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Agroscope

LCA FOOD 2024

Promoting harmonization of life cycle inventory and food composition databases through semi-automatic standardization

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Introduction

- **Driving food systems more sustainable** is widely discussed due to the various dramatic implication of the intensification of food production on environment and health (Alemu, 2022; Sirdey *et al.* 2023; Zhu *et al.* 2023)
- Efforts are increasing to direct food production towards products with **low environmental impacts and high nutritional value** (Mazac *et al.* 2023)
- For that purpose, nutritional and environmental data of food products is needed **for multi-dimensional optimization**
- **Lack** of publicly available combined databases

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Research questions

The paper aims to answer the following questions:

1. Do **LCI** and **FCDB databases** (Agribalyse and EuroFIR, respectively) provide **enough (meta) data to successfully describe and interlink** food entries between environmental and nutritional databases?

2. Can manual and automatized matching procedures be coupled into a **semi-automatized standardization approach** to facilitate data interlinkage?

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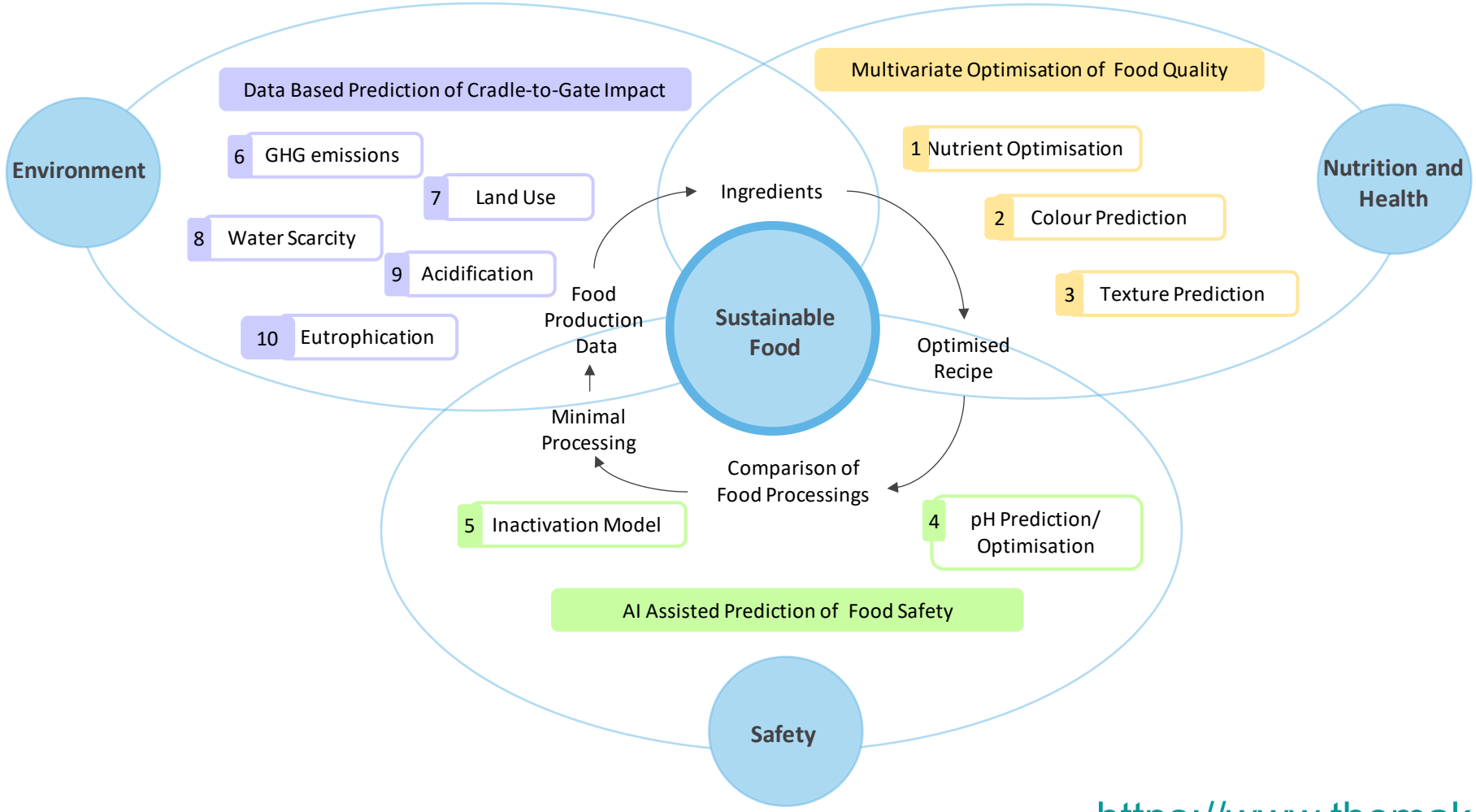
EU project OptiSignFood



- Horizon 2020 call EIC-FTI-2018-2020
- Project OptiSignFood
- Title: Data Science and AI assisted holistic software to digitally design optimized high quality and safe food products with minor environmental impact
- 1.7.2021-30.6.2024

https://www.themakersfood.com/optisignfood

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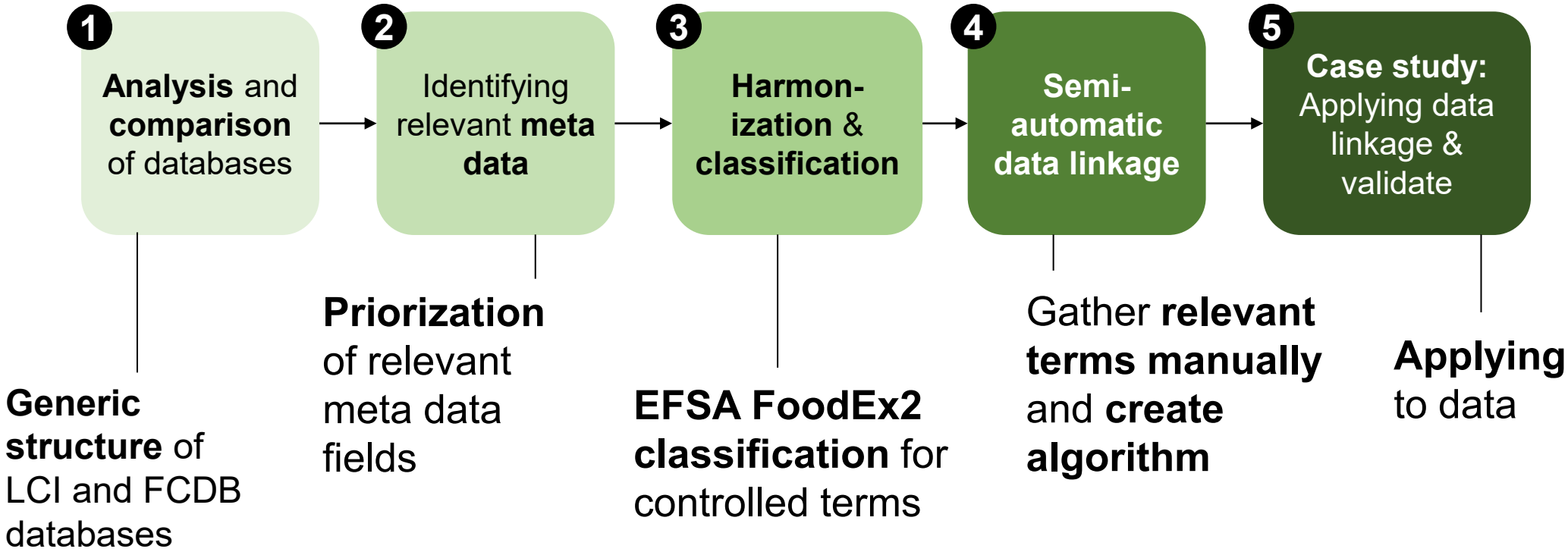
Methods

Relevant research areas for database interlinkage considered in this study



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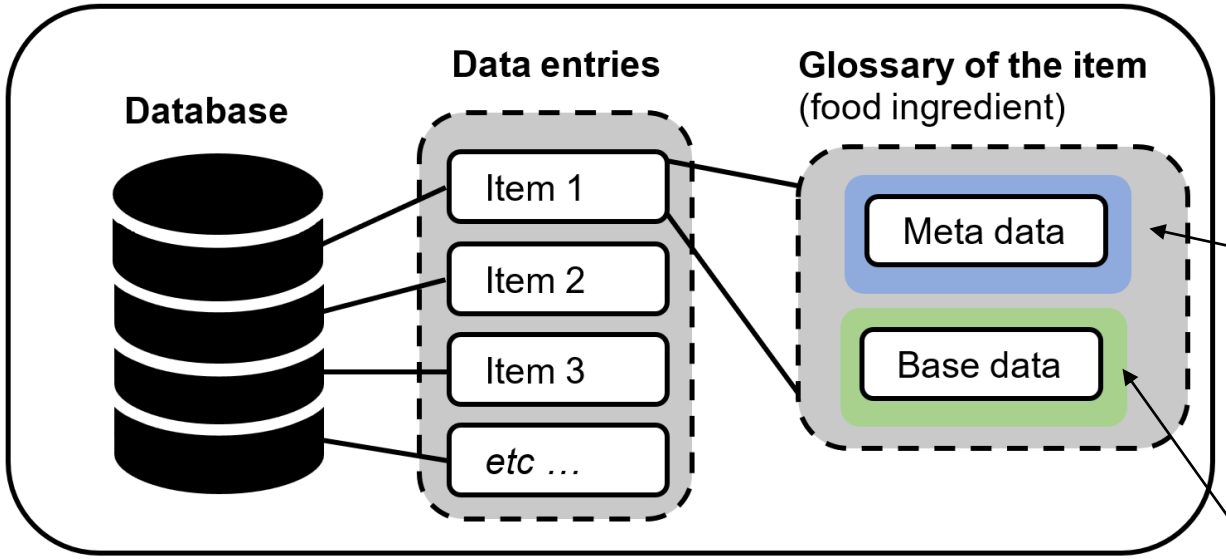
Data structure



Relevant for interlinkage
Database-specific

Values
Environmental impacts or nutritional characteristics of food

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Data structure and availability
Comparing meta data

Description	Agribalyse	EuroFIR
ID		0211051
Name	Apple, conventional, electric platform, at orchard/kg/FR	Apple, fresh
Unit	Per kilogram	Per 100g edible portion
Category	AGRIBALYSE/Plant production/Fruits	Fruit or fruit product
Country	France	Switzerland
LanguaL™ code(s)		A0833, B1245, G0003, H0003, J0003, K0003 ...
Data quality	Technological representativeness = 2, Geographical representativeness = 2, Technological representativeness = 2, Completeness = 2, Precision/uncertainty = 2, Methodological appropriateness and consistency = 2	
Included processes	(1) the processes of soil preparation and cultivation, sowing, weed control, fertilisation, pest and pathogen control, harvest; (2) the machines and shed or surface used to park them; (3) all inputs as seed, fertilizers (mineral and organic), active substances, water for irrigation, fuels as well as the transport to the farm; (4) the direct emissions of the fuel combustion, the abrasion of tyres and the direct emissions on the field.	

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Useful meta data

Partially useful

Missing and/or **incomplete**

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Relevant meta data

Parameter	Example	FCDB databases (e.g., EuroFIR)	LCI databases (e.g., Agribalyse)	Additional info
Food name	*"Apple"*, *"Mango"*, etc.	*** (III)	*** (III)	Information needs to be extracted from title of a database entry
Food specification	*"Juice"*, *"Oil"*, etc.	*** (II)	*** (II)	Information needs to be extracted from title of a database entry. Often inconsistently accessible information (e.g., "sunflower oil" vs. "oil, sunflower")
Food recipe	Percentage of water added to apple juice	*** (I)	*** (I)	Information, if provided, only in base data. Difficult to extract.
Food processing	*"pasteurized"*	*** (III)	*** (II)	Information needs to be extracted from title of a database entry
System boundaries	*"at farm"* or *"at processing"*	* (I)	*** (II)	Not always provided in the database entry in Agribalyse
Yield	Yield of apple from agricultural production	* (I)	*** (II)	Information only provided in base data. Difficult to extract.
Country of origin of food	*"Germany"*, *"France"*, etc.	** (I)	*** (III)	
Production system	*"conventional"*, *"organic"*, etc.	* (I)	*** (II)	Information needs to be extracted from title of a database entry

*: little relevant or irrelevant; **: moderately relevant; ***: highly relevant
I: not provided; II: sometimes provided; III: fully provided

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Categories for connection list

Name
e.g., Apple

→ Describes **basic ingredient** without any further specification

Default
Not applicable

Specification
e.g., Juice

→ Describes a food in **more detail**

Default
None

Treatment
e.g., pasteurized

→ Any further **procedures** applied to the food

Default
Raw

Production System
e.g., Organic

→ Describes **how** the food is produced

Default
Conventional

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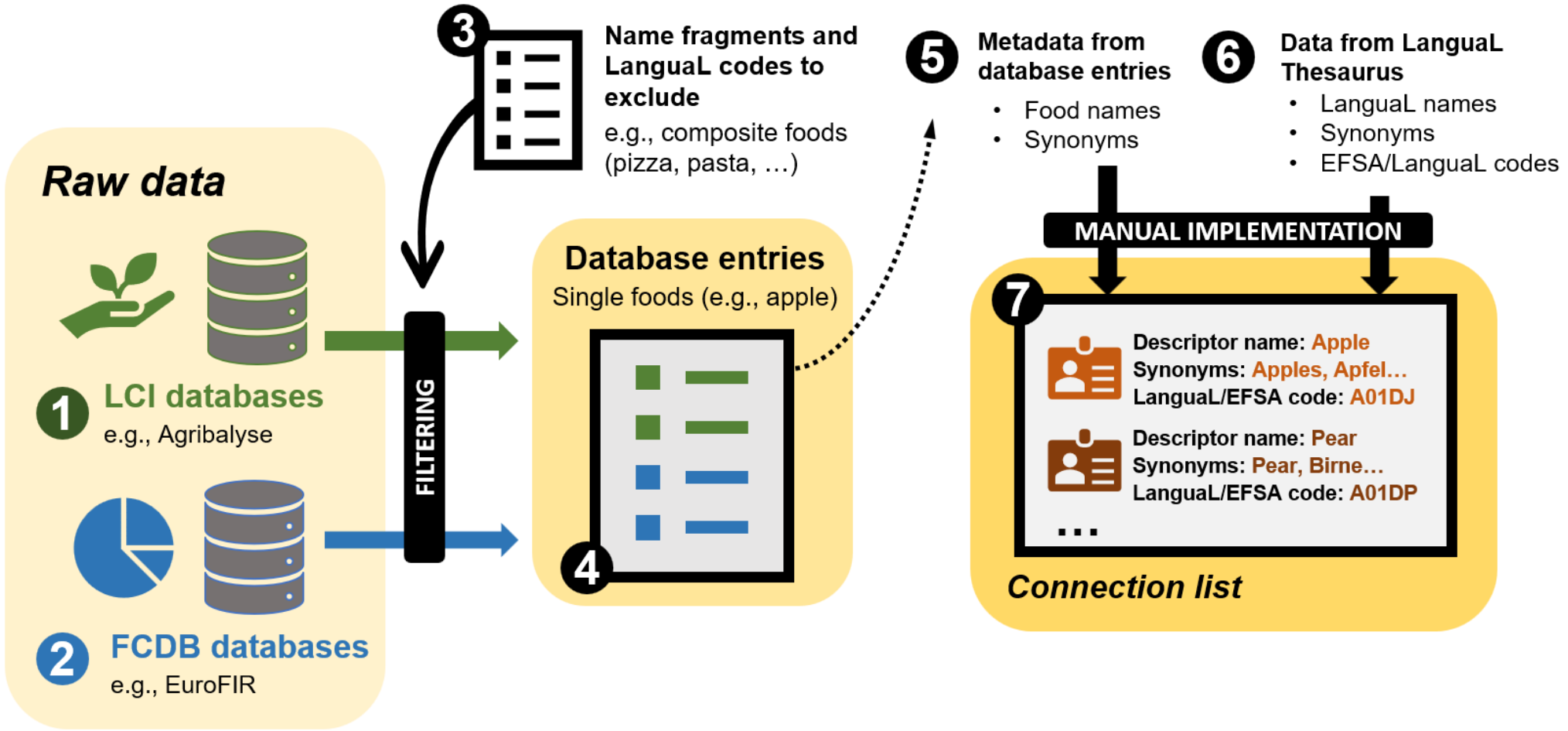
Connection list set-up



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Semi-automatic data interlinkage

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Validation

Name	Specification	Treatment	Production system	n (LCI)	n (EuroFIR)	Validation
Beef	Minced	Cooked	Conv.	4	6	
Cashew		Roasted	Conv.	2	6	
Cheese	Emmental	Raw	Conv.	5	8	
Rice	Flour	Raw	Conv.	2	6	
Sunflower	Oil	Raw	Conv.	4	6	1 wrong → Tuna canned in sunflower oil
Sweet potato		Cooked	Conv.	1	4	1 wrong → Puree with cream

Correct: **52** (17 LCI, 35 EuroFIR)
Incorrect: **2** (1 LCI, 1 EuroFIR)

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Discussion

Classification systems

- Importance and relevance
- Implementation in Agribalyse and EuroFIR

Meta data

- Limited availability
- Often difficult to access
- Food water content
- Implementation in Agribalyse and EuroFIR

Complex technical infrastructure

- Data format
- Process automatization

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Conclusion

The procedure developed **showed to work and connect data successfully**

Aspects that should be further elaborated

- Handling of **incomplete or missing data**
- **Technological complexity and data format**

Standardization remains a **challenge**

- Several attempts, none of them has been shown to satisfy the needs → incomplete matching achieved, time-consuming process for manual validation of data

Use of **artificial intelligence**

Furrer C., Sieh D., Jank A. M., le Bras G., Herrmann M., Reguant-Closa A., & Nemecek T., 2024. Interlinking environmental and food composition databases: an approach, potential and limitations. J Cleaner Prod, 143198. https://doi.org/10.1016/j.jclepro.2024.143198

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Thank you for your attention

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