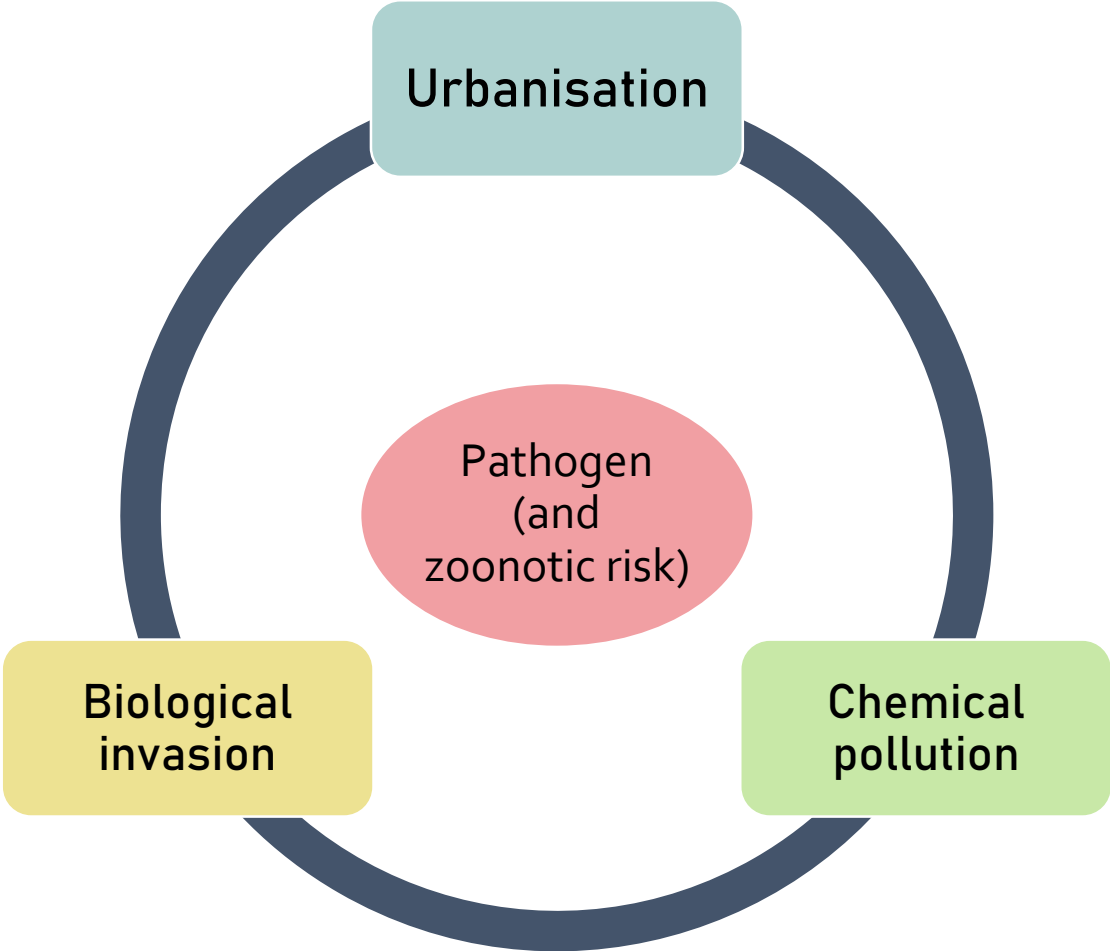


# Pollution, parasitism and health of socio-ecosystems: the rodent-helminth pathosystem as a study system in Senegal

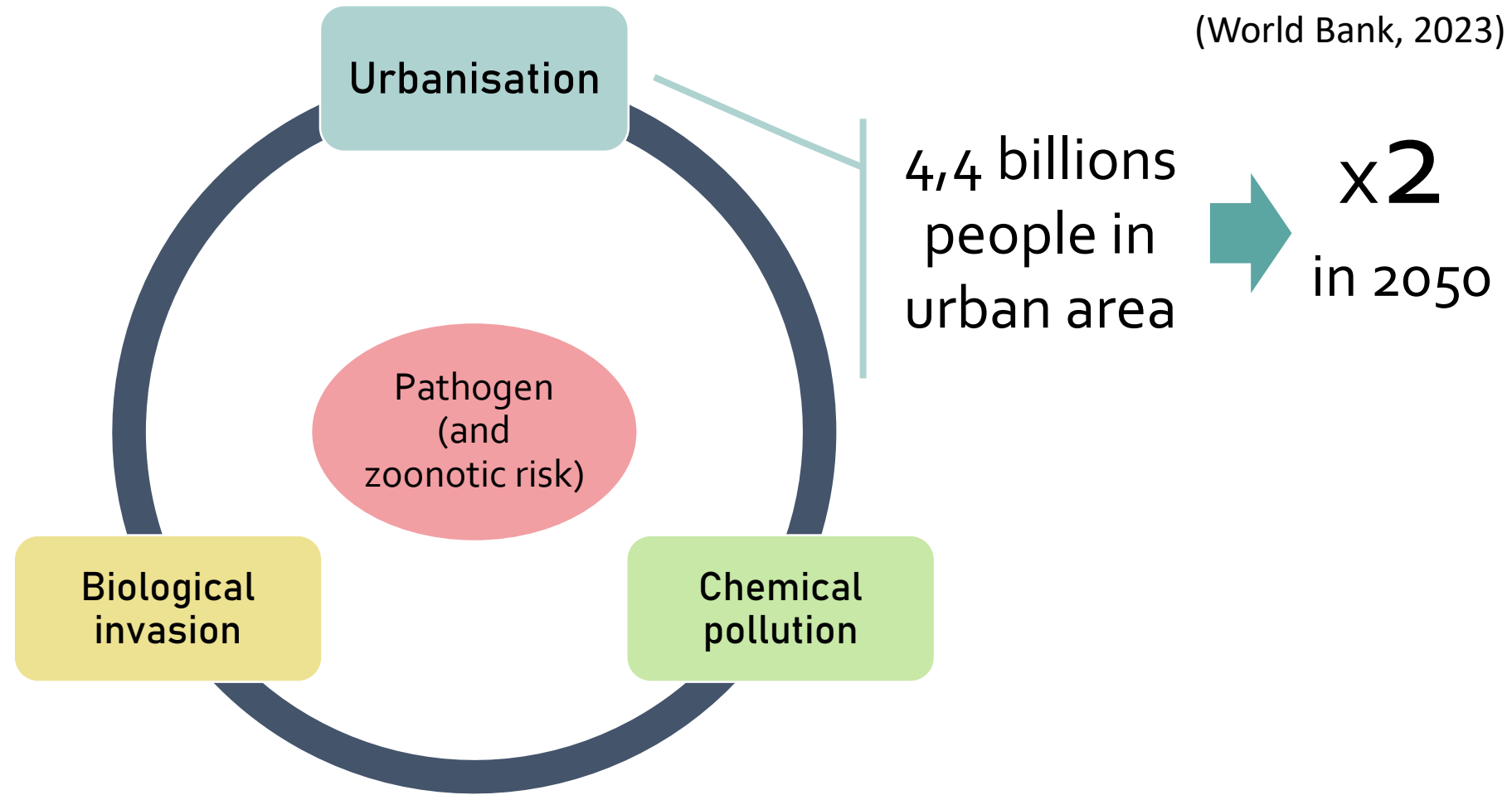
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Romane LUX – M2 internship  
Supervisor: Christophe DIAGNE

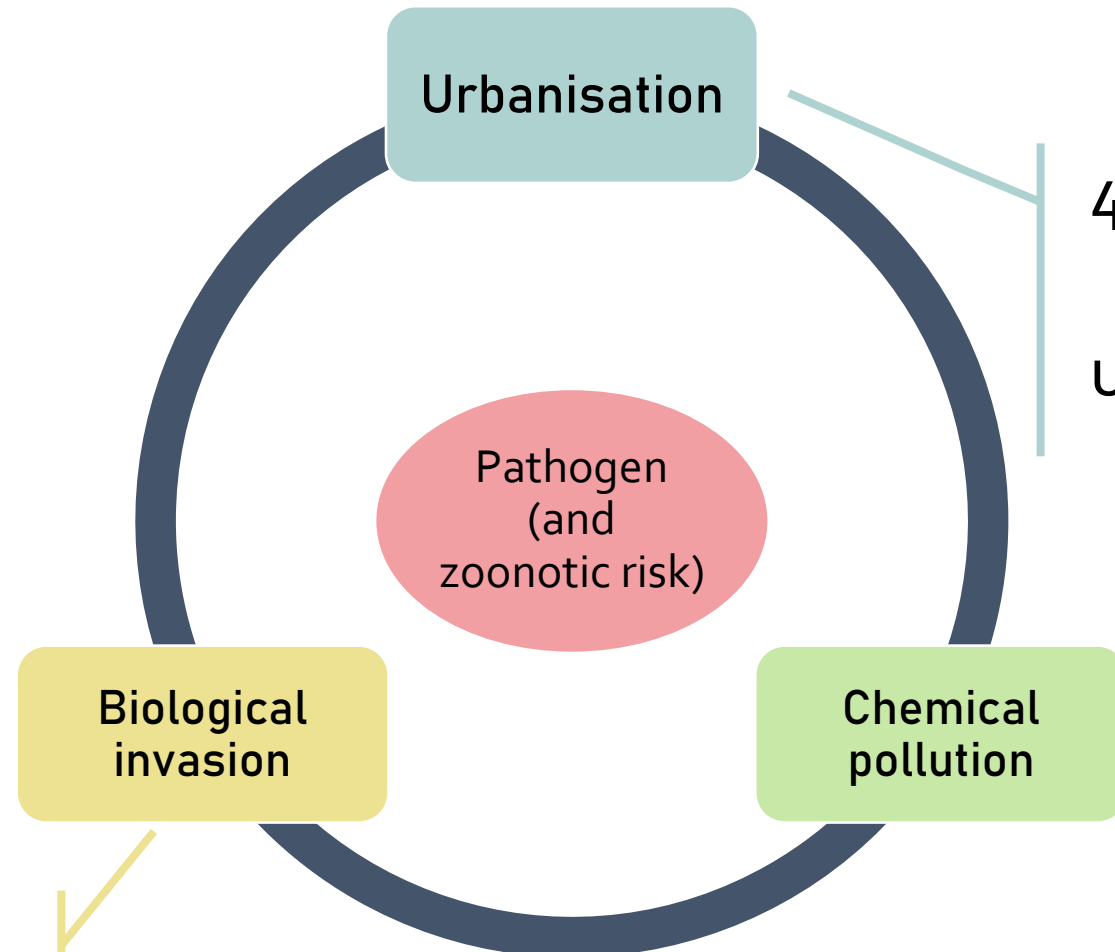
# Context



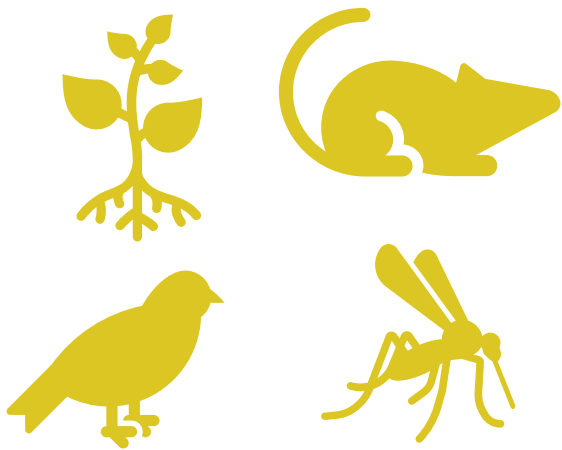
# Context



# Context



4,4 billions people in urban area → x2 in 2050



# Context

Urbanisation

4,4 billions  
people in  
urban area

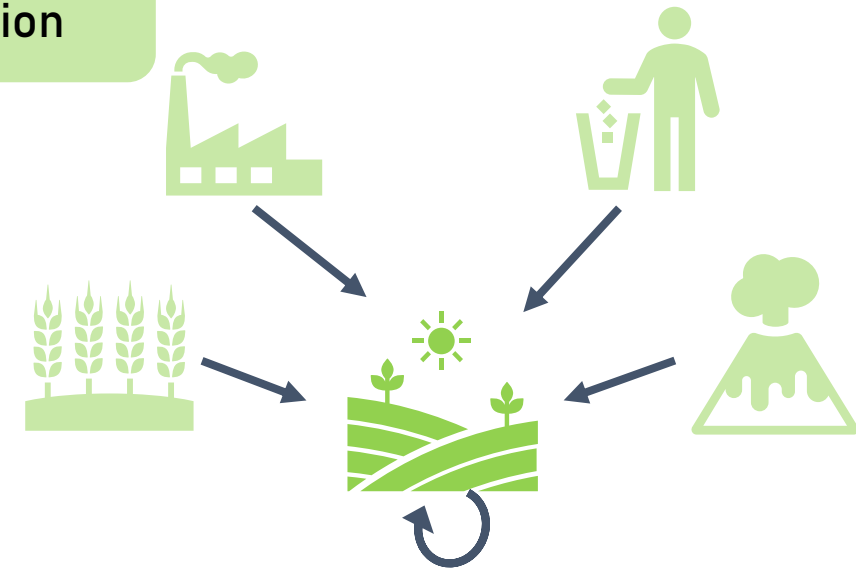
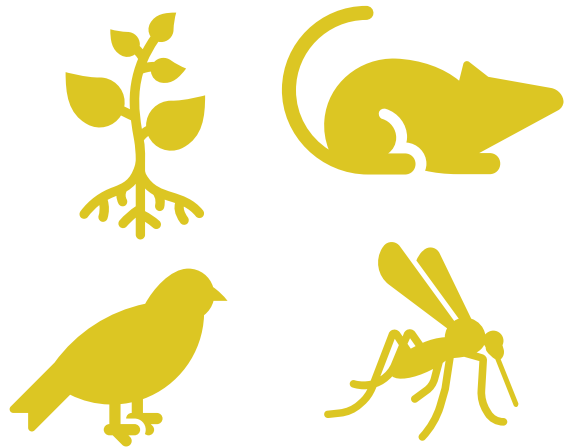


x2  
in 2050

Pathogen  
(and  
zoonotic risk)

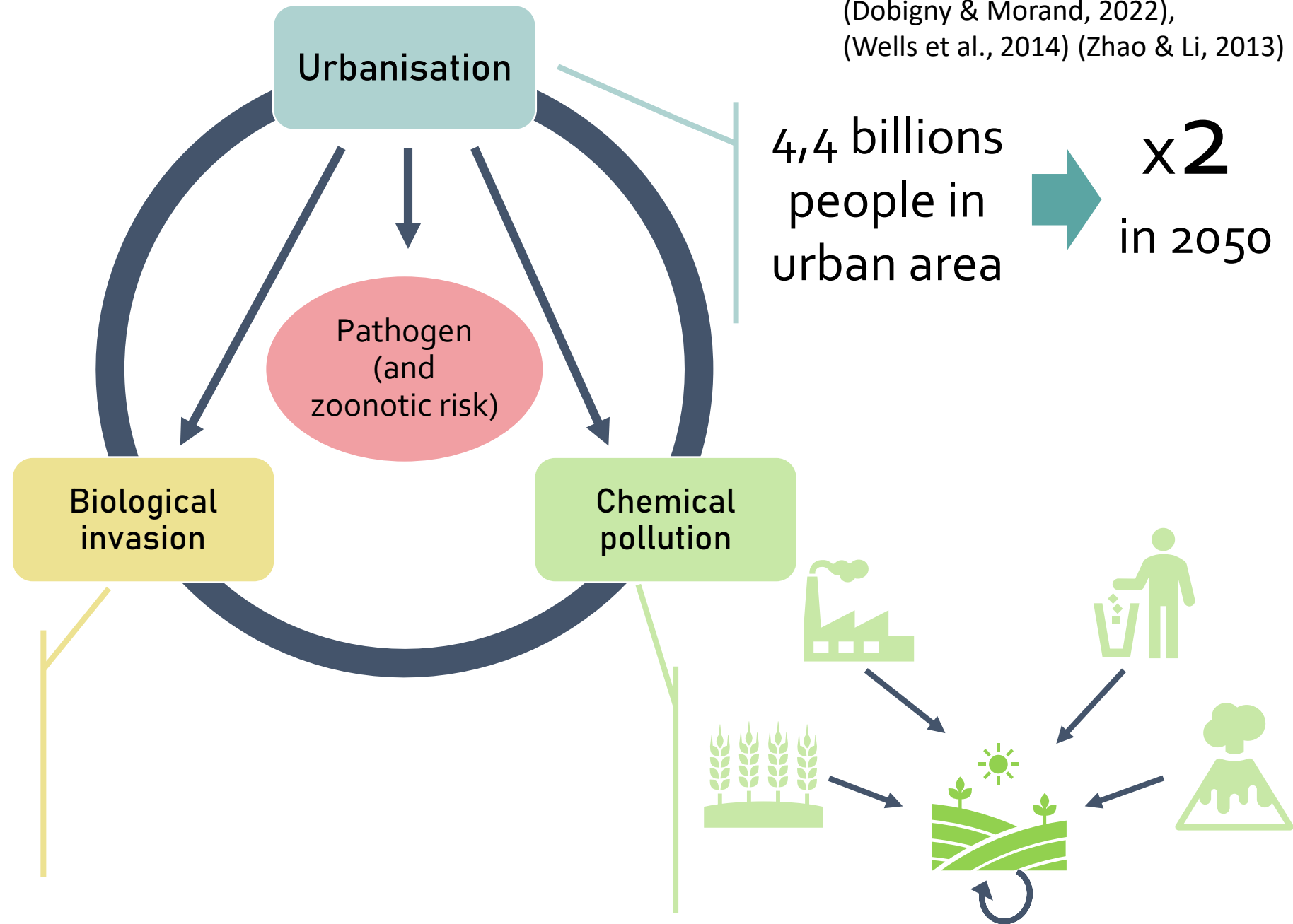
Biological  
invasion

Chemical  
pollution

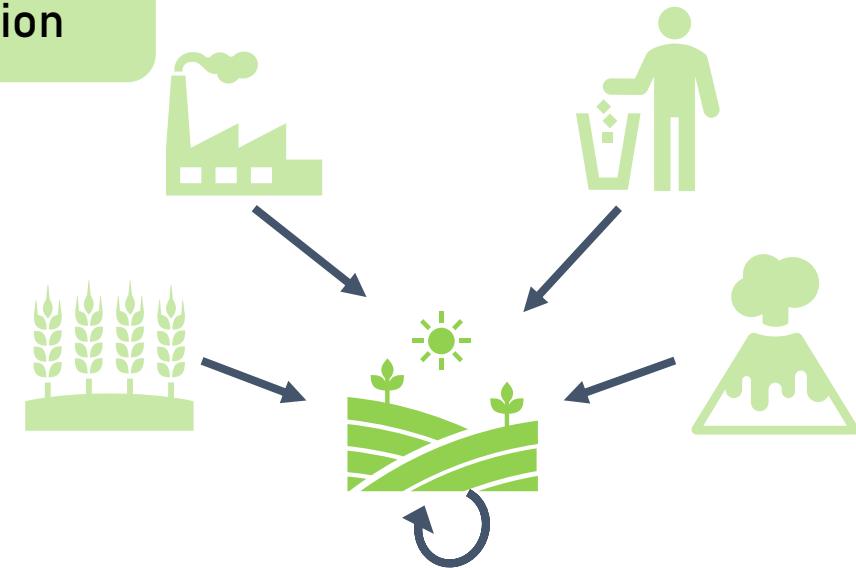
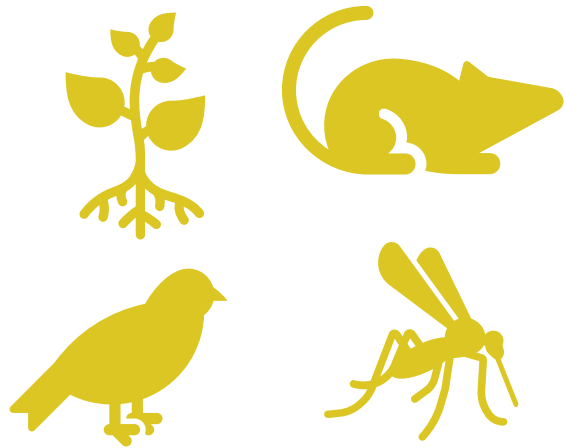
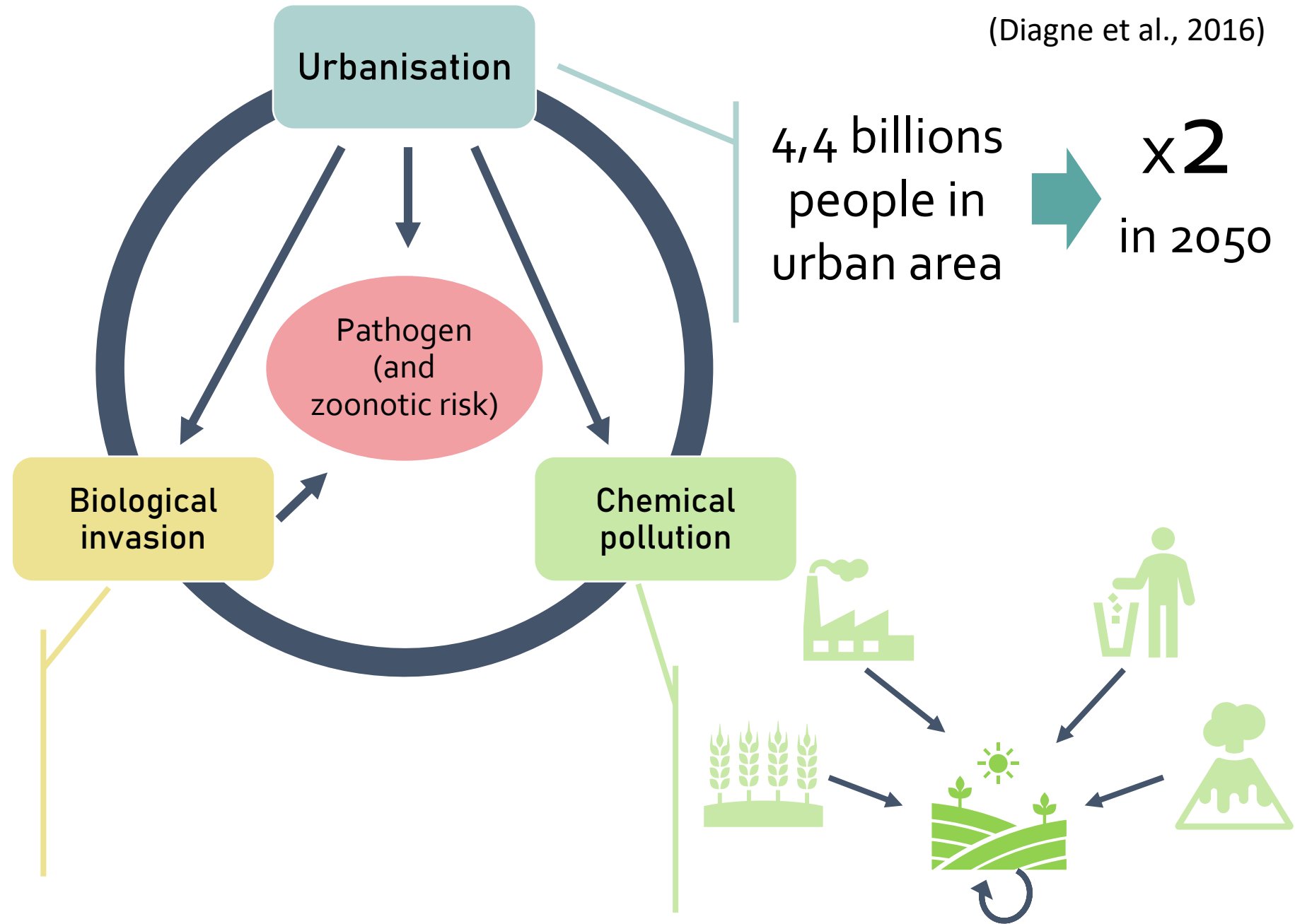


(Dobigny & Morand, 2022),  
(Wells et al., 2014) (Zhao & Li, 2013)

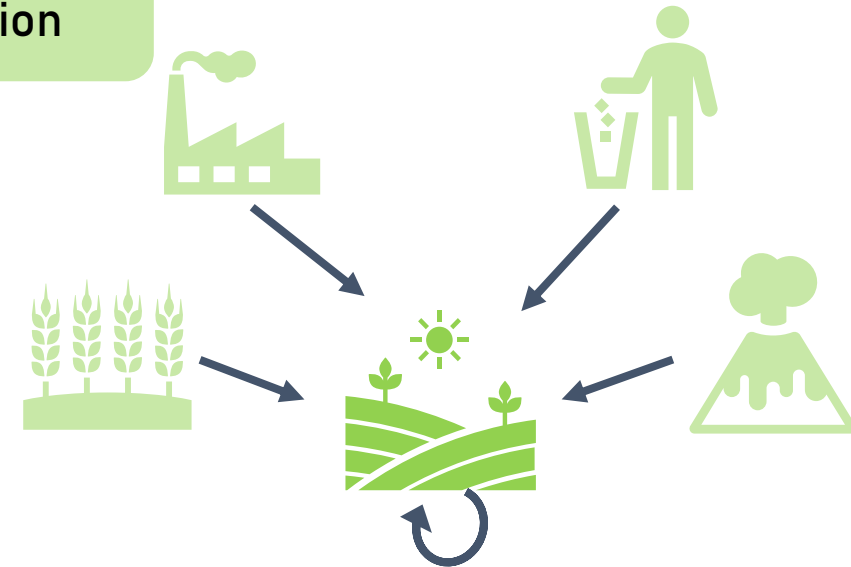
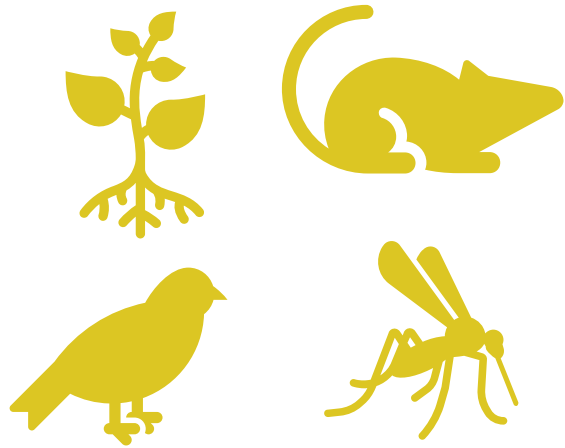
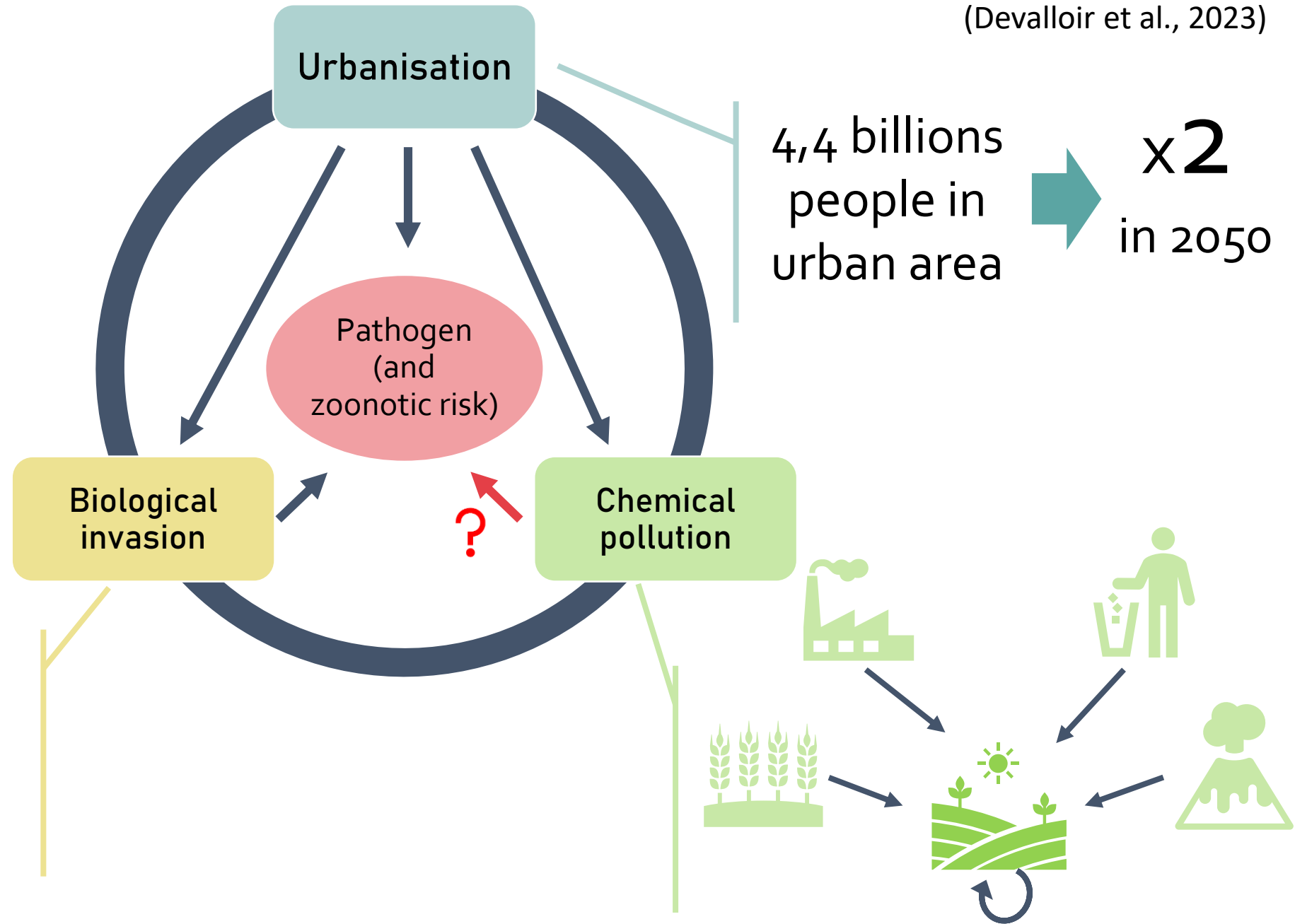
# Context



# Context



# Context





# Context

Helminths

*Mus Musculus  
Domesticus*



(Dalecky et al., 2015)

Urbanisation

Senegal  
(Dakar and rural villages)

(ANSD, 2018)

Pathogen  
(and  
zoonotic risk)

Biological  
invasion

Chemical  
pollution

27 mineral elements

# Research question and objectives

What is the link between helminth communities and mineral elements in *Mus musculus domesticus* in the context of urbanisation?

Patterns of contamination by mineral elements

Patterns of (co)infections by helminth taxa

between an urban and a rural area

within an urban area

1

Identification of helminth assemblages

2

Measurement of mineral elements

3

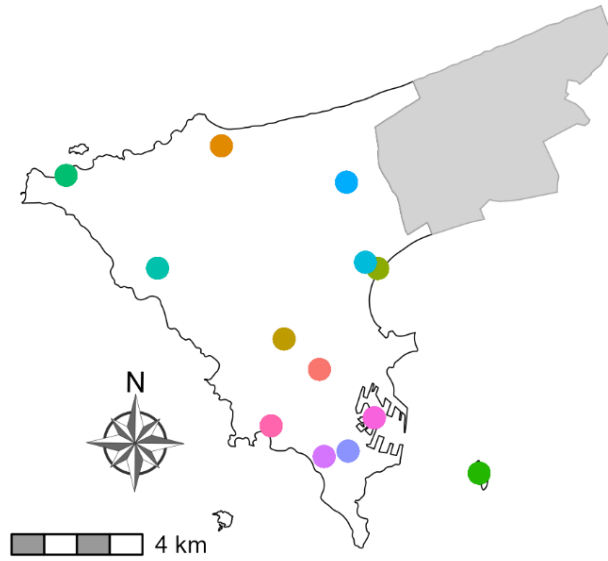
Statistical analyses

# Samples' origin and selection



## localite

- Colobane
- Dakar-Yoff
- Grand Dakar
- Hann Pêcheur
- Ile de Gorée
- Ngor
- Ouakam
- Parc Hann-Zoo
- Patte d'Oie
- Plateau-Faidherbe
- Plateau-Rebeuss
- Port
- Soubédioune - Gueule Tapée



2016

(Stragier 2022)

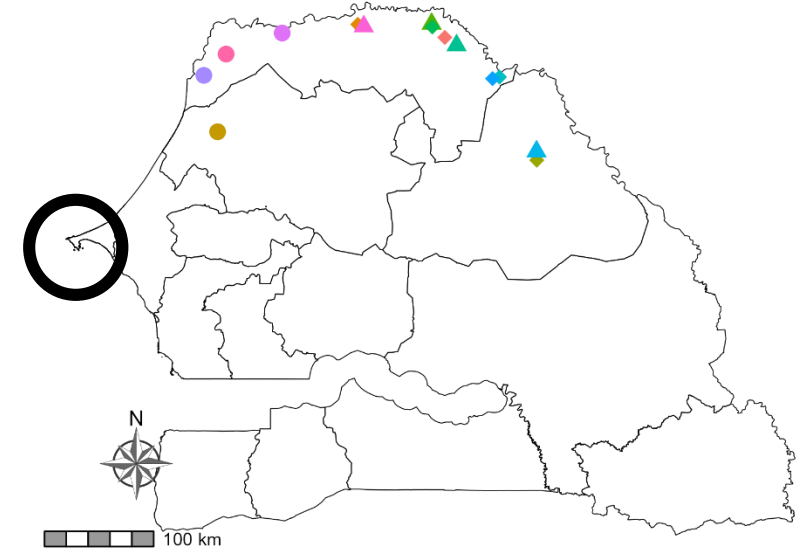
Dakar Mission – Claire Stragier

## Locality

- Aere Lao
- Croisement Boube
- Dagathie
- Dendoudi
- Diomandou Walo
- Dodel
- Doumnga Lao
- Galoya
- Lambago
- Lougue
- Mbakhana
- Ndombo
- Thiewle
- Thilene

## Statut

- AE
- ▲ NE
- ◆ RE

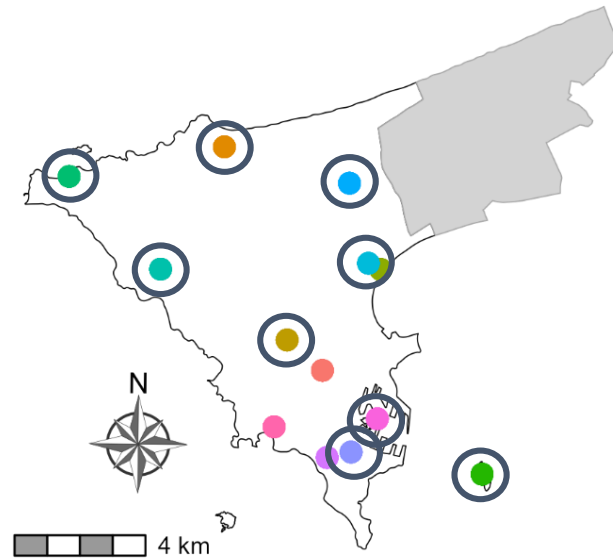


2013

ANR ENEMI

# Samples' origin and selection

- localite
- Colobane
  - ➔ Dakar-Yoff
  - ➔ Grand Dakar
  - Hann Pêcheur
  - ➔ Ile de Gorée
  - ➔ Ngor
  - ➔ Ouakam
  - ➔ Parc Hann-Zoo
  - ➔ Patte d'Oie
  - ➔ Plateau-Faidherbe
  - Plateau-Rebeuss
  - ➔ Port
  - Soubédioune - Gueule Tapée



2016

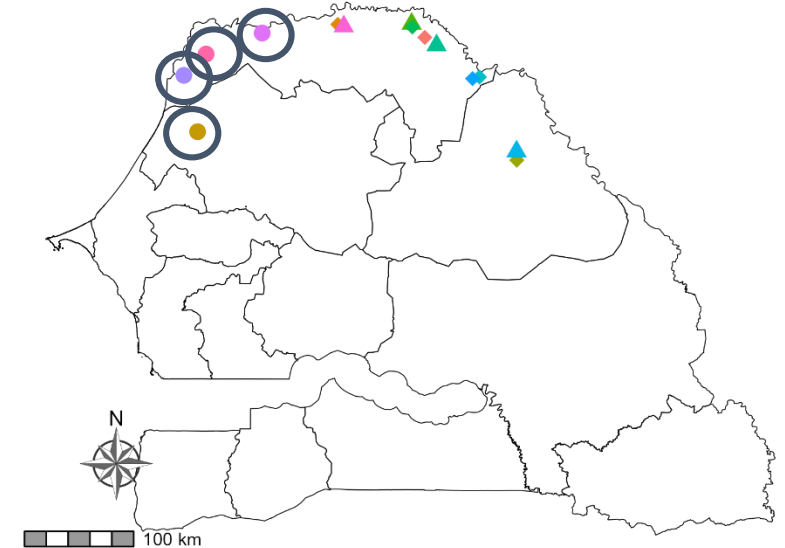
(Stragier 2022)

## Locality

- Aere Lao
- Croisement Boube
- Dagathie
- Dendoudi
- Diomandou Walo
- Dodel
- Doumnga Lao
- Galoya
- Lambago
- Lougue
- Mbakhana
- Ndombo
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- Thilene

## Statut

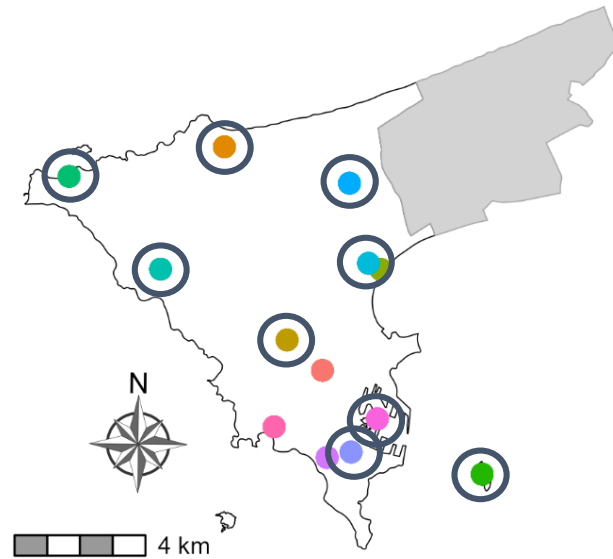
- AE
- ▲ NE
- ◆ RE



2013

# Samples' origin and selection

- localite
- Colobane
  - ➔ ● Dakar-Yoff
  - ➔ ● Grand Dakar
  - Hann Pêcheur
  - ➔ ● Ile de Gorée
  - ➔ ● Ngor
  - ➔ ● Ouakam
  - ➔ ● Parc Hann-Zoo
  - ➔ ● Patte d'Oie
  - ➔ ● Plateau-Faidherbe
  - Plateau-Rebeuss
  - ➔ ● Port
  - Soubédioune - Gueule Tapée

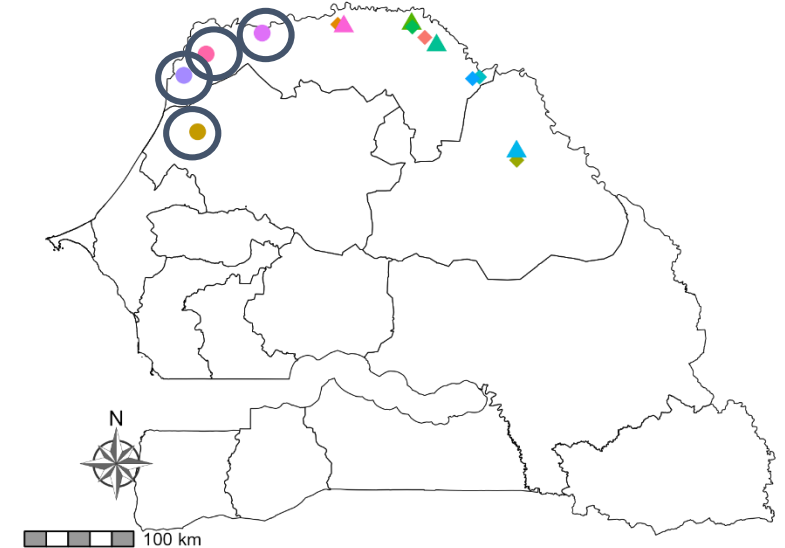


## Locality

- Aere Lao
- Croisement Boube
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- Dodel
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- Lougue
- Mbakhana
- Ndombo
- Thiewle
- Thilene

## Statut

- AE
- ▲ NE
- ◆ RE

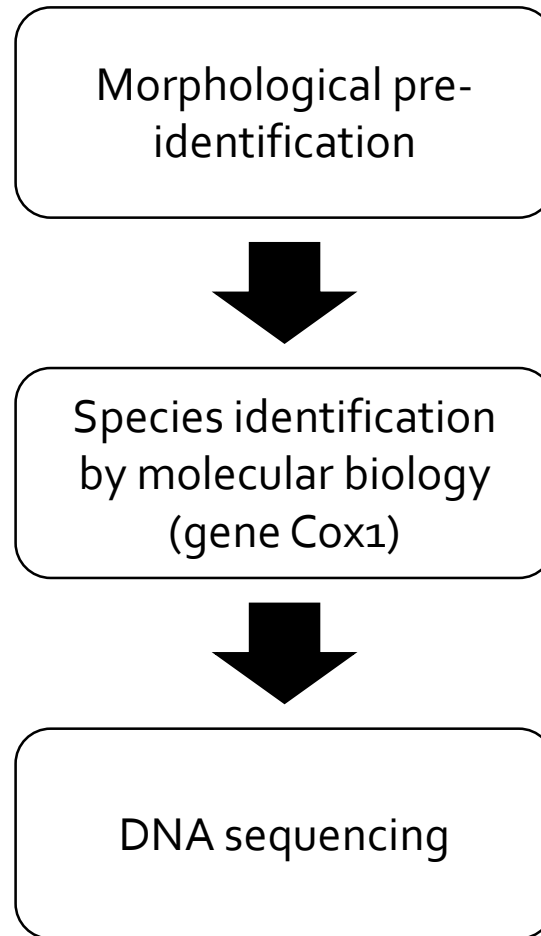
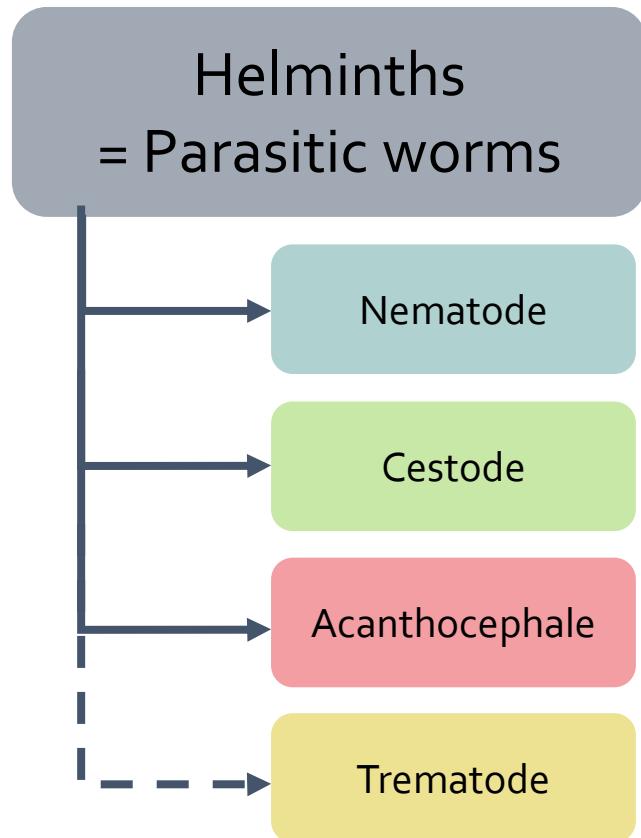


Data filtering steps

169 rodents

53 rodents

# Helminths



|       | Not infected | Infected | Total |
|-------|--------------|----------|-------|
| Urban | 138          | 31       | 169   |
| Rural | 37           | 16       | 53    |
| Total | 175          | 47       | 222   |

7 rodents with co-infections

- **4 nematodes** (*Aspiculuris tetraptera*, *Syphacia obvelata*, *Anatrichosoma sp.*, *Pterygodermatites senegalensis*)
- **3 cestodes** (*Hymenolepis microstoma*, *Hydatigera taeniaeformis*, *Mathevotaenia symmetrica*)

# Which mineral elements?

Heavy metals,  
Metal elements,  
Trace metals...

|           | Essential   | Possibly essential | Non-essential  | Unknown        |
|-----------|---|--------------------|----------------|----------------|
| Metal     | <b>Ca</b><br>Co<br>Cr<br>Cu<br>Fe<br><b>K</b><br><b>Mg</b><br>Mn<br>Mo<br><b>Na</b><br>Zn | Al<br>Ni<br>Sn     | Cd<br>Hg<br>Pb | Sr<br>Ti<br>Tl |
| Metalloid |   | Si                 | As<br>Sb       | B              |
| Nonmetal  | <u>P</u><br><u>S</u><br>Se  |                    |                |                |

Aa : Major element  
Aa : Minor or trace element

Pollution

# Which mineral elements?

Heavy metals,  
Metal elements,  
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|           | Essential   | Possibly essential | Non-essential  | Unknown        |
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| Metal     | <u>Ca</u><br>Co<br>Cr<br>Cu<br>Fe<br><u>K</u><br><u>Mg</u><br>Mn<br>Mo<br><u>Na</u><br>Zn | Al<br>Ni<br>Sn     | Cd<br>Hg<br>Pb | Sr<br>Ti<br>Tl |
| Metalloid |   | Si                 | As<br>Sb       | B              |
| Nonmetal  | <u>P</u><br><u>S</u><br>Se  |                    |                |                |

Aa : Major element  
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Pollution



# Which mineral elements?

Heavy metals,  
Metal elements,  
Trace metals...

|           | Essential   | Possibly essential | Non-essential  | Unknown        |
|-----------|---|--------------------|----------------|----------------|
| Metal     | <b>Ca</b><br>Co<br>Cr<br>Cu<br>Fe<br><b>K</b><br><b>Mg</b><br>Mn<br>Mo<br><b>Na</b><br>Zn | Al<br>Ni<br>Sn     | Cd<br>Hg<br>Pb | Sr<br>Ti<br>Tl |
| Metalloid |   | Si                 | As<br>Sb       | B              |
| Nonmetal  | <u>P</u><br><u>S</u><br>Se  |                    |                |                |

Aa : Major element  
Aa : Minor or trace element

Pollution

# Which mineral elements?

Heavy metals,  
Metal elements,  
Trace metals...

|           | Essential   | Possibly essential            | Non-essential                 | Unknown                       |
|-----------|---|-------------------------------|-------------------------------|-------------------------------|
| Metal     | <p><u>Ca</u> Fe Mo</p> <p>Co <u>K</u> <u>Na</u></p> <p>Cr <u>Mg</u> Zn</p> <p>Cu Mn</p> | <p>Al</p> <p>Ni</p> <p>Sn</p> | <p>Cd</p> <p>Hg</p> <p>Pb</p> | <p>Sr</p> <p>Ti</p> <p>Tl</p> |
| Metalloid |   | <p>Si</p>                     | <p>As</p> <p>Sb</p>           | <p>B</p>                      |
| Nonmetal  | <p><u>P</u></p> <p><u>S</u></p> <p>Se</p>   |                               |                               |                               |

Aa : Major element  
Aa : Minor or trace element

Pollution

# How to measure mineral elements?



Liver stored in alcohol



Lyophilisation (and weighing)



Digestion with nitric acid



Ultrapure water addition and filtration



Measurement



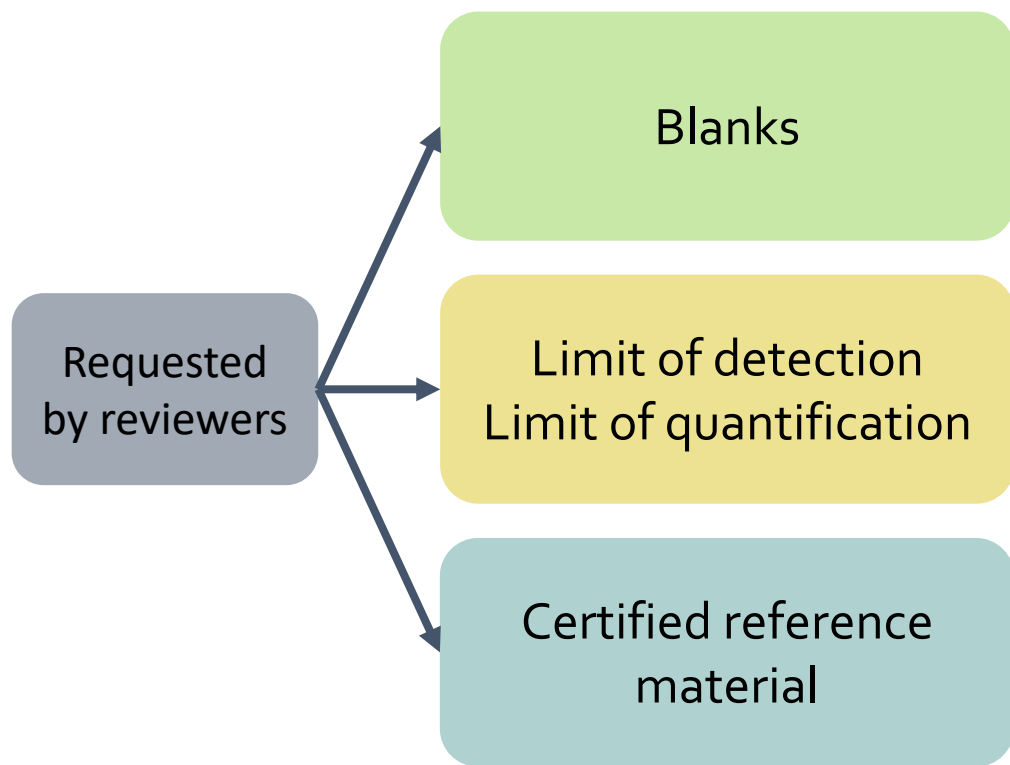
UMR Chrono-environnement (Besançon)  
→ Renaud Scheifler (Pr., Univ Franche-Comté)  
→ 4 weeks in March/April 2024

## Two methods :

- **AES (optical)**: can measure highly concentrated elements (Na, K, Ca...)
- **MS (spectrometry)**: can measure trace elements (Pb, Fe...)

Pollution

# Metrology

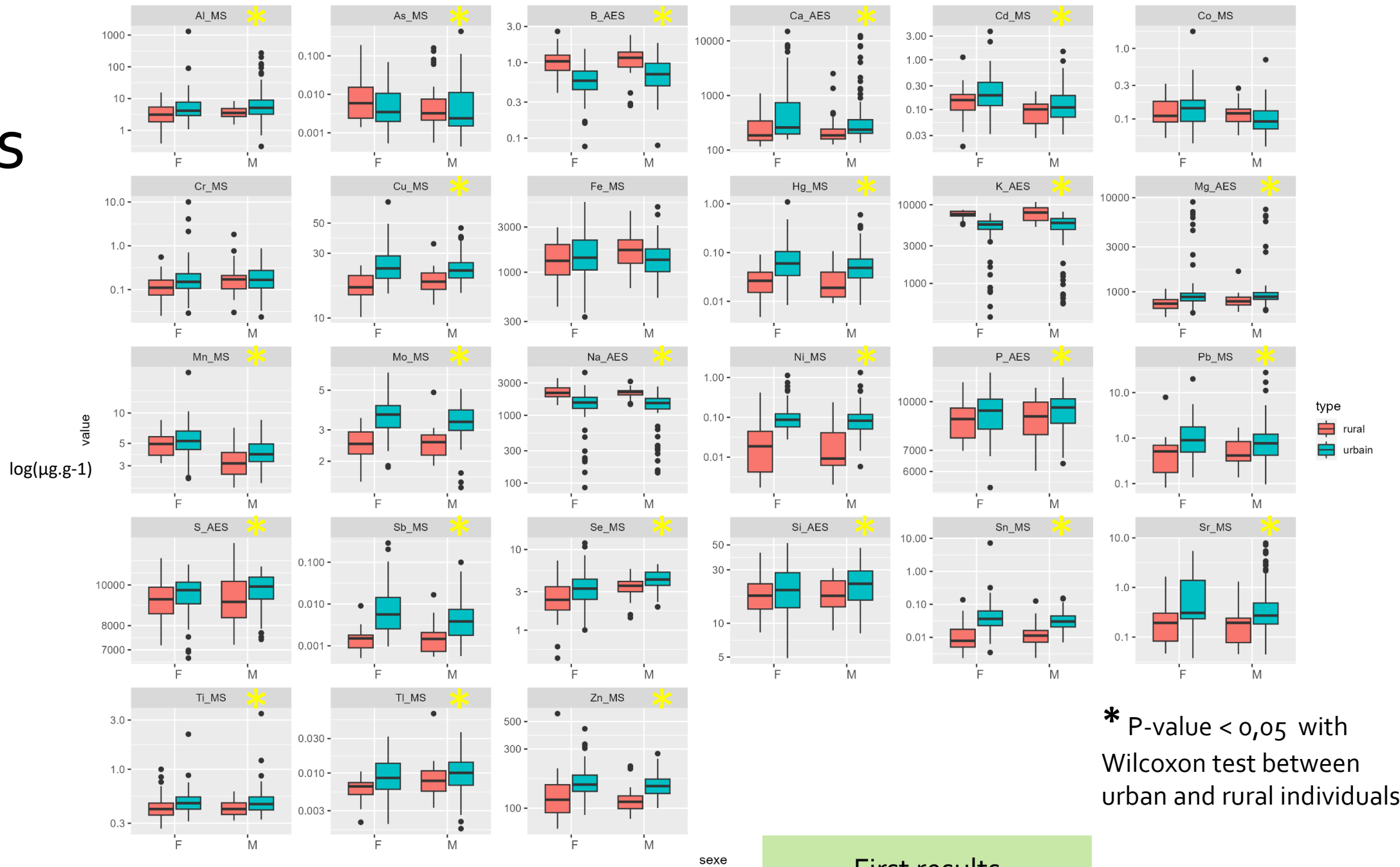


Conservation in alcohol

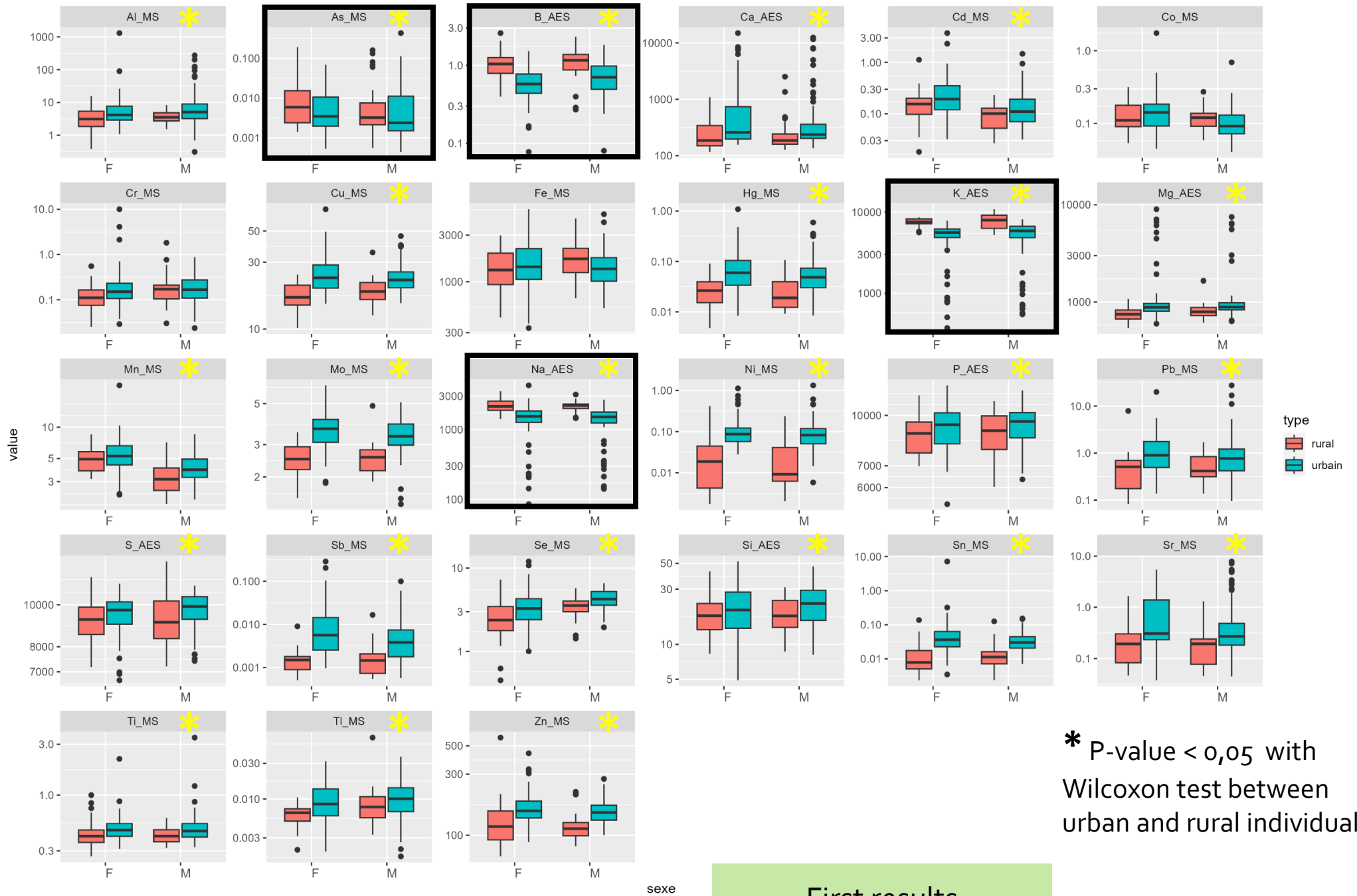
Conservation with  
kidney

Pollution

# First results

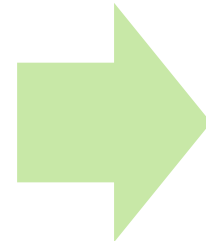
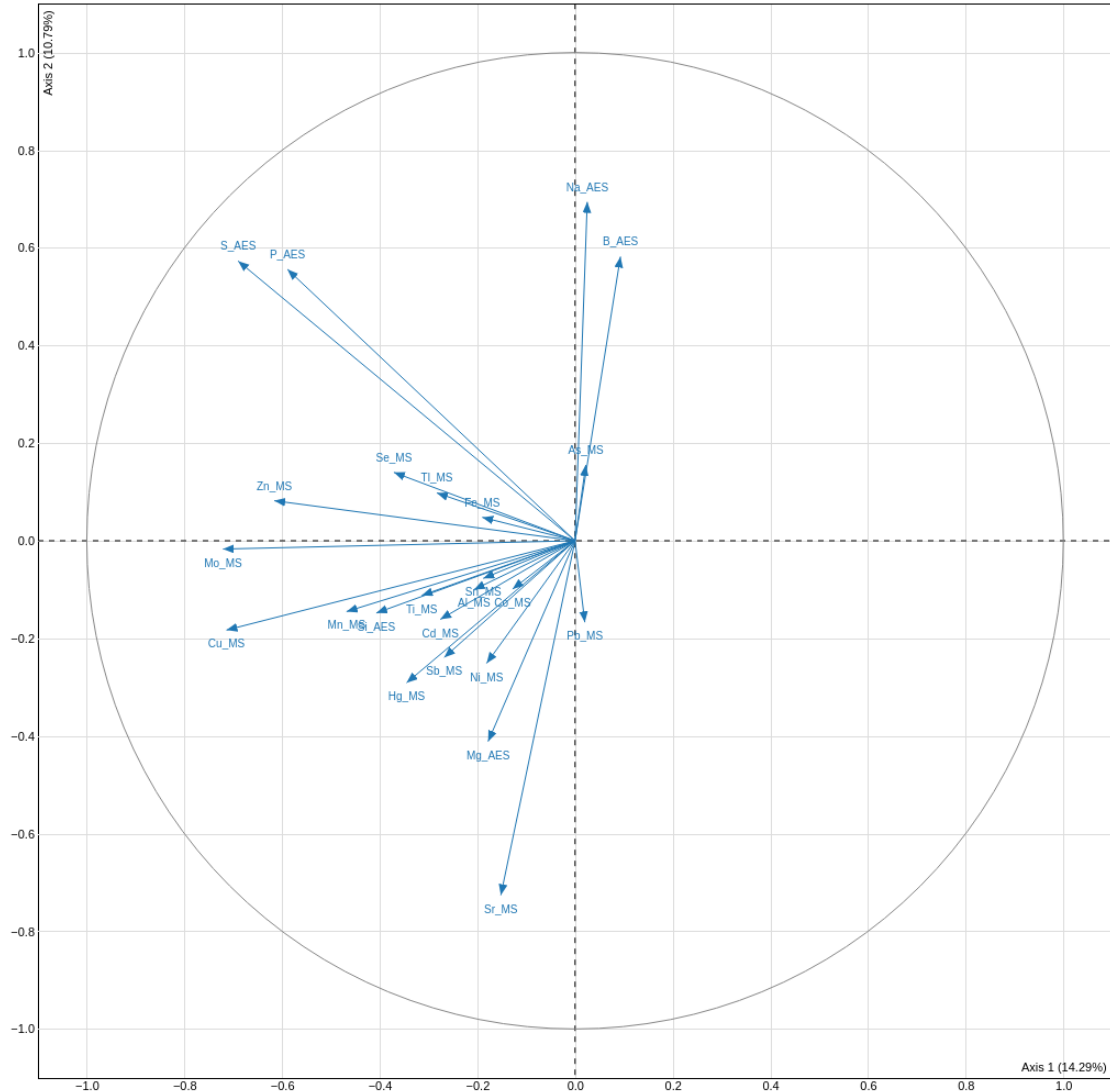


# First results



First results

# First results: ACP



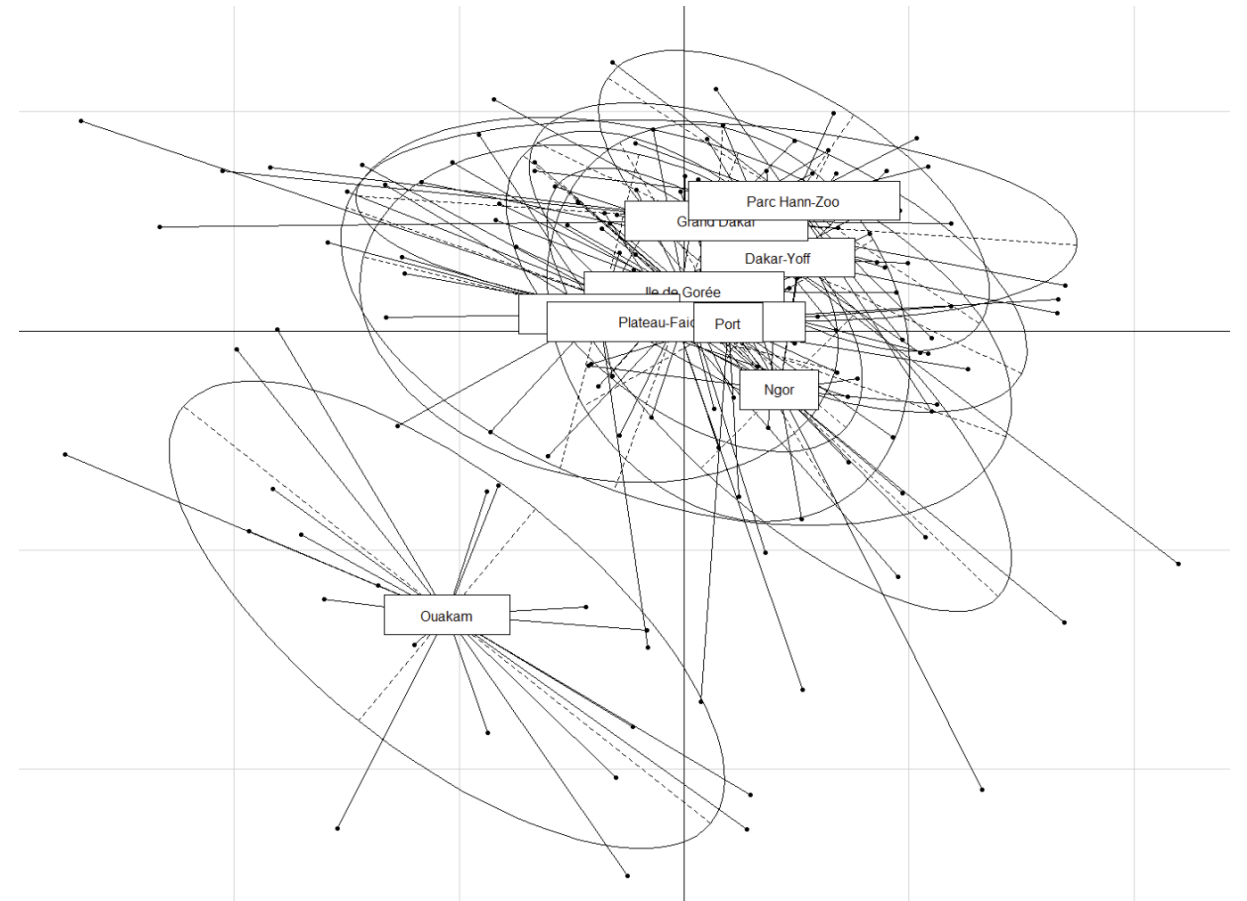
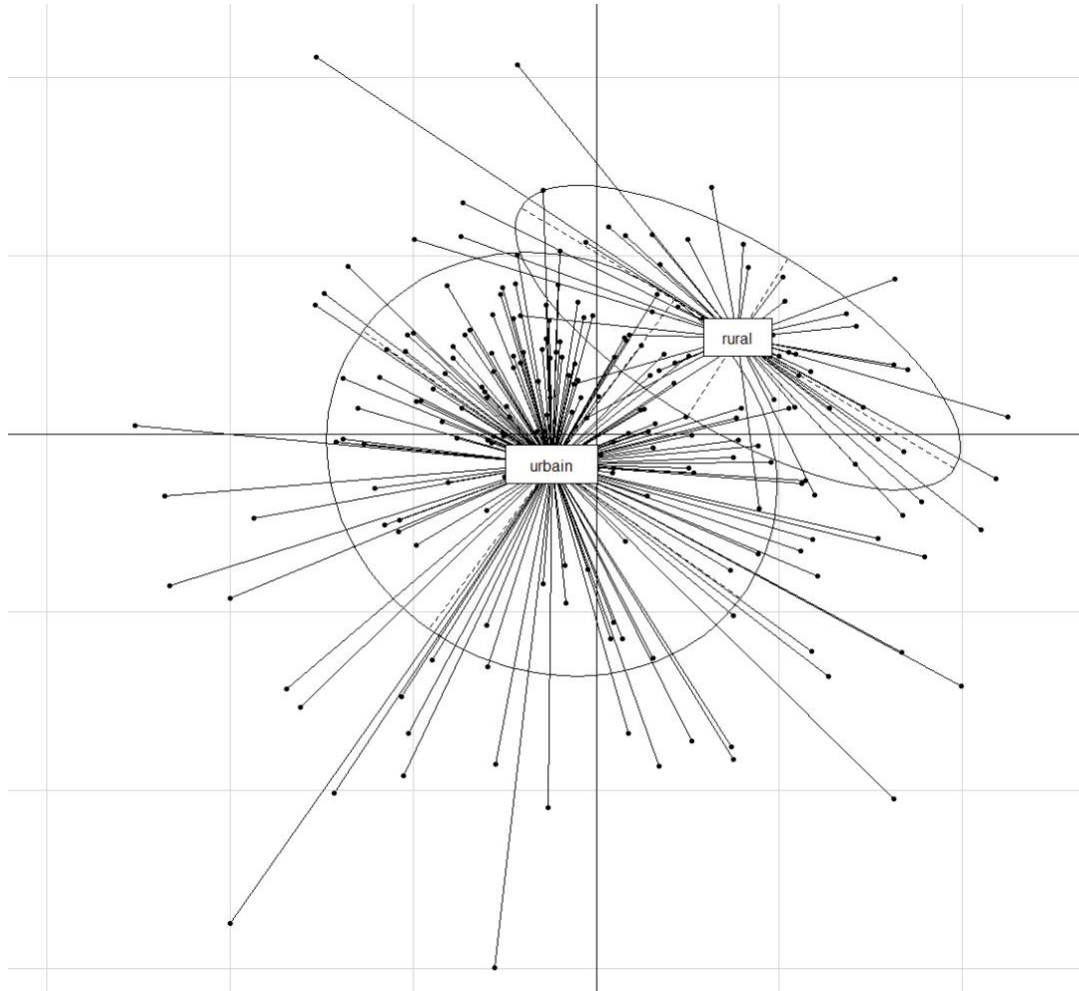
No structuration observed following the classification of mineral elements

For next analyses: keep each element as an independant variable  
Interaction between elements (protective effect, cocktail effect?)

One outlier removed and 3 correlated elements (Cr, Ca, K)

First results

# First results: ACP



Only Dakar localities



# Next steps

Discuss about ACP with the UMR Chrono-environnement

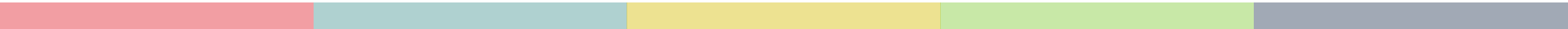
Start GLM

Analysis, discussion and redaction

Add bacteria data?

What next?

Thank you for  
your attention!



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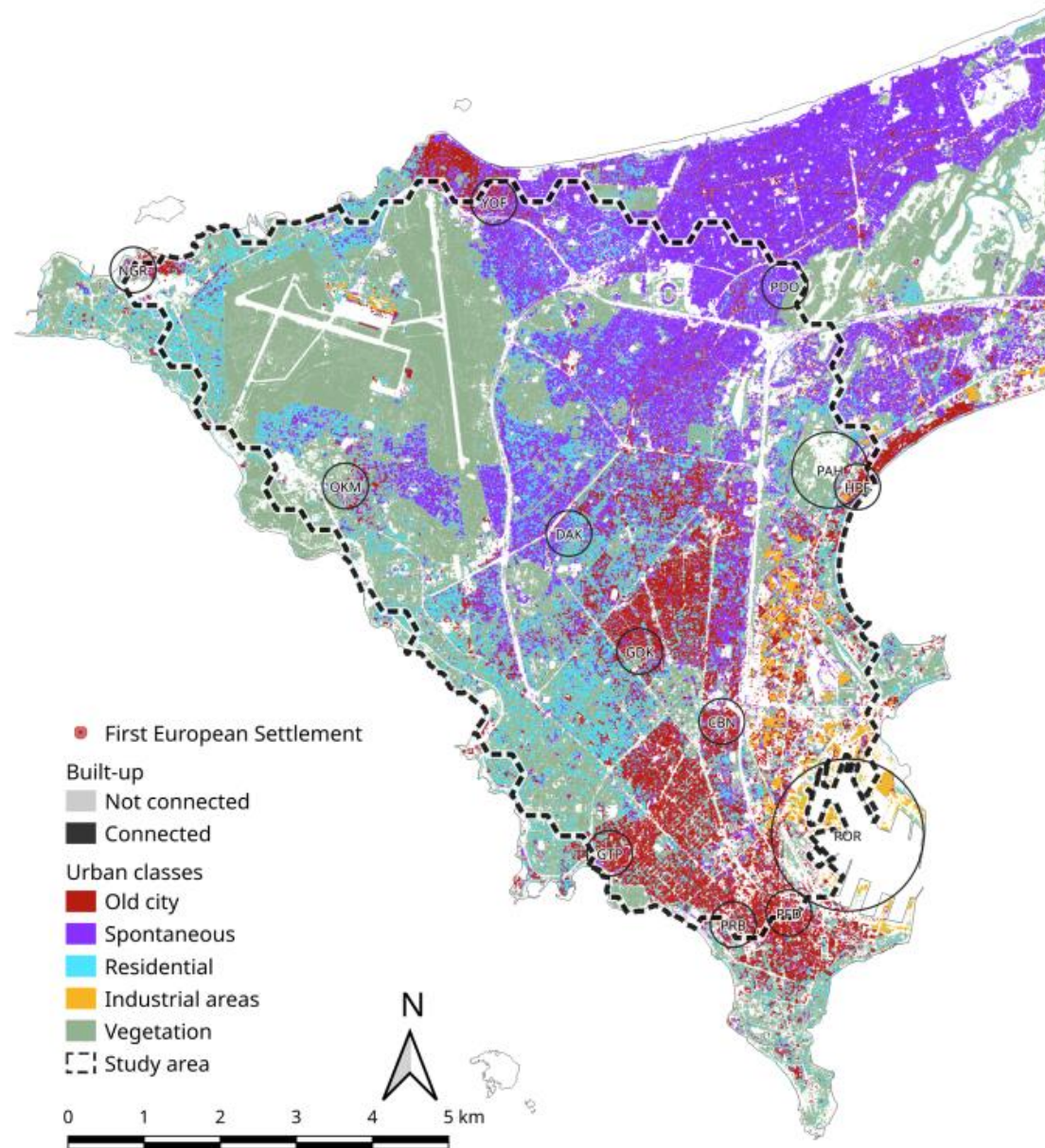
Stragier, C., Piry, S., Loiseau, A., Kane, M., Sow, A., Niang, Y., Diallo, M., Ndiaye, A., Gauthier, P., Borderon, M., Granjon, L., Brouat, C., & Berthier, K. (2022). Interplay between historical and current features of the cityscape in shaping the genetic structure of the house mouse (*Mus musculus domesticus*) in Dakar (Senegal, West Africa). *Peer Community Journal*, 2. <https://doi.org/10.24072/pcjournal.85>

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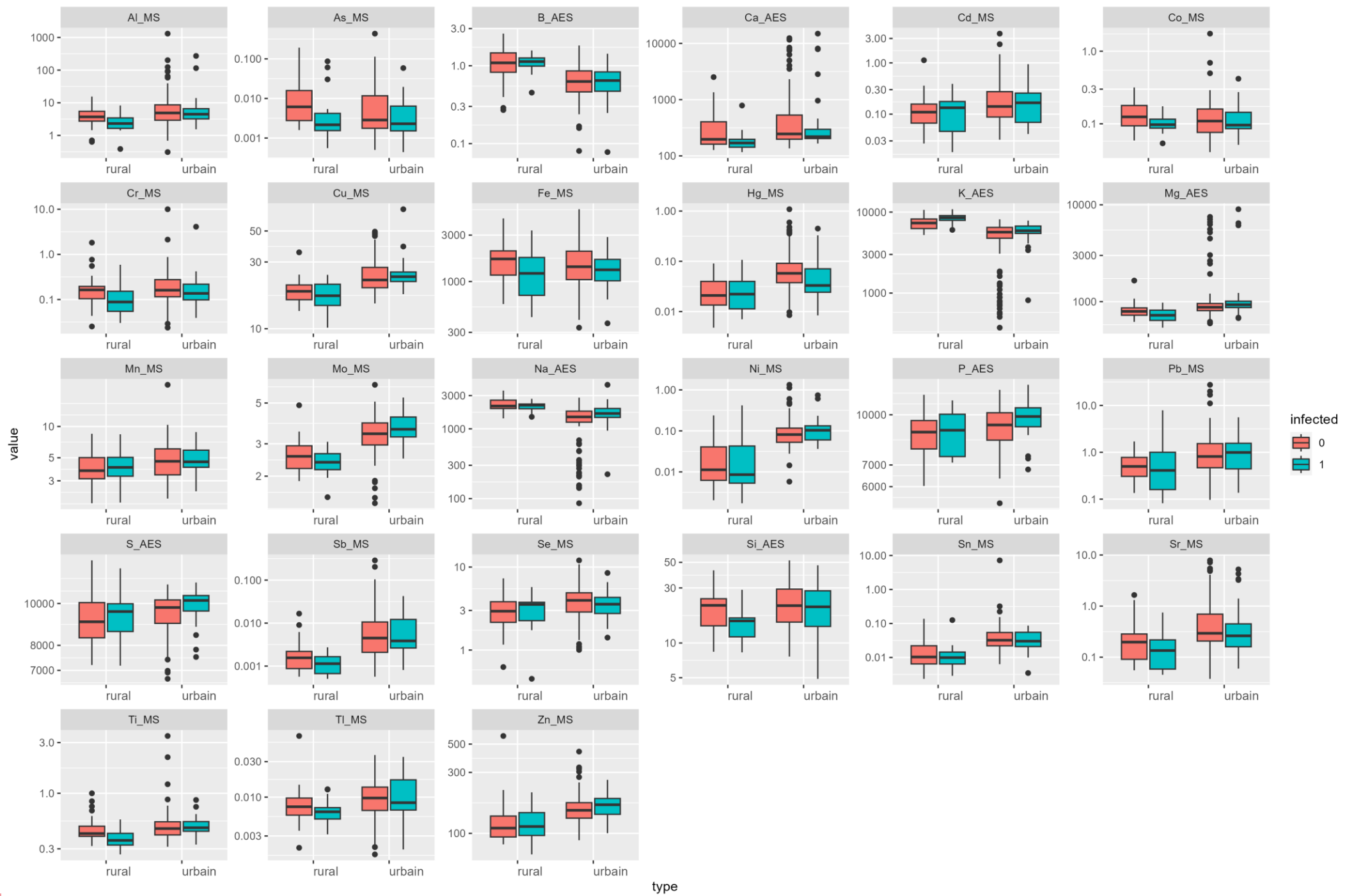
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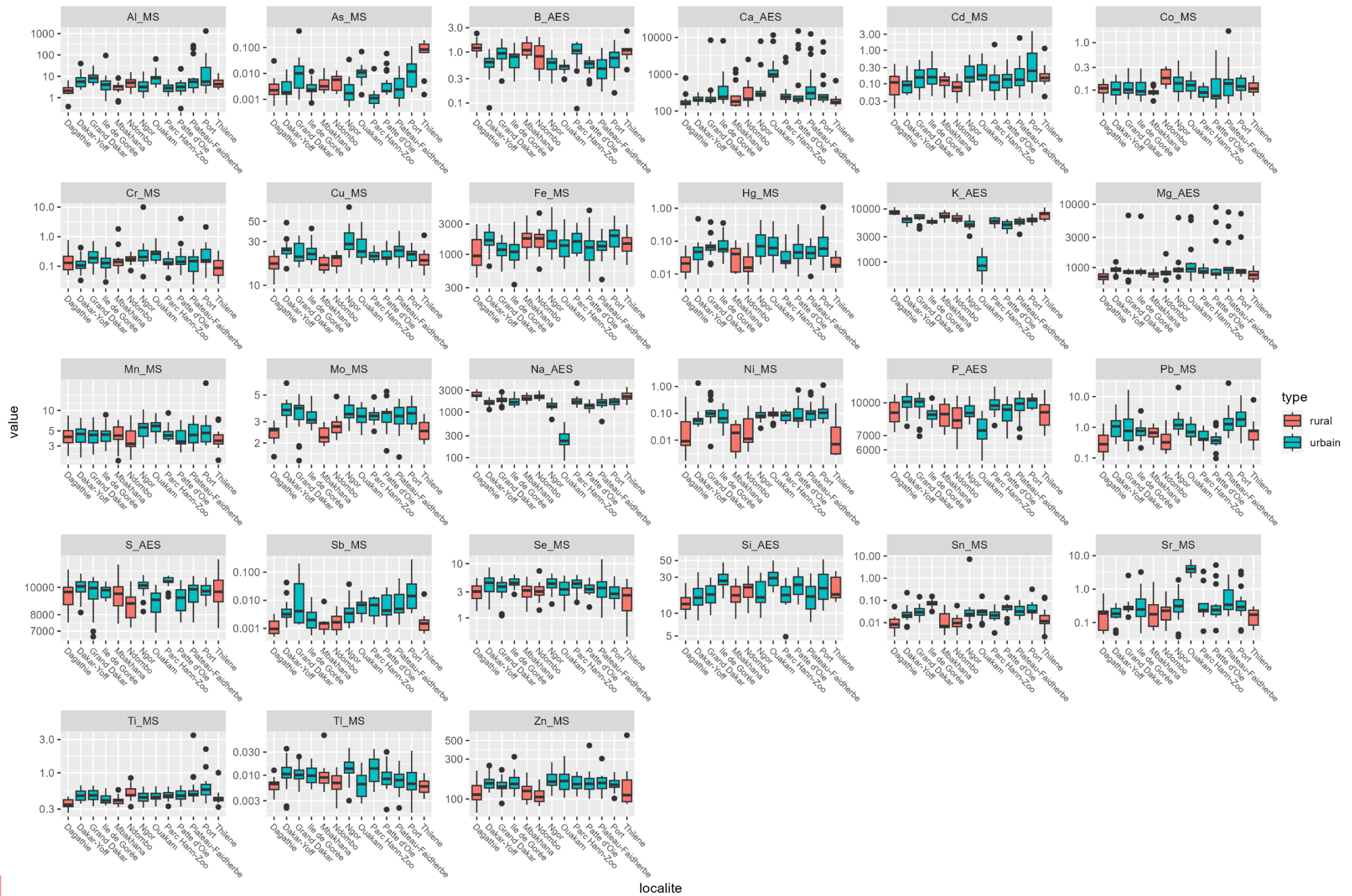
Zhao, H., & Li, X. (2013). Risk assessment of metals in road-deposited sediment along an urban–rural gradient. *Environmental Pollution*, 174, 297–304. <https://doi.org/10.1016/j.envpol.2012.12.009>

# Current cityscape



(Stragier 2022)





localite