Targeted monitoring of veterinary pharmaceuticals in the environment based on soil vulnerability to antibiotics

Antonio Rodríguez, Ana de la Torre

Introduction

Therapeutic effectiveness of antibiotics is decreasing because of their widespread use.

This is a major threat for both animal and human health

Veterinary antibiotics

- Poorly absorbed by animals (30-90% excreted unaltered)
- Major contributors of environmental contamination (ecotoxicological effects, antibiotic resistance)
- Monitoring efforts are focused on humans and livestock, neglecting the environment

Spanish Ministry of Agriculture, 2015

EU + UK: > 1.4 billion tonnes of animal manure

90% is directly applied to soils (Köninger et al. 2021)

Introduction

2019: EU Strategic Approach to Pharmaceuticals in the Environment (PiE)

- Component of the European Union's One Health Action Plan against Antimicrobial Resistance
- Prioritises the use of innovative strategies like advanced modelling and information technology (IT)-based tools and platforms
- Prioritises cost-effective monitoring of contaminants in environment

MAPS FOR MONITORING ANTIBIOTICS IN ENVIRONMENT

Previous work:

Map of soil vulnerability to antibiotic contamination in Europe (de la Torre et al. 2012)

Maps at national scale (example: Spain)

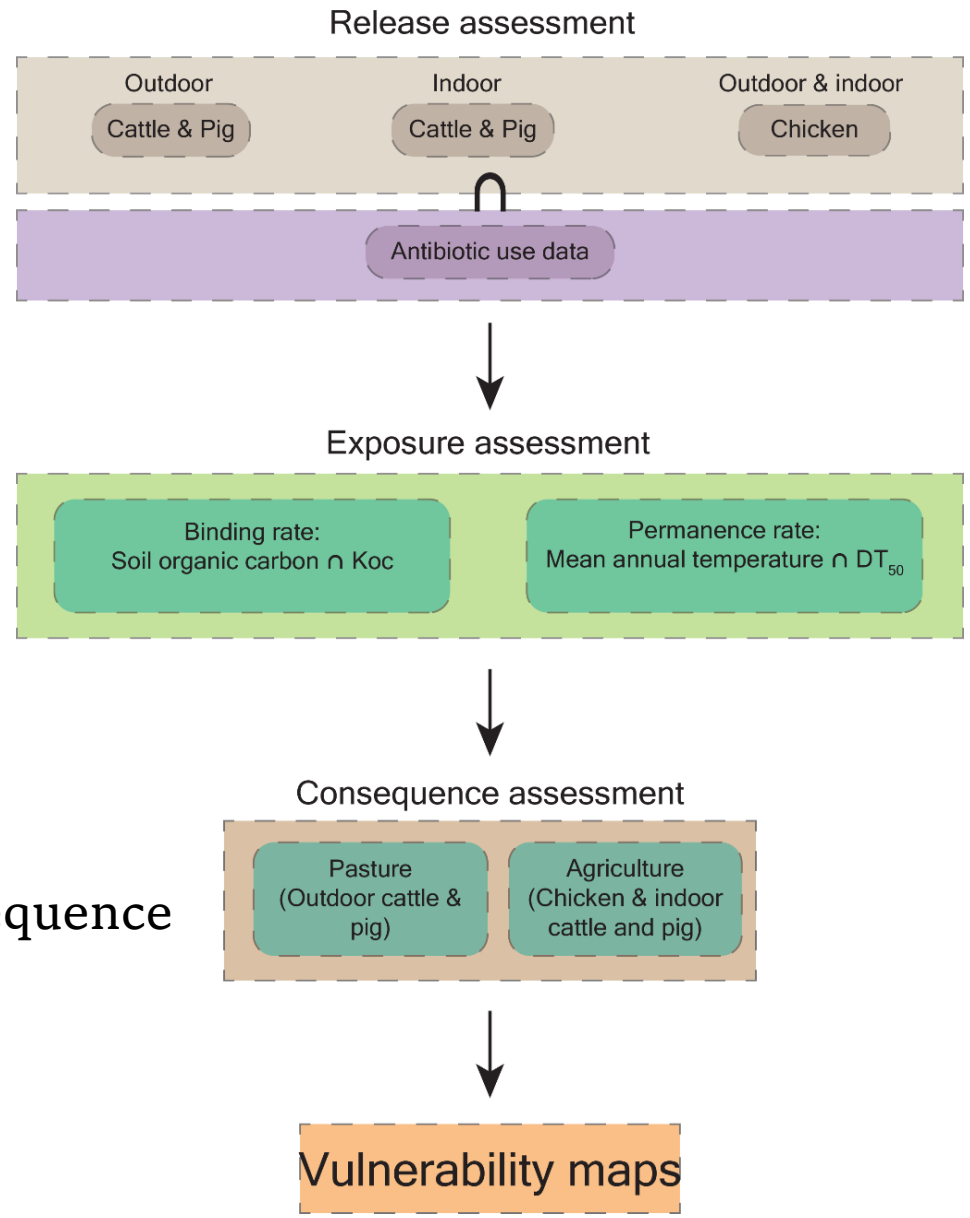
- Information about the use of antibiotics.
- Different antibiotic types and livestock species.
- Distinction between **agriculture and pasture areas**

PUBLIC DATA

Questions

1. Can we use this tool to characterize **the ecologically valuable areas** potentially affected by antibiotics?
2. Can this tool help us to identify **the antibiotics** with most potential impact in the environment?
3. Can this tool be useful to identify **the animal species** on which we should focus the measures to reduce the impact of antibiotics?

Methods

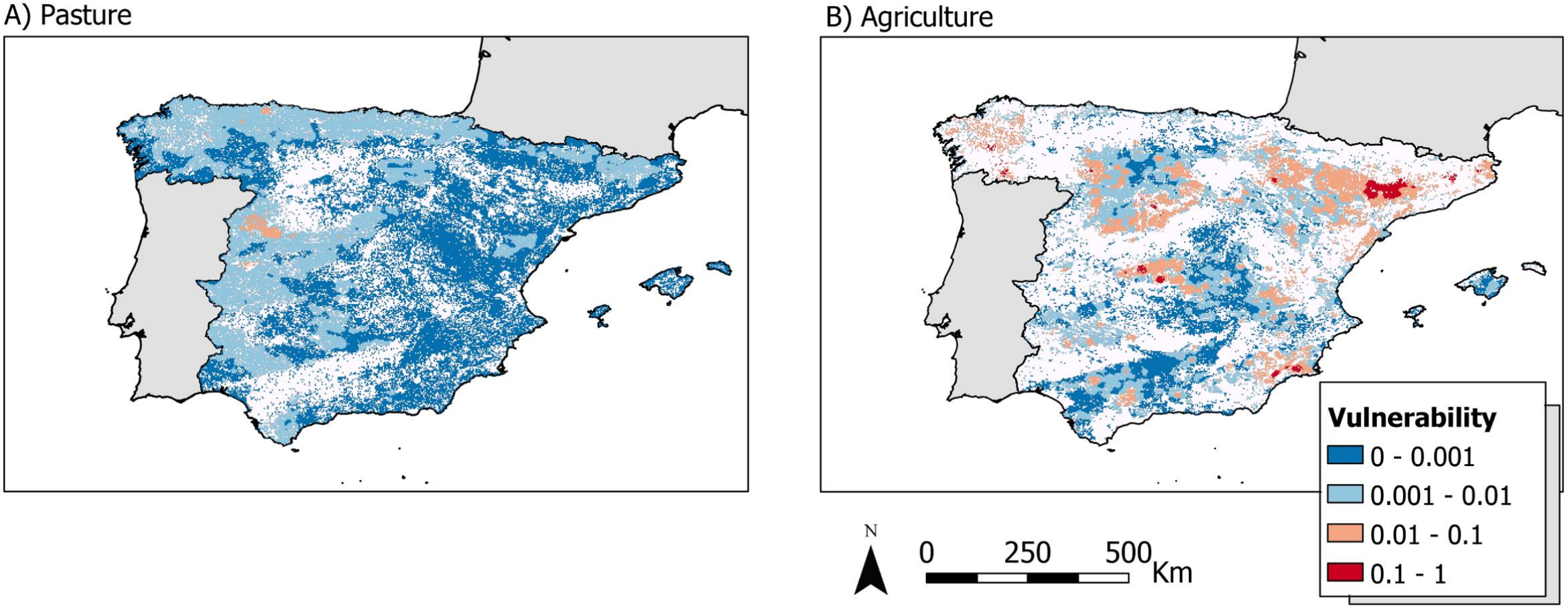


Vulnerability =

Release x Exposure x Consequence

Results and conclusions

Maps of soil vulnerability to antibiotics

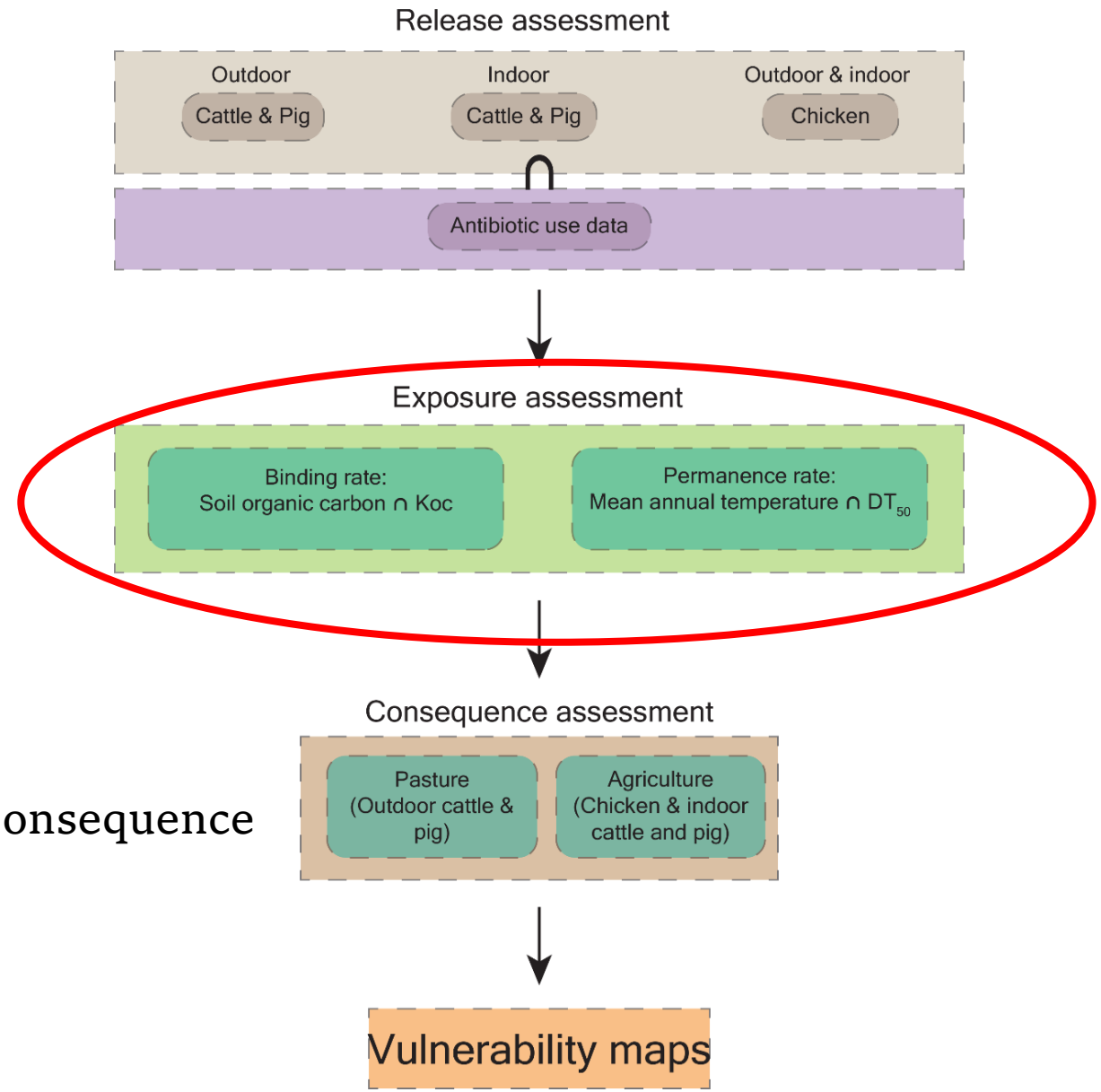


1. Can we use this tool to characterize the **ecologically valuable areas** potentially affected by antibiotics?

Mean vulnerability by livestock species and scenario

Results and conclusions

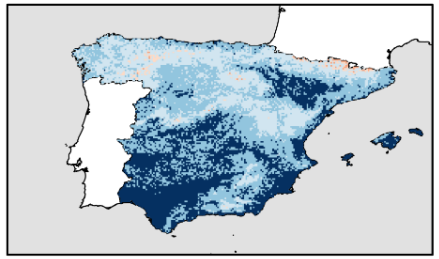
2. Can this tool help us to identify **the antibiotics** with most potential impact in the environment?



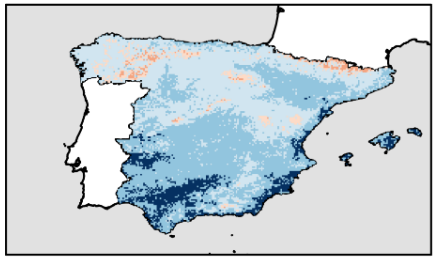
Vulnerability =

Release x Exposure x Consequence

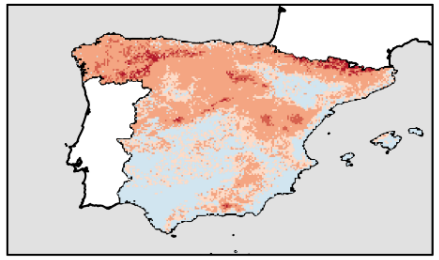
A) Beta-lactamics



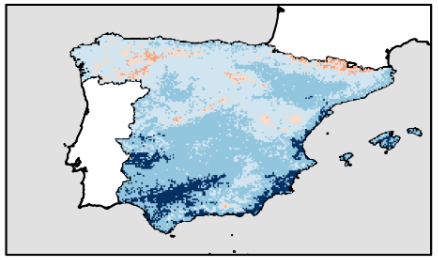
B) Cephalosporins



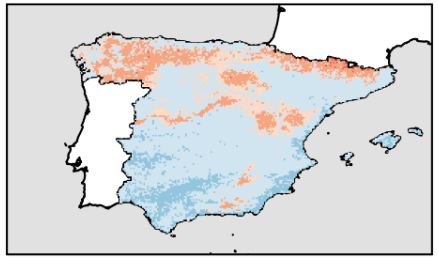
C) Fluoroquinolones

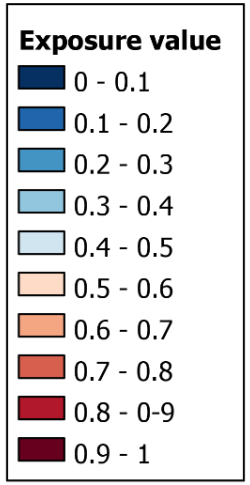


D) Macrolides

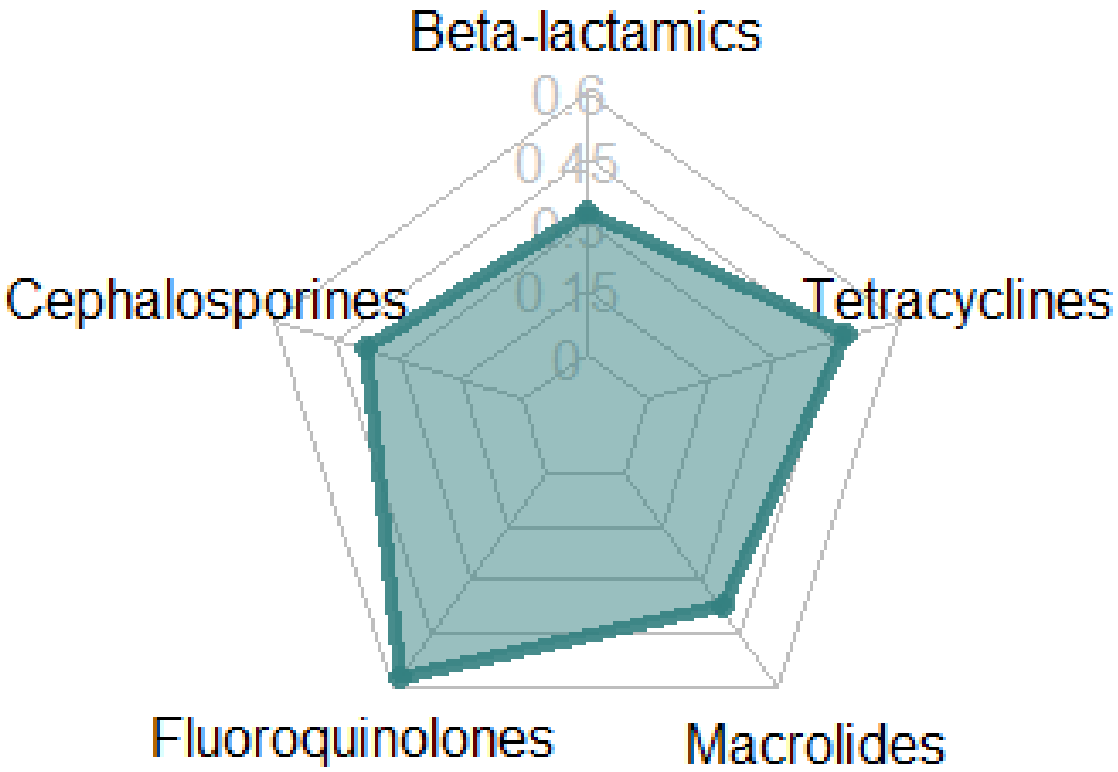


E) Tetracyclines



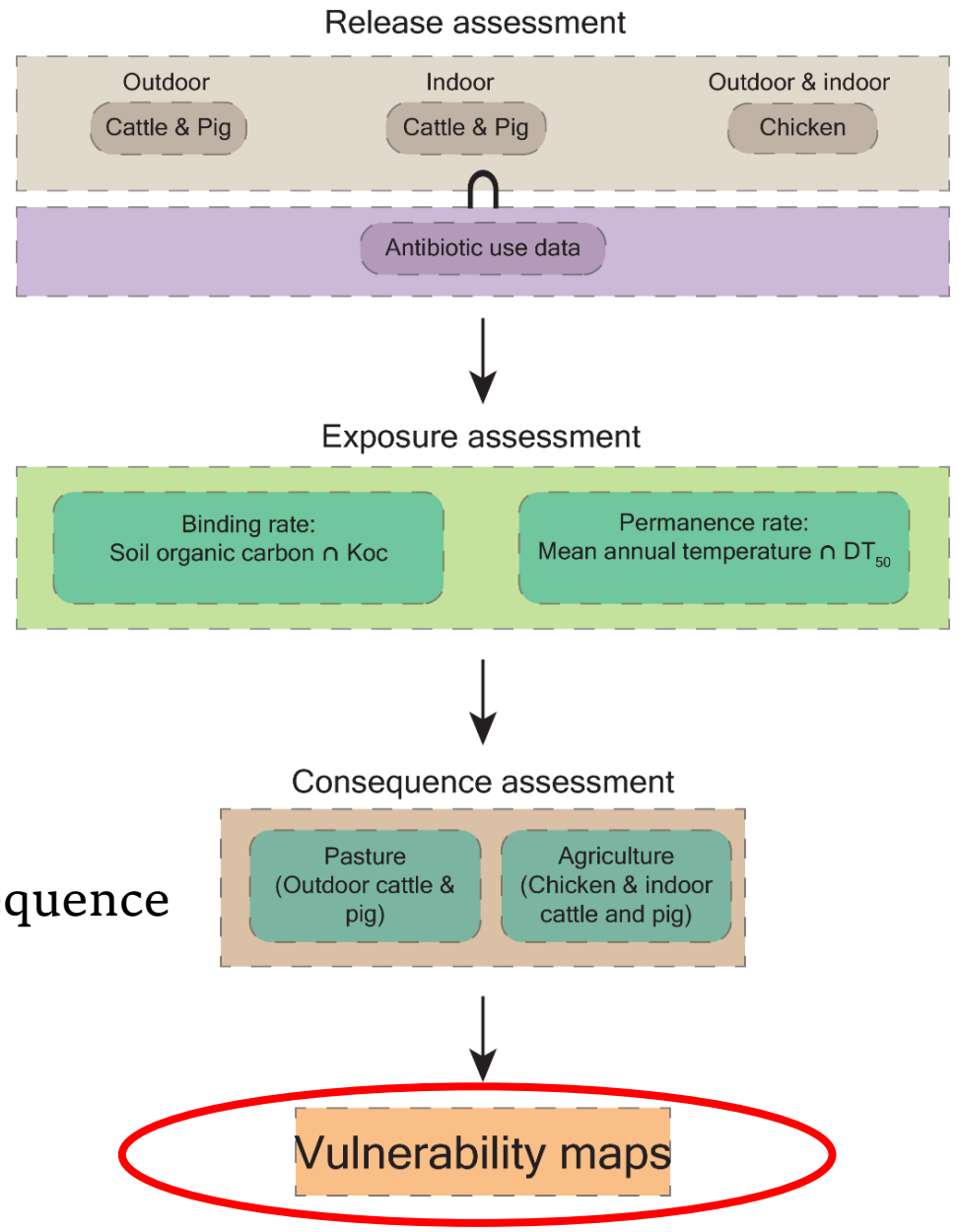


Mean exposure values

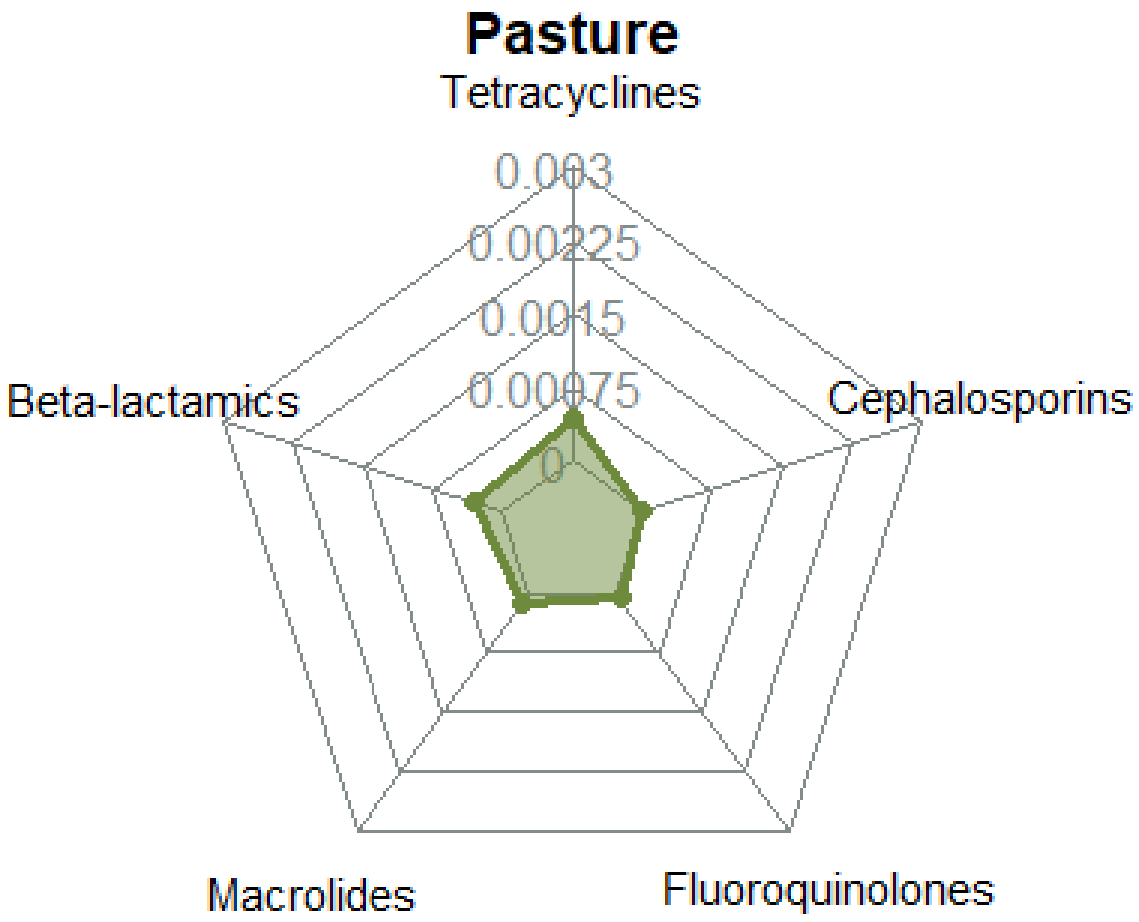


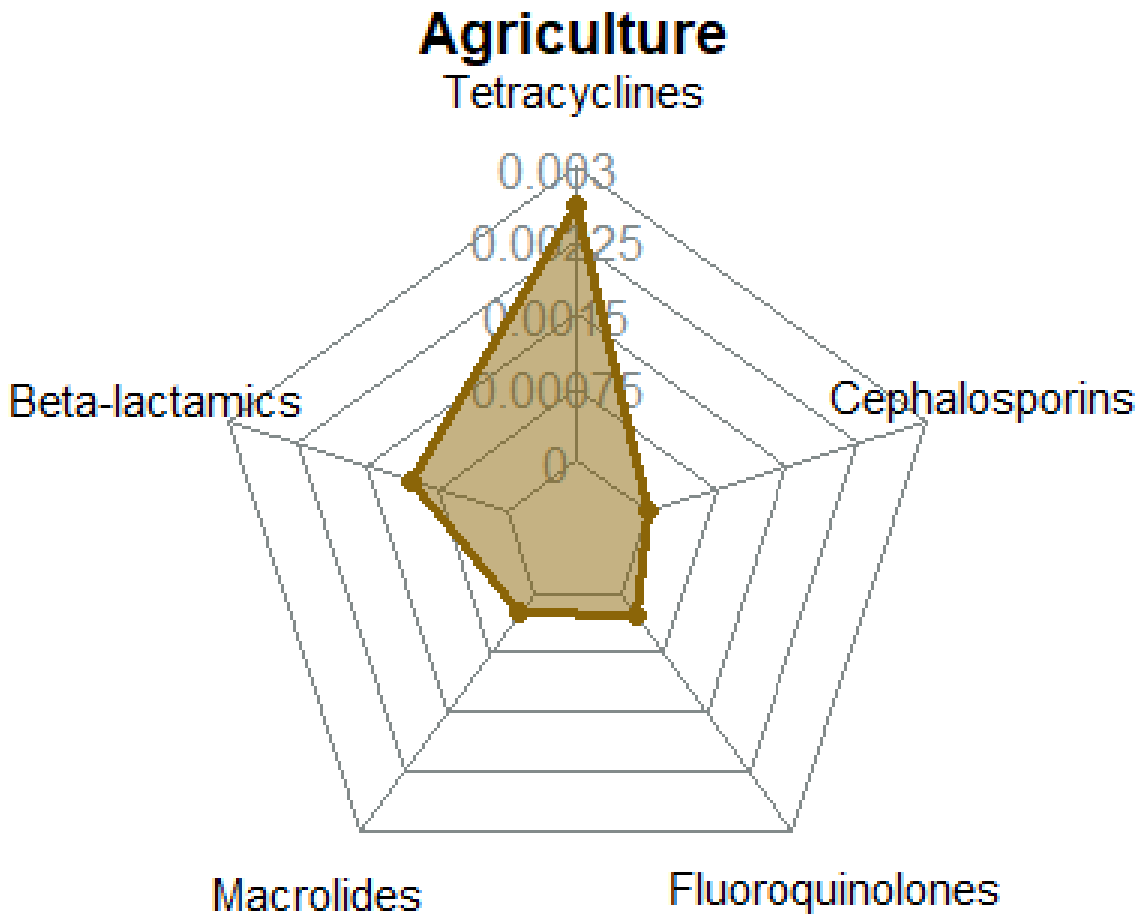
Vulnerability =

Release x Exposure x Consequence

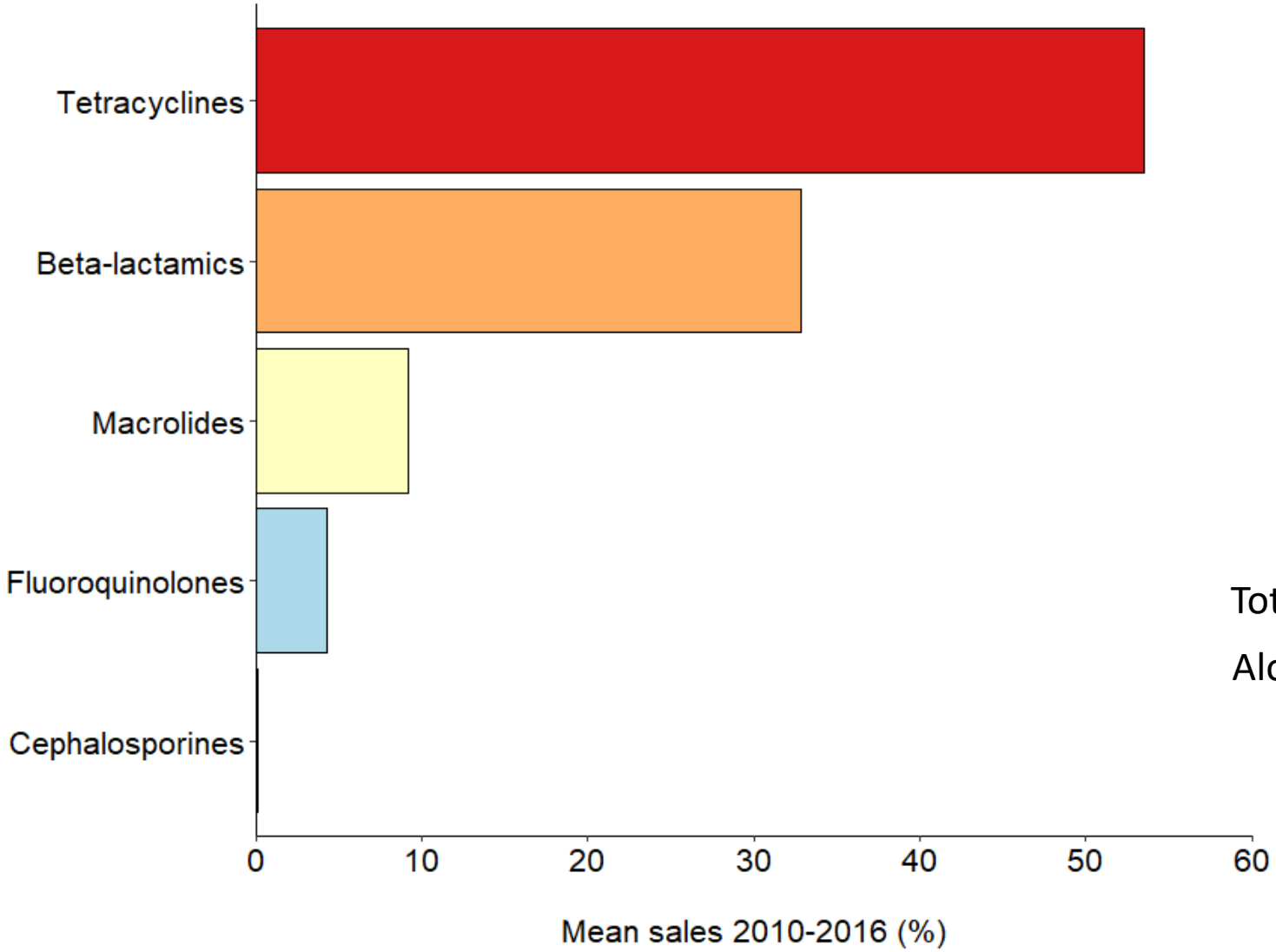


Mean vulnerability by antibiotic types





Use of veterinary antibiotics in Spain

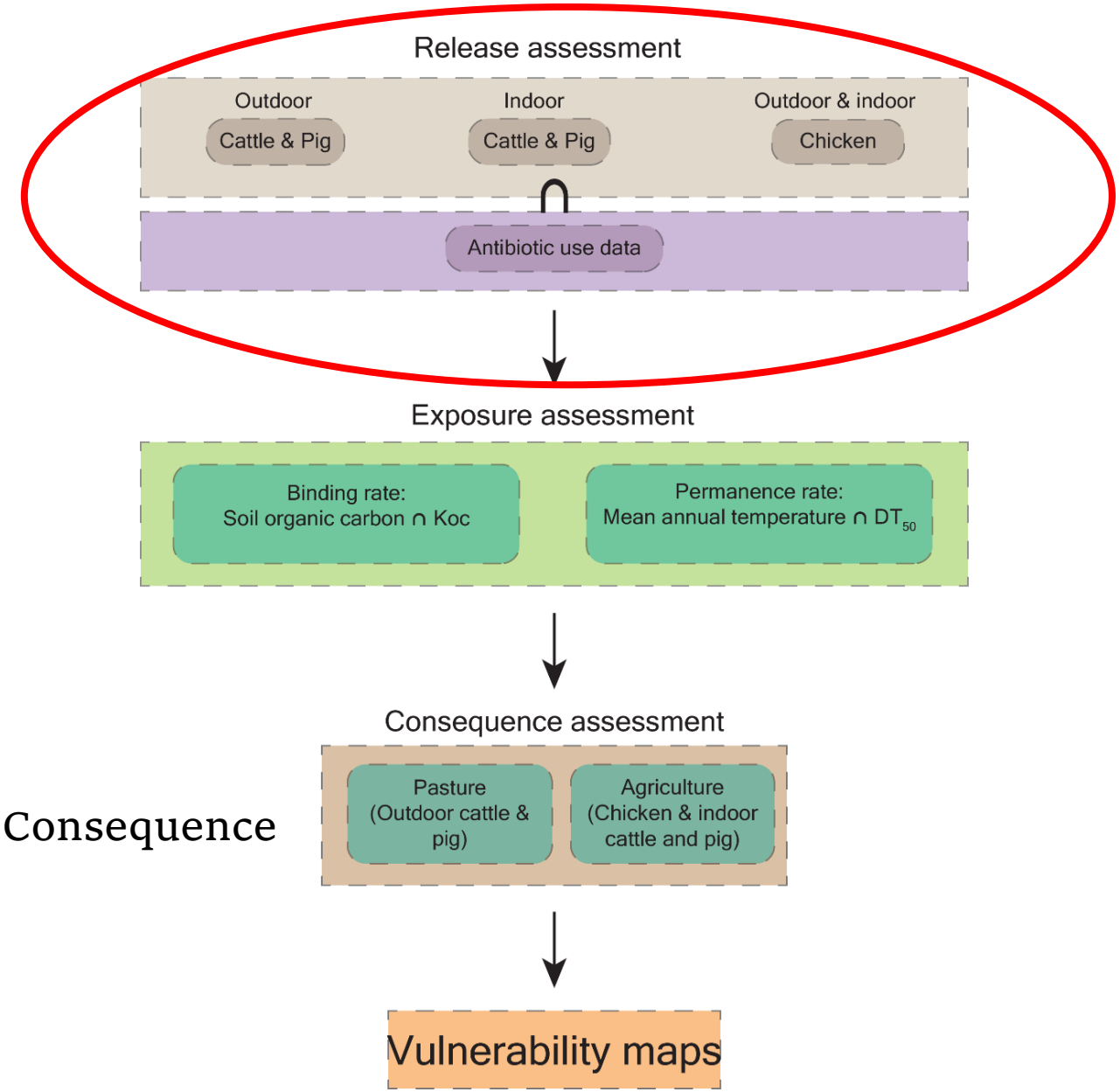


Total sales : 230.2 mg/PCU

Alonso Herreras et al. (2018)

Results and conclusions

3. Can this tool be useful to identify **the animal species** on which we should focus the measures to reduce the impact of antibiotics?



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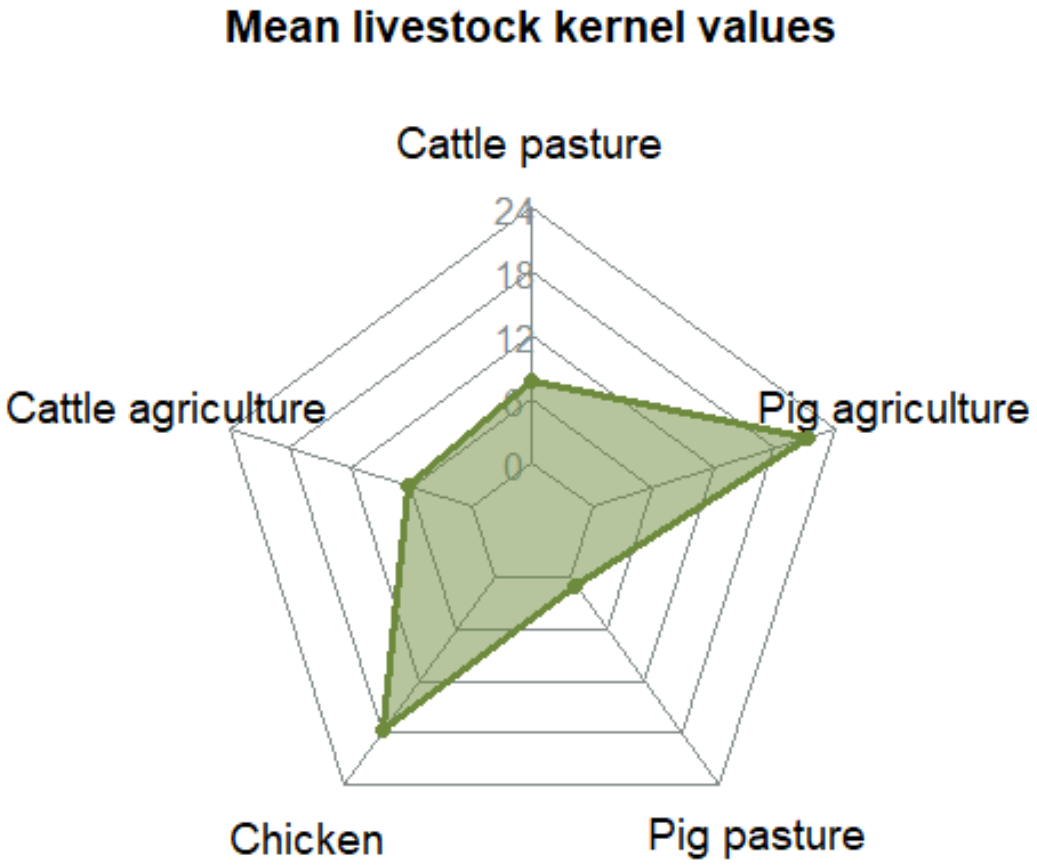
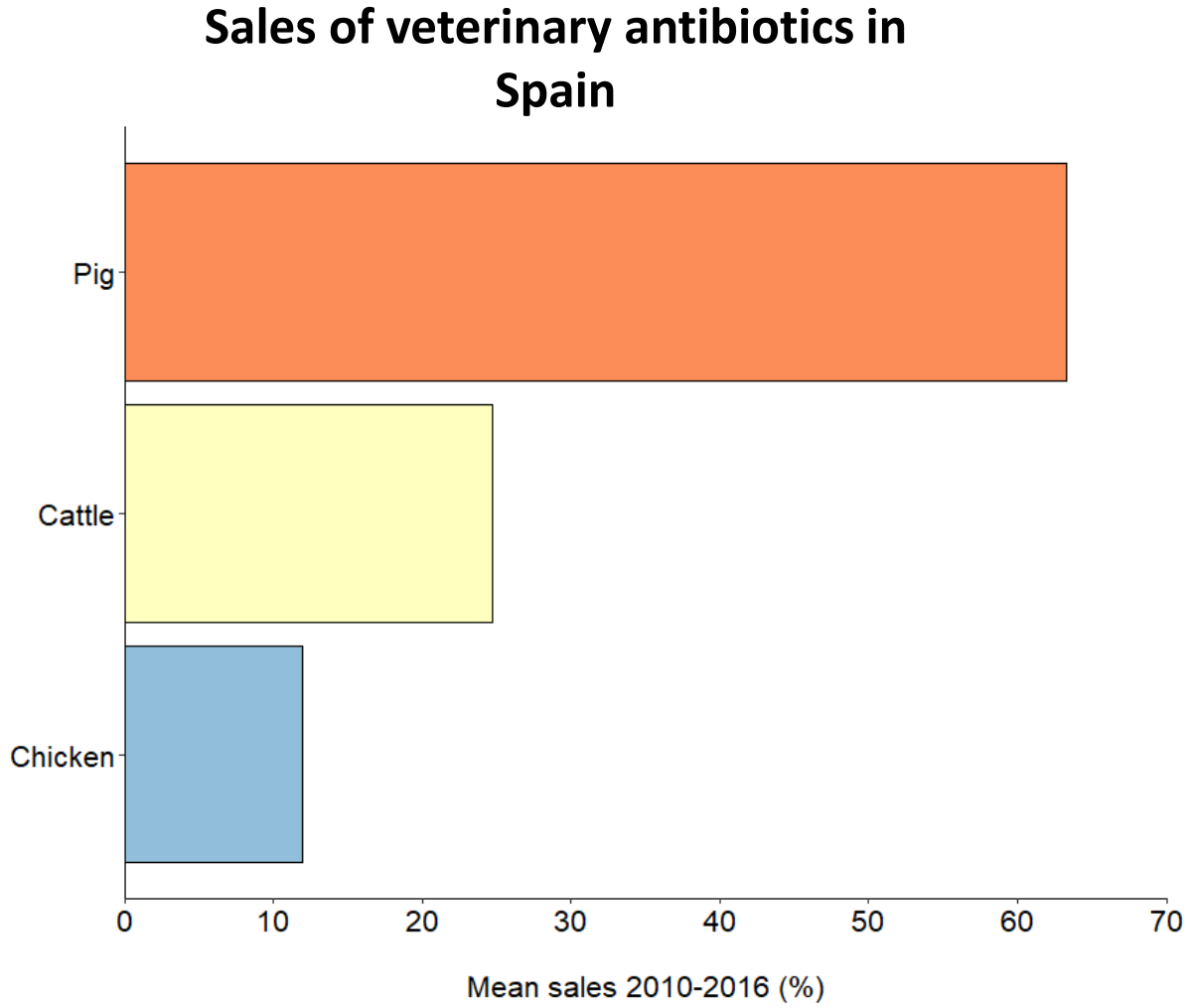
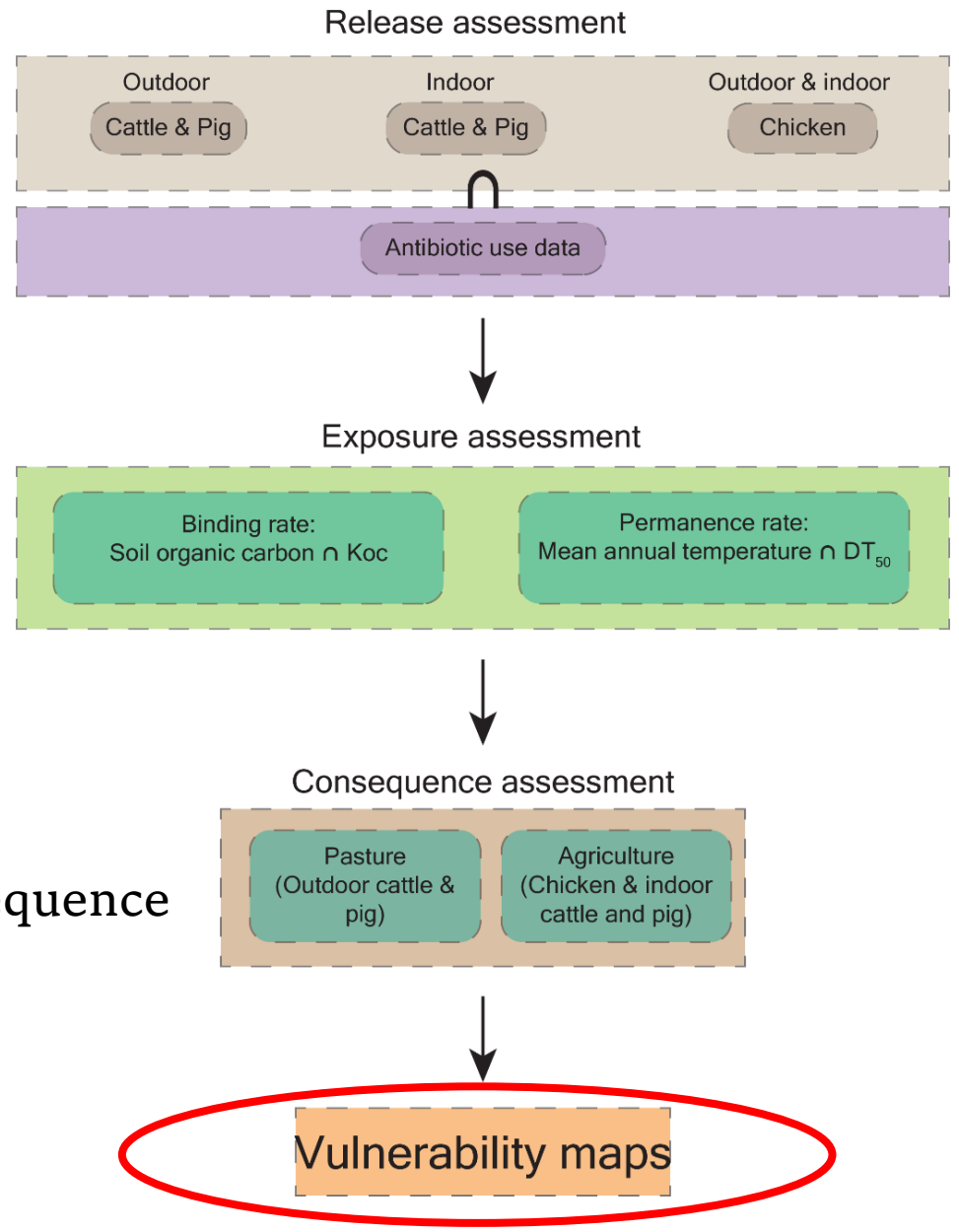

Mean livestock kernel values
Cattle pasture
24
18
12
6
0
Cattle agriculture
Pig agriculture
Chicken
Pig pasture

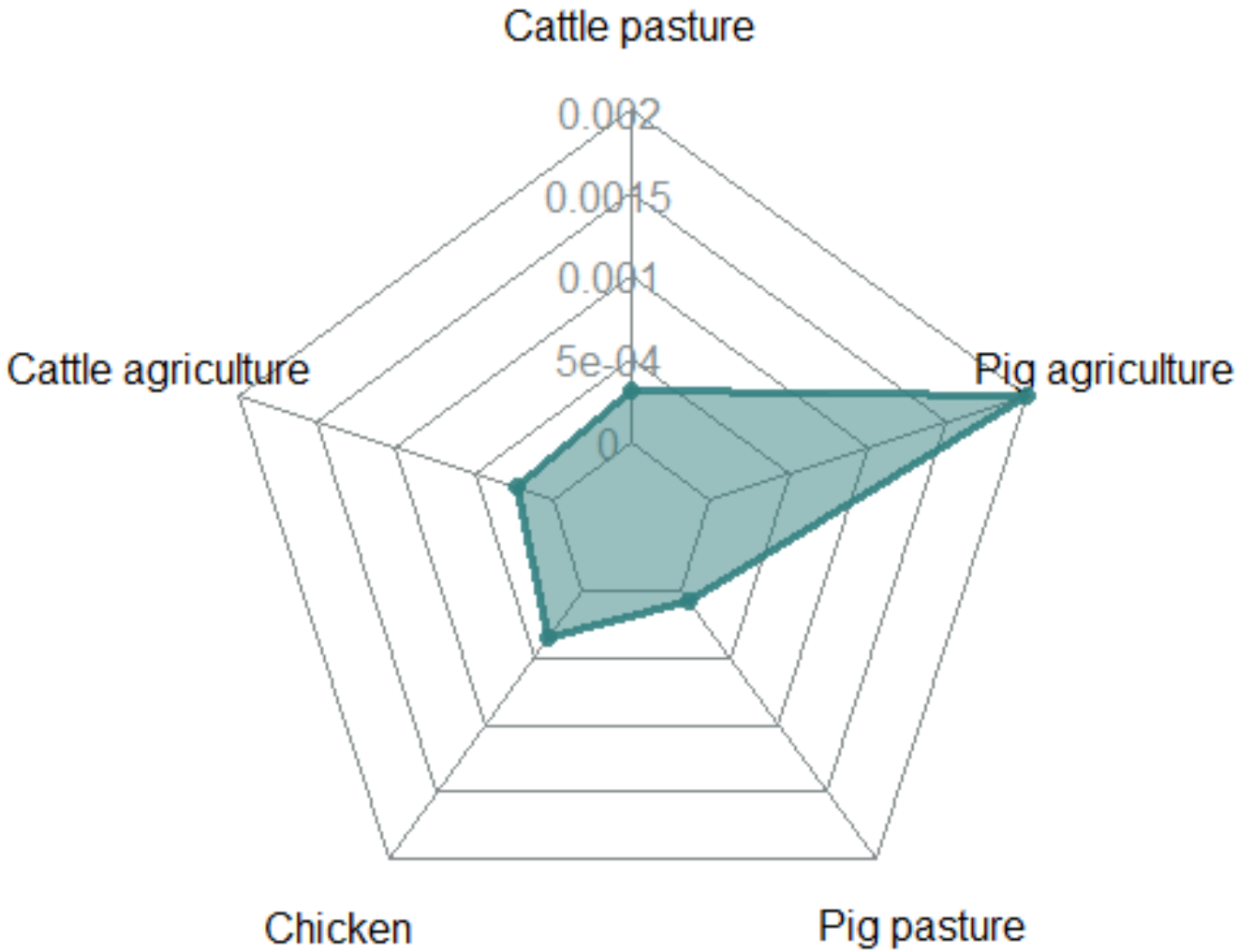

Sales of veterinary antibiotics in Spain
Pig
Cattle
Chicken
0
10
20
30
40
50
60
70
Mean sales 2010-2016 (%)

Vulnerability =

Release x Exposure x Consequence



Mean vulnerability by livestock species and scenario



Take home message

We do not have enough field data of antibiotics in the environment, but **we can start with maps of soil vulnerability** to antibiotics based on **public information** from national and EU institutions

Our results support that **antibiotic use is a determinant factor** of soil vulnerability to antibiotics

Targeted interventions could reduce the environmental impact of veterinary antibiotics

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References

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