# Joint assessment of the environmental impacts and resource criticality of French food consumption scenarios in 2050

Lazare DETEIX and Eléonore LOISEAU

ETH LCA DF89 - Wednesday, 5 February 2025

RÉPUBLIQUE FRANÇAISE
*Liberté Égalité Fraternité*

INRAE

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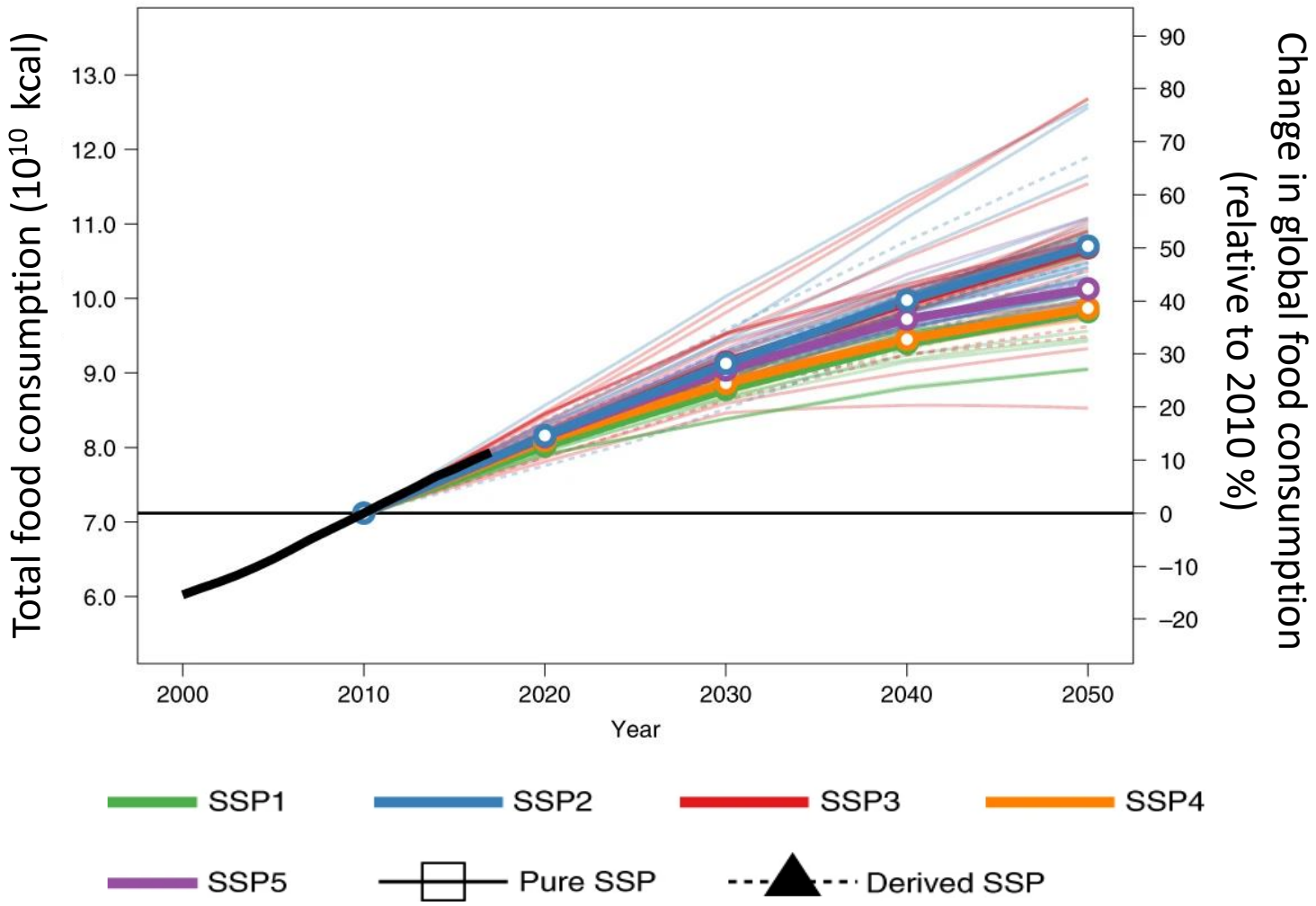
# The double challenge of food consumption

## Food consumption

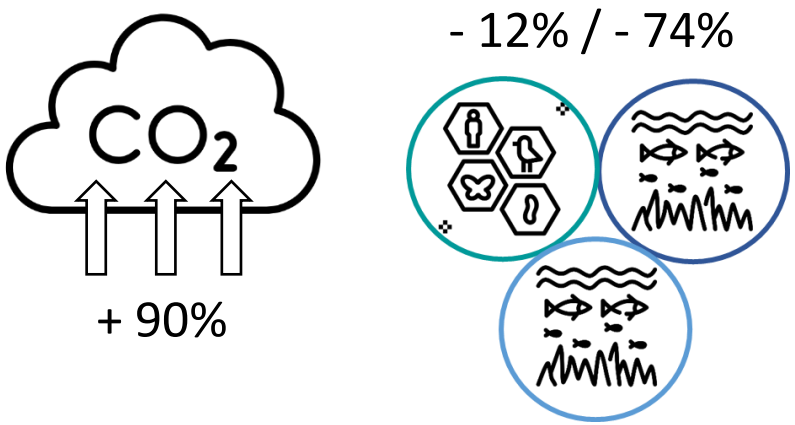



*Source : van Dijk et al. (2021)*

# The double challenge of food consumption

**Food consumption**

**Environmental Impacts**




*Source: Springmann et al. (2018), Millenium Ecosystem Assessment (2005), Pereira et al. (2024)*

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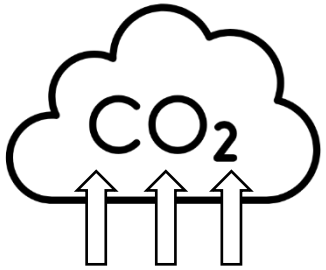
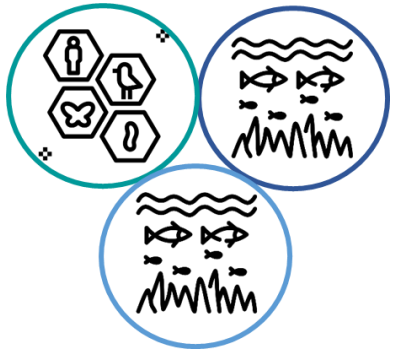
**Environmental Impacts**




+ 90%

- 12% / - 74%



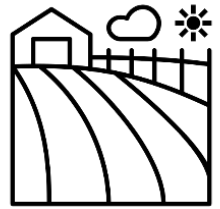
**Resource Vulnerability**

+ 65%

+ 32 - 50%


+ 50 - 70%


+ 60 - 67%



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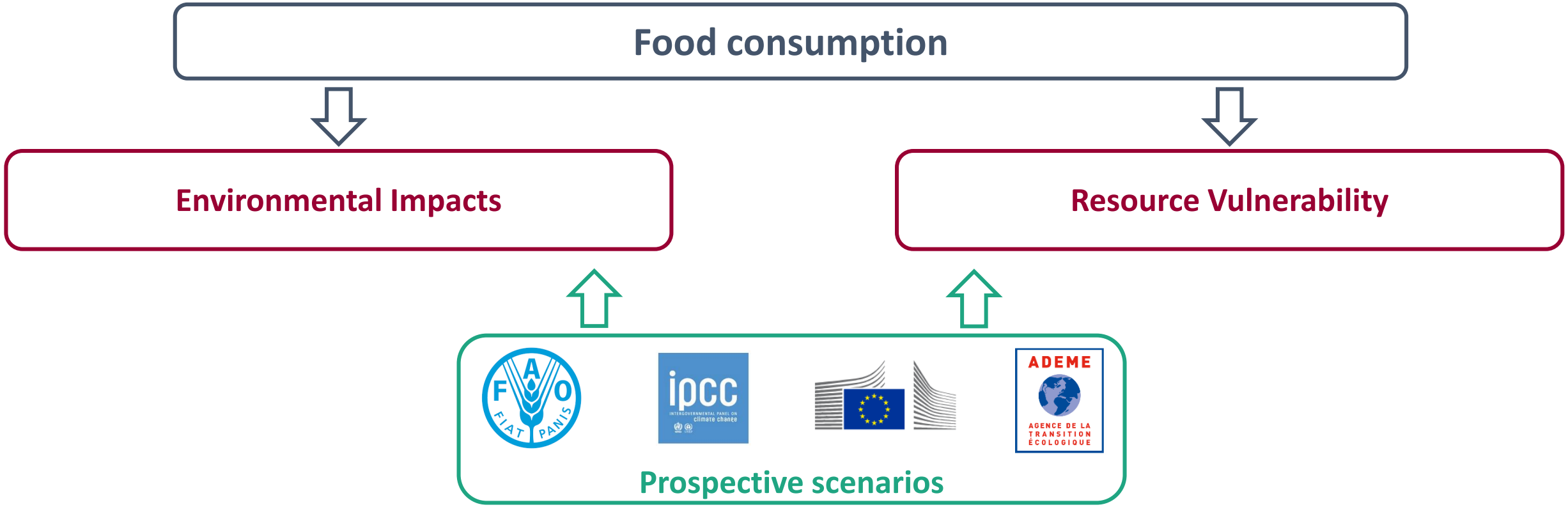

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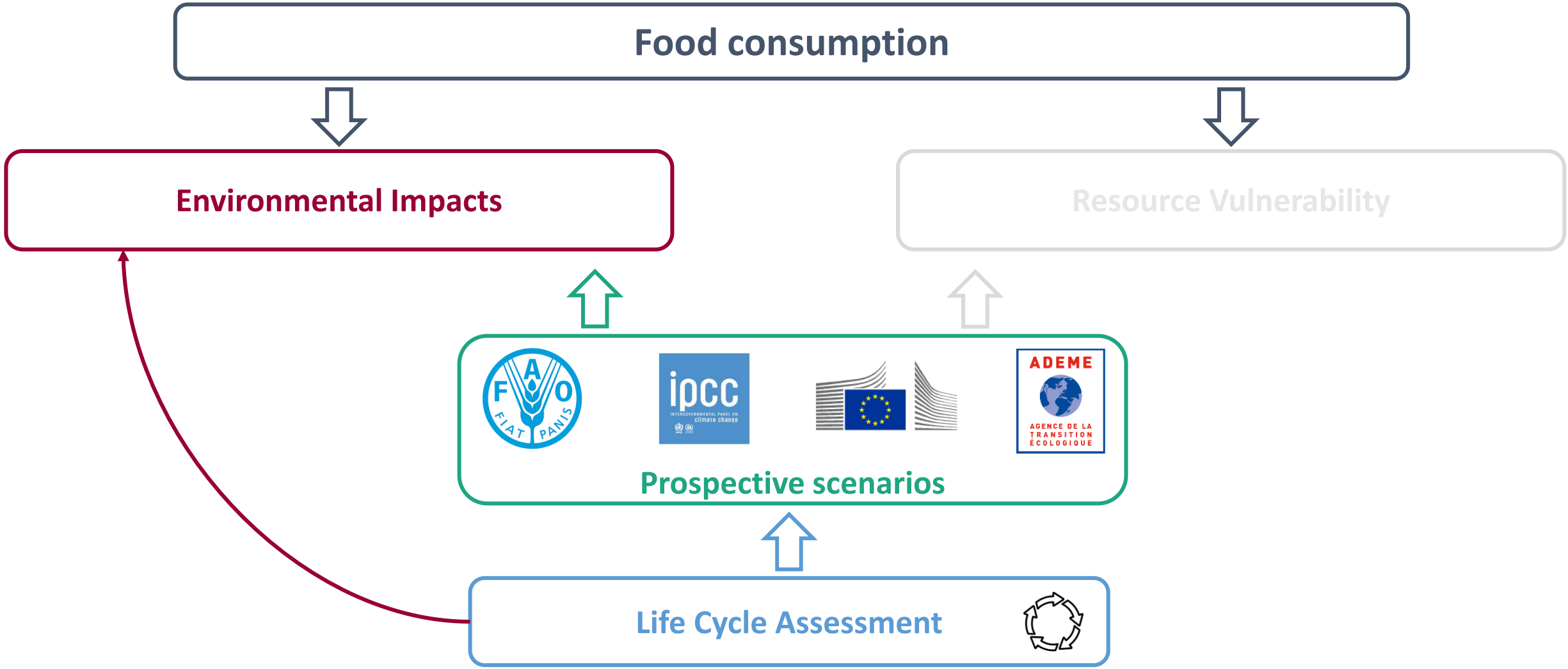

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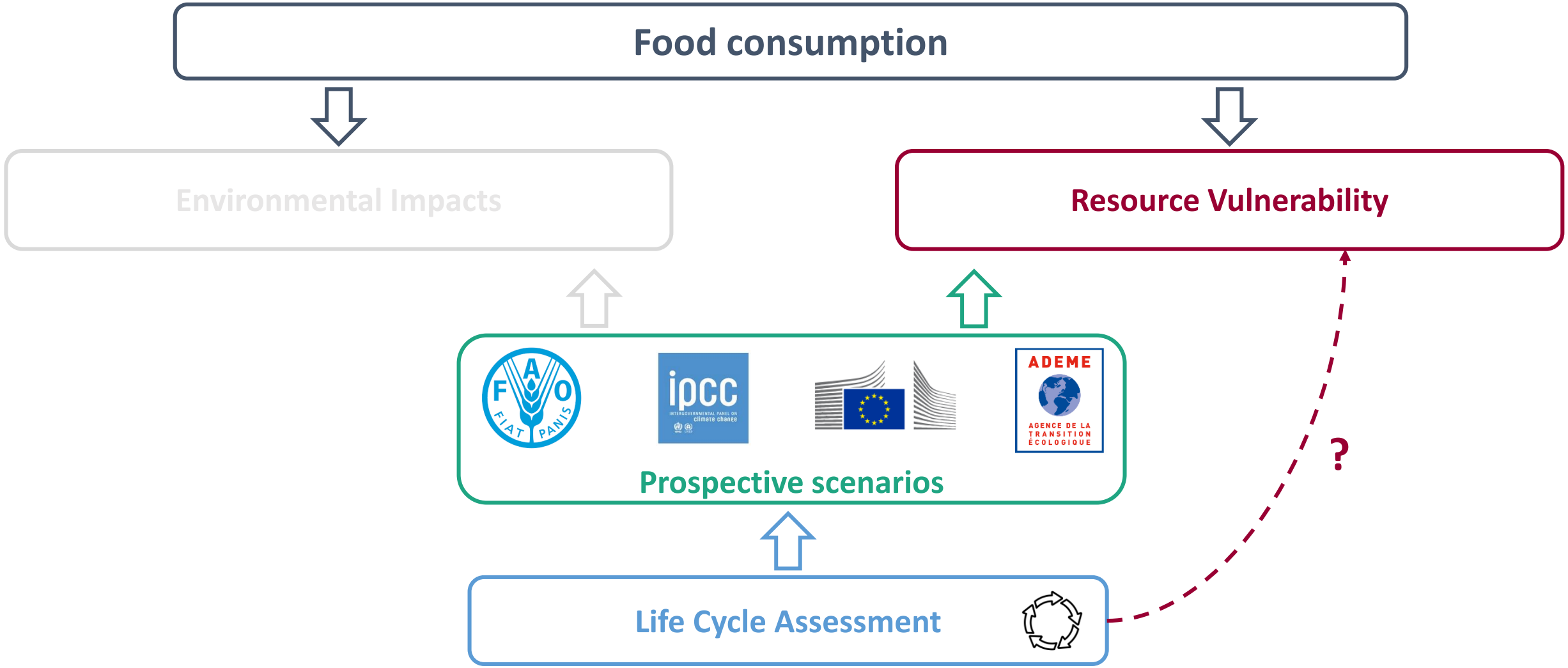

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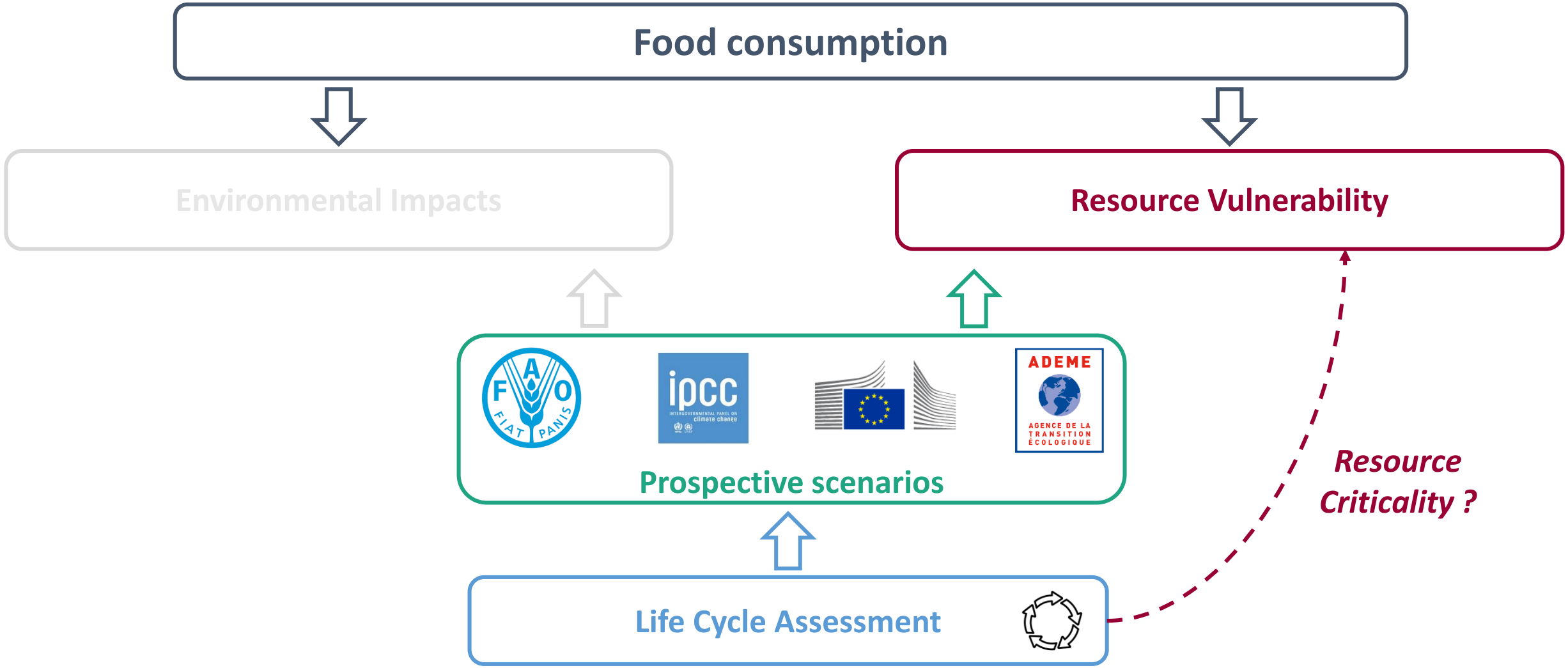

# Criticality to assess vulnerability

**The field of study that evaluates the economic and technical dependency on a certain material, as well as the probability of supply disruptions**


- **Supply Risk**:

possibility of supply disruption depending on geological, technological, economic, social and geopolitical availability.

*Source : Schrijvers et al. (2020)*
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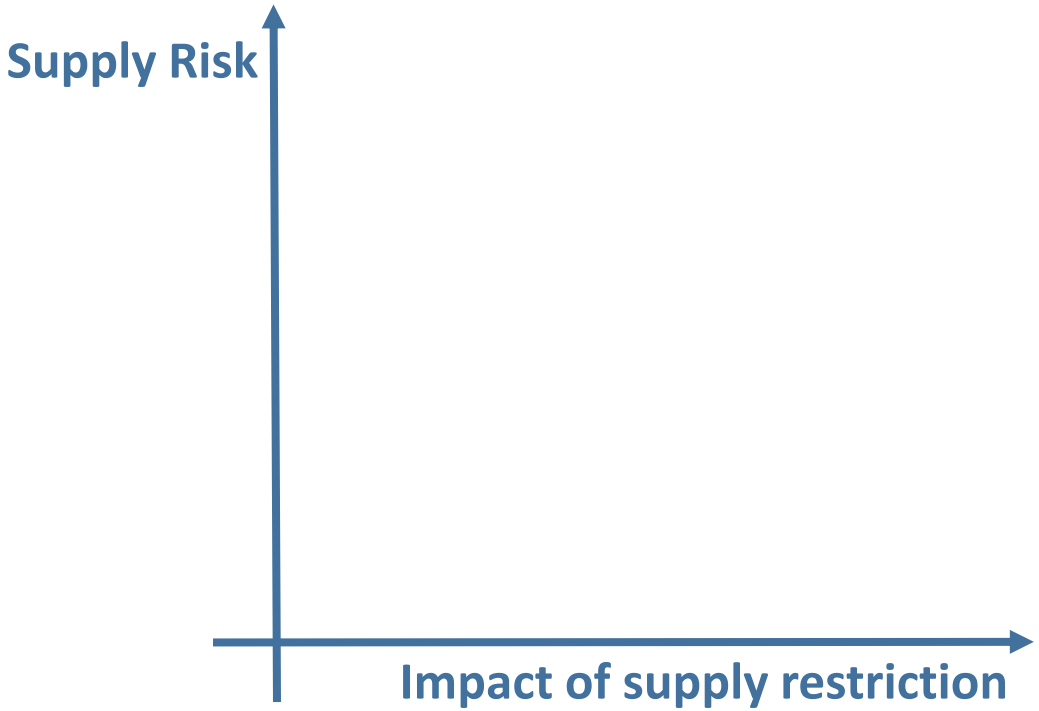


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effects of restrictions, depending on substitutability and importance of use of the resources under consideration

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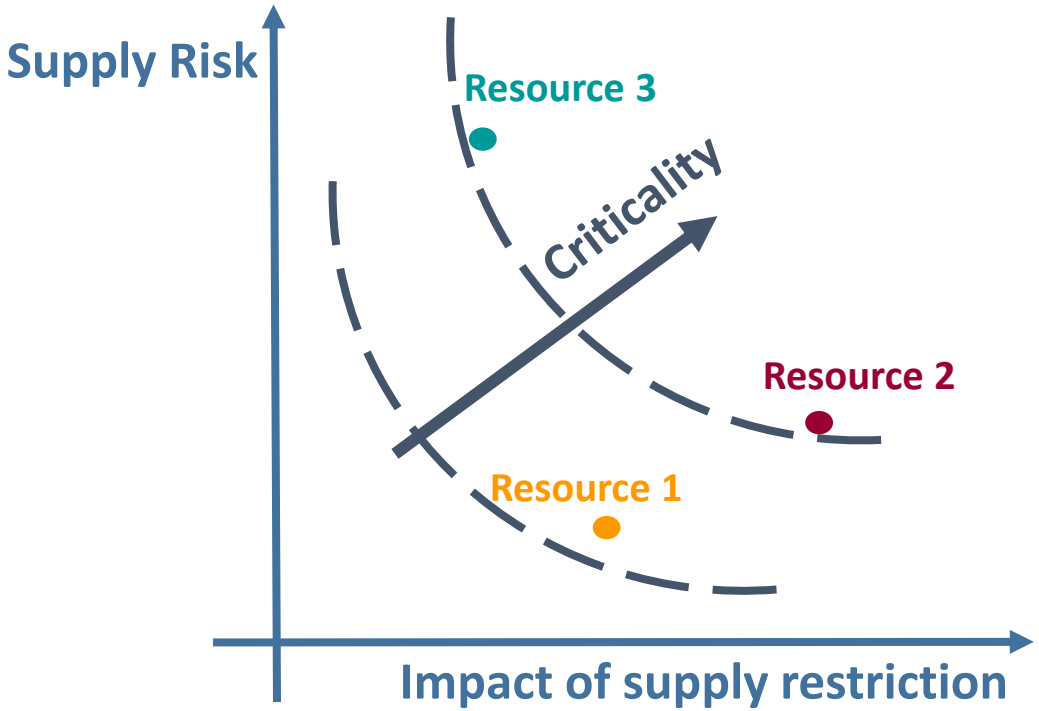


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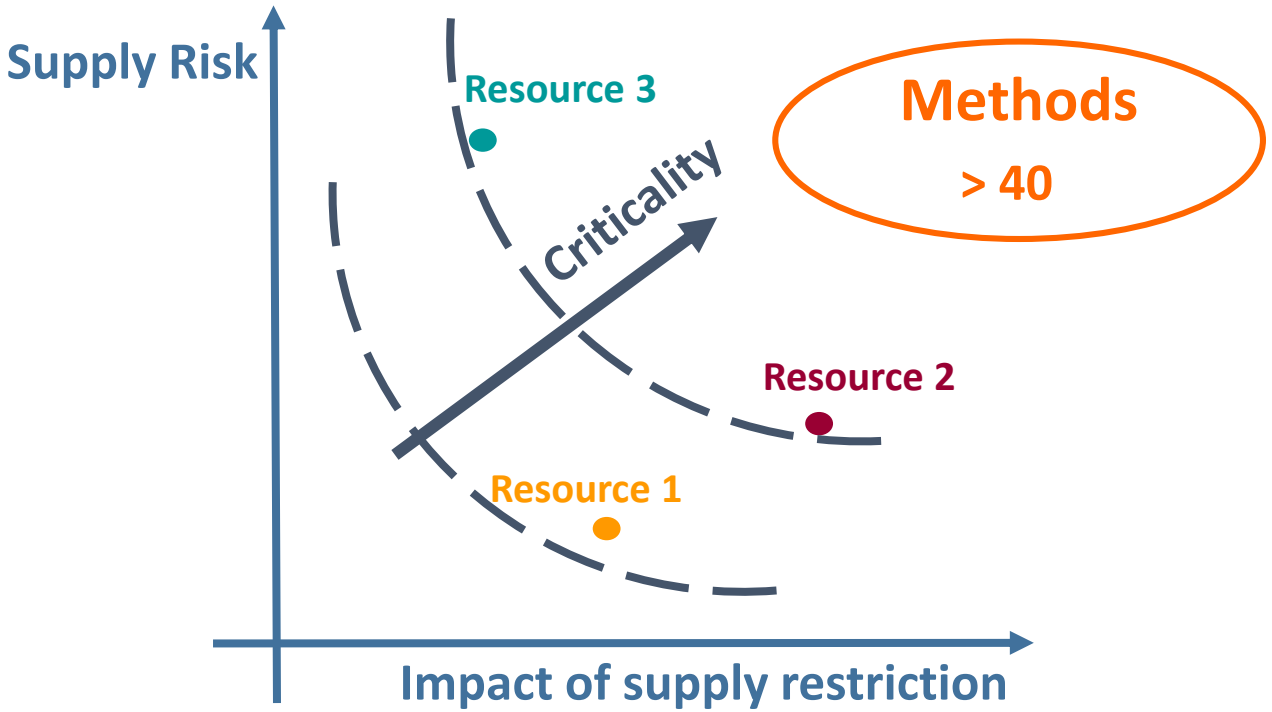


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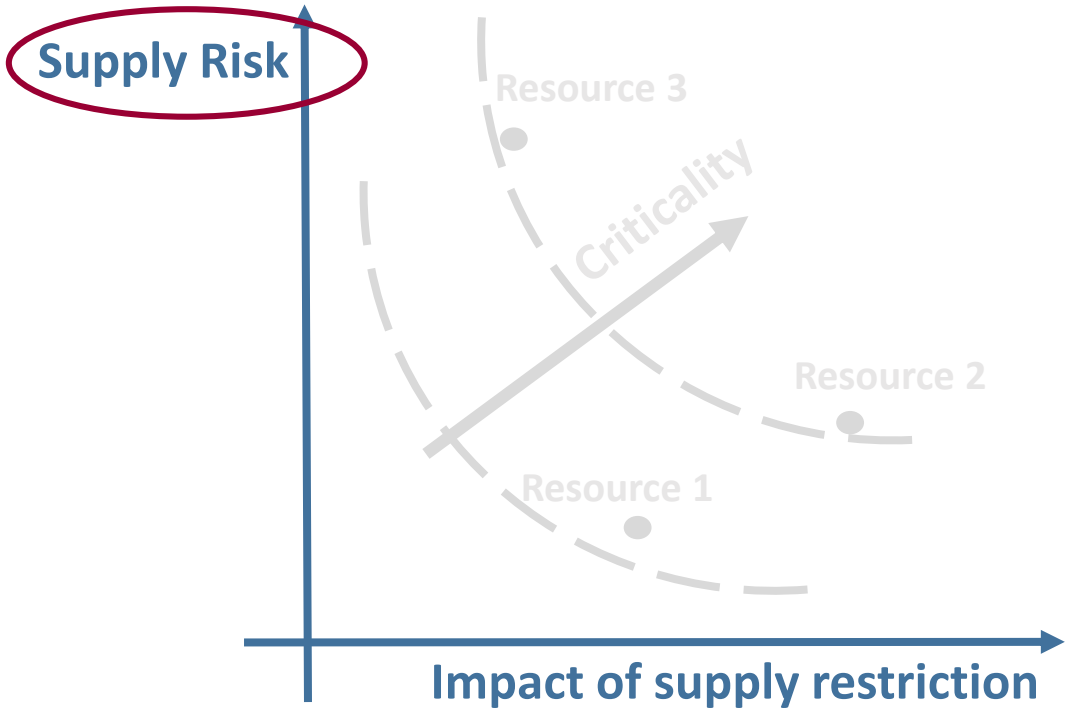



- **In LCA:** Supply Risk to characterize resource accessibility (mineral, fossil, biotic, water)
- **Mainly applied to High Tech systems**

# Main objective of the study

**Apply LCA to prospective food consumption scenarios:**
i/ to assess both their environmental impacts and resource vulnerability
ii/ and identify potential trade-offs or synergies between these two dimensions

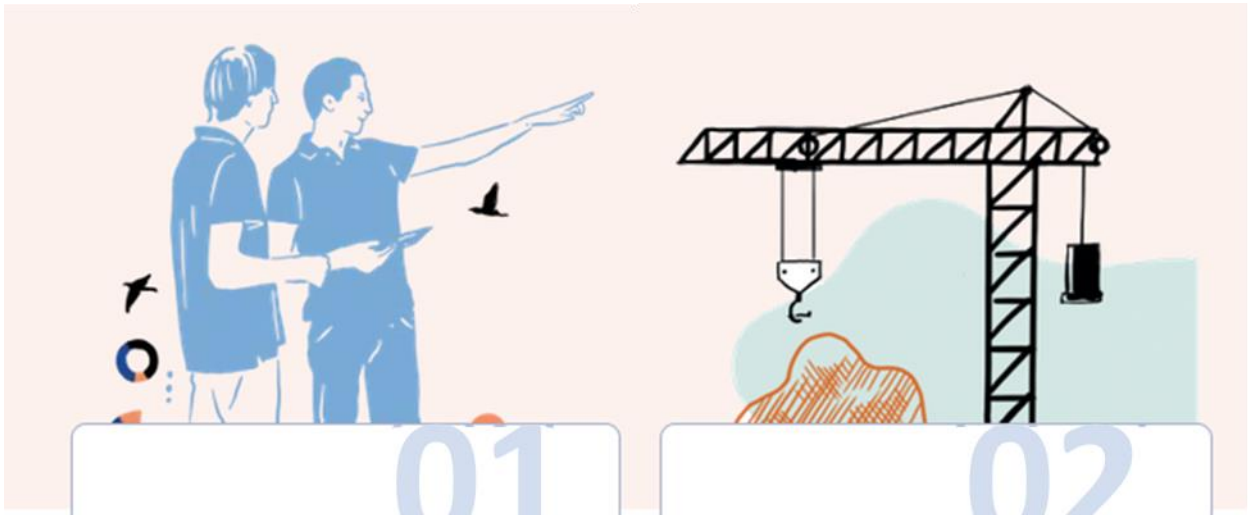
## Goal & Scope

**2050**

**Average consumption of 1 French inhabitant**

# Scenario description

## ADEME 2050



01

**FRUGAL GENERATION**

The transition is mainly driven by imposed frugality and by sufficiency.

02

**RESTORATION GAMBLE**

Society places its trust in its ability to repair social and ecological systems.

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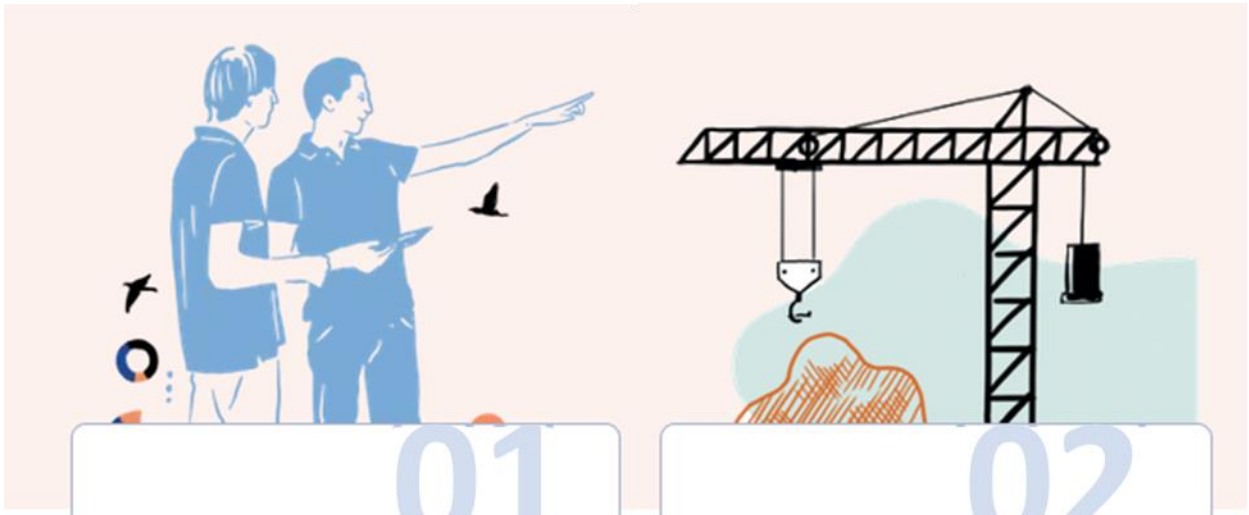

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Society places its trust in its ability to repair social and ecological systems.

Adapted to the food sector by Barbier et al. (2022)

**+ S0**
**Business as Usual**

# Scenario description

**Scenarios rely on 4 key factors (KF)**

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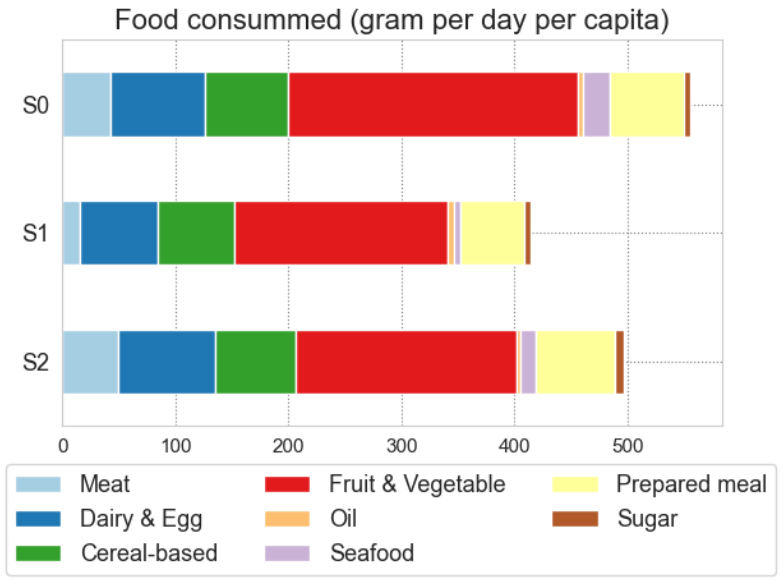
- Diet composition



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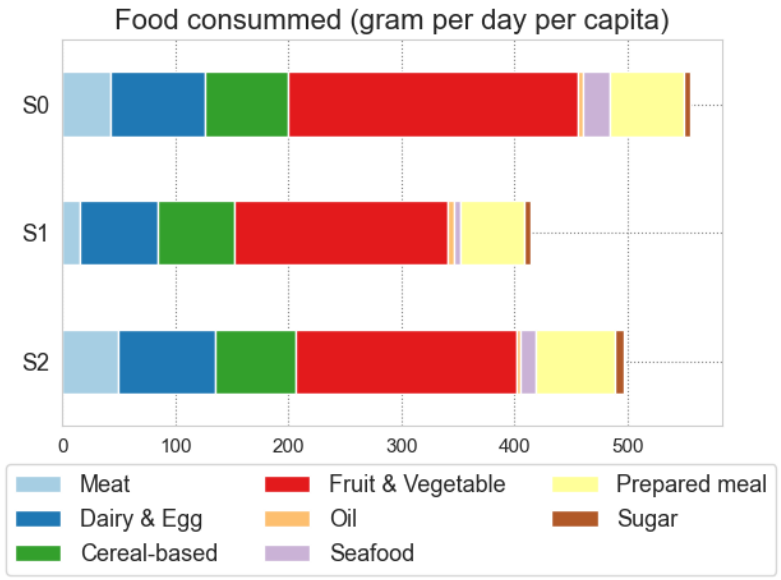
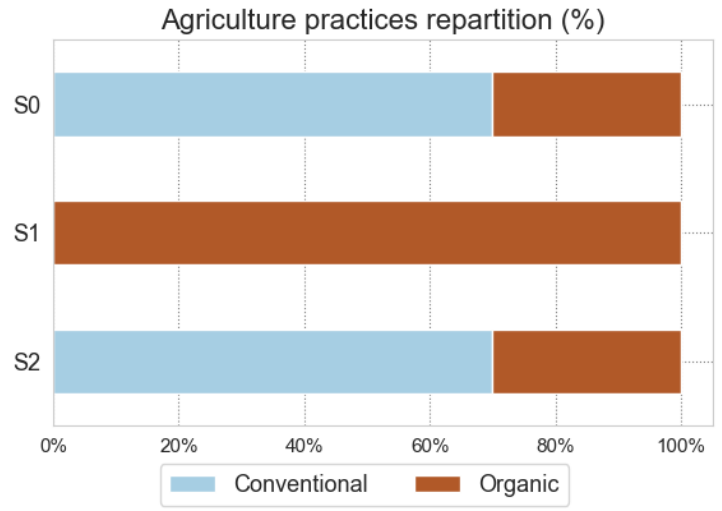
**Scenarios rely on 4 key factors (KF)**

- Diet composition
- Agricultural practices

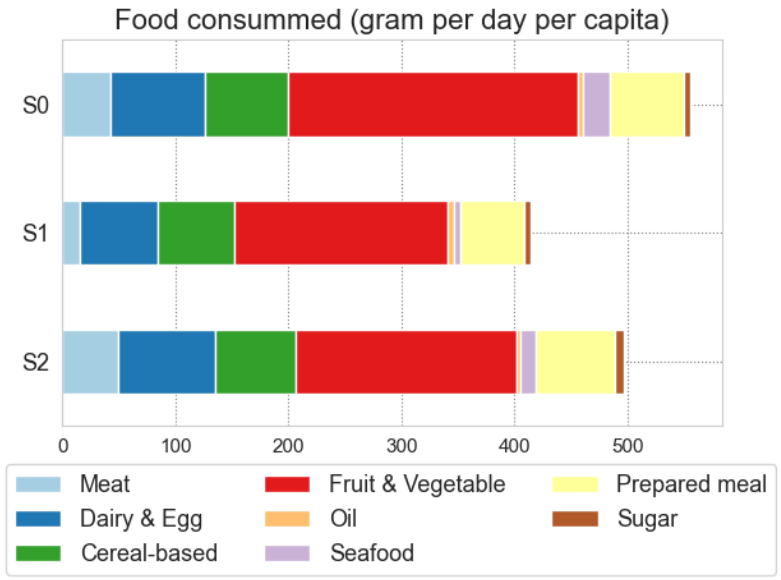


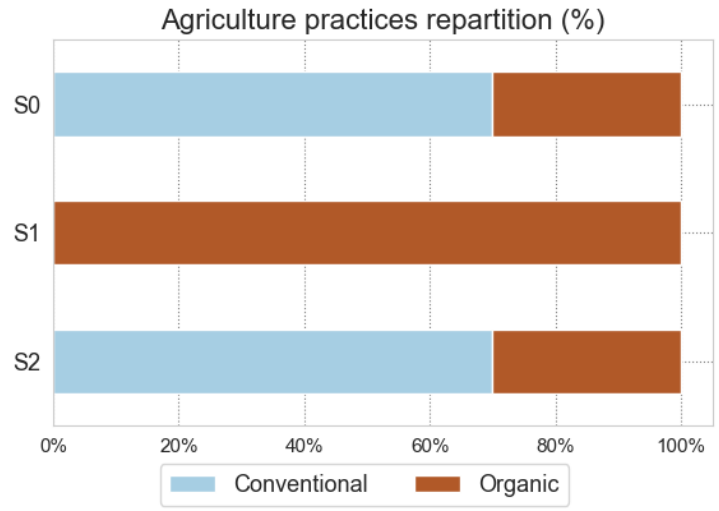



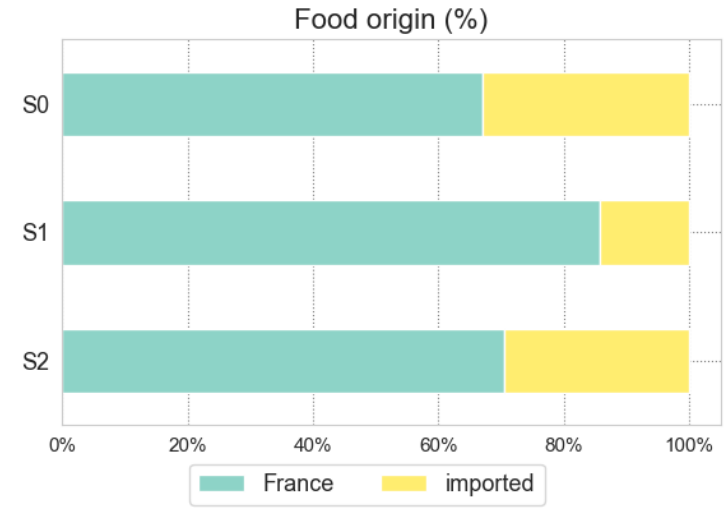
# Scenario description

**Scenarios rely on 4 key factors (KF)**

- Diet composition
- Agricultural practices
- Trade level



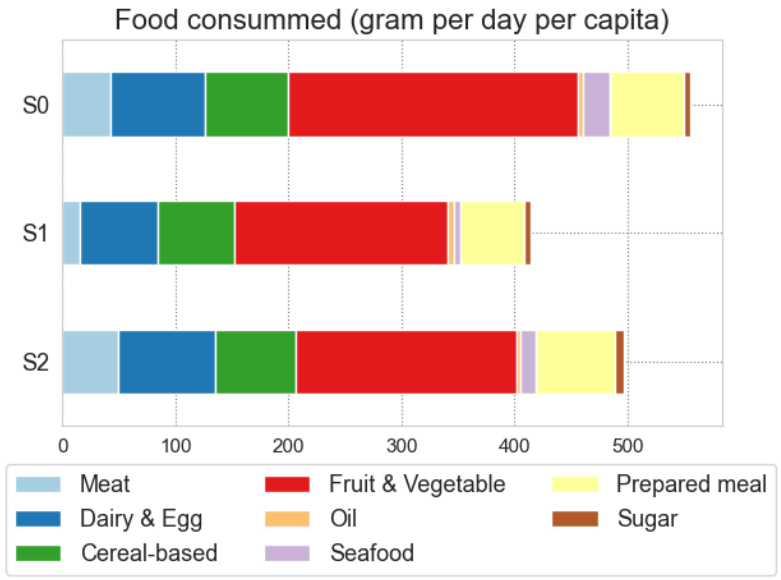



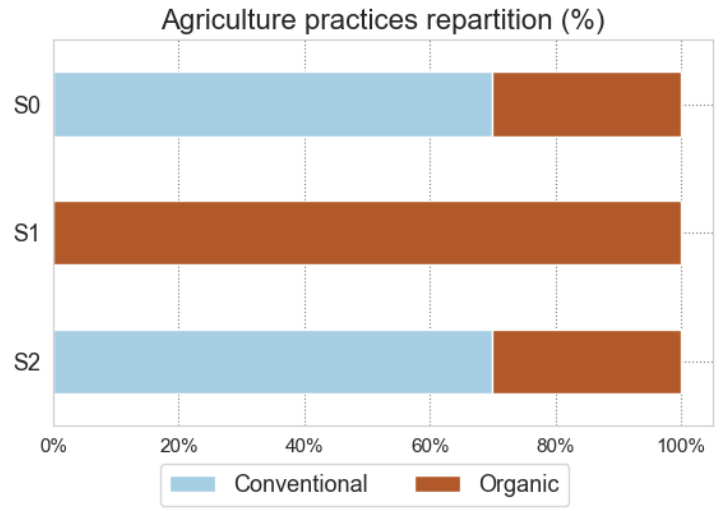



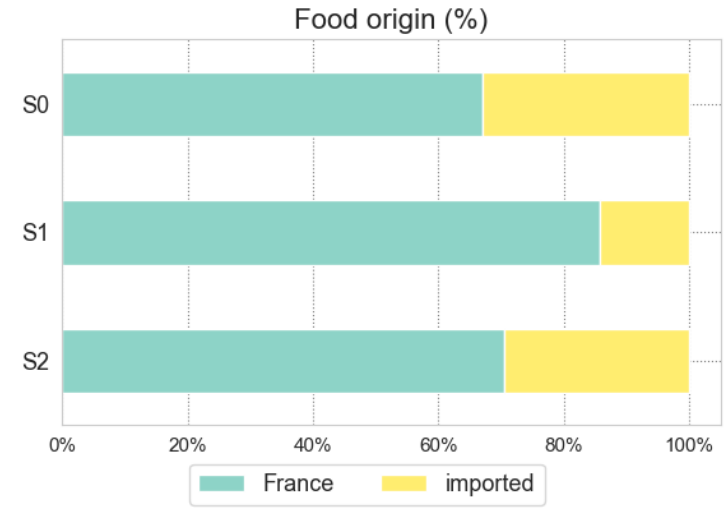
# Scenario description

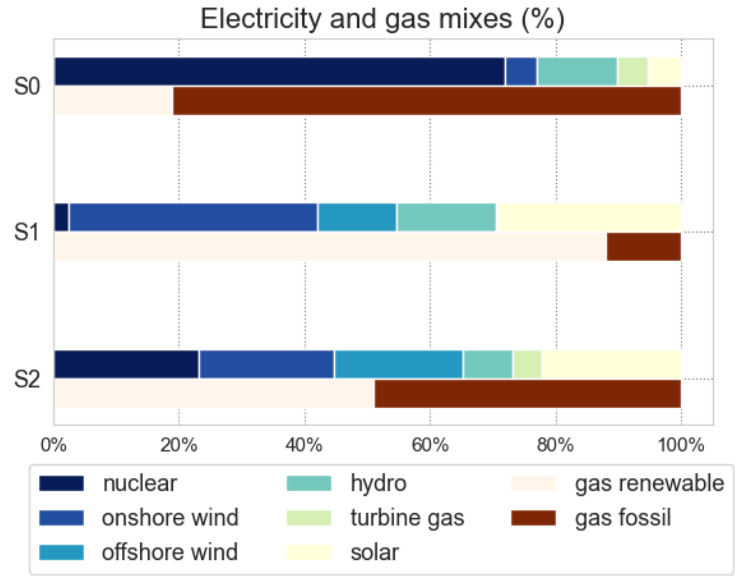
**Scenarios rely on 4 key factors (KF)**

- Diet composition
- Agricultural practices
- Trade level
- Energy mixes



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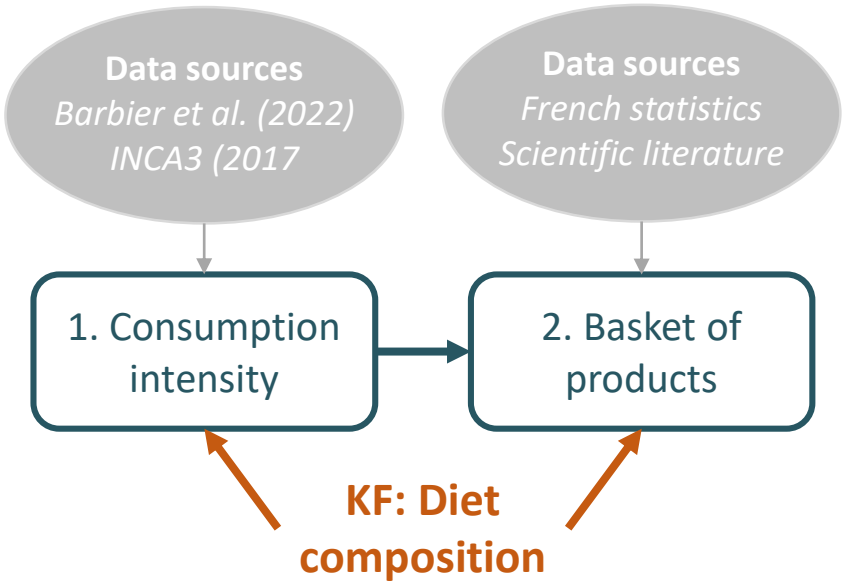

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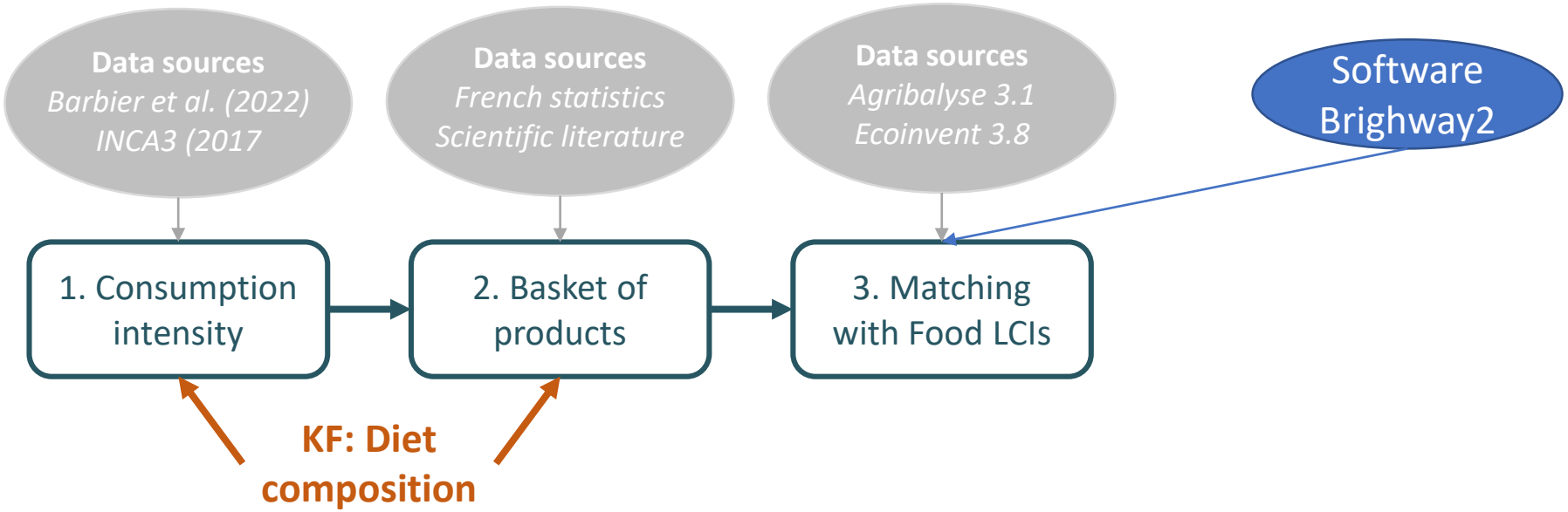

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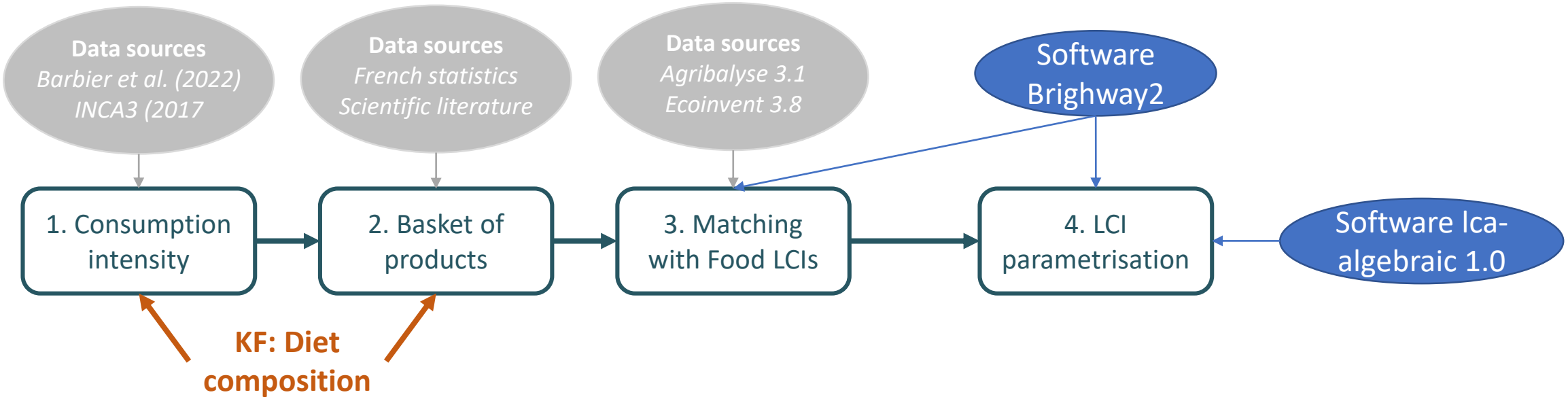

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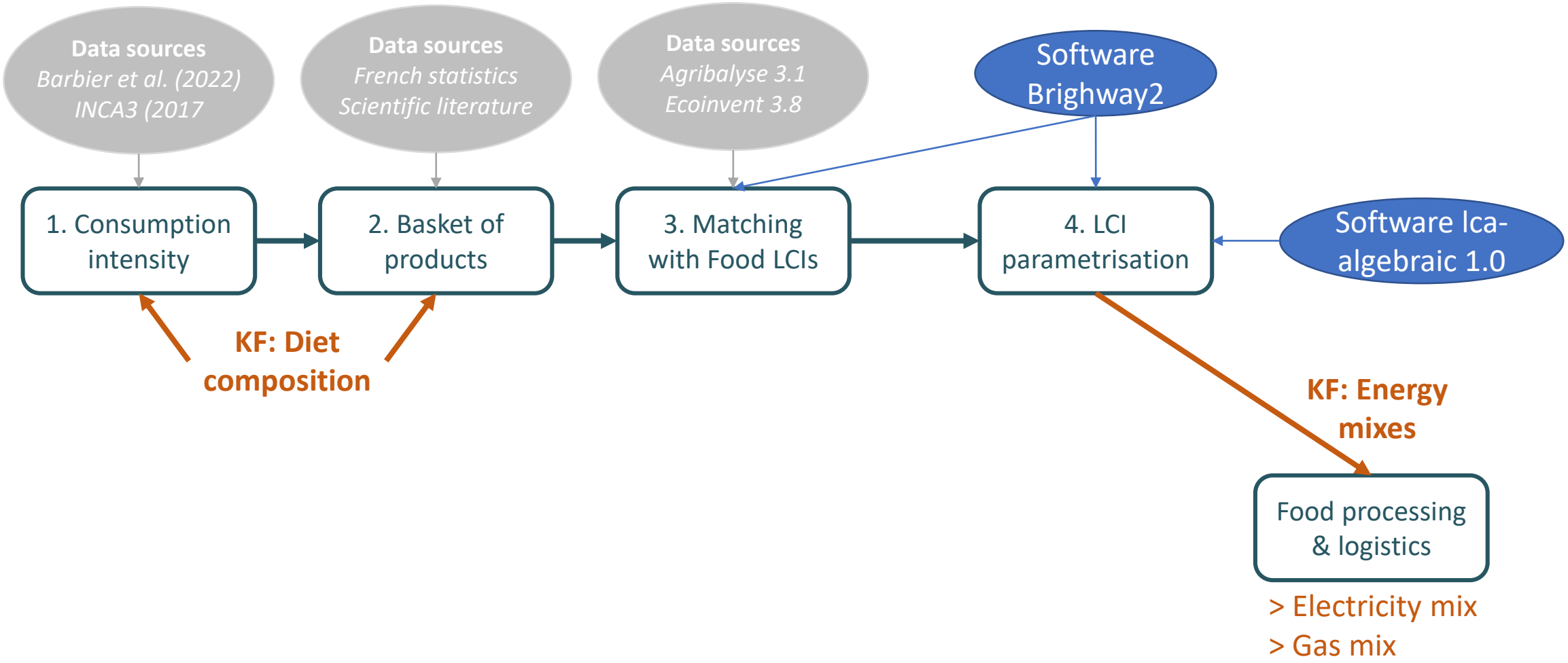

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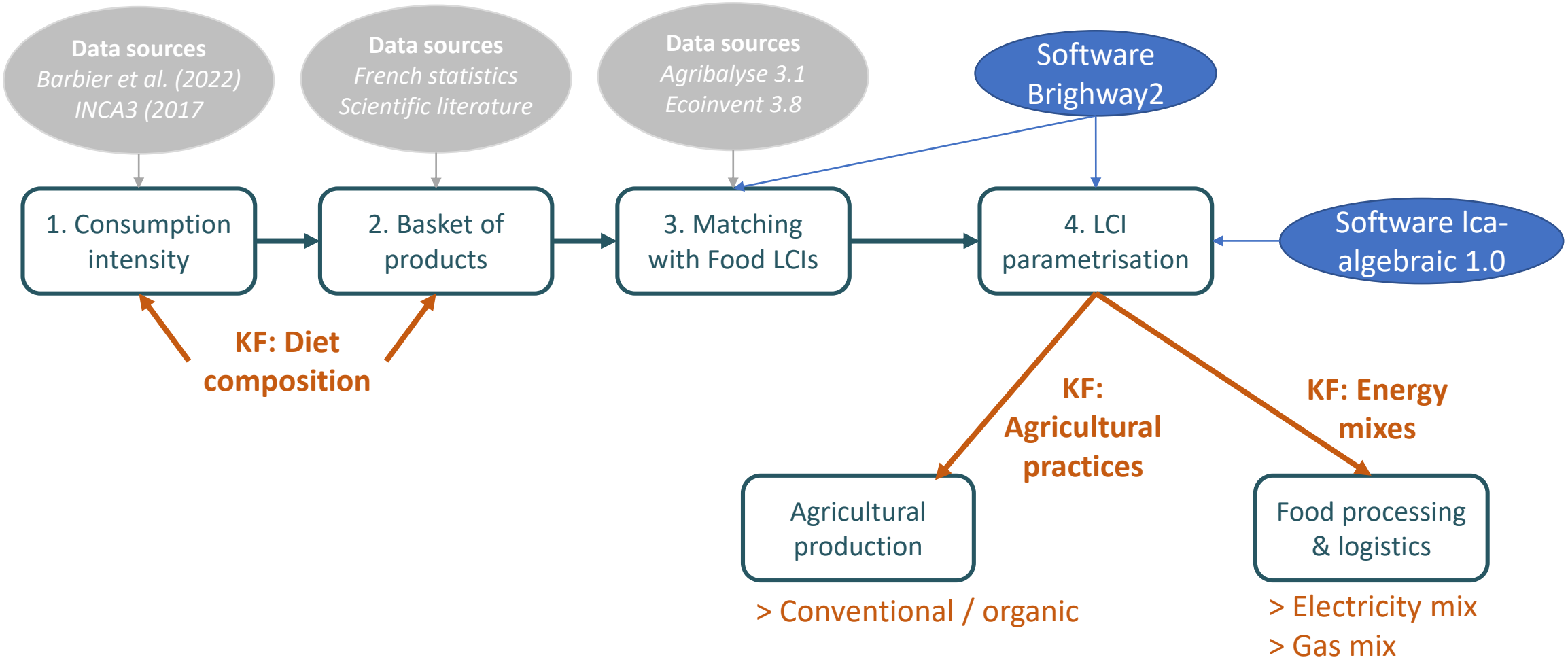

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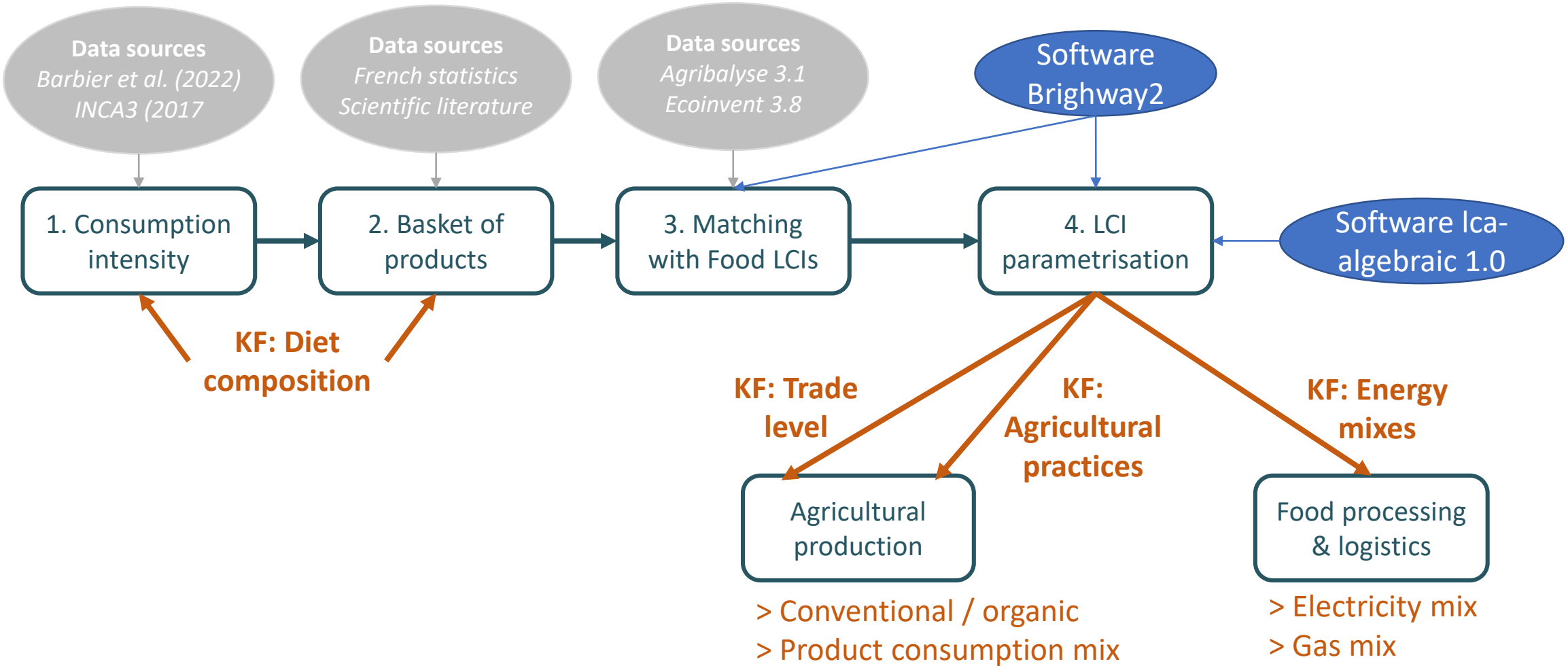

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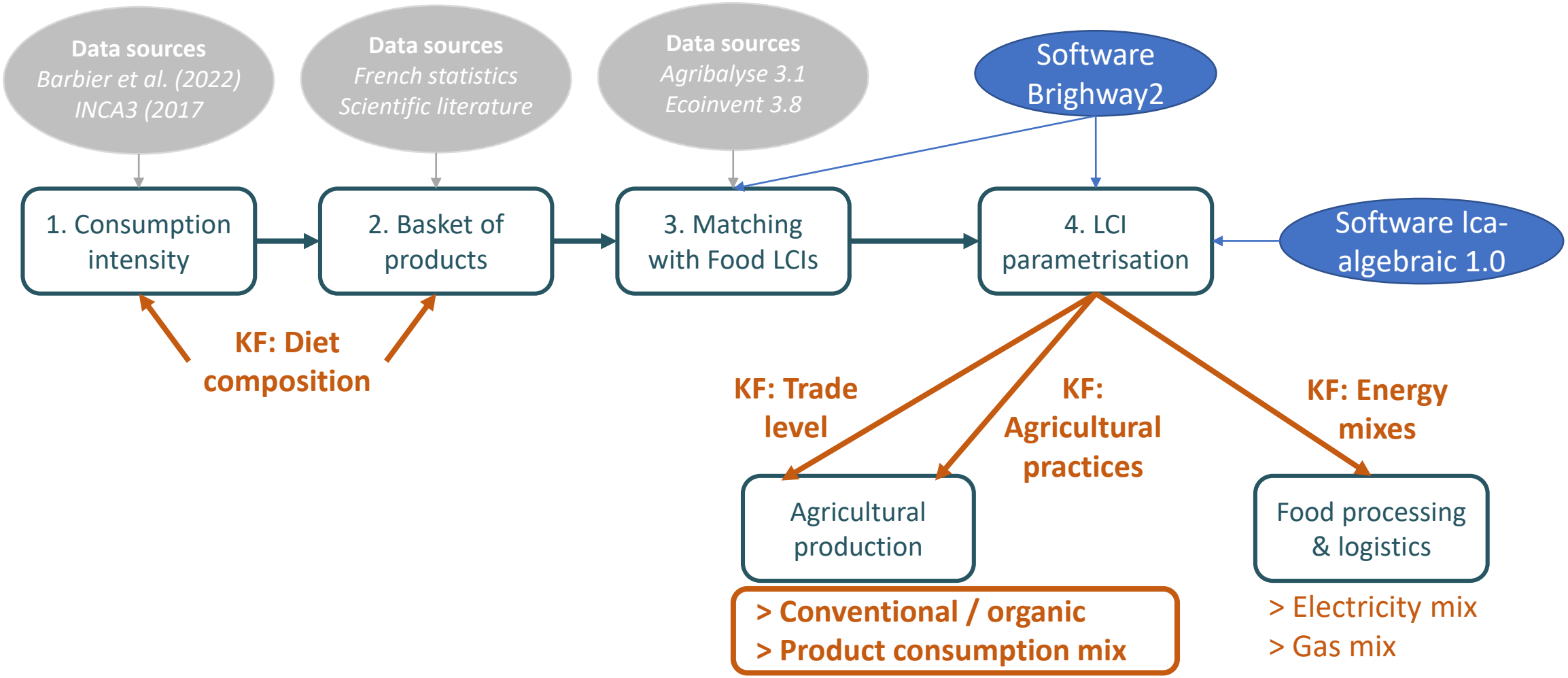
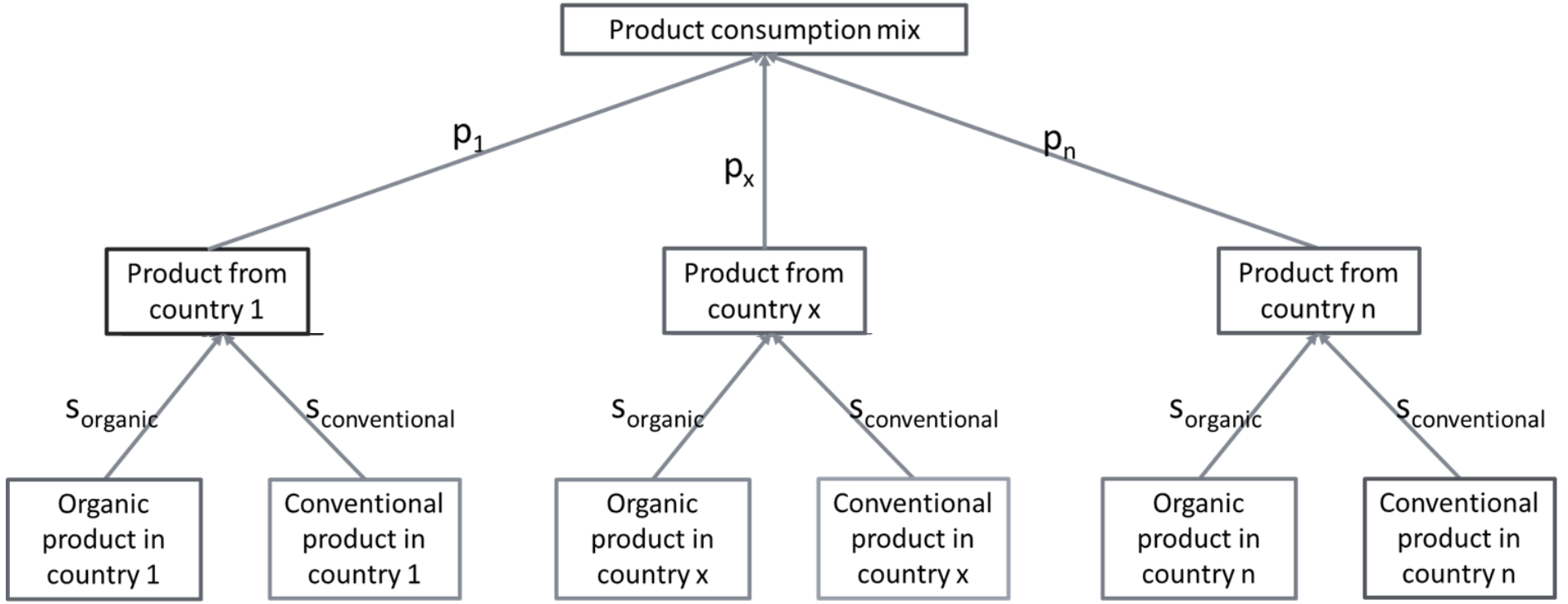


# Prospective Life Cycle Inventory modelling

## Product consumption mix computation

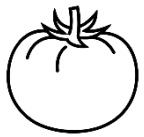



**Data sources**
*FAOSTAT*
*Agribalyse 3.1*
*Ecoinvent 3.8*

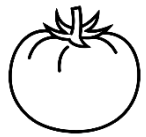
**Adaptation** of Agricultural **LCIs** with **country mixes for fertilisers, transport, electricity, & irrigation**

# Prospective Life Cycle Inventory modelling

## Adaptation of Agricultural LCIs

| Output | | |
|---|---|---|
| 1 kg of tomato (conventional) | | ES |
| **Inputs** | | |
| ***Amount*** | ***Name*** | ***Location*** |
| ***n*** | N fertiliser mix | ES |
| ***p*** | P fertiliser mix | ES |
| ***k*** | K fertiliser mix | ES |
| ***p*** | Pesticides | GLO |
| ***i*** | Irrigation mix | ES |
| ***e*** | Electricity mix | ES |
| ***t_es-fr*** | Transport ES-FR | GLO |

| Output | | |
|---|---|---|
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| ***t_ma-fr*** | Transport MA-FR | GLO |

# Impact assessment

**New midpoint indicators**

**Environmental Impacts**

IMPACT World+


**Supply Risk Potential**

*Adaptations of the **JRC criticality** method to account for **key resources** for food systems*

*(Blengini et al. (2017))*

**Software**
*brightway2-regional*

# Impact assessment

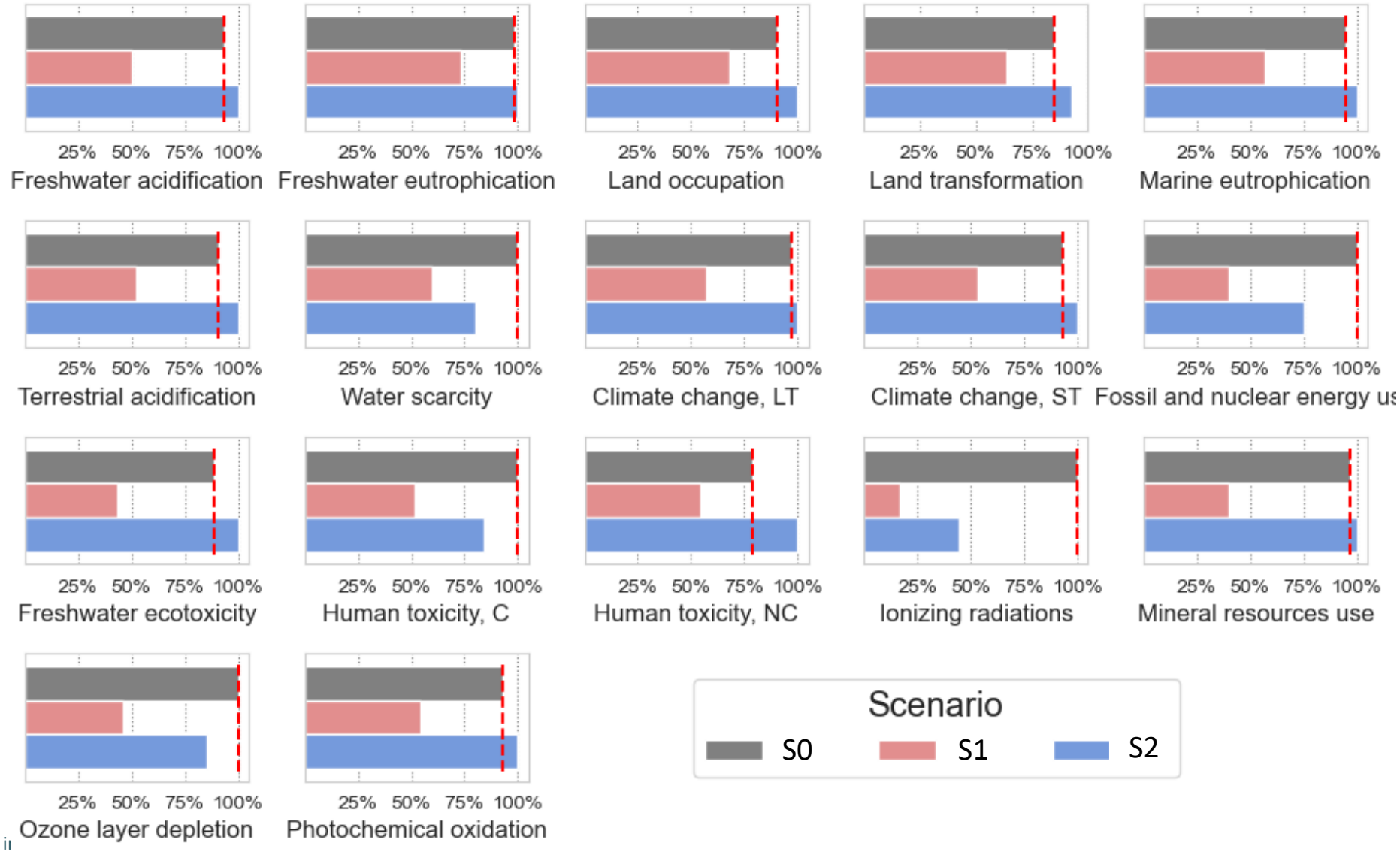
**Mineral Supply Risk (JRC 2017)**


**Land Supply Risk (Deteix et al. 2023)**


**Water Supply Risk (Deteix et al. 2023)**

# Results: Scenario Environmental Impacts

**Impacts for the average consumption of 1 French inhabitant in 2050**



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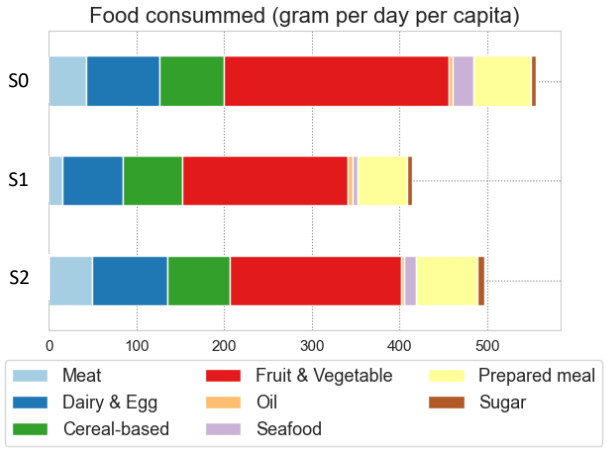


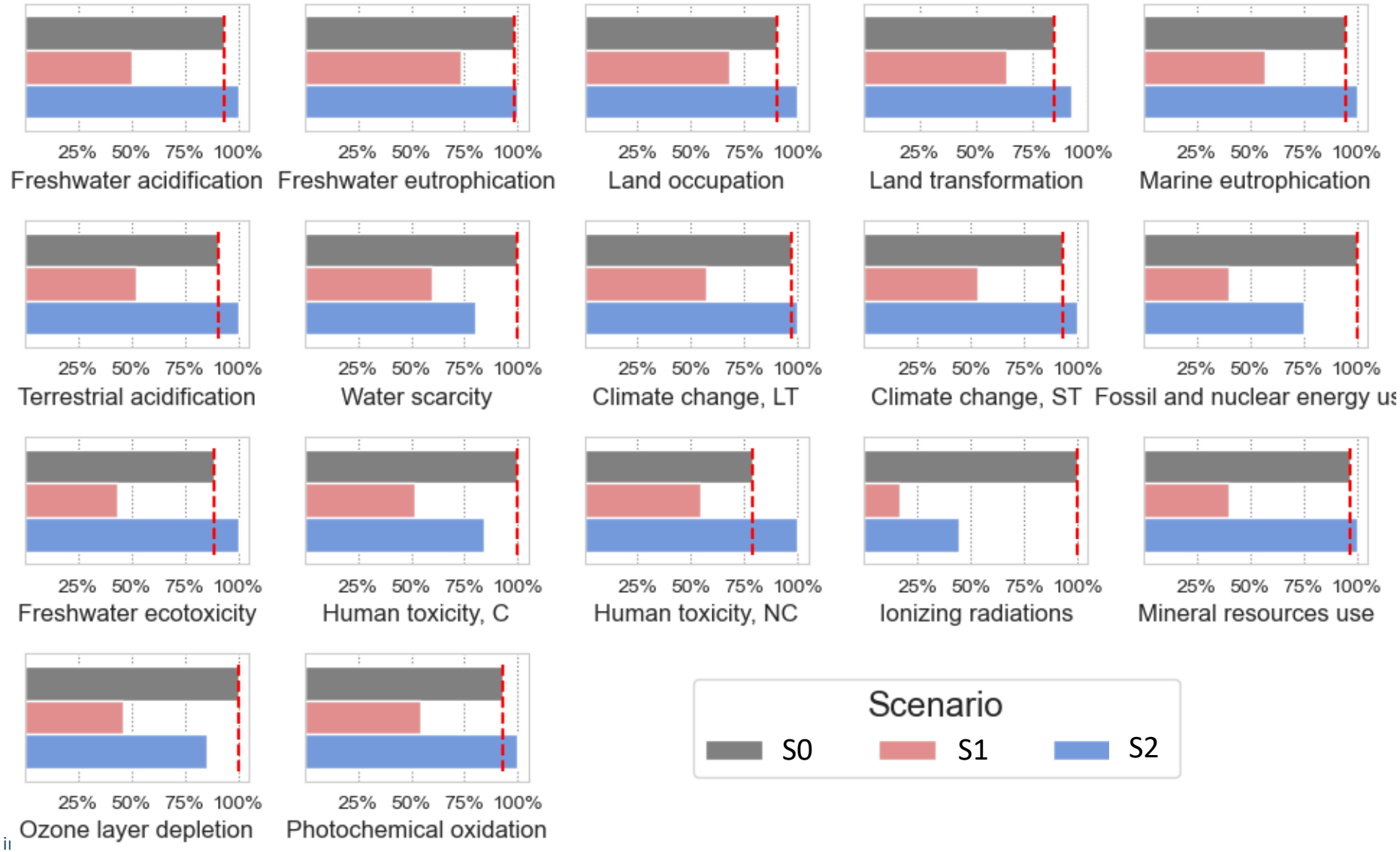

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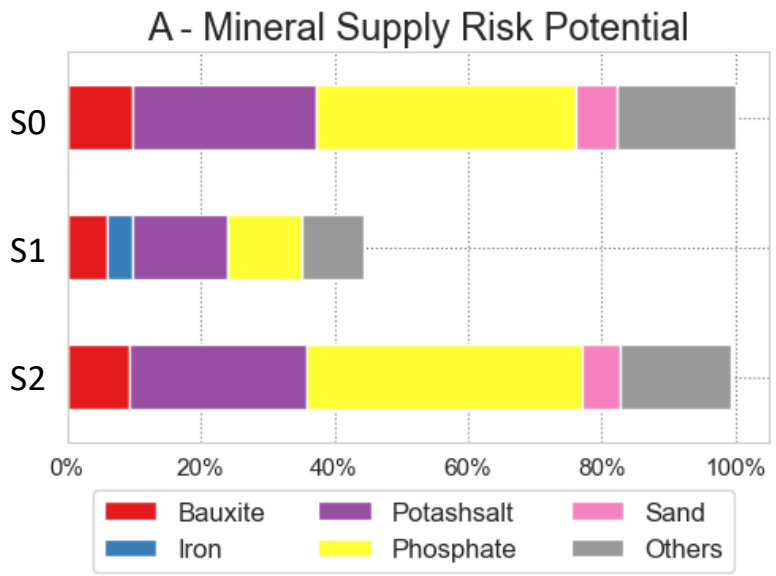

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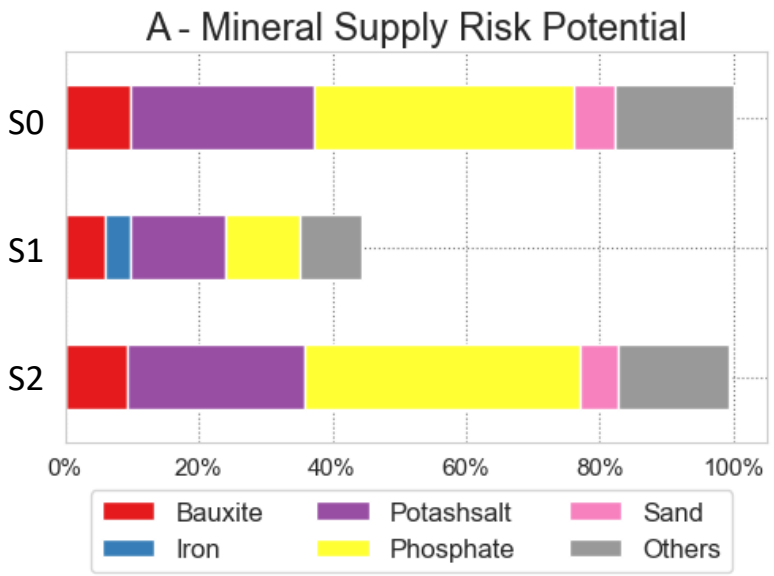


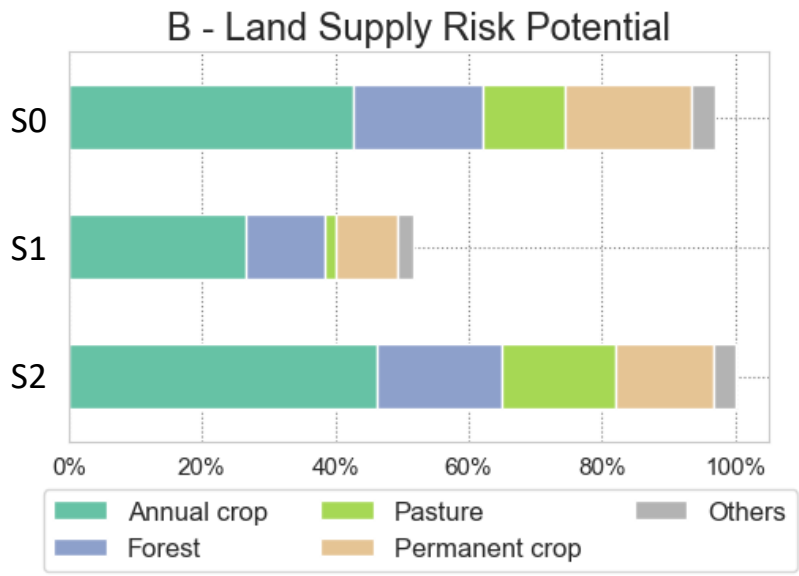

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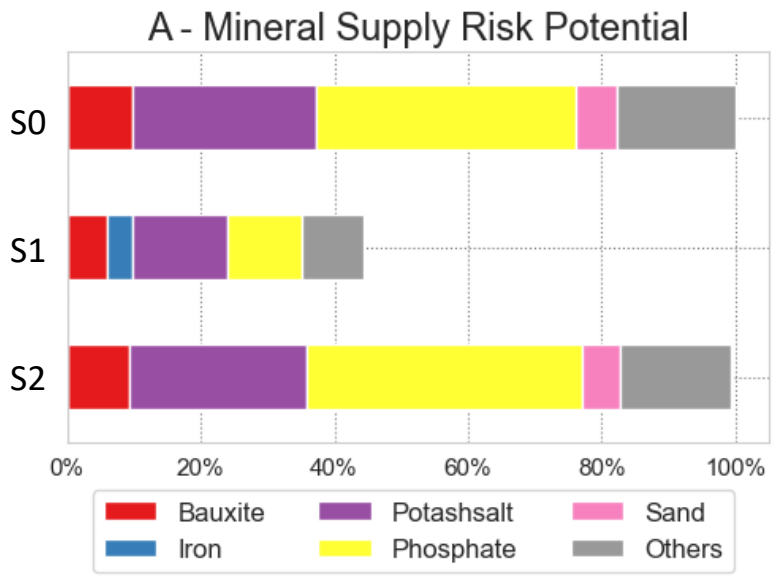
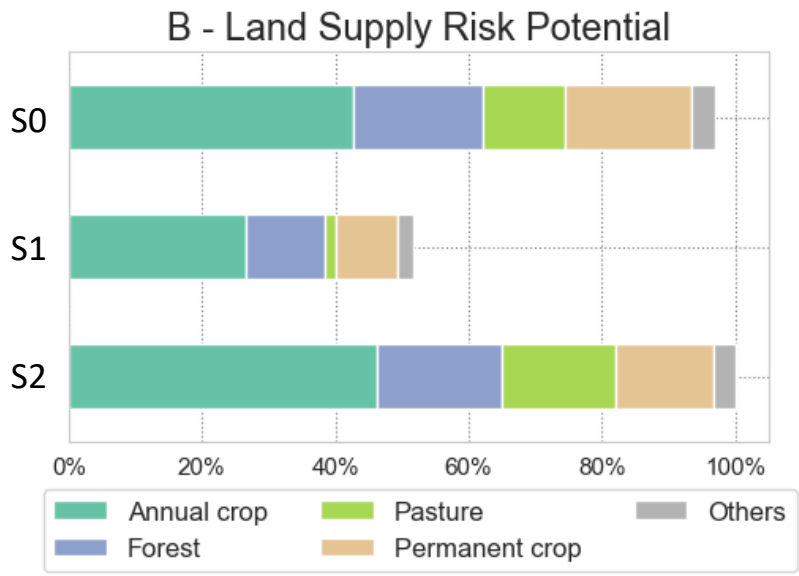
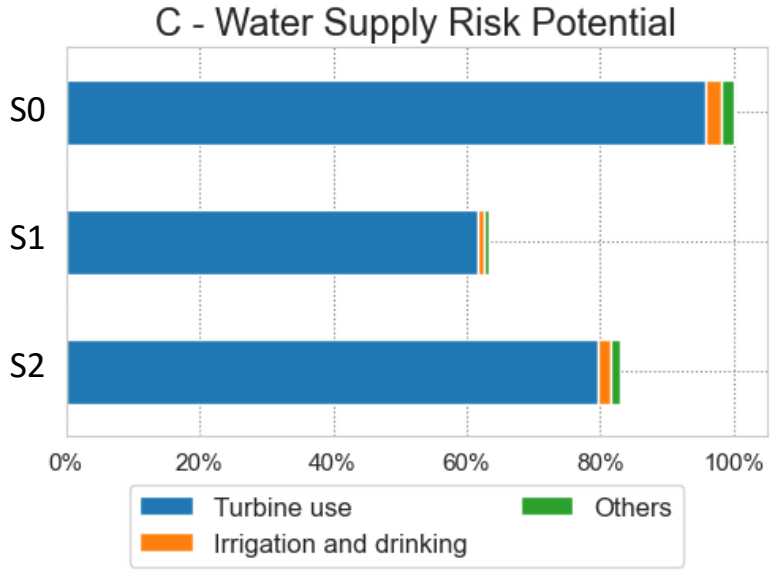
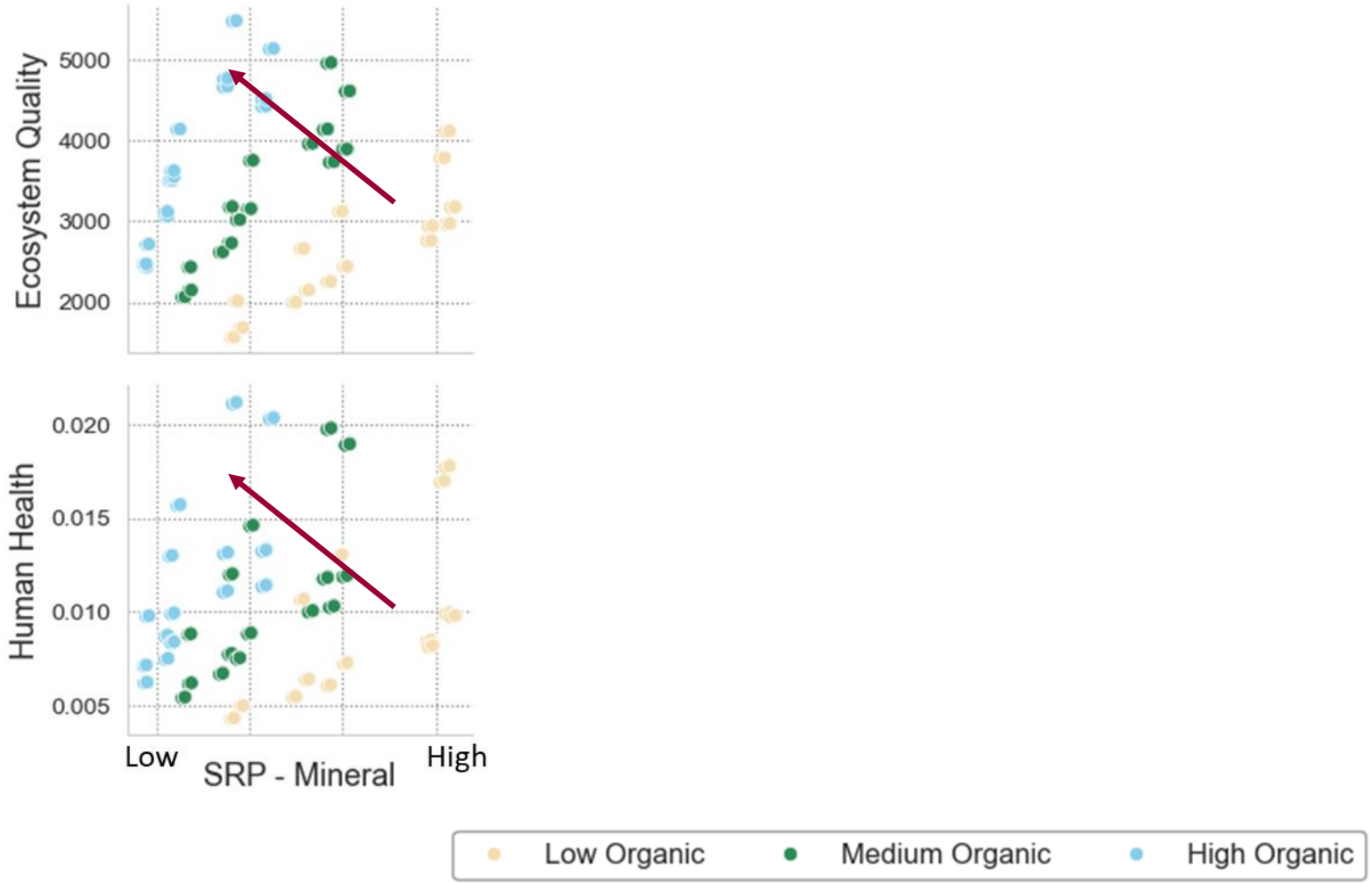


# Results: Environmental Impacts and Supply Risk Potentials

**Combination of all key factors**
(225 scenarios)



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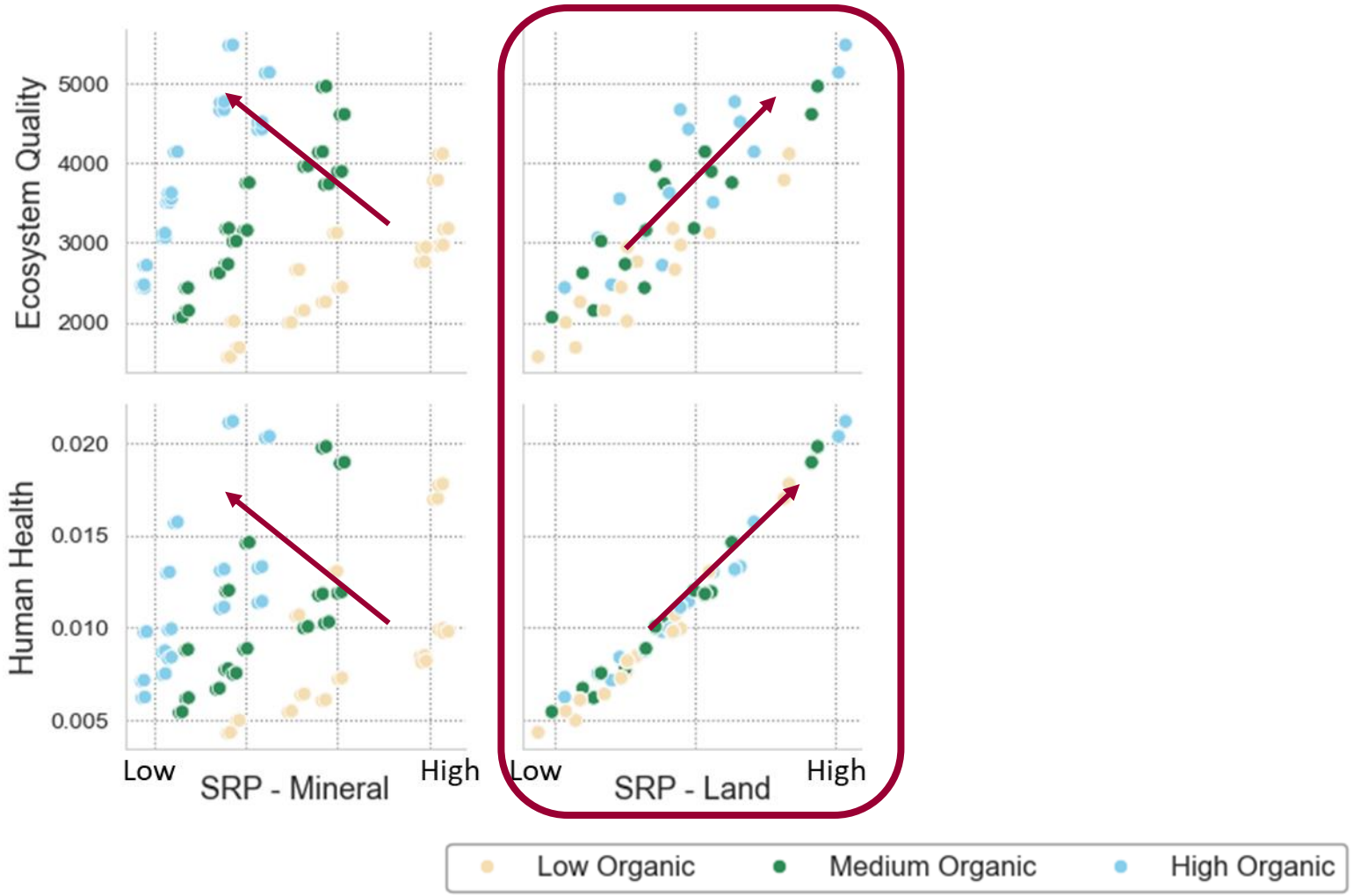

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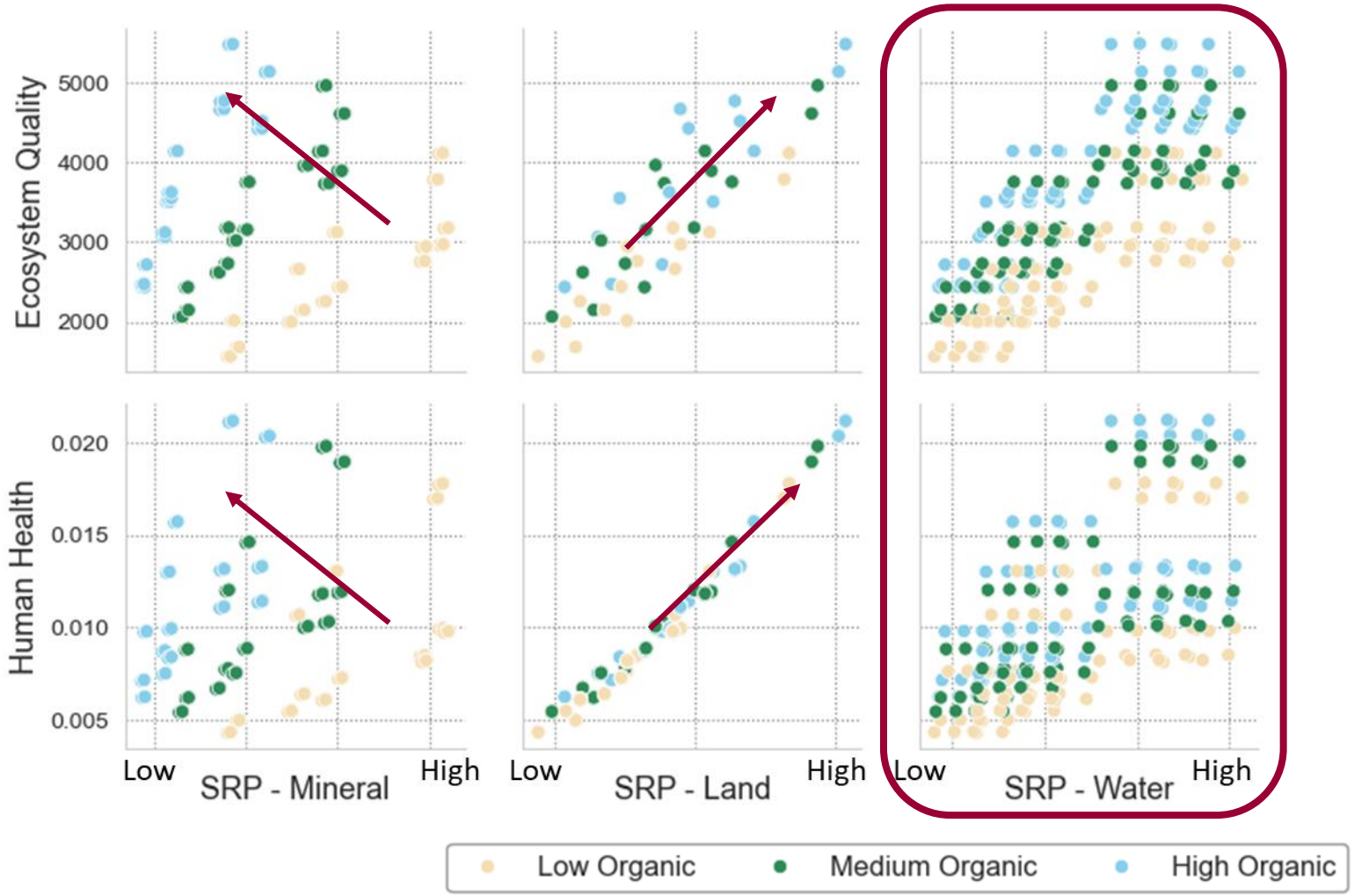
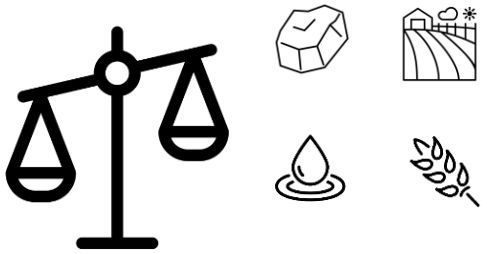


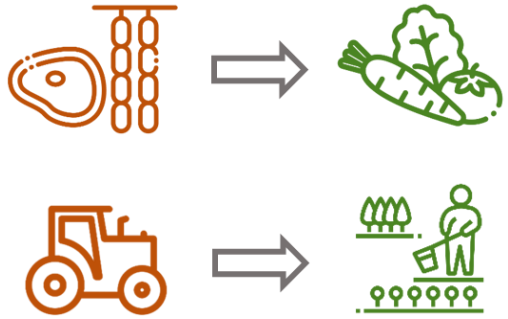
# Key messages

## Criticality & Environmental Impact



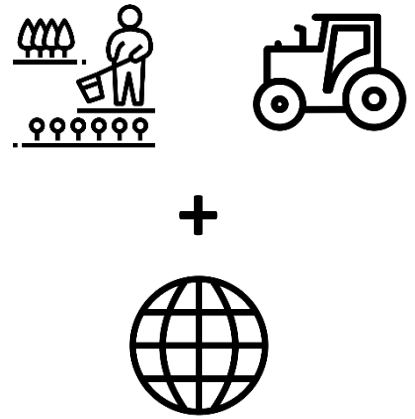
Trade-offs or Synergies between environmental impacts and resource criticality depending on resource considered

## Food system strategies



Importance to consider both consumption & production changes for food system environmental sustainability

## Perspectives



Integrate other agricultural practices

Further regionalise agricultural practices & emissions

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## Thank you for your attention

# Questions ?

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