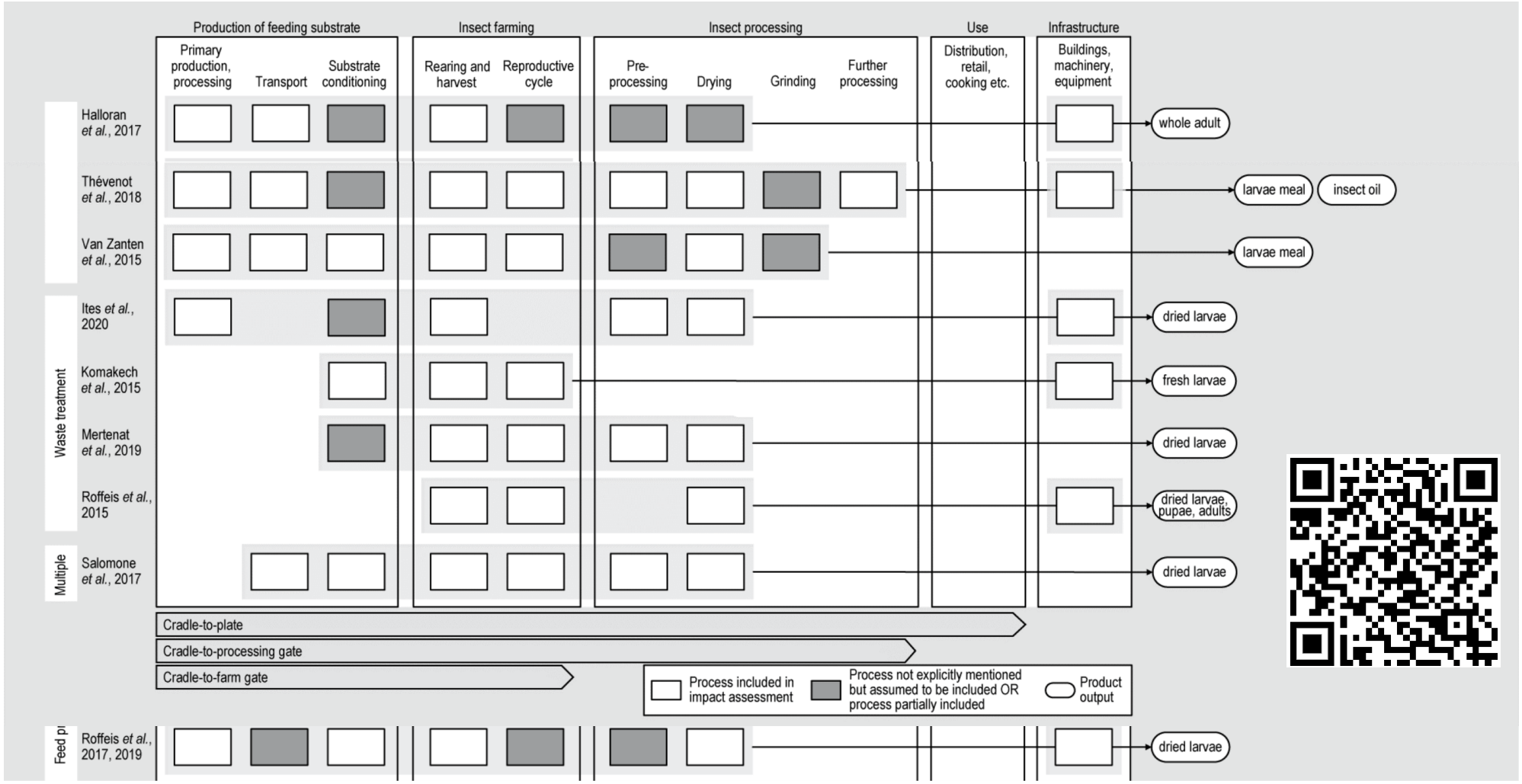
- Hotspots
- Best options
- Cradle-to-grave
- FU
- Comprehensive methods
- Potential impacts

Dietary shifts studies for emergency



courtesy of ShiftN

System boundaries overview



Smetana, S., Spykman, R., & Heinz, V. (2021). Environmental aspects of insect mass production. *Journal of Insects as Food and Feed*, 1-20.

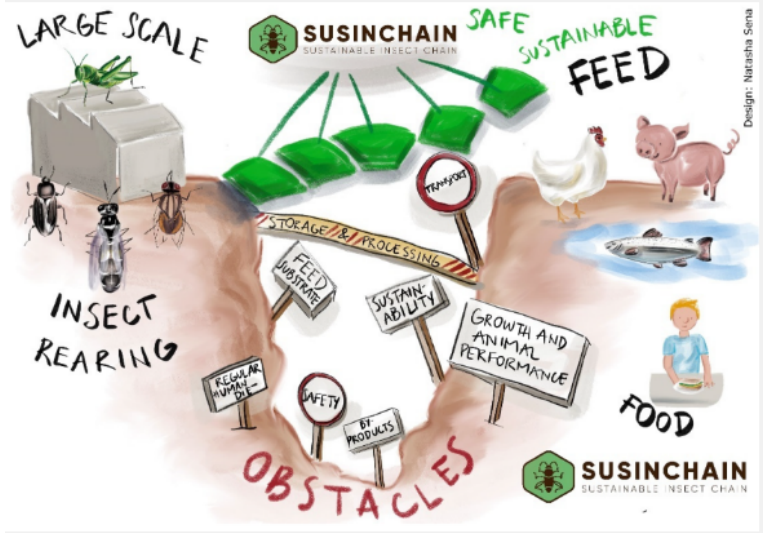
SUSINCHAIN online tool

SUSINCHAIN SUSTAINABLE INSECT CHAIN

DIL

DIL SUSINCHAIN **SUSINCHAIN Decision Tool** Home Tool Feedback

http://susinchain.herokuapp.com/index



Susinchain Tool

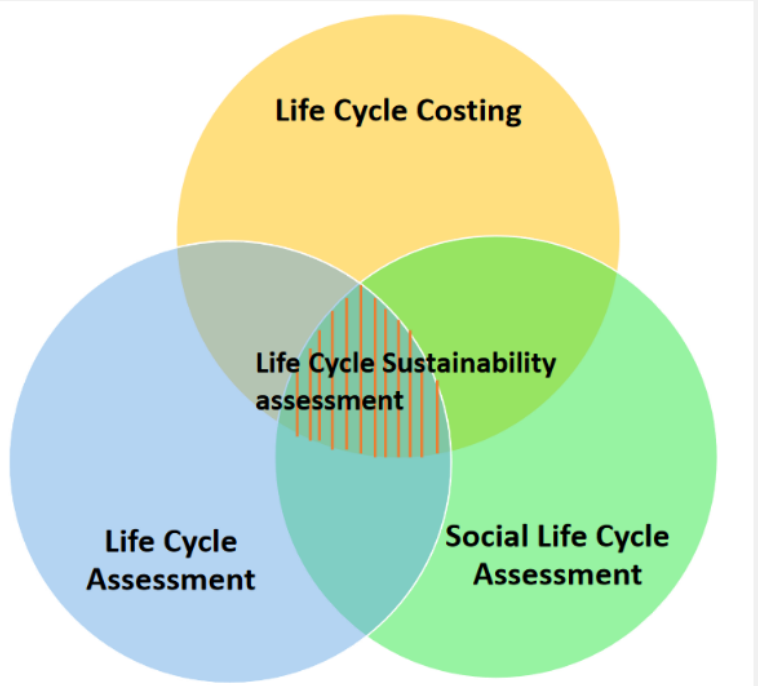
This calculation and recommendation tool has been developed by DIL e.V. in the scope of SUSINCHAIN project in 2021. It allows to calculate the approximate environmental impact in four categories of global warming potential (GWP), non-renewable energy use (NRE), Land use (LU) and Water use (WU). Additionally it provides the estimation on the potential cost of such production, in euro according to the prices in 2021. The tool is intended for the use by the companies and start-ups dealing with the insect mass rearing for food and feed. By using the tool, insect stakeholders can estimate the production impacts and costs at the design stage and identify the improvement strategies

Authors
Anita Bhatia, Sergiy Smetana

References

- Jolliet, O., Margni, M., Charles, R., Humbert, S., Payet, J., Rebitzer, G., & Rosenbaum, R. (2003). IMPACT 2002+: a new life cycle impact assessment methodology. The international journal of life cycle assessment, 8(6), 324-330.
- Bulle, C., Margni, M., Patouillard, L., Boulay, A., Bourgault, G., De Bruille, V., ... Jolliet, O. (2019). IMPACT World+: a globally regionalized life cycle impact assessment method. The International Journal of Life Cycle Assessment.https://doi.org/10.1007/s11367-019-01583-0

Click here for tool



Methodology

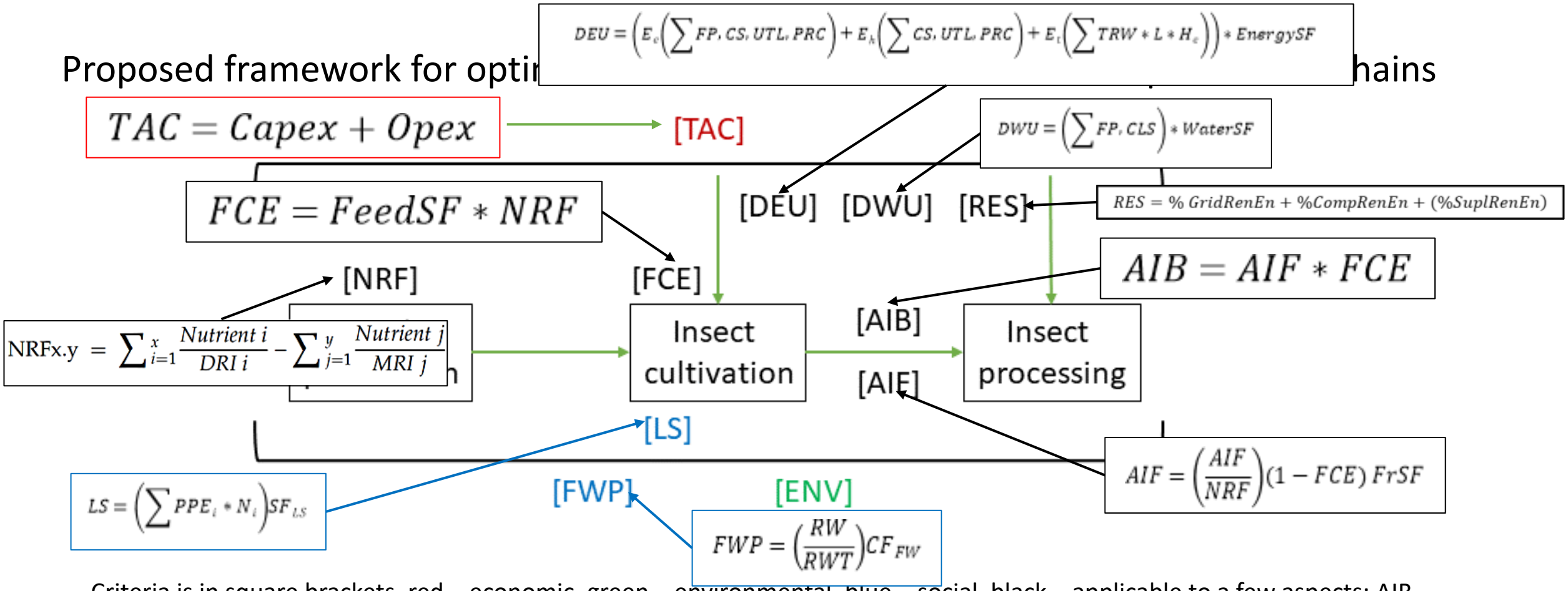
- The tool is based mainly on IMPACT 2002+ LCIA Methodology (Jolliet et al., 2003) for the calculation of environmental impacts.
- The costs of activities were calculated based on publicly available prices.
- Water use (water scarcity) was calculated using IMPACT WORLD+ methodology (Bulle et al., 2019)

SUSINCHAIN Decision Tool

This study has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 861976 project SUSINCHAIN.

Sustainability is complex and … complicated…

Proposed framework for optim… hains



Criteria is in square brackets, red – economic, green – environmental, blue – social, black – applicable to a few aspects; AIB – amount of insect biomass; AIF – amount of insect frass; DEU – direct energy use; DWU – direct water use; ENV – integrated environmental impact; FCE – feed conversion efficiency; FWP – fair wage potential; LS – labor safety; NRF – nutritional value of feed; RES – renewable energy share; TAC – total annual cost

Mouhrim, Smetana, Paguero, Green, Silva, Bhaita, Ristic, Tonda, Mathys, Heinz (2023) under revision

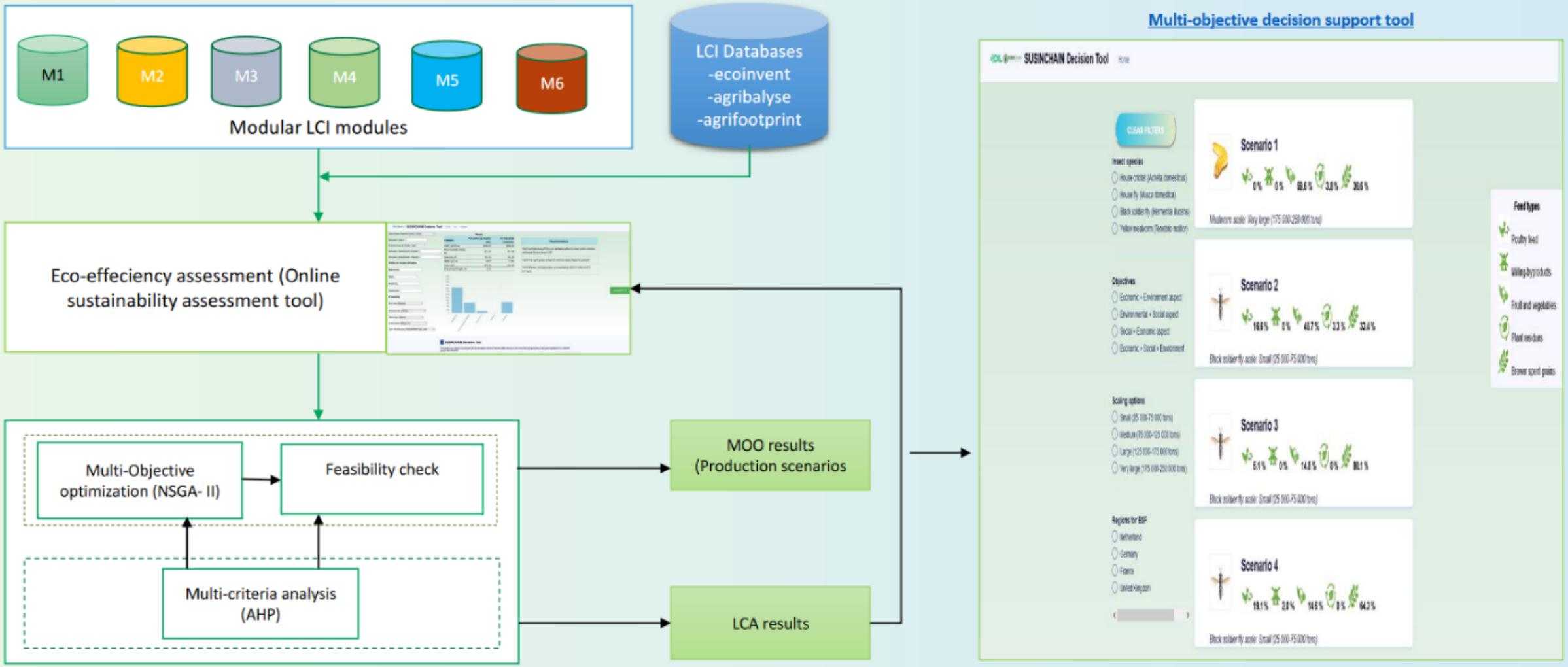
Multi-objective optimization

Barbiero, Squillero & Tonda (2020)
https://arxiv.org/pdf/2002.08645.pdf

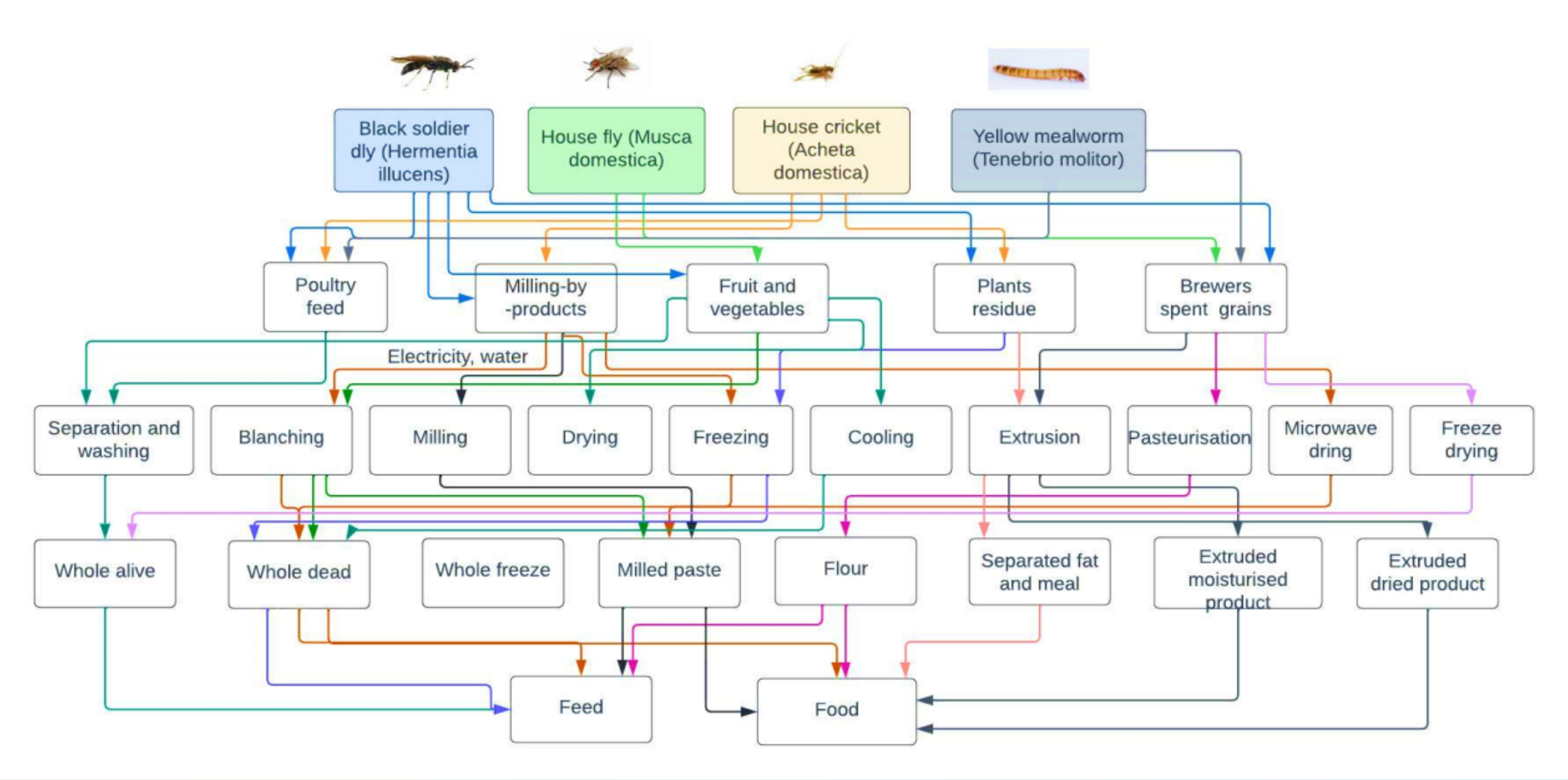
Objectives

Amount of insect biomass (AIB)
Amount of insect frass (AIF)
Direct energy use (DEU)
Direct water use (DWU)
Integrated environmental impact (ENV)
Feed conversion efficiency (FCE)
Fair wage potential (FWP)
Labor safety (LS)
Nutritional value of feed (NRF)
Renewable energy use share (RES)
Total annual costing (TAC)

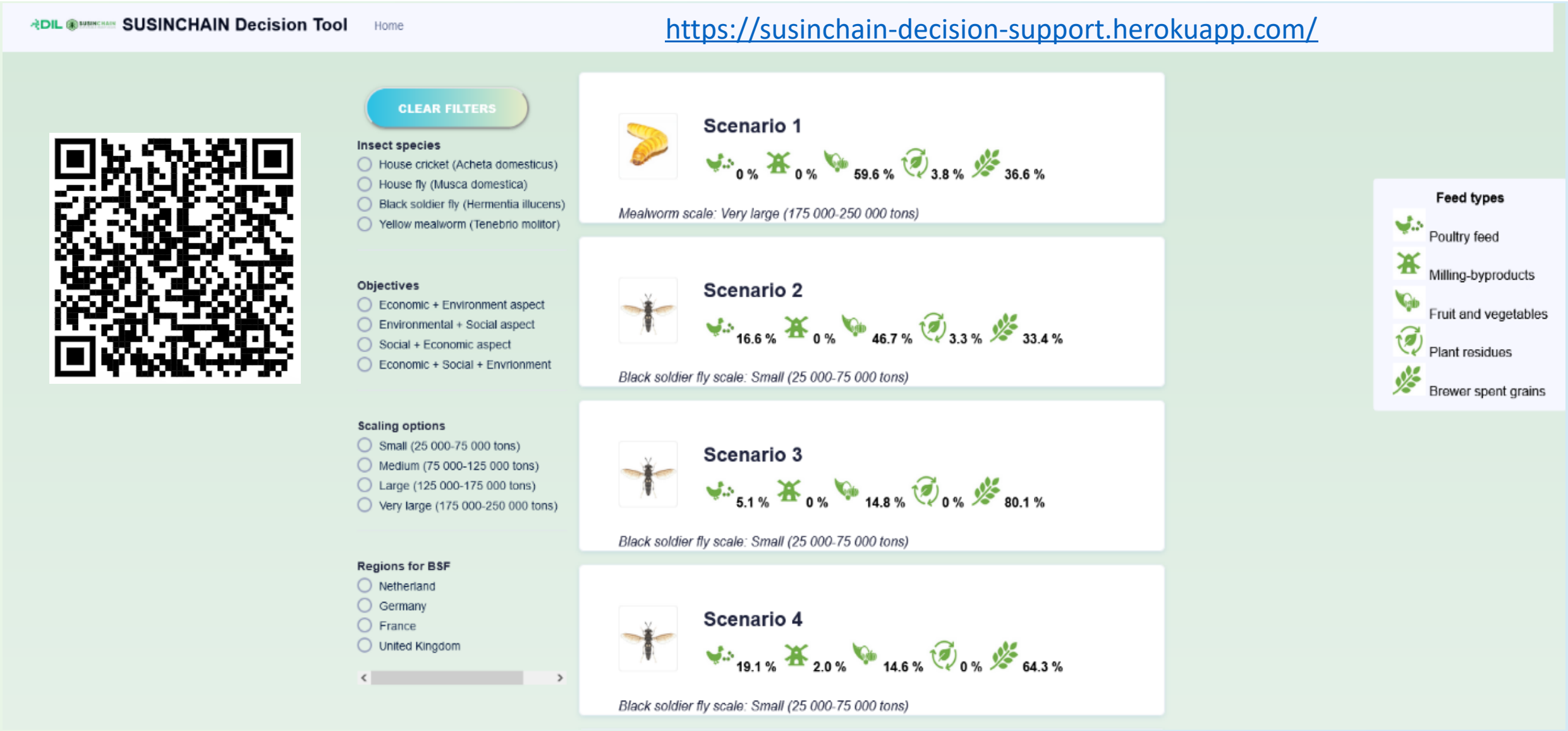
SUSINCHAIN MULTI-OBJECTIVE OPTIMIZATION



Industrial blueprint scheme for sustainable insect value chains



SUSINCHAIN DSS



Take away messages

1. More studies and more data is needed to train MOO and even more AI
2. Combination of sustainability aspects is already a complex system
3. Separate aspects of optimization (e.g., feed mixtures, breakeven points and optimal technological solutions) can be already solved with the data available

Acknowledgments

Project **SUSINCHAIN** H2020 nº 861976

SUSINCHAIN
SUSTAINABLE INSECT CHAIN

Funded by the Horizon 2020 Framework Programme of the European Union

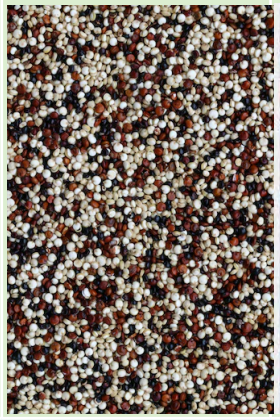
GIANT LEAPS

https://giantleaps.eu/

DIL

Gap resolutIon in sAfety, NuTritional, alLergenicity and Environmental assessments to promote Alternative Protein utilization and the dietary

HORIZON EUROPE
€ 11.9 Million
01.09.2022 – 31.08.2026
COORDINATOR
STICHTING WAGENINGEN RESEARCH

Faba bean	Lentil	Oat	Quinoa	Rapeseed	Microalgae	Single-cell proteins	Crickets	Cultured beef
								

Thank you for for your attention!

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