

# Food/Excretion systems :

Potential of human excretions recycling for food production

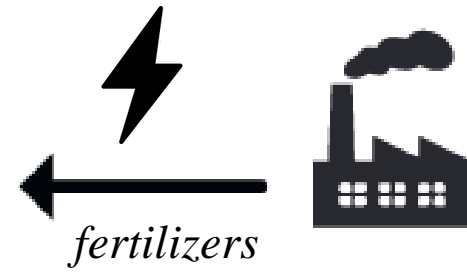
*Thomas STARCK, 1<sup>st</sup> year PhD*

*Supervisors : Bruno Tassin, Fabien Esculier*



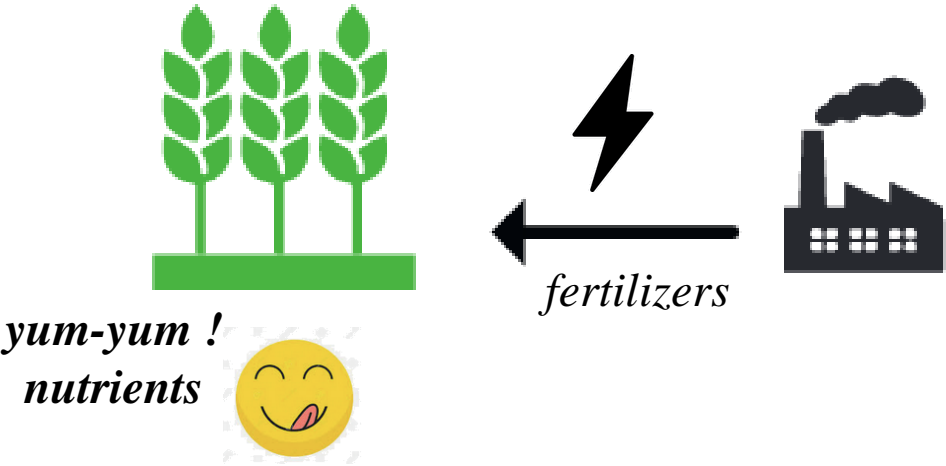


OCAPI



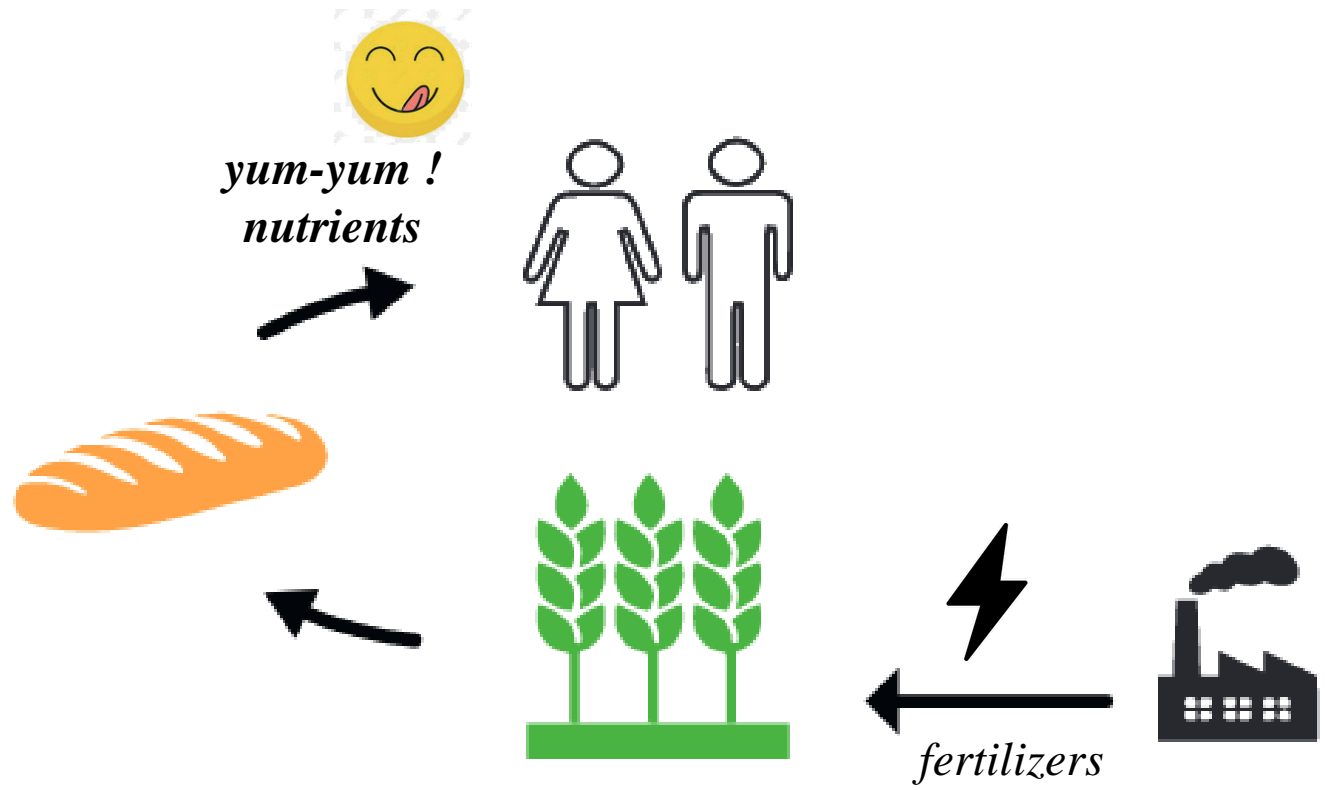


OCAPI



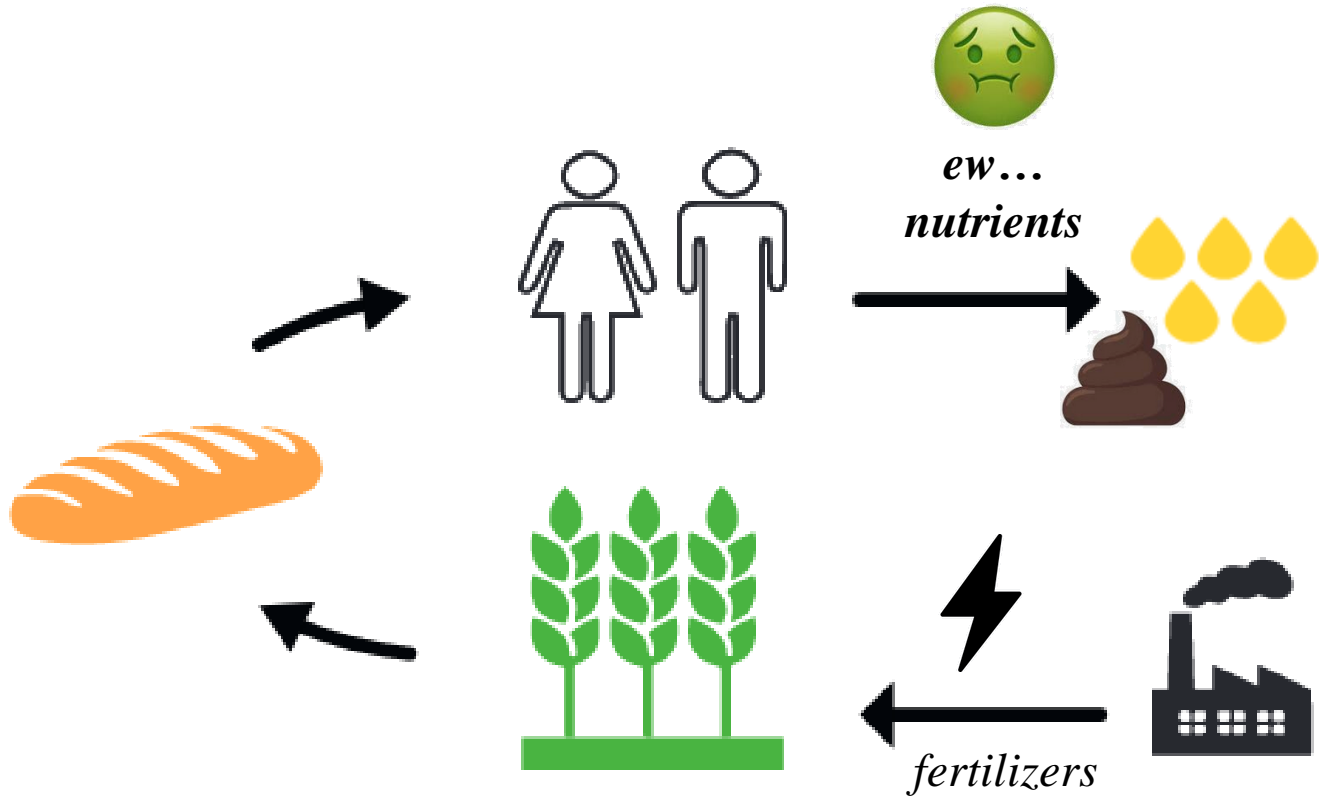


OCAPI



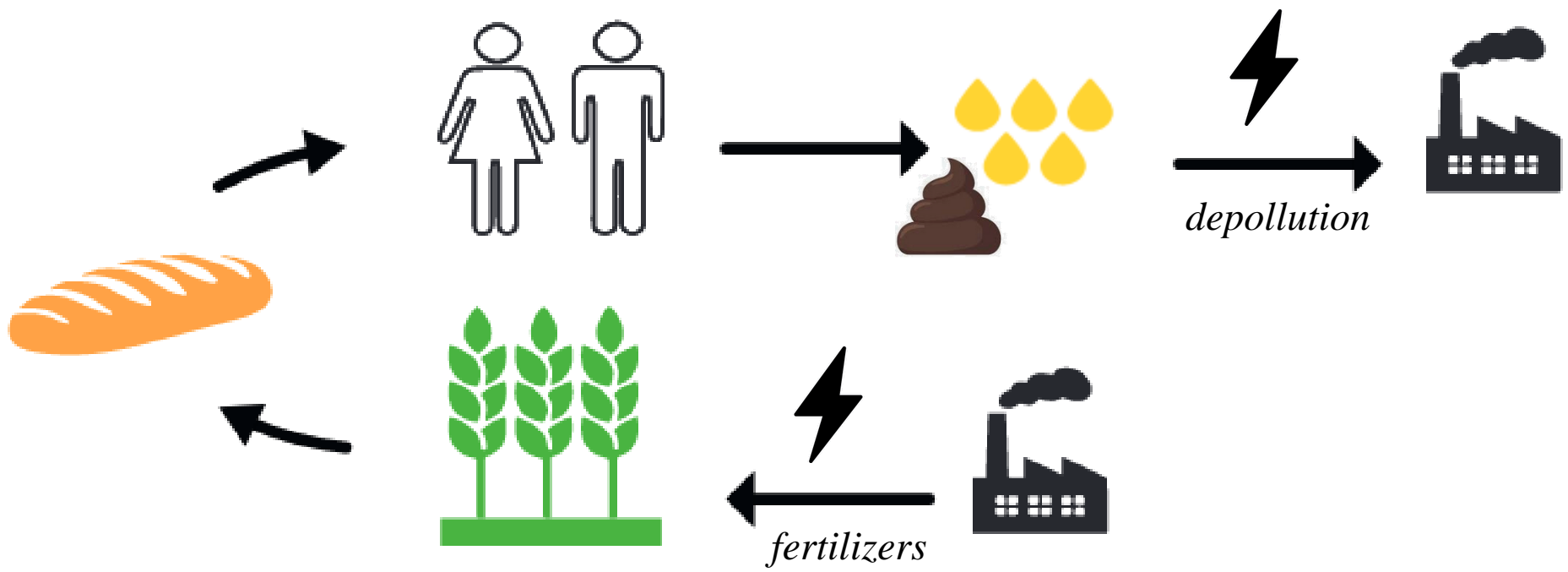


OCAPI



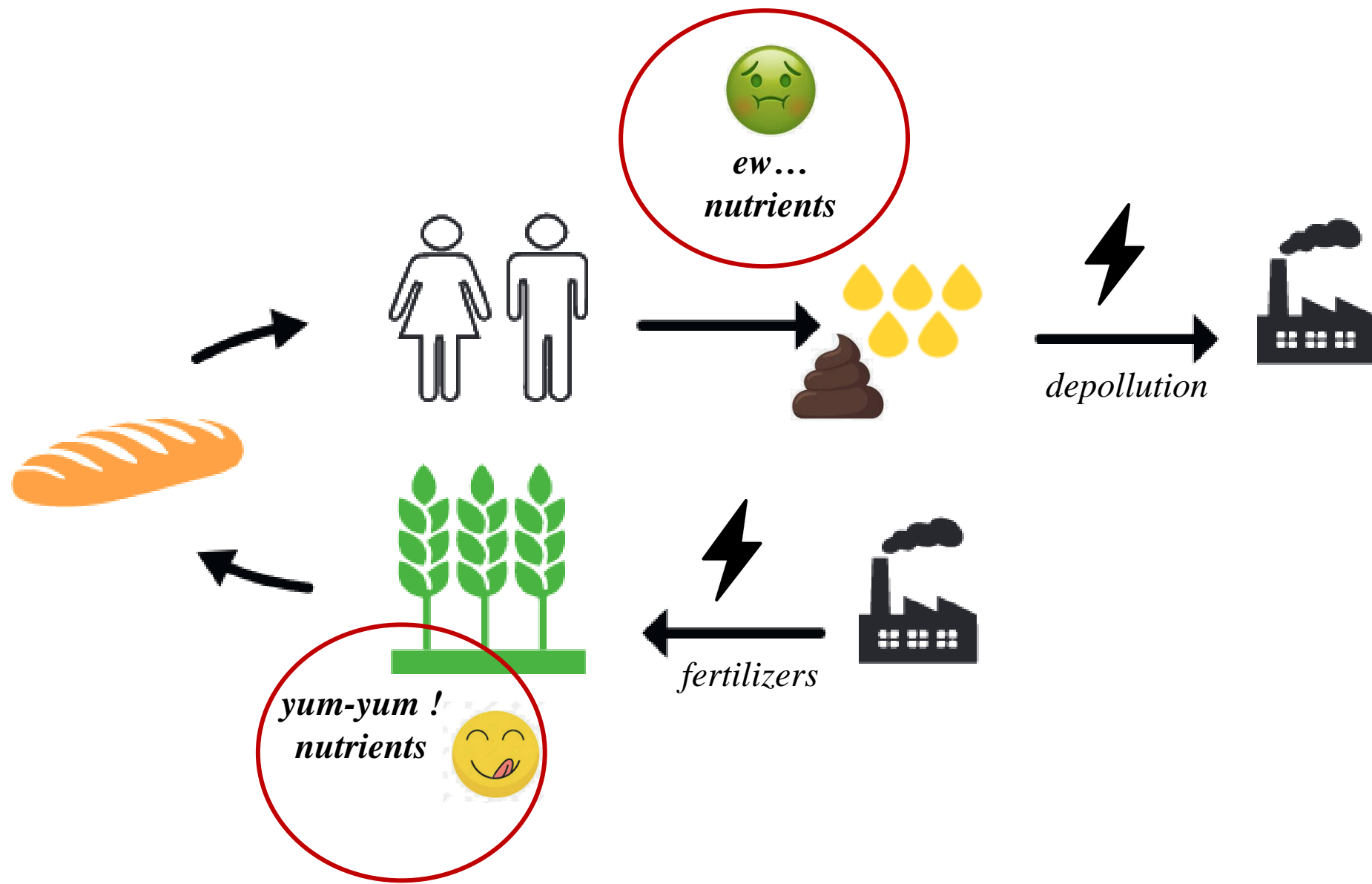


OCAPI



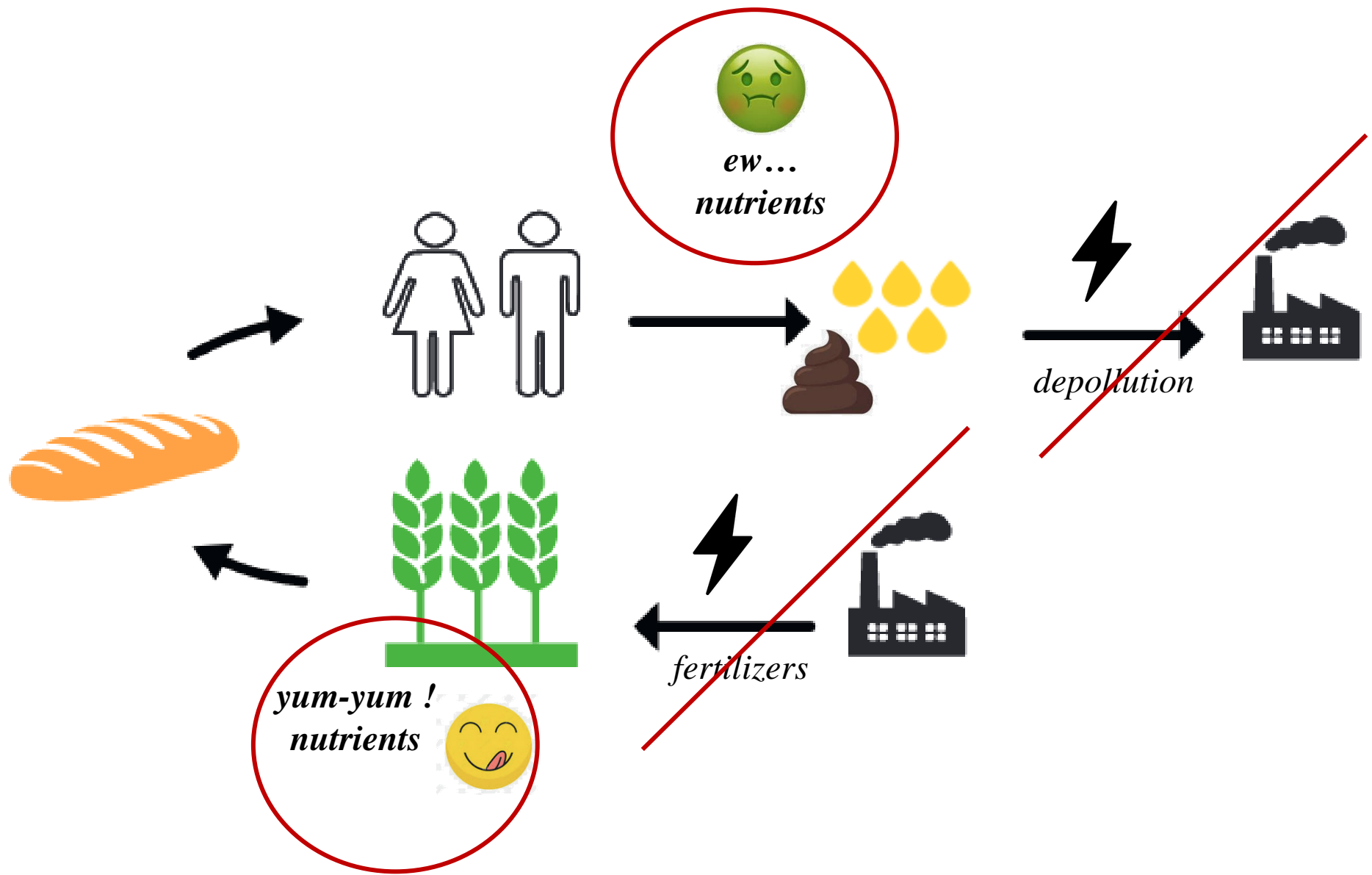


OCAPI





OCAPI







*“What can be the contribution of human excretions used as fertilizers for food production, within the planetary boundaries ?”*

# How to answer :

1. ***Describe the current excretion system (in France)***

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1. ***Describe the current excretion system (in France)***
2. ***Redesign the excretion system => current potential***
3. ***Redesign the food/excretion system => future potential ?***

# Current handling of excretions in France

Current excretion system : **Nitrogen**

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Own calculations, data and methods based on :

INCA3

*(food intakes)*

Citepa

*(wastewater treatment plant uses and nutrient content)*

Vigiak et al., (2020)

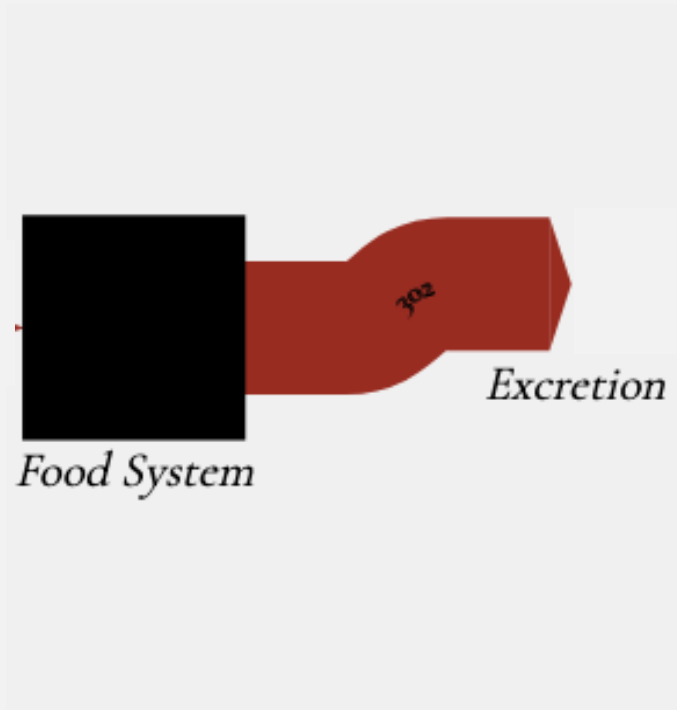
*(wastewater treatment plant yields, detergents...)*

Eurostat

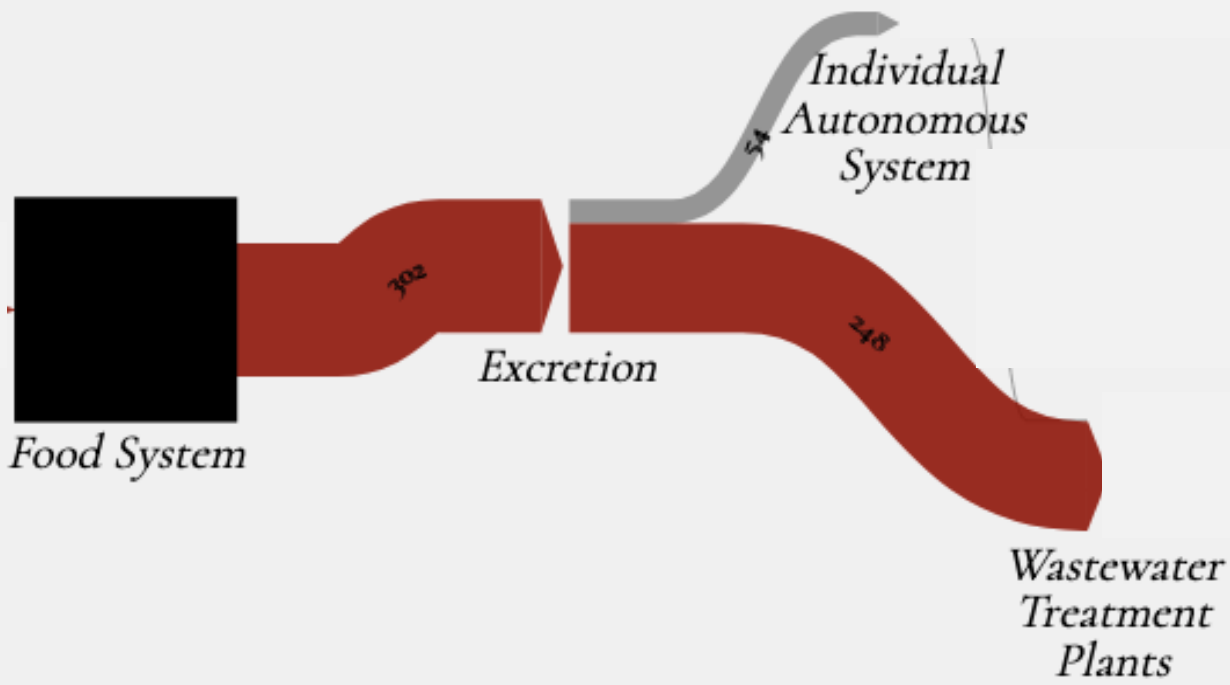
*(connection to sewage system and individual autonomous system)*



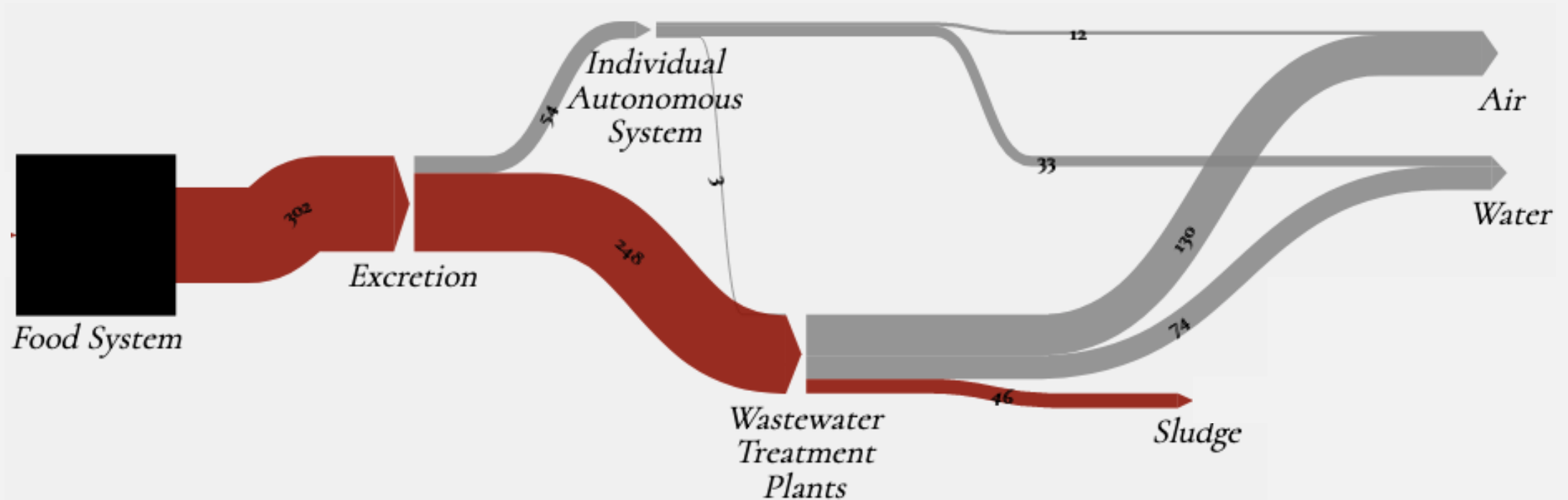
# Current excretion system : Nitrogen



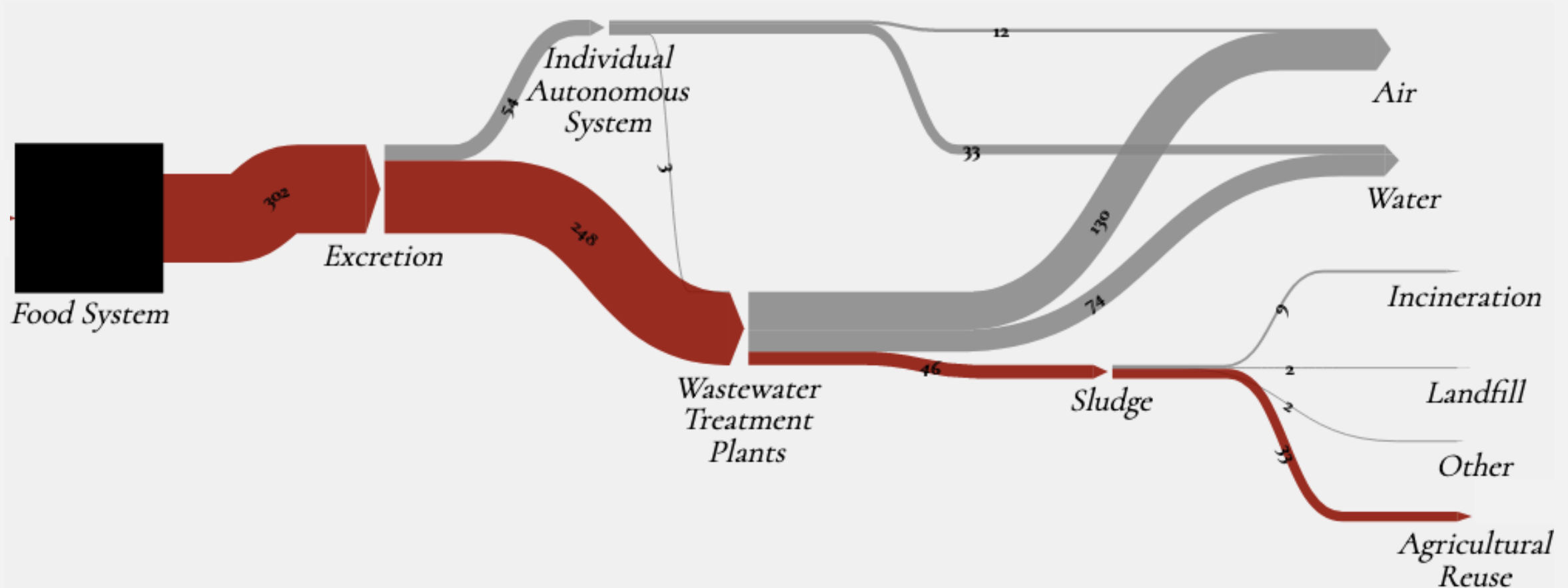
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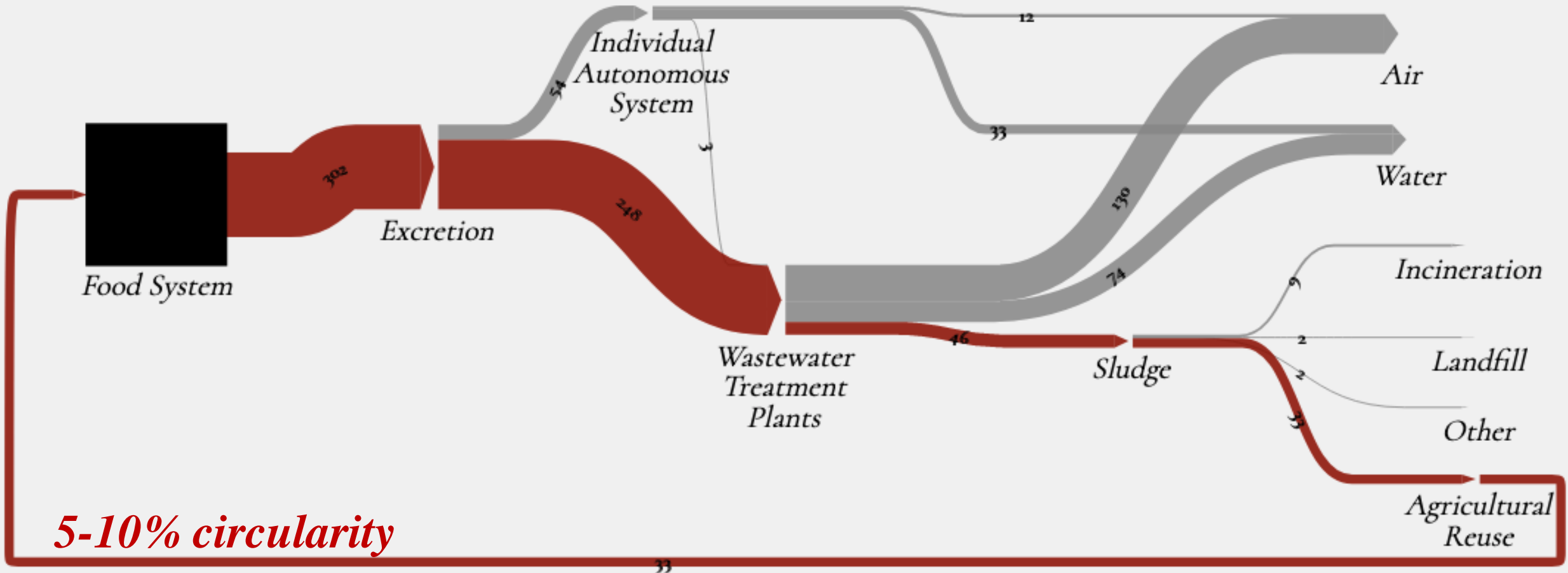
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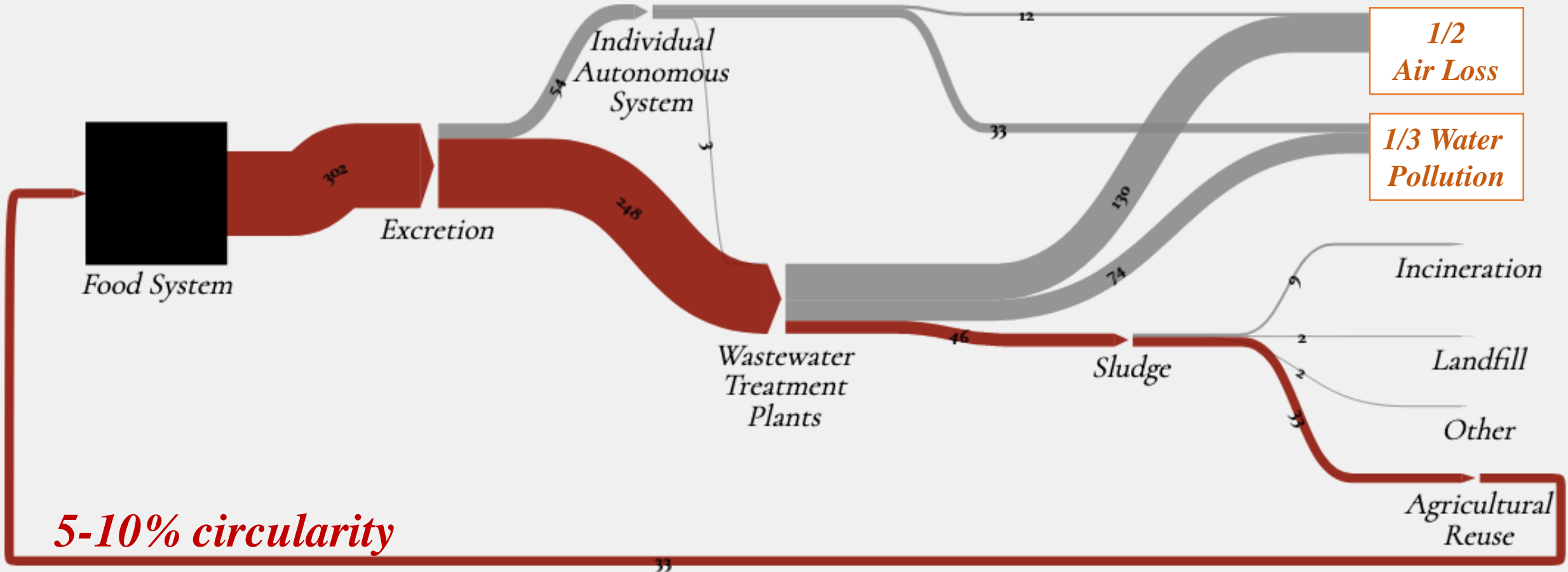
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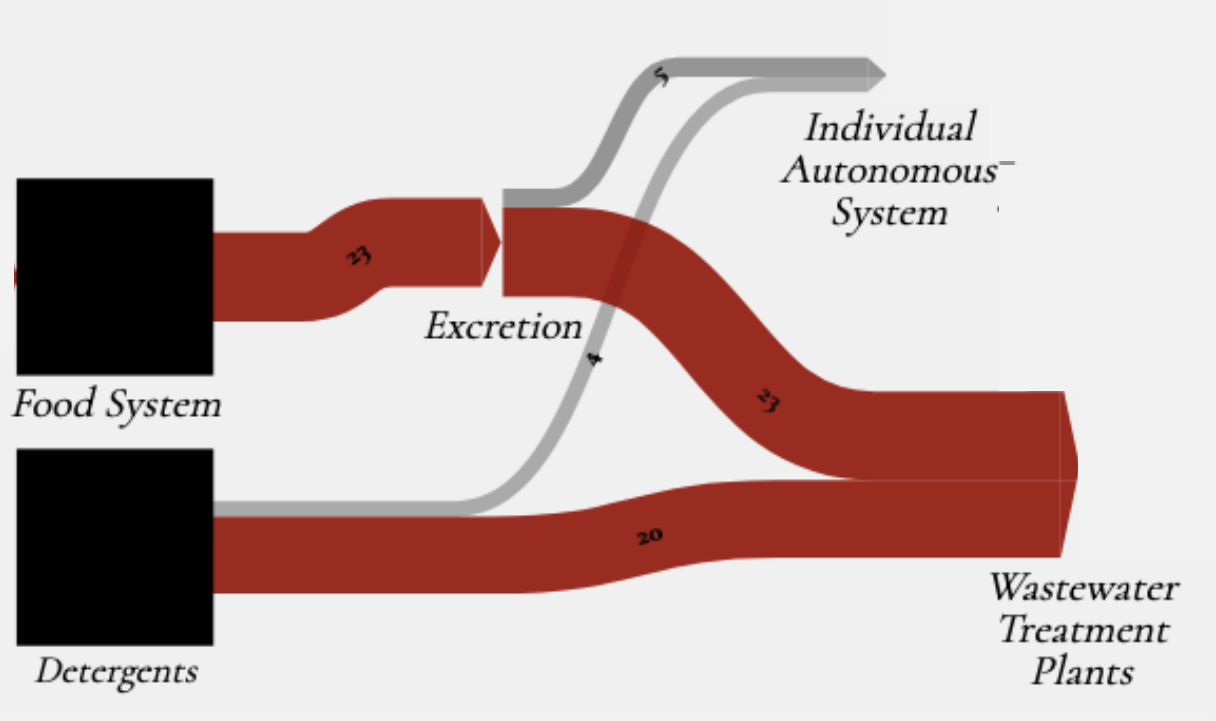
# Current excretion system : Nitrogen



# Current excretion system : Phosphorus

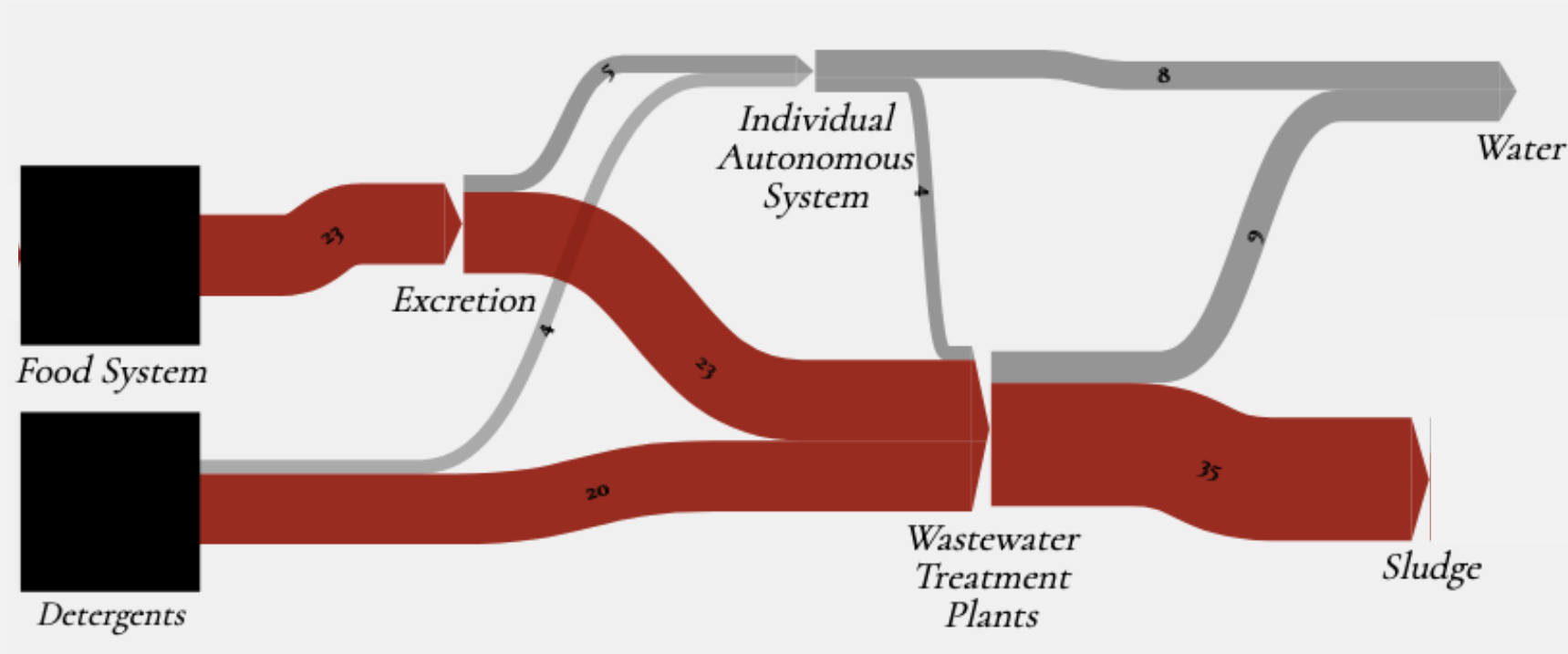


# Current excretion system : Phosphorus

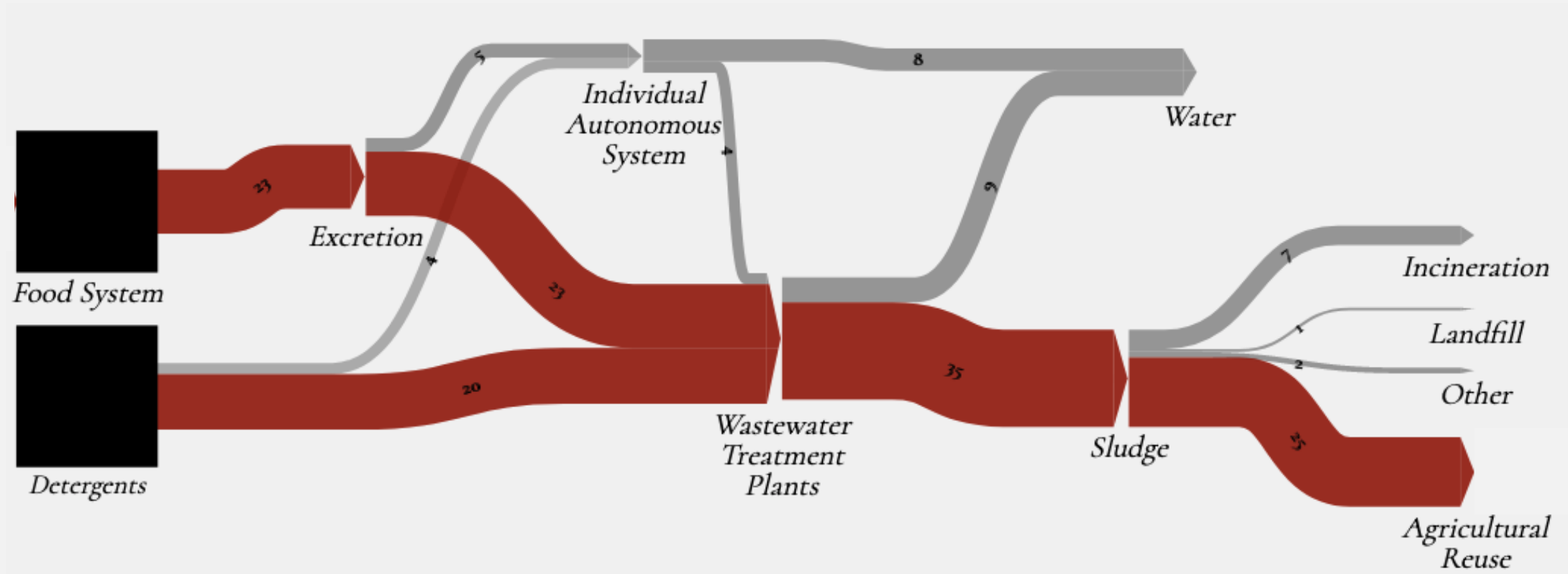




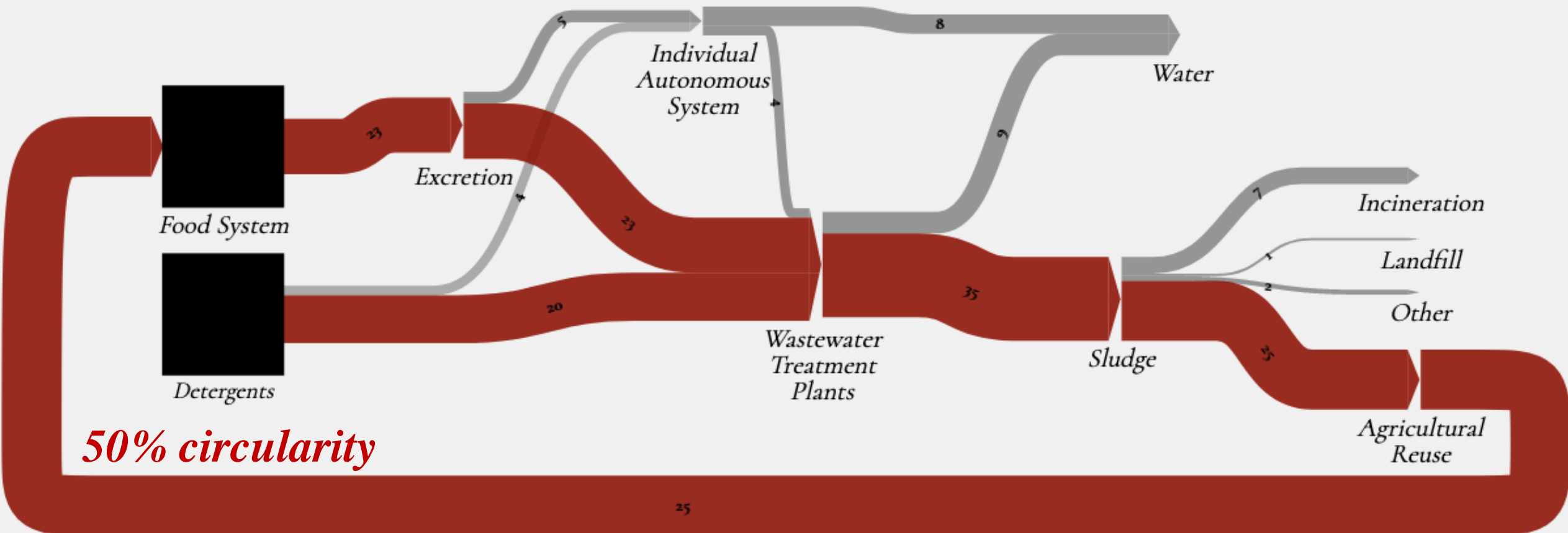
# Current excretion system : Phosphorus



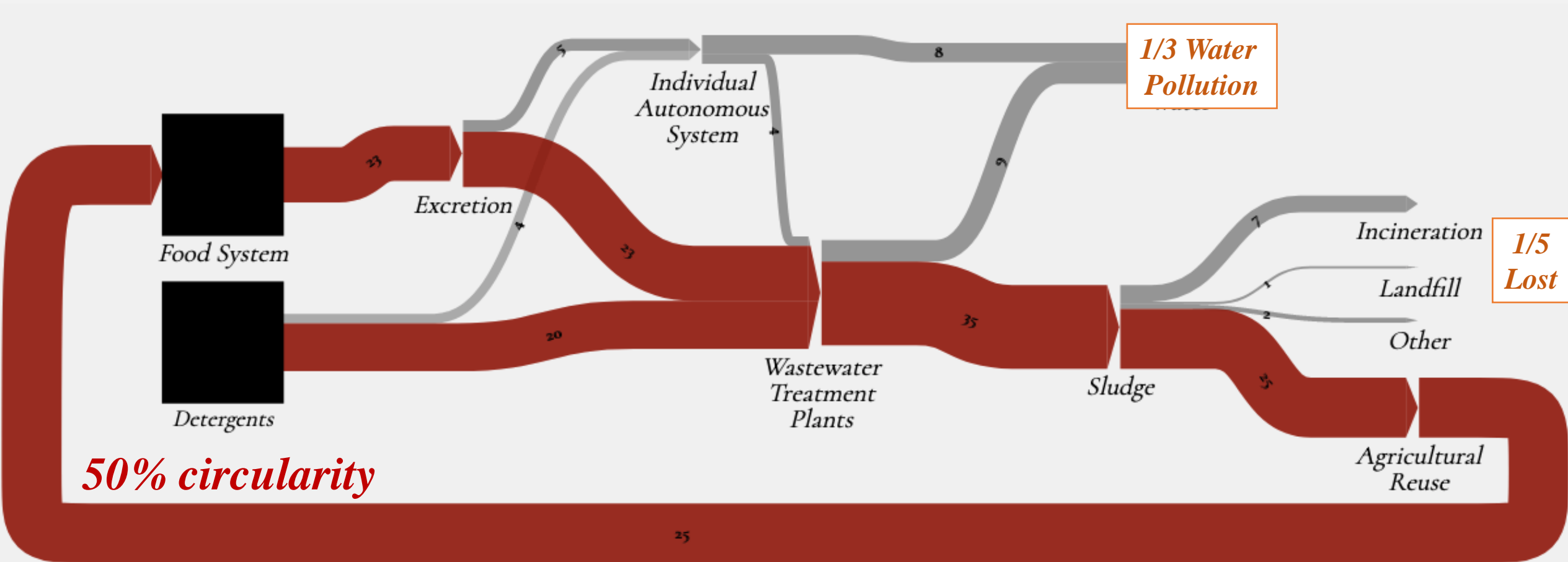
# Current excretion system : Phosphorus



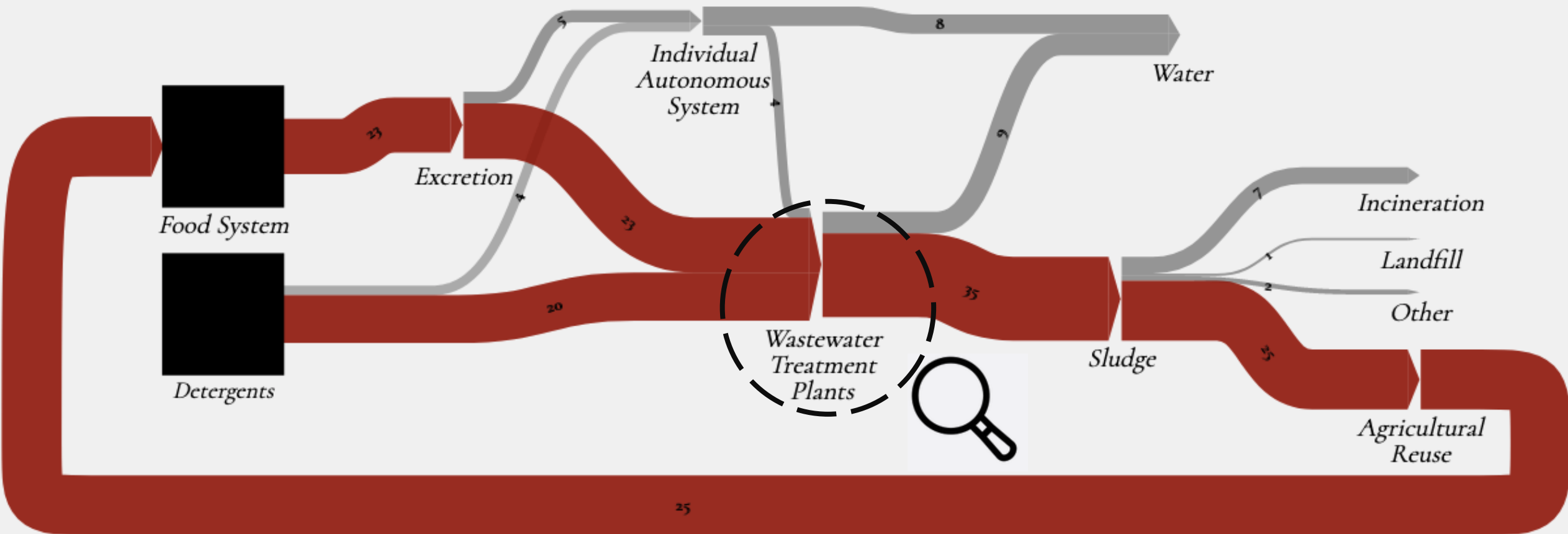
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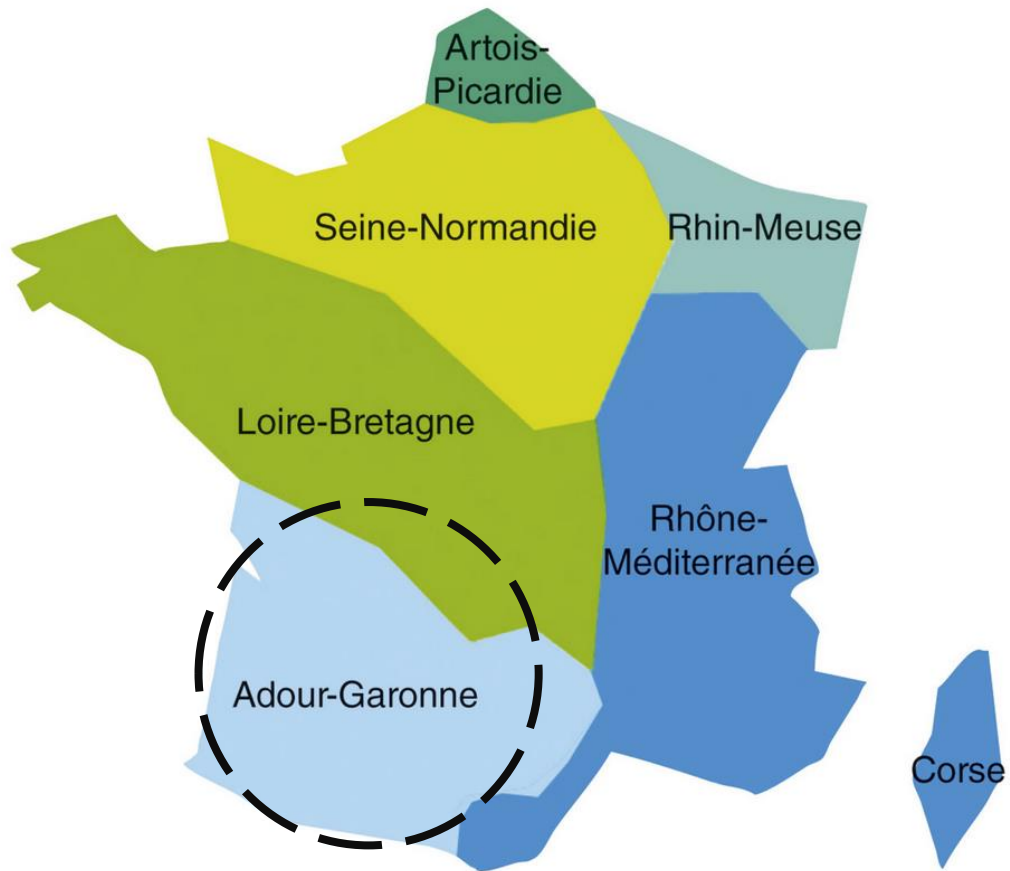


# Current excretion system : Phosphorus



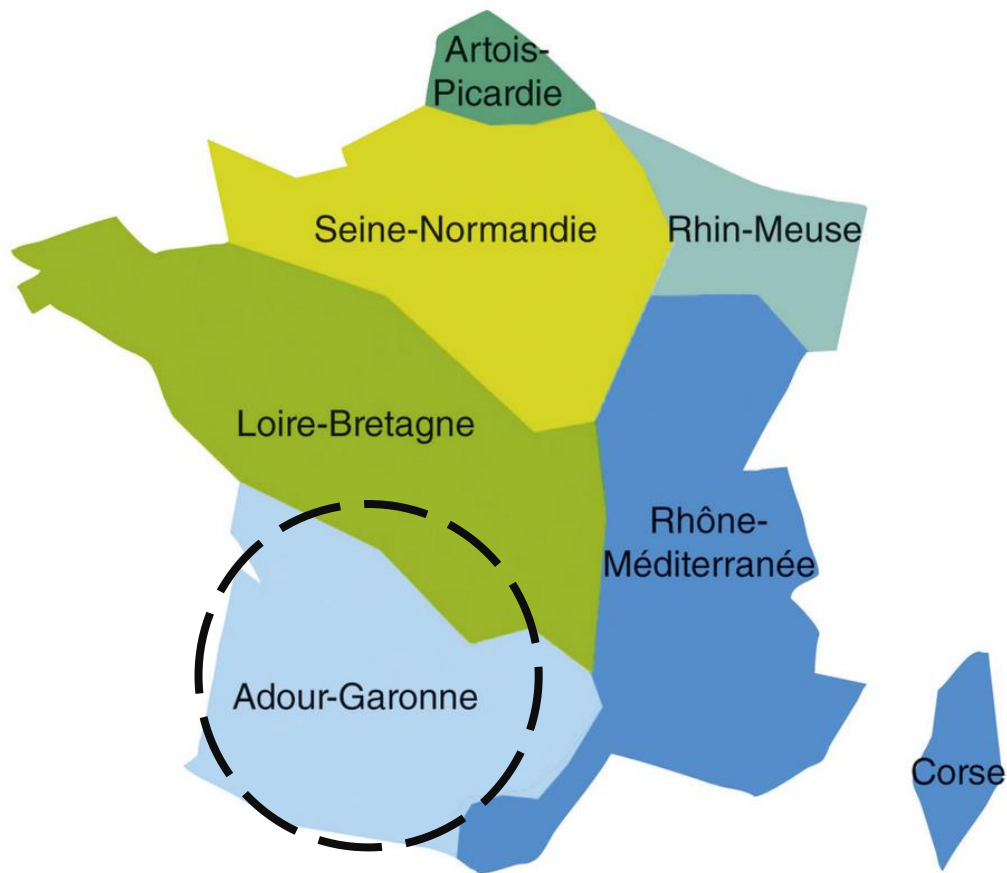
# Wastewater Treatment Plants yield

*basin scale, real operational data*



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*basin scale, real operational data*



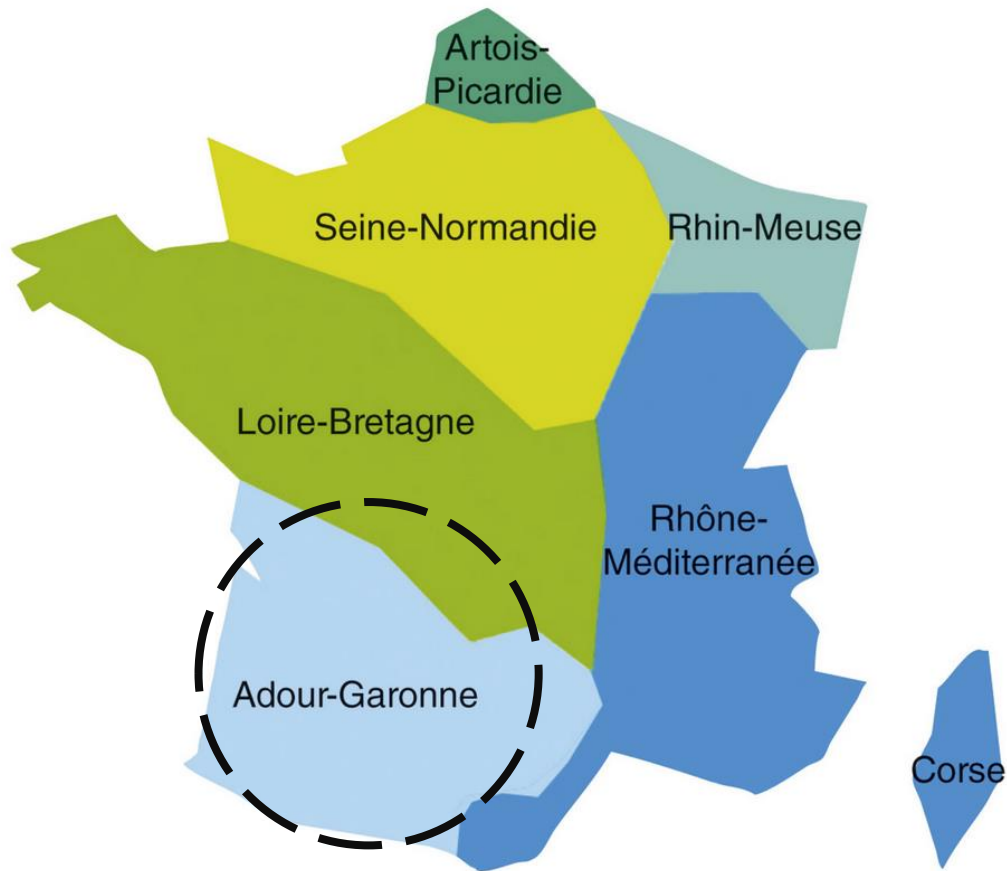
**Global abatement rate of Adour-Garonne WWTPs**



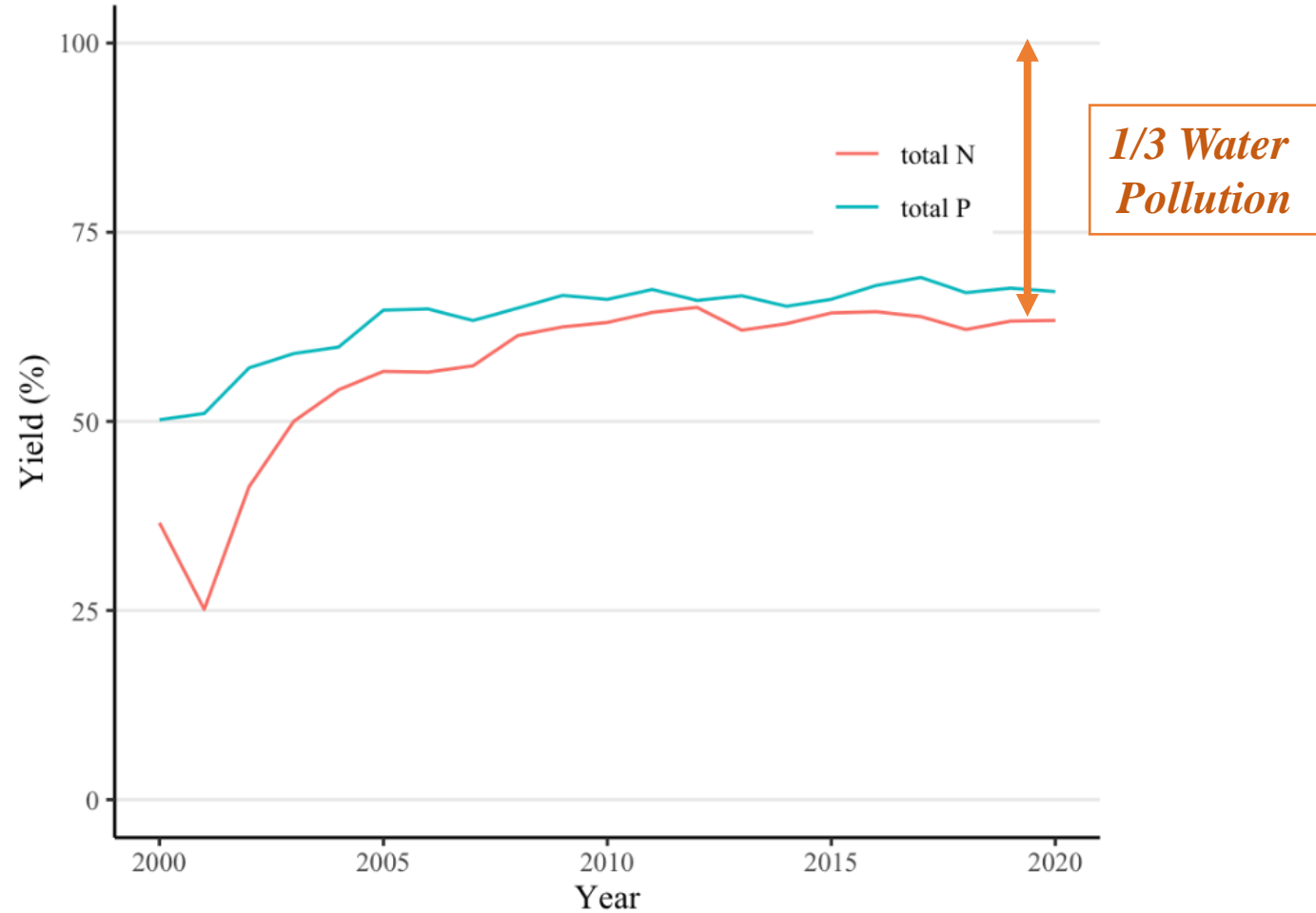
Source:  
Système d'Information sur l'Eau (SIE) Adour-Garonne, 2022

# Wastewater Treatment Plants yield

*basin scale, real operational data*



## Global abatement rate of Adour-Garonne WWTPs

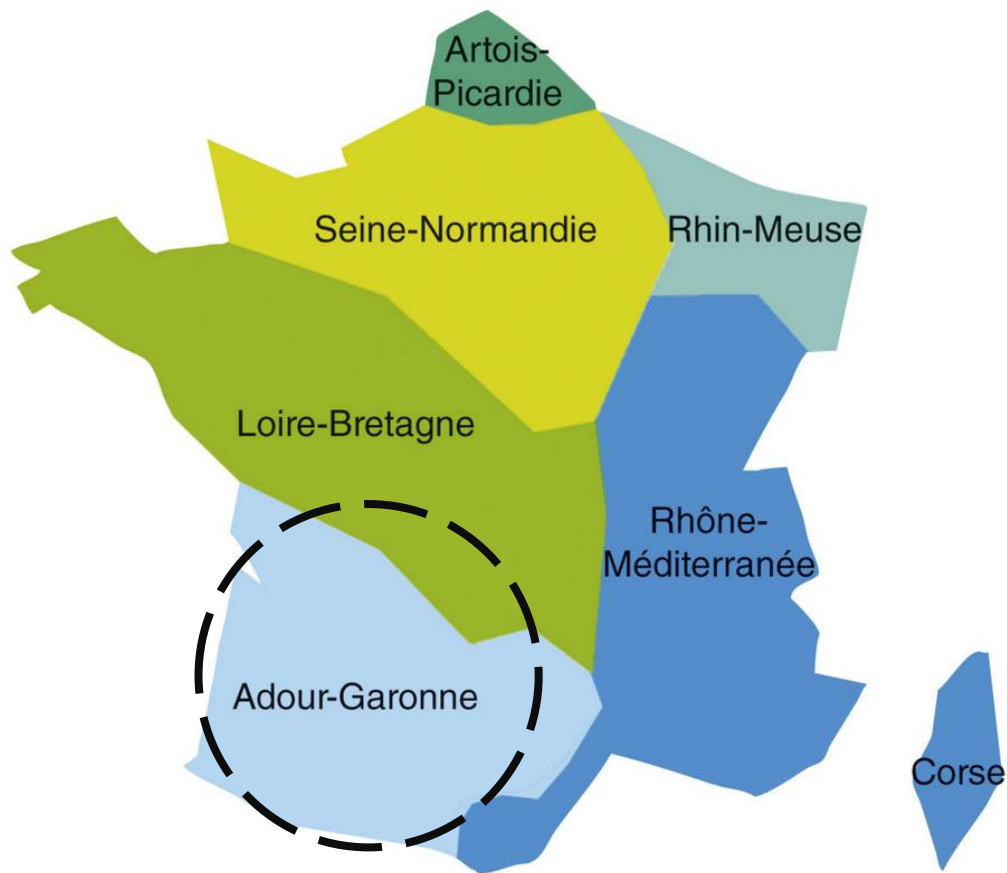


Source:  
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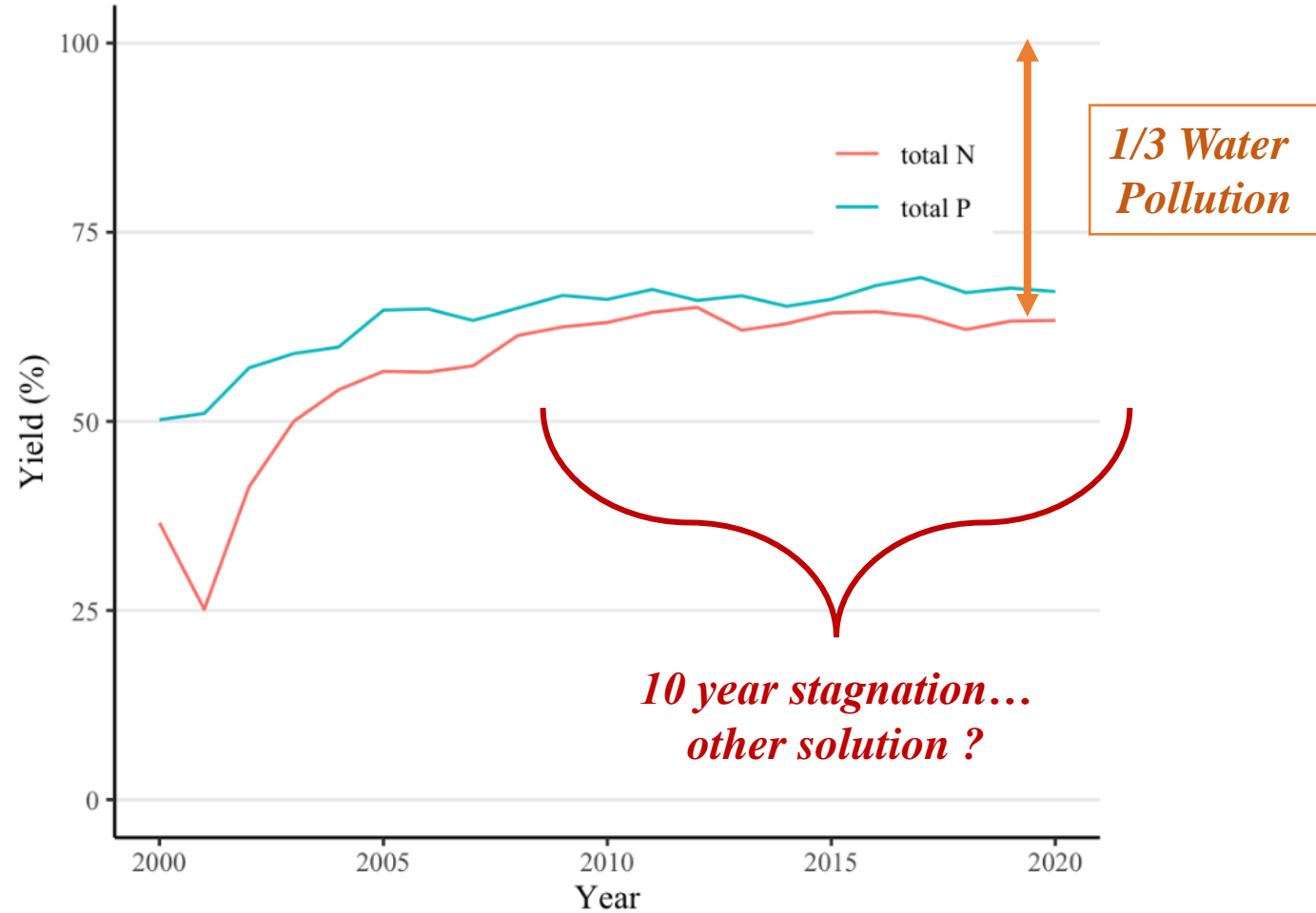


# Wastewater Treatment Plants yield

*basin scale, real operational data*



## Global abatement rate of Adour-Garonne WWTPs



# Utiliser l'urine humaine en agriculture

Fiches pratiques



OCAPI

Seuls les urinofertilisants ayant un faible potentiel de volatilisation peuvent être épandus avec un pulvérisateur.

Credits : Marco Carozzi



*Toilette à séparation*



*Urinoir sec*

# Current potential of human excretions

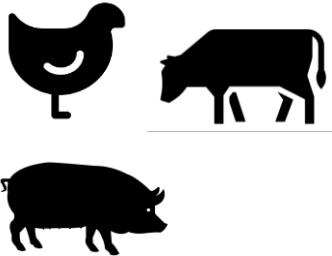
# Potential of **Nitrogen** in human excretions, compared to **livestock** excretions on crops



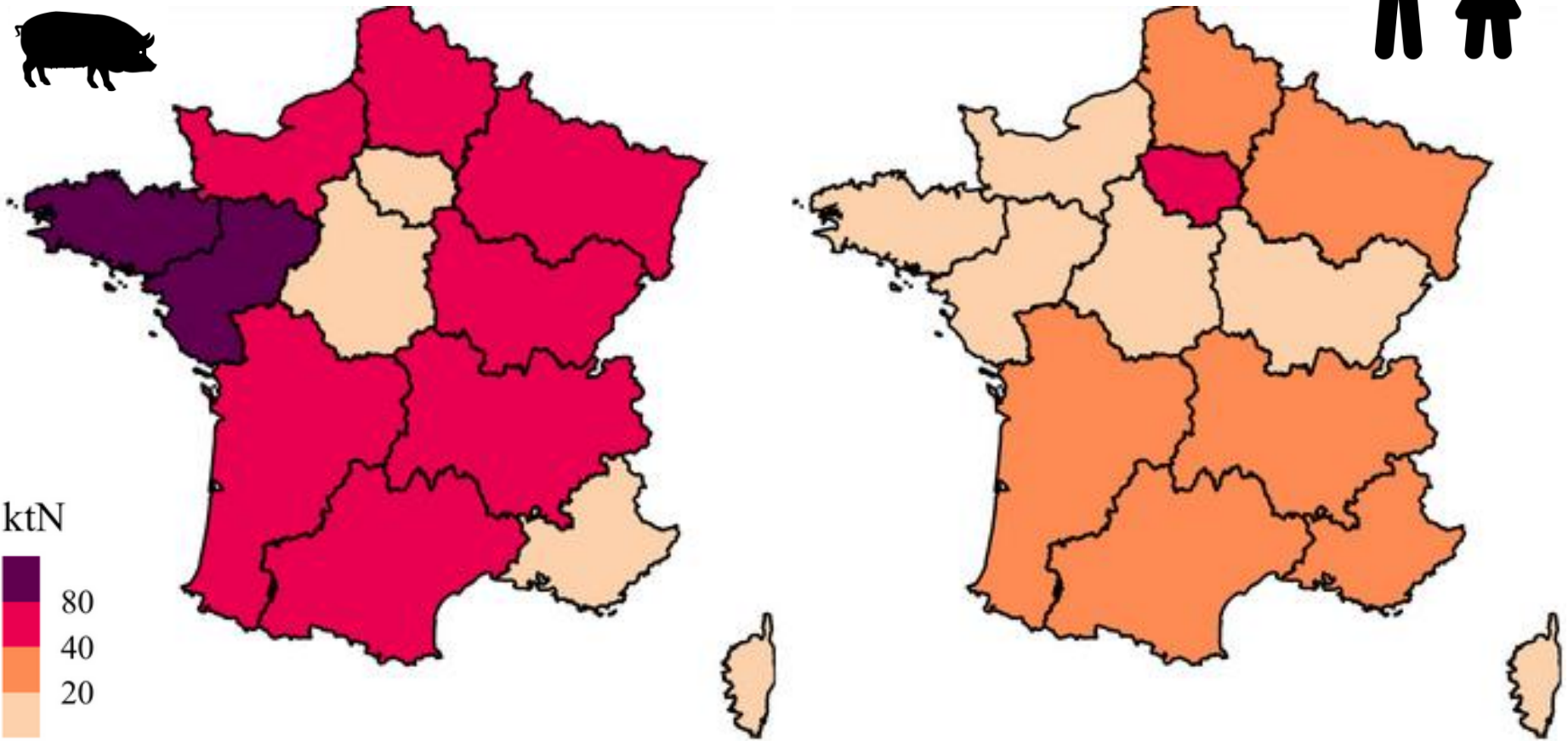
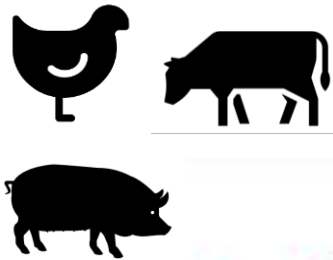
*potential*

~

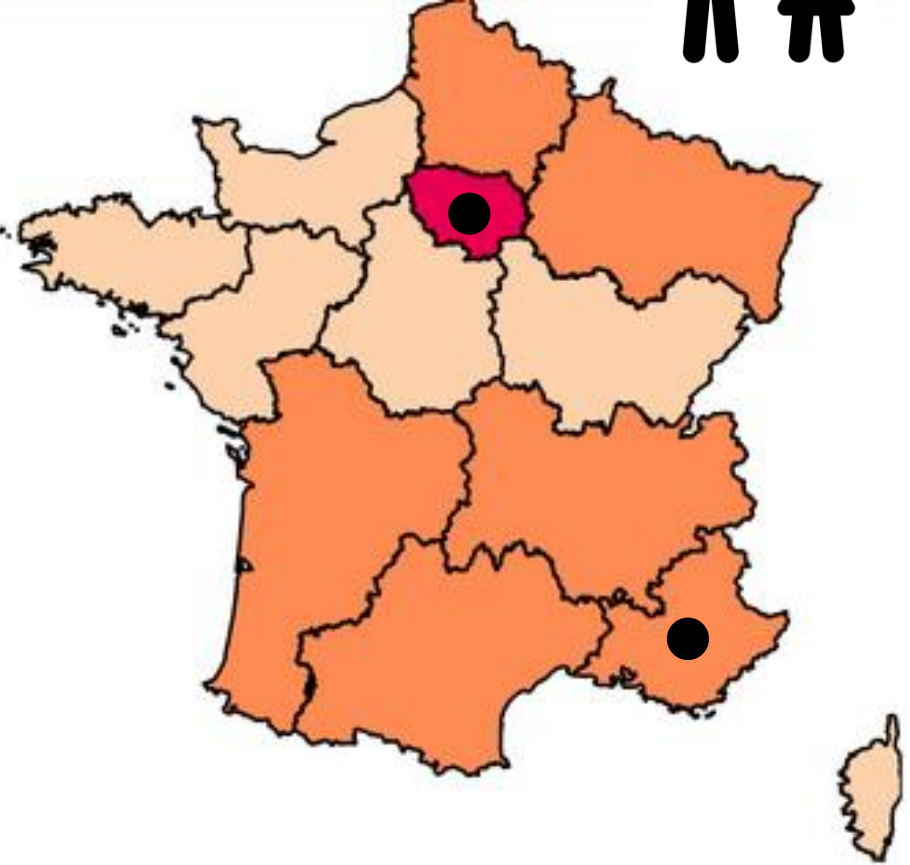
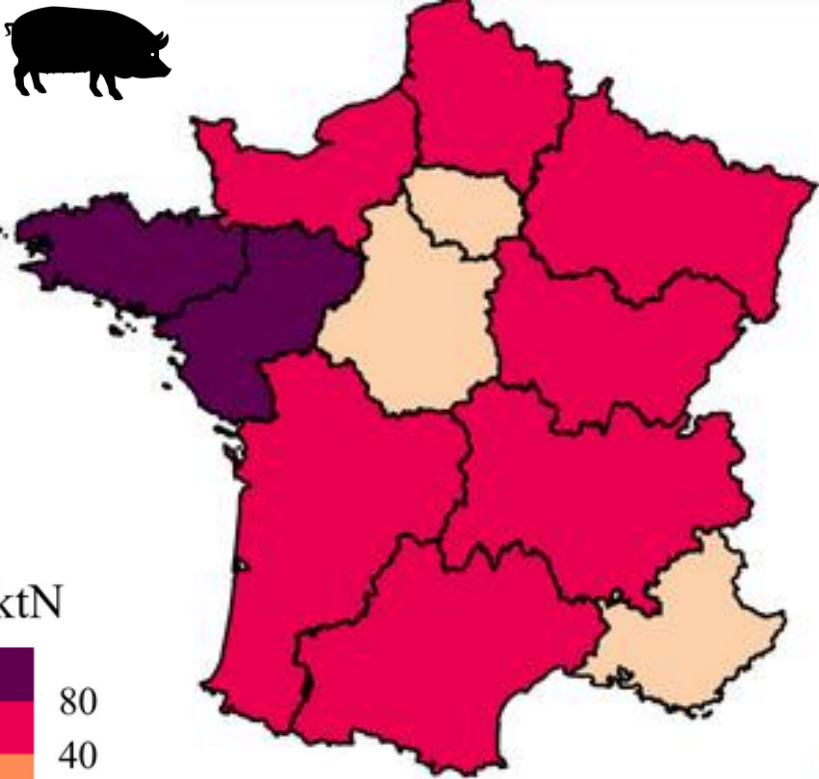
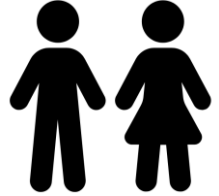
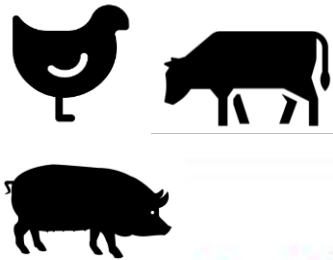
40%



# Potential of Nitrogen in human excretions, compared to livestock excretions on crops



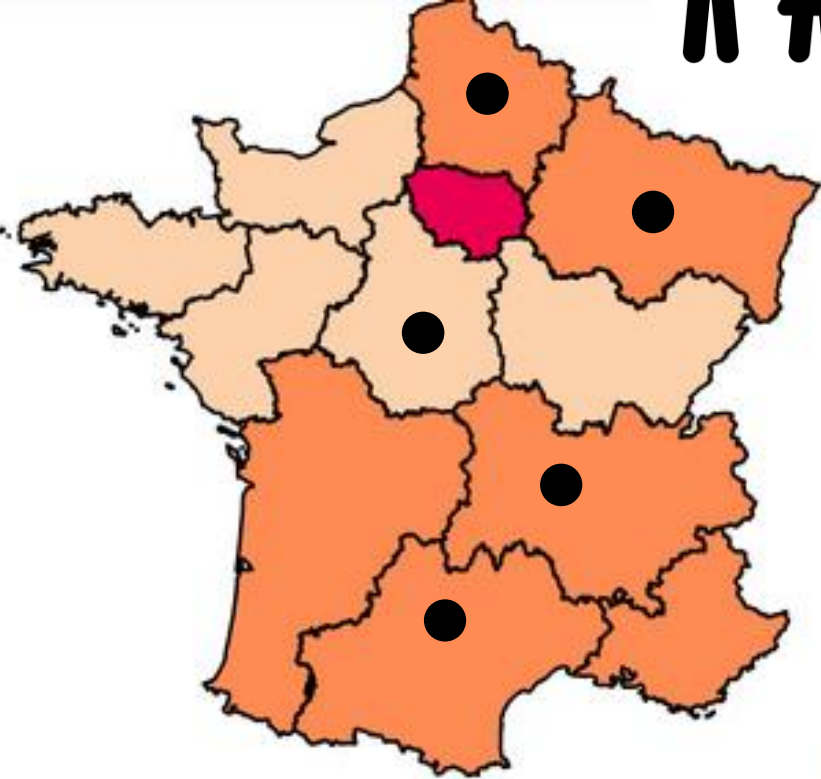
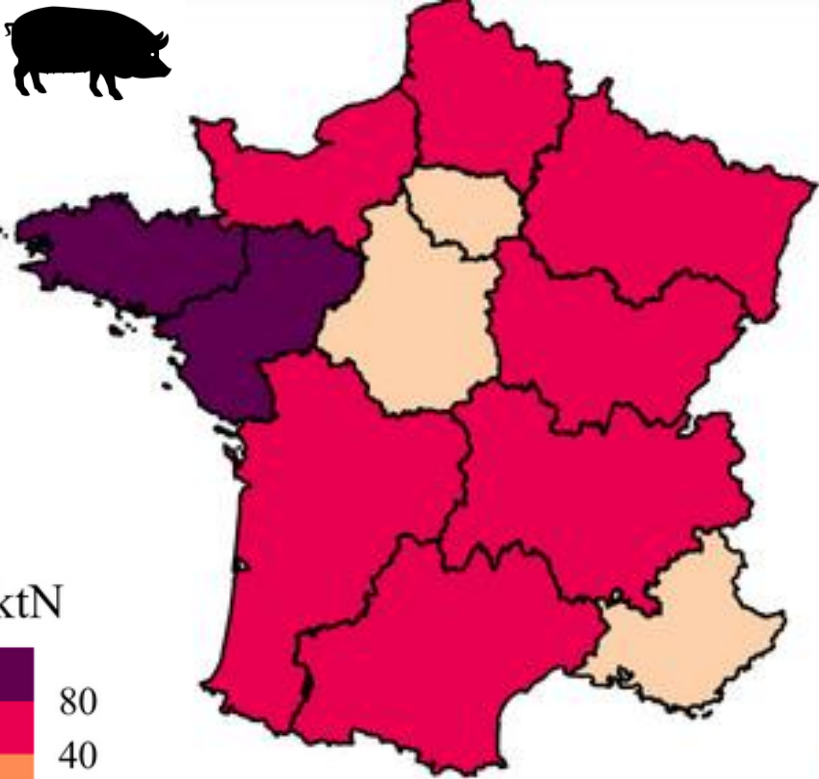
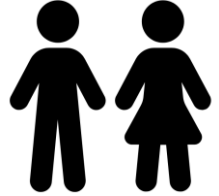
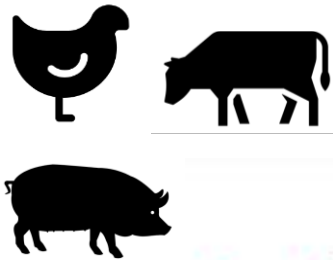
# Potential of Nitrogen in human excretions, compared to livestock excretions on crops



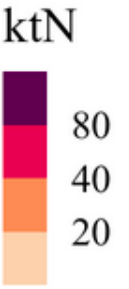
*humans > livestock*



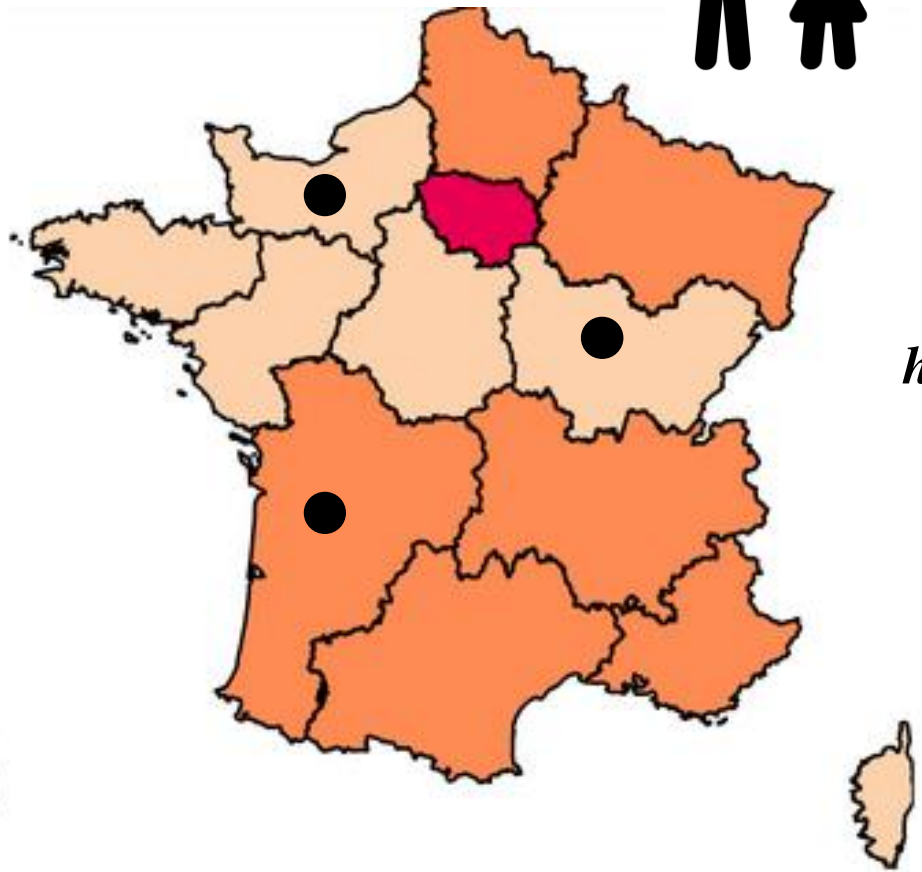
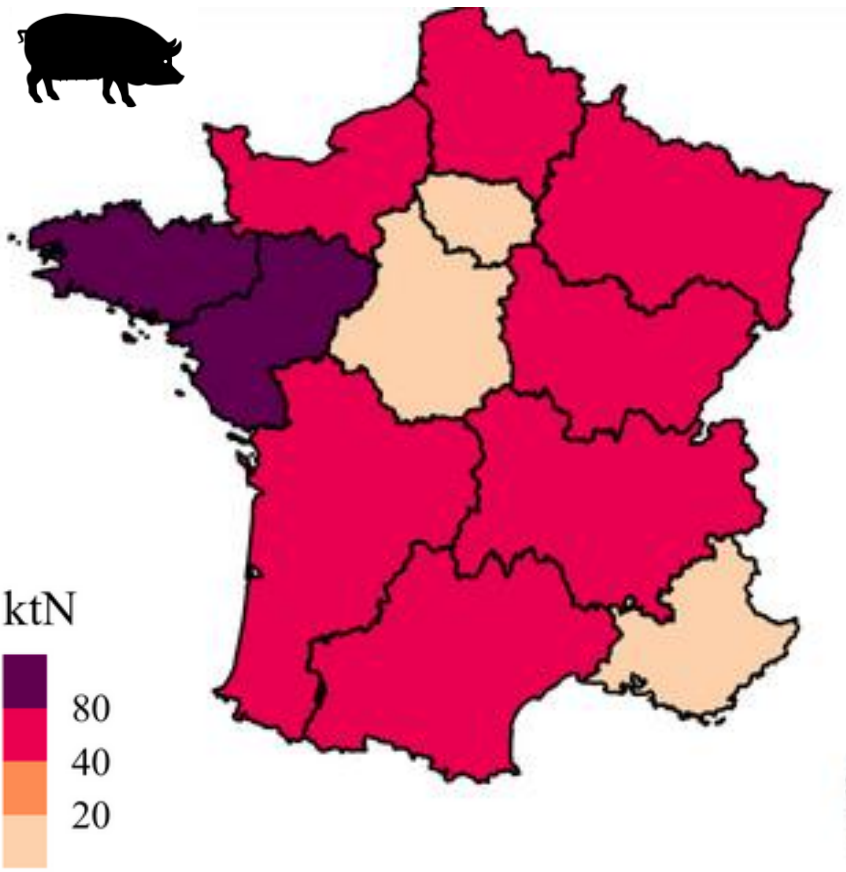
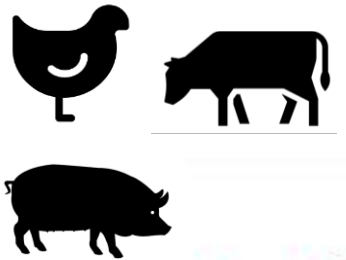
# Potential of Nitrogen in human excretions, compared to livestock excretions on crops



*humans ~ 50-100% livestock*



# Potential of **Nitrogen** in human excretions, compared to livestock excretions on crops

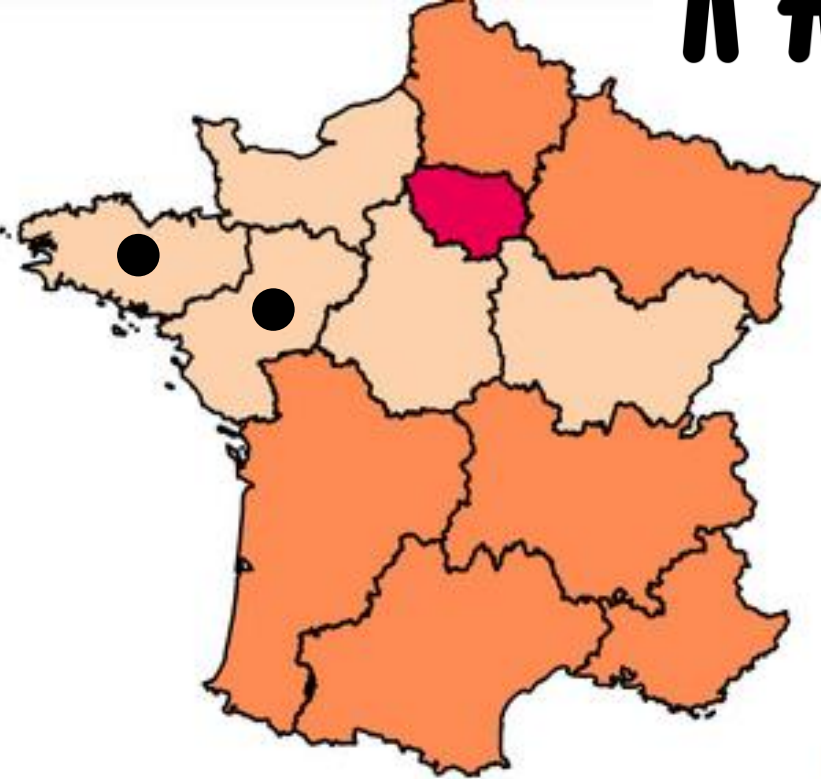
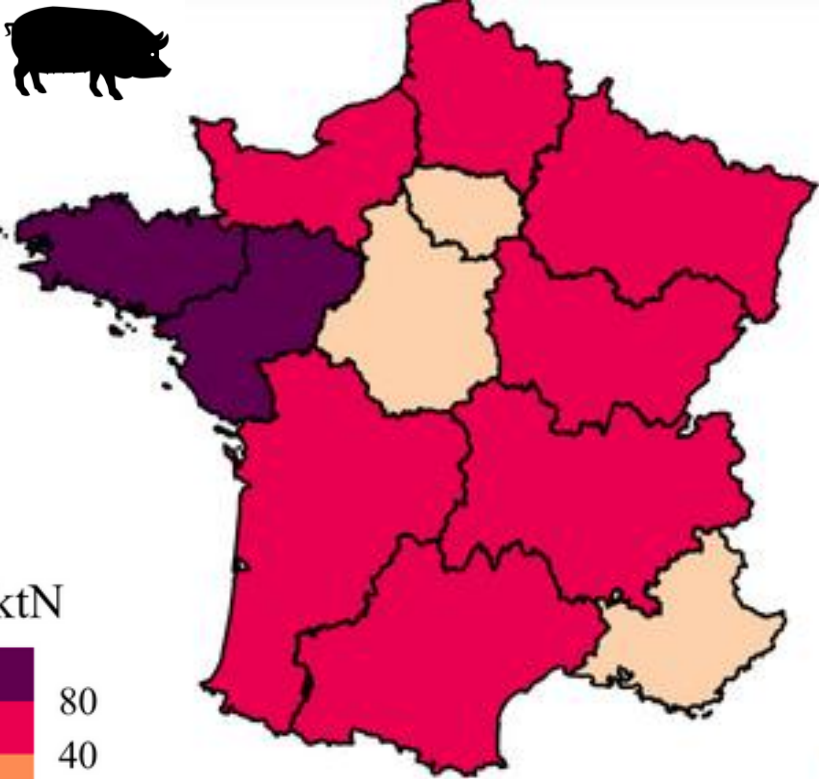
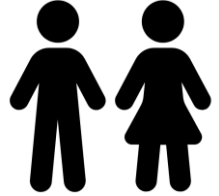
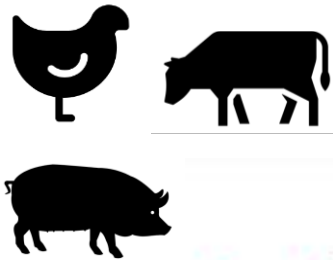


*humans ~ 20-50% livestock*

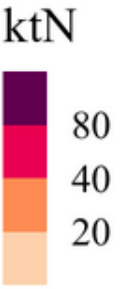




# Potential of Nitrogen in human excretions, compared to livestock excretions on crops



*humans < 20% livestock*



# Potential of **Nitrogen** in human excretions, compared to fertilizers



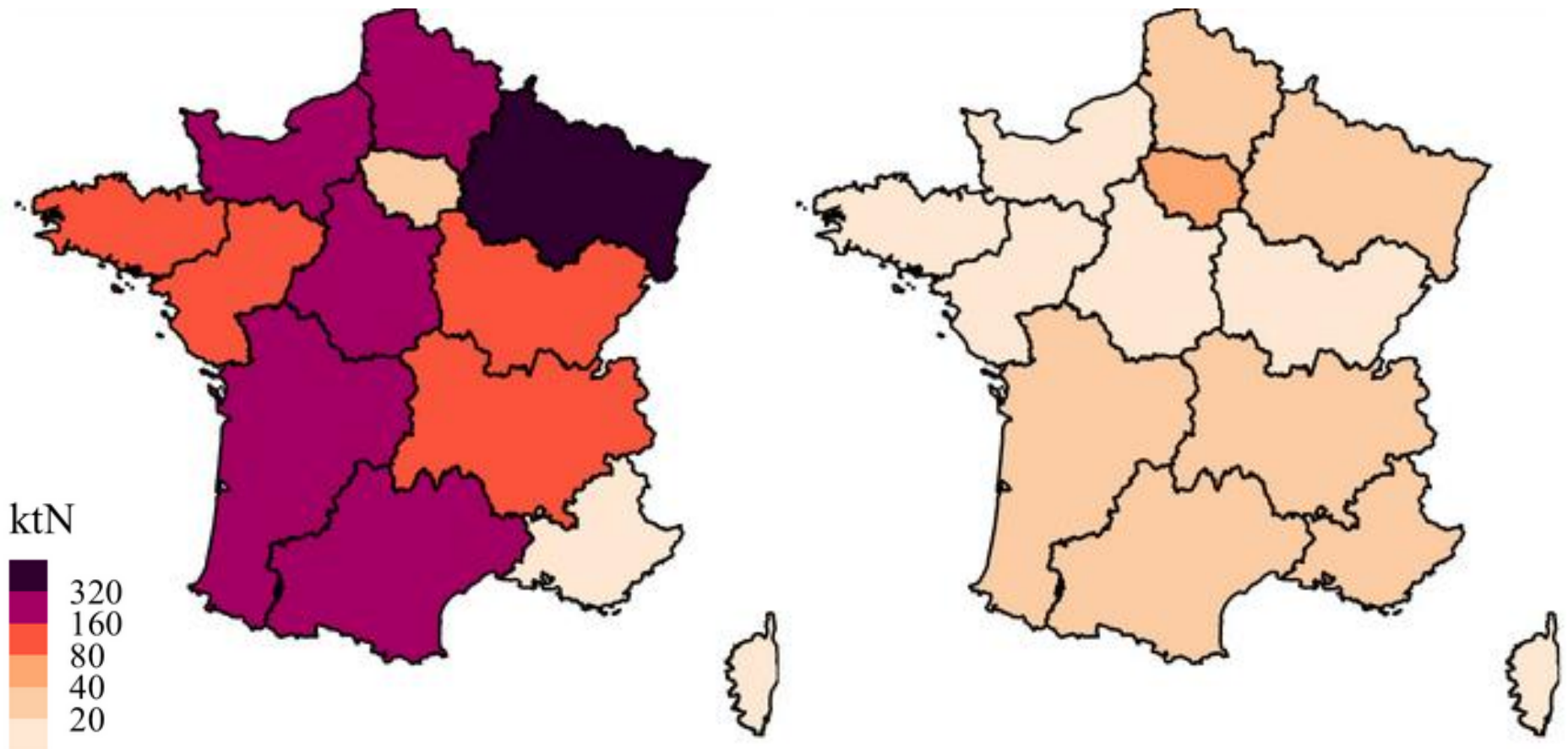
*potential*

~

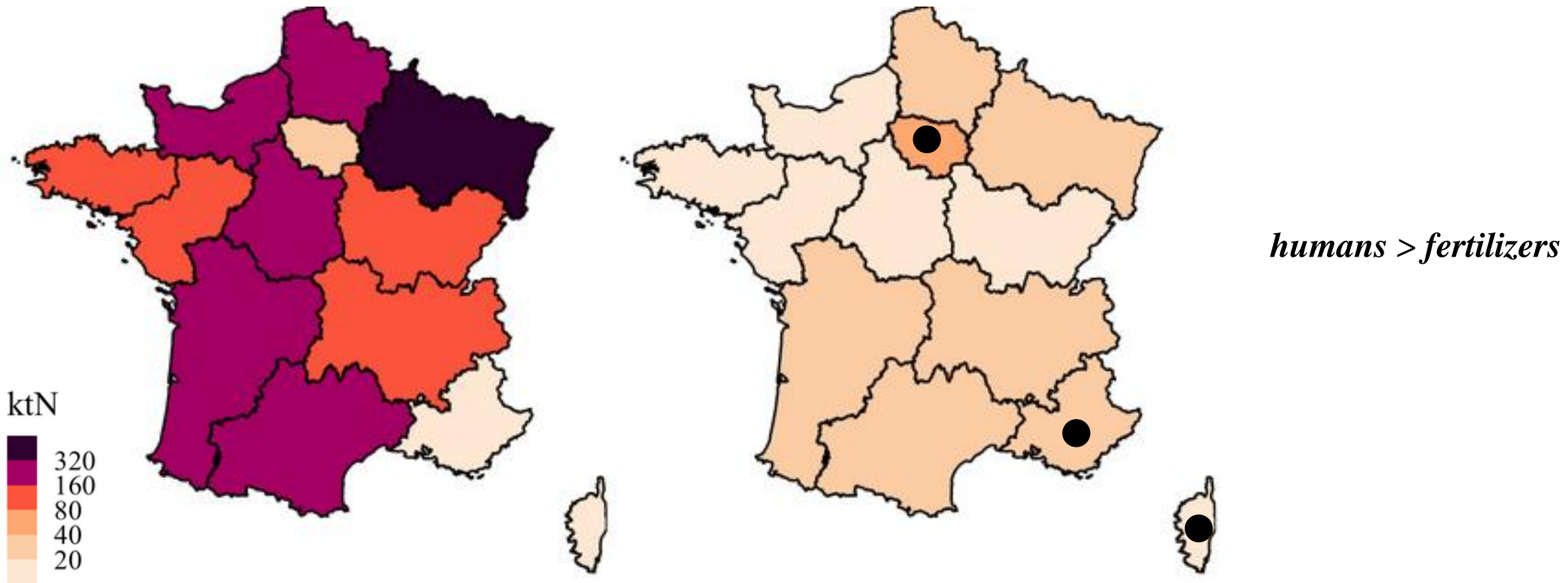
*10-15 %*



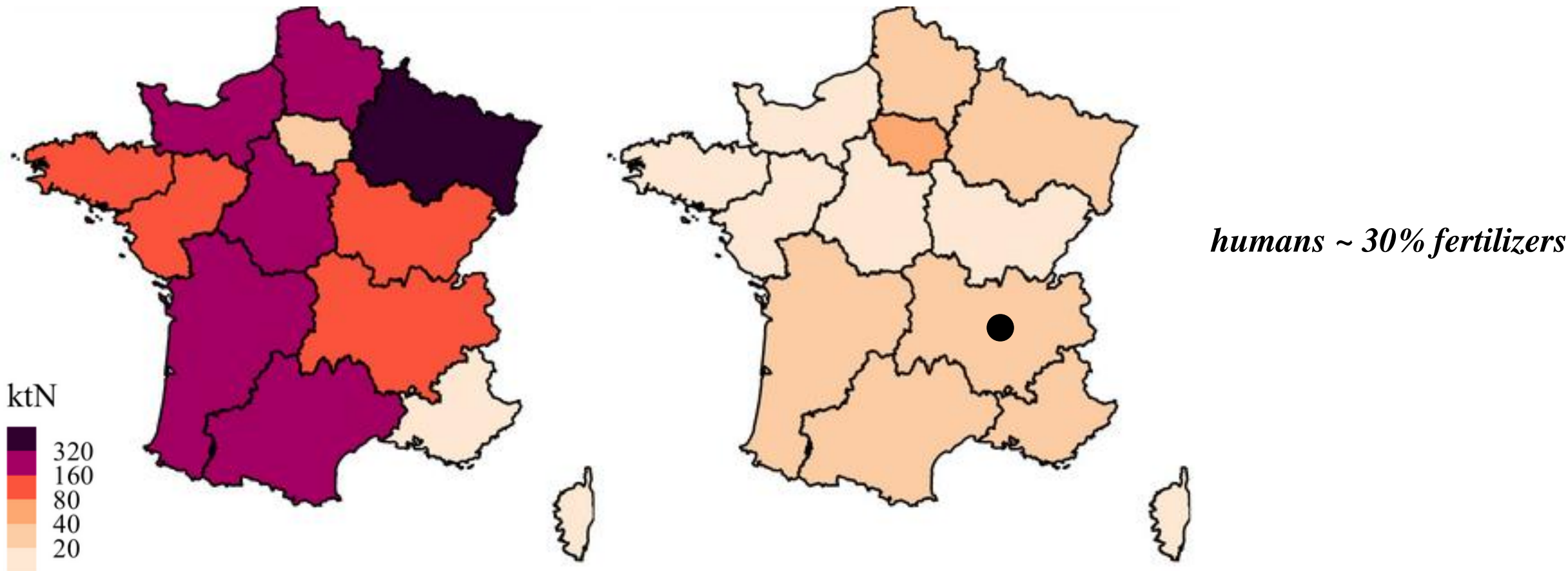
# Potential of **Nitrogen** in human excretions, compared to fertilizers



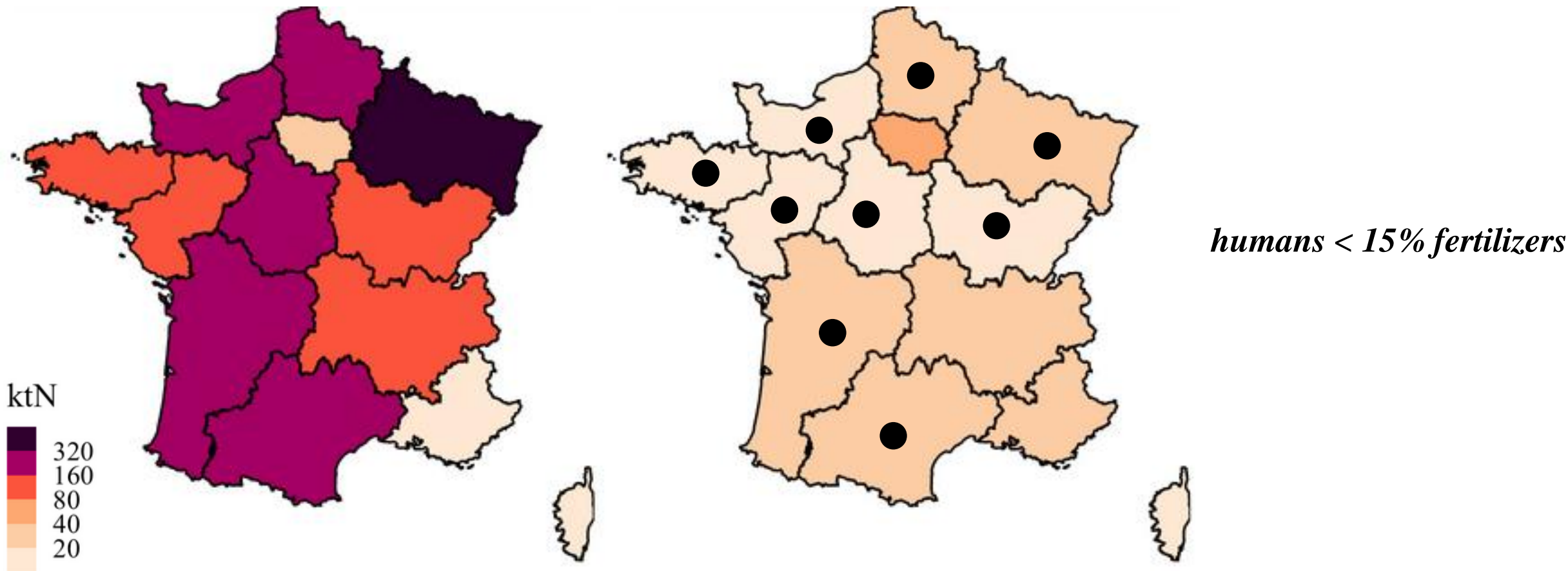
# Potential of Nitrogen in human excretions, compared to fertilizers



# Potential of Nitrogen in human excretions, compared to fertilizers



# Potential of Nitrogen in human excretions, compared to fertilizers



So, it's negligible, right ?

So, it's negligible, right ?

- Not for Phosphorus (not shown here)



# So, it's negligible, right ?

- Not for Phosphorus (not shown here)
- Not if we redesign the food system : less animal products...

Potential when changing the  
food system ?

Perspective

# Reshaping the European agro-food system and closing its nitrogen cycle: The potential of combining dietary change, agroecology, and circularity

Gilles Billen,<sup>1,\*</sup> Eduardo Aguilera,<sup>2</sup> Rasmus Einarsson,<sup>2,3</sup> Josette Garnier,<sup>1</sup> Simone Gingrich,<sup>4</sup> Bruna Grizzetti,<sup>5</sup> Luis Lassaletta,<sup>2</sup> Julia Le Noë,<sup>4</sup> and Alberto Sanz-Cobena<sup>2</sup>

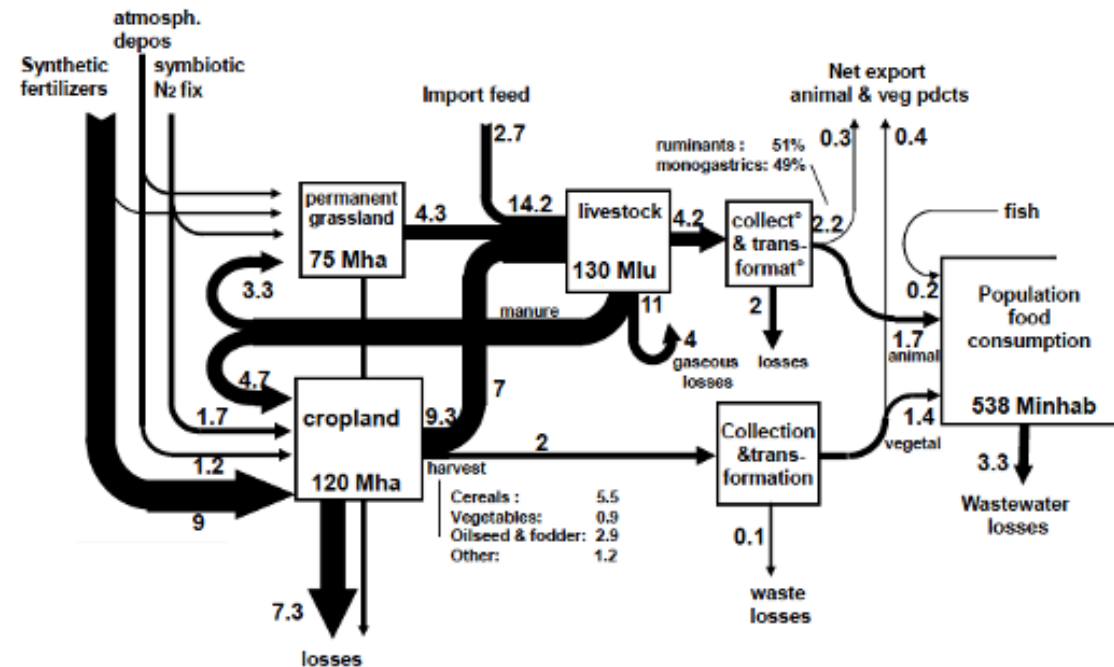
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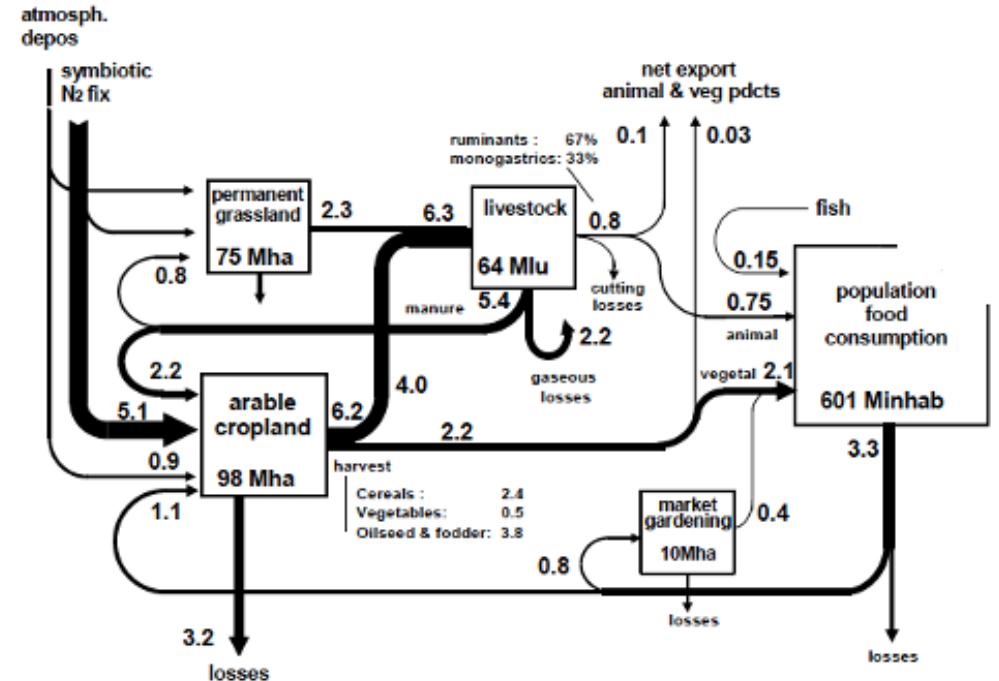
Europe, 2009-2013  
TgN/yr

*Current*



Europe, agro-ecological scenario 2050  
TgN/yr

*Scenario 2050*

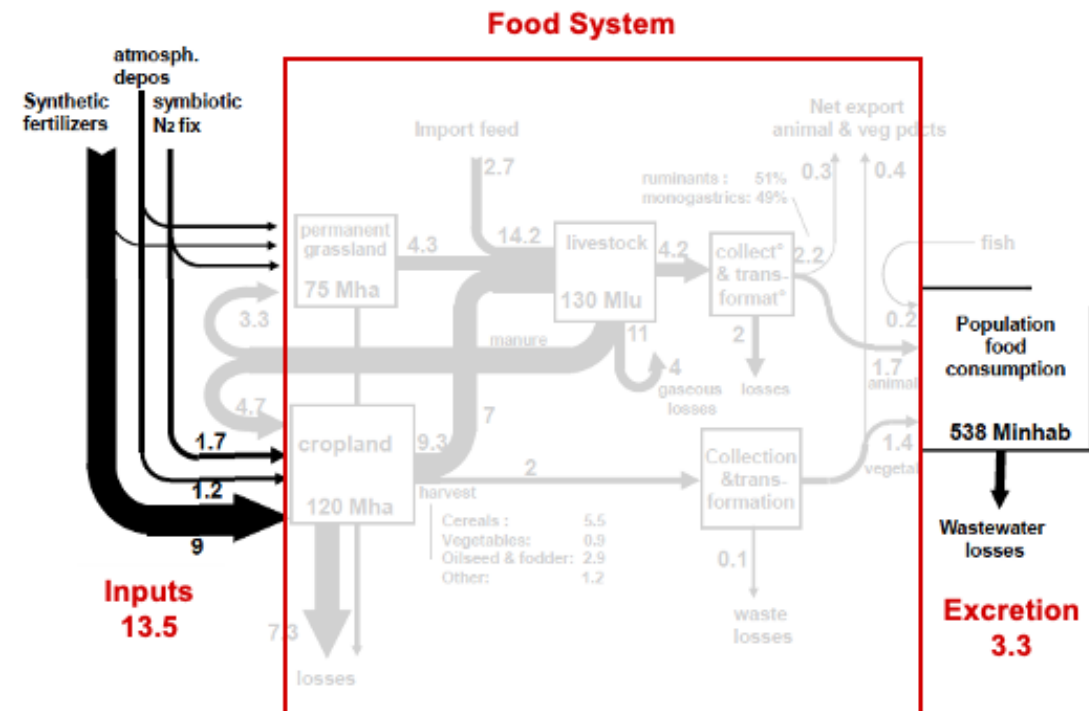


Perspective

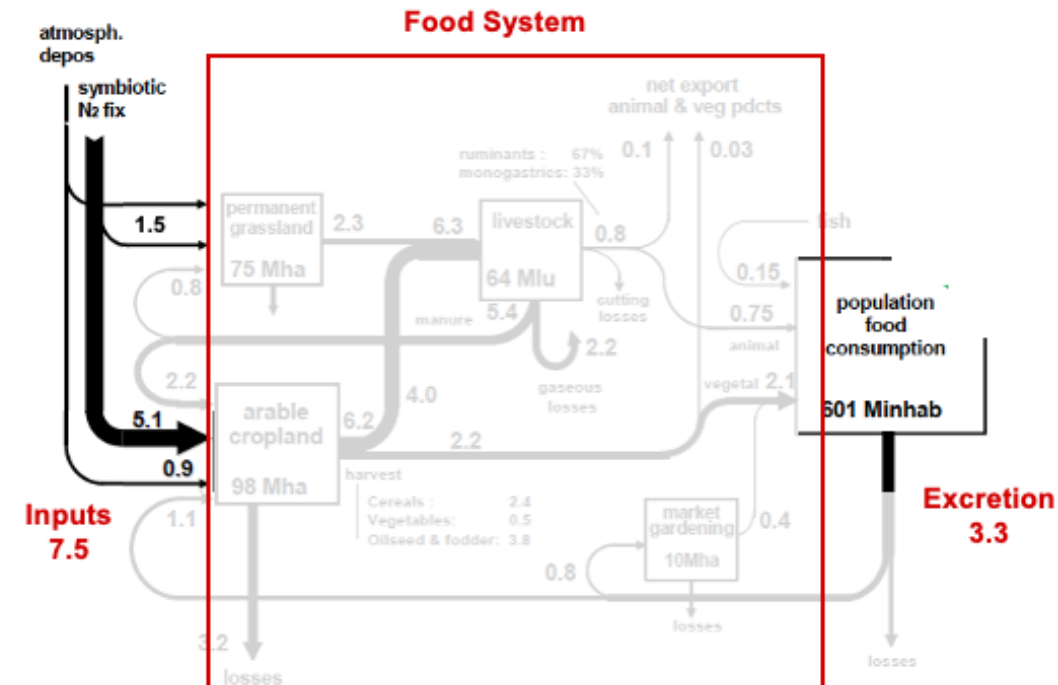
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Europe, 2009-2013  
TgN/yr



Europe, agro-ecological scenario 2050  
TgN/yr



Perspective

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*Excretion :*

*25% of N inputs*

*Excretion :*

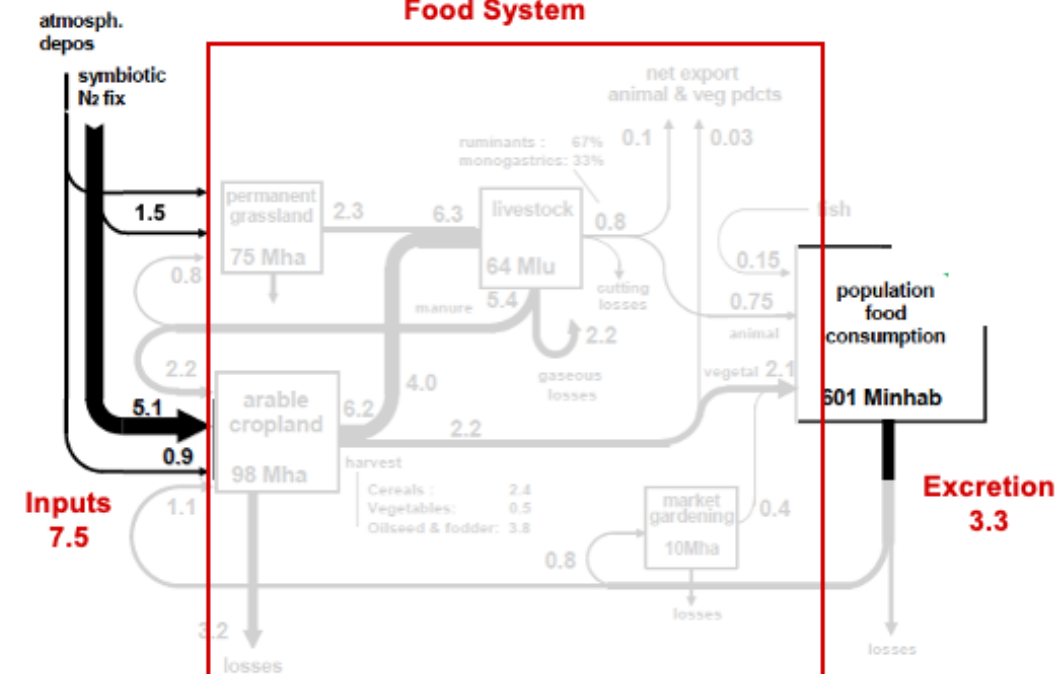
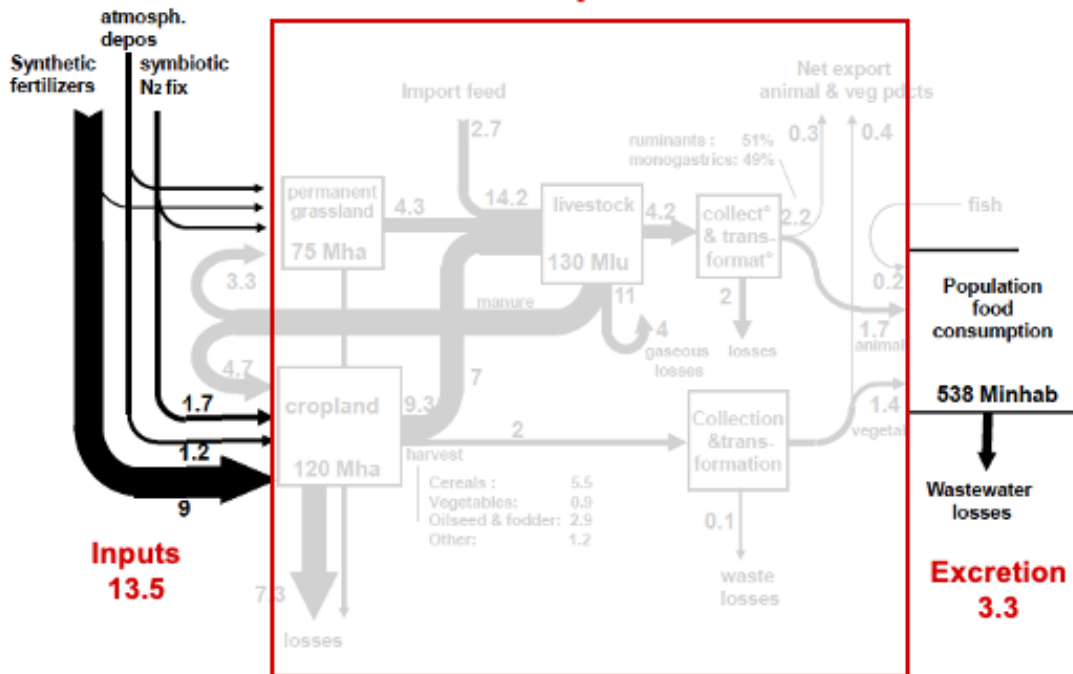
*45% of N inputs*

Europe, 2009-2013  
TgN/yr

Europe, agro-ecological scenario 2050  
TgN/yr

Food System

Food System



*To be continued...*

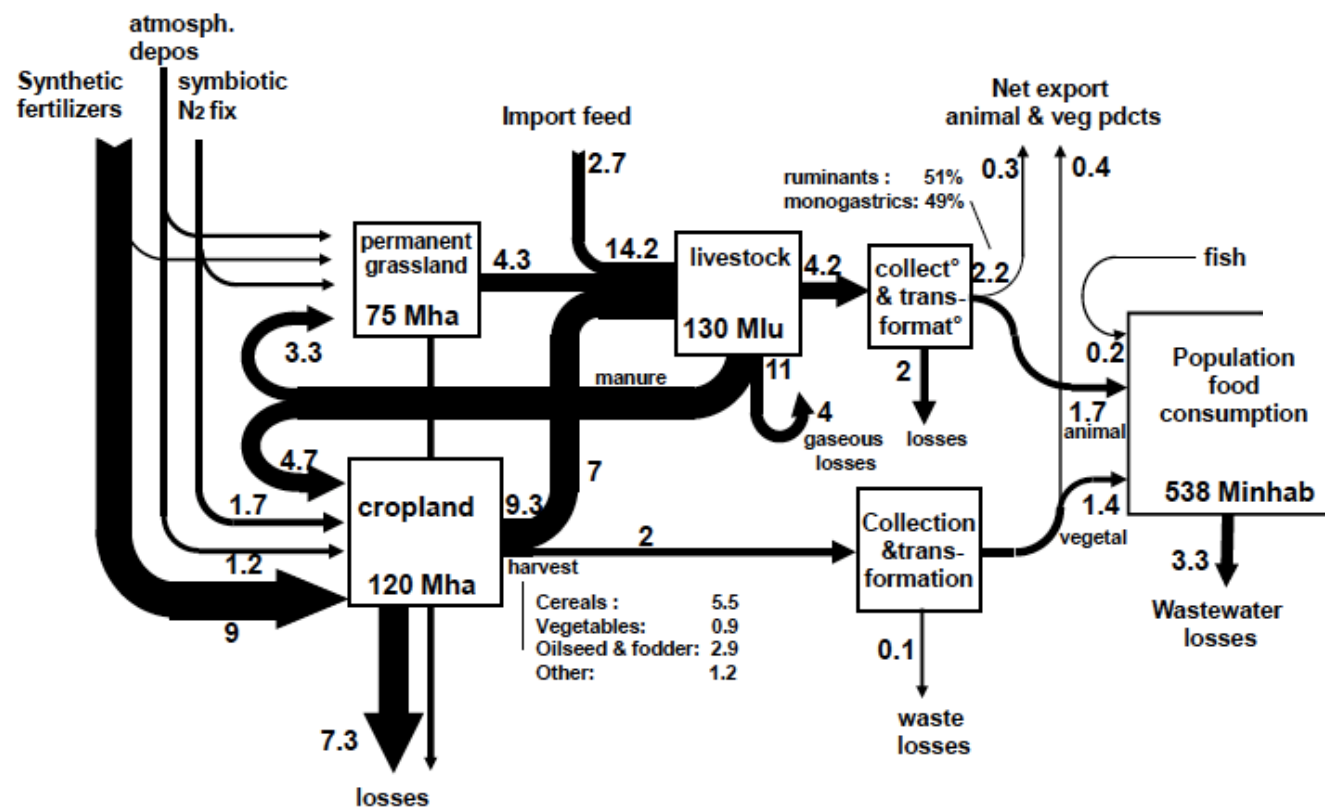




# Appendix

# Europe, 2009-2013

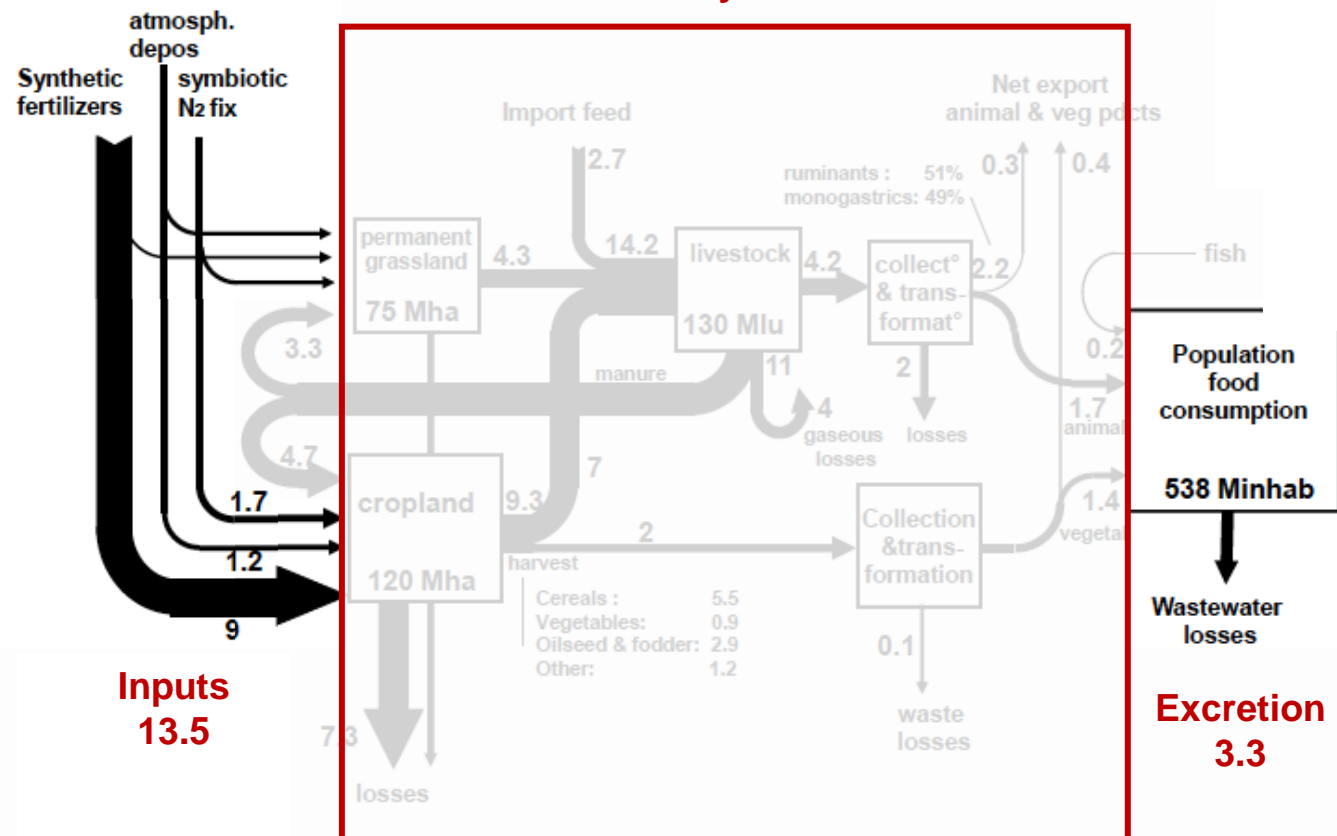
TgN/yr



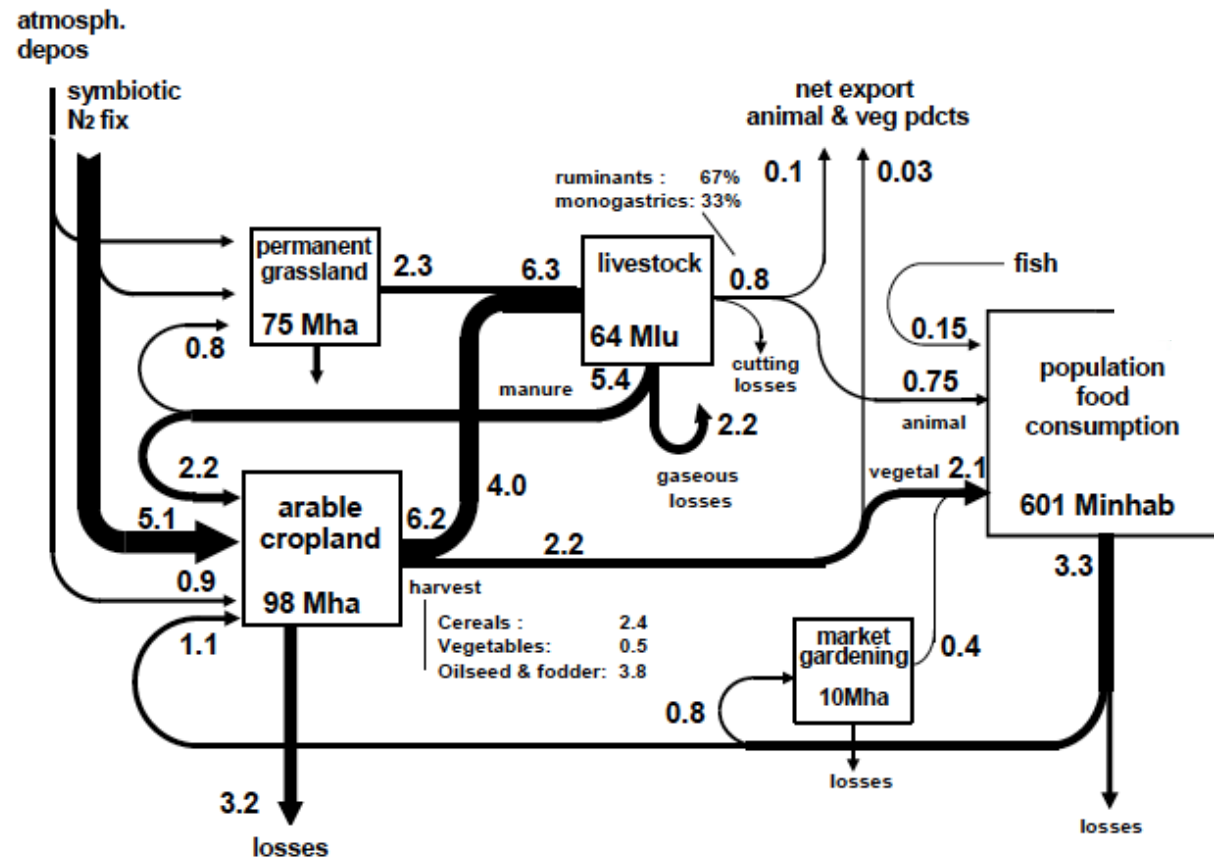
# Europe, 2009-2013

TgN/yr

## Food System



## Europe, agro-ecological scenario2050 TgN/yr



# Europe, agro-ecological scenario2050 TgN/yr

