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Centro Nacional Instituto de Investigación  
y Tecnología Agraria y Alimentaria

# 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)



An approach for mapping the vulnerability of European Union soils to antibiotic contamination

Ana de la Torre\*, Irene Iglesias, Matilde Carballo, Pablo Ramírez, María Jesús Muñoz

## 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**

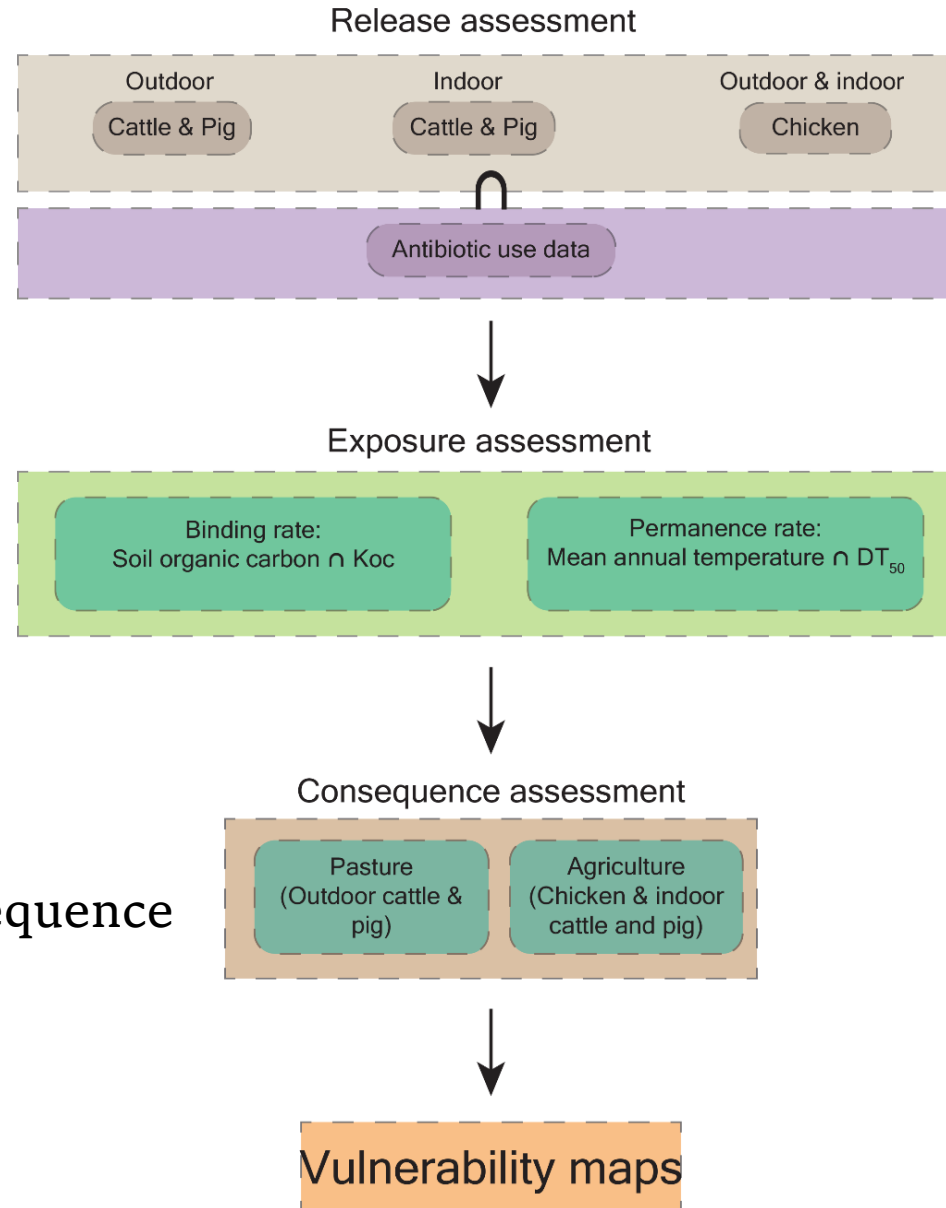


# Questions

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



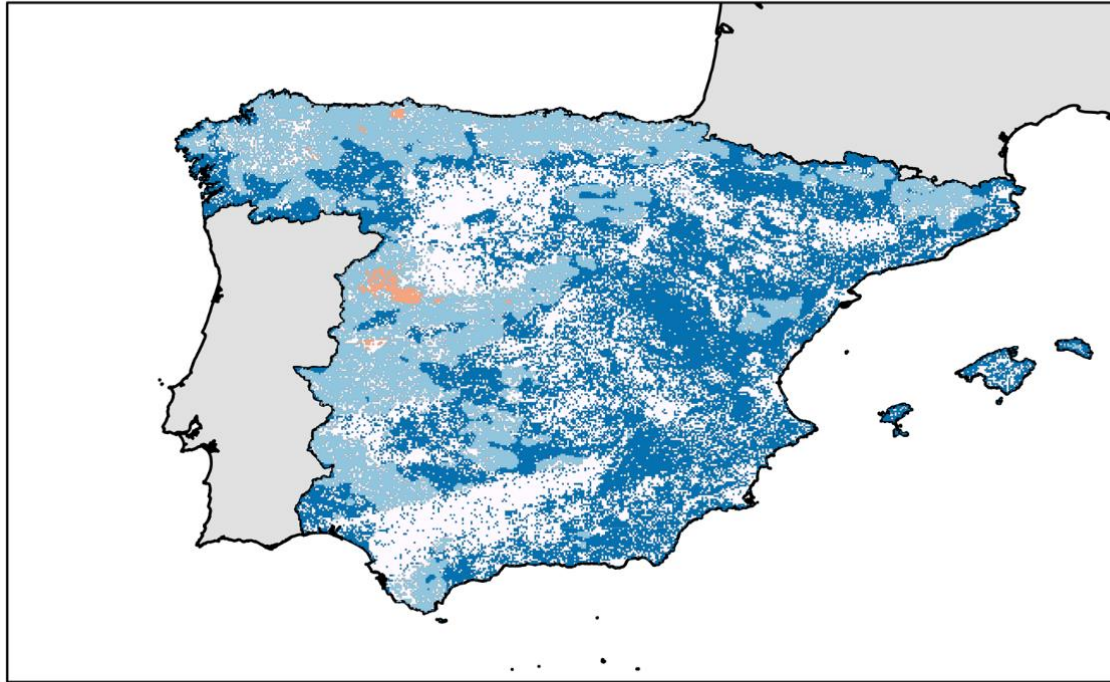
Vulnerability =  
Release x Exposure x Consequence



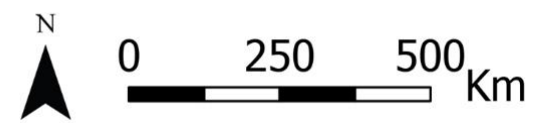
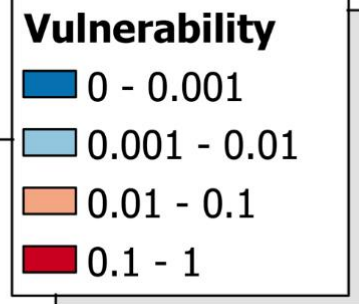
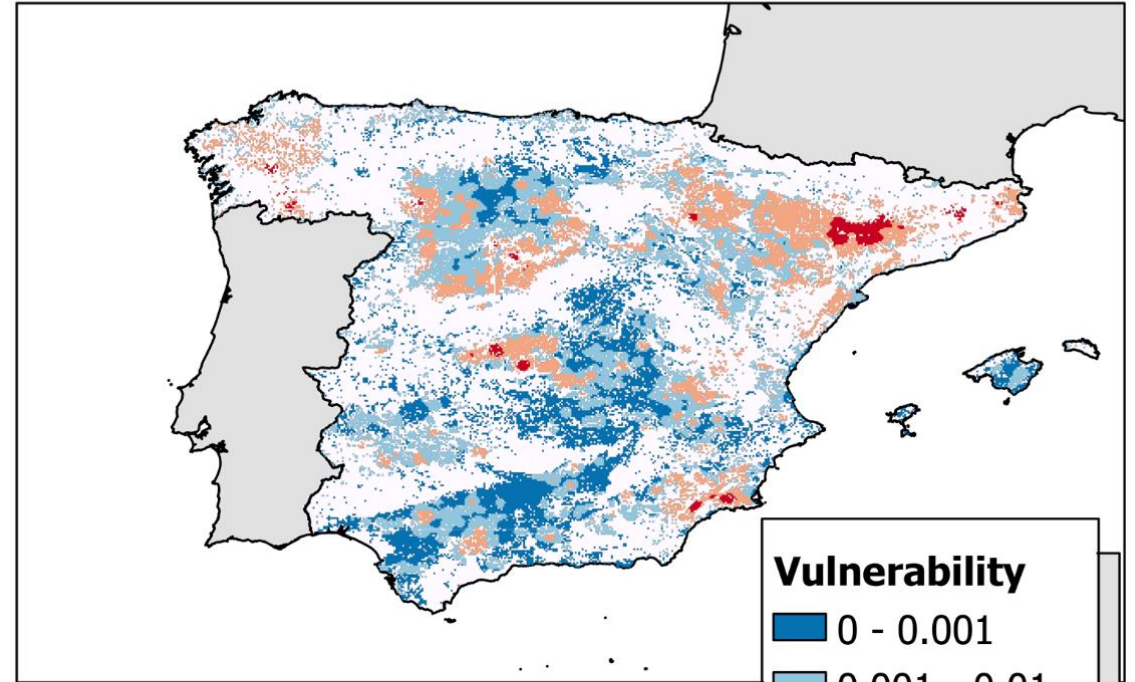
# Results and conclusions

## Maps of soil vulnerability to antibiotics

A) Pasture



B) Agriculture

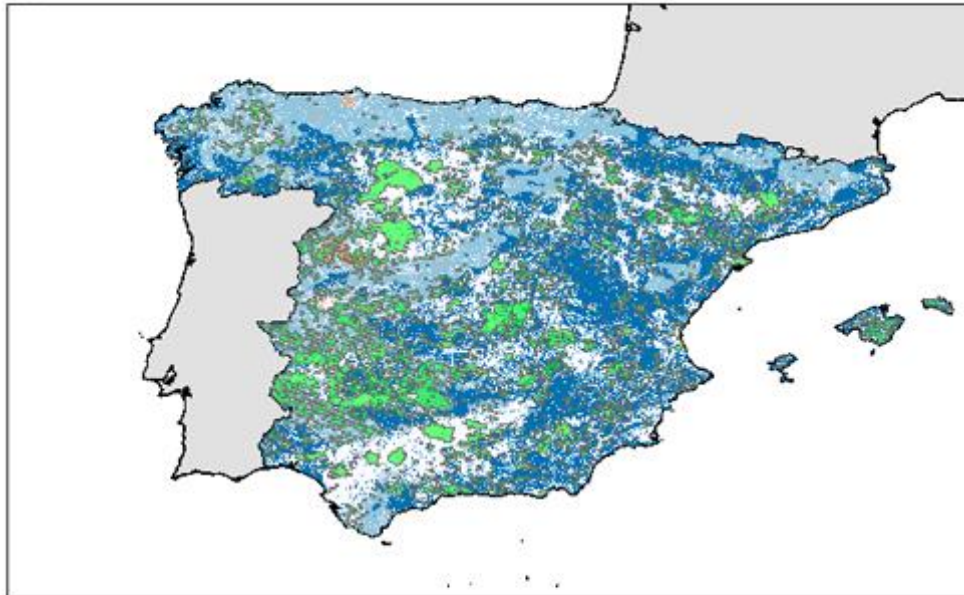




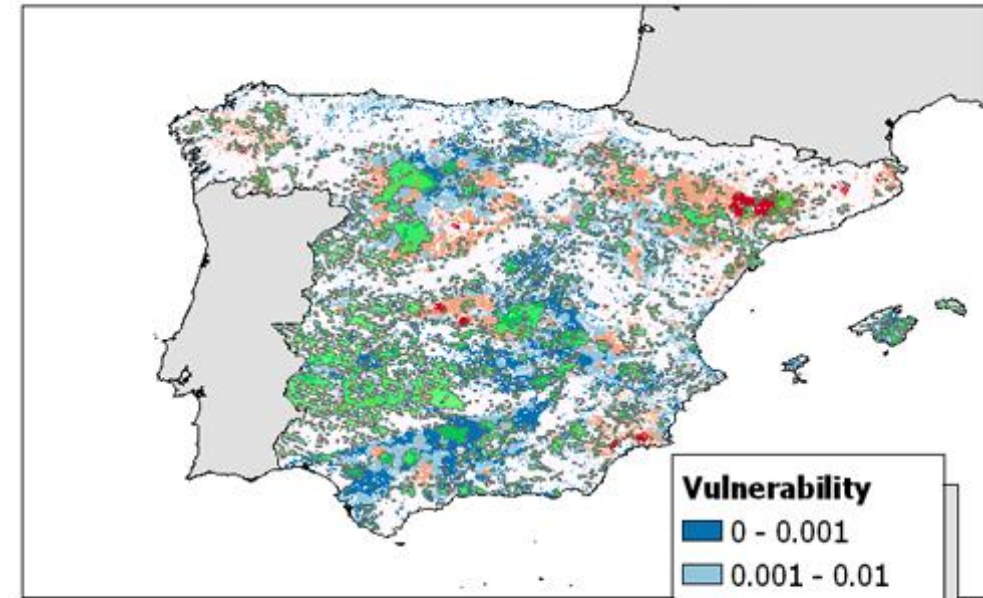
1. Can we use this tool to characterize the **ecologically valuable areas** potentially affected by antibiotics?

## Mean vulnerability by livestock species and scenario

A) Pasture



B) Agriculture



0 250 500 Km

### Vulnerability

0 - 0.001

0.001 - 0.01

0.01 - 0.1

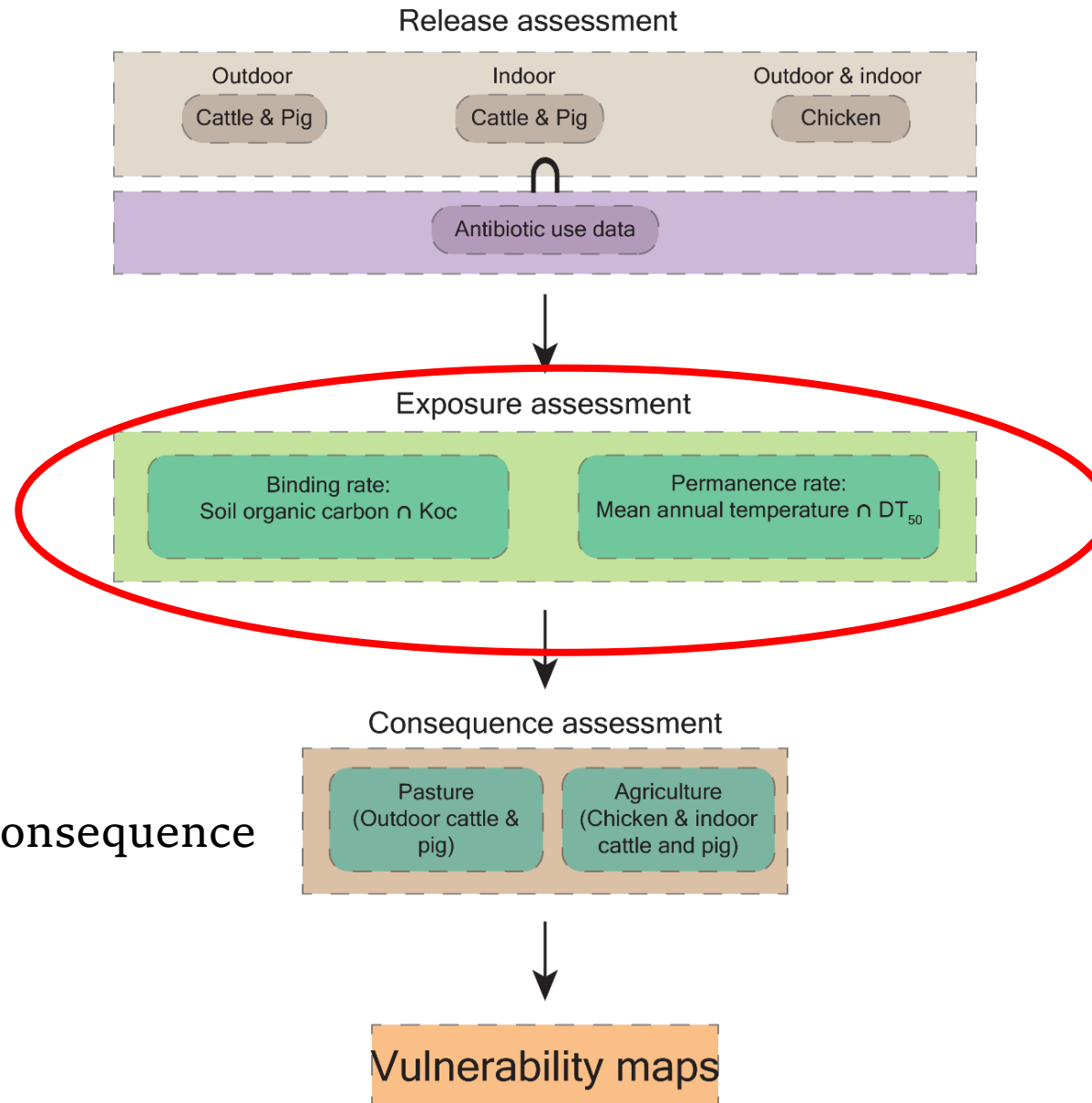
0.1 - 1

HNV farmland



## Results and conclusions

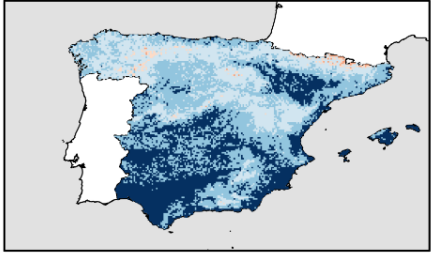
2. Can this tool help us to identify **the antibiotics** with most potential impact in the environment?



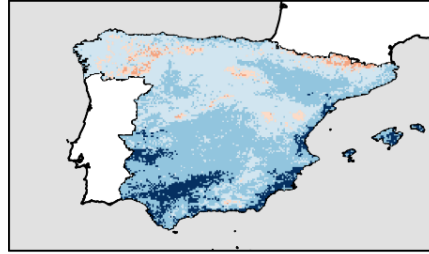
Vulnerability =  
Release x Exposure x Consequence



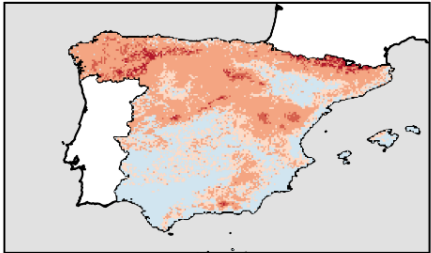
A) Beta-lactámicos



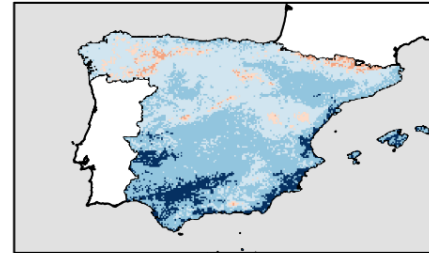
B) Cephalosporins



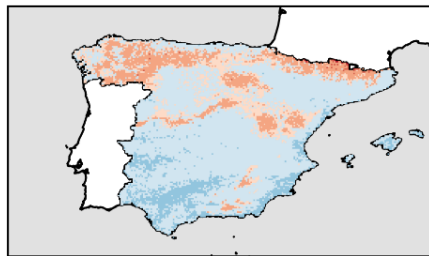
C) Fluoroquinolones



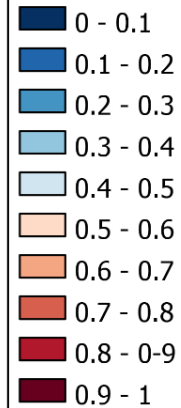
D) Macrolides



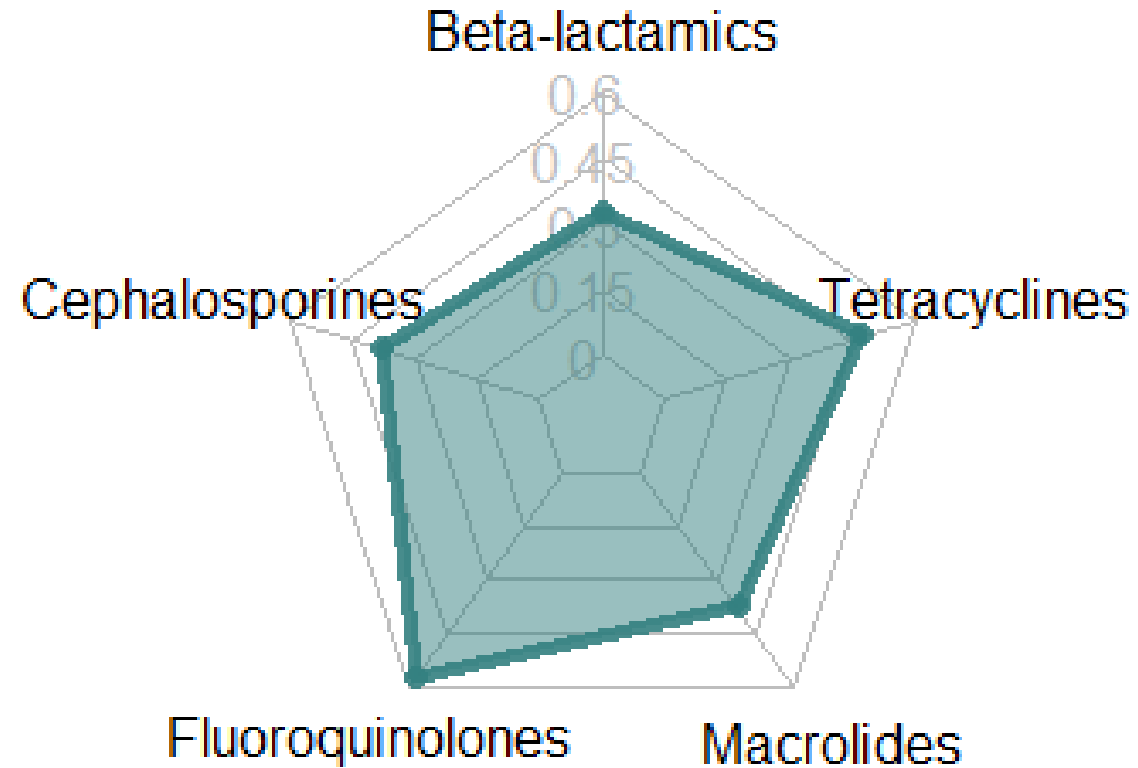
E) Tetracyclines



**Exposure value**

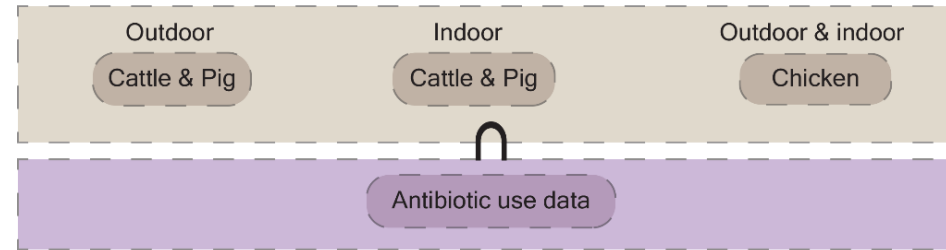


# Mean exposure values





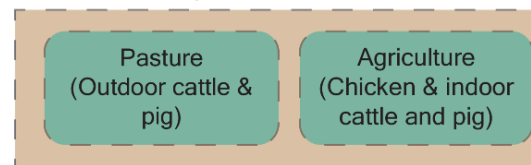
### Release assessment



### Exposure assessment



### Consequence assessment



Vulnerability maps

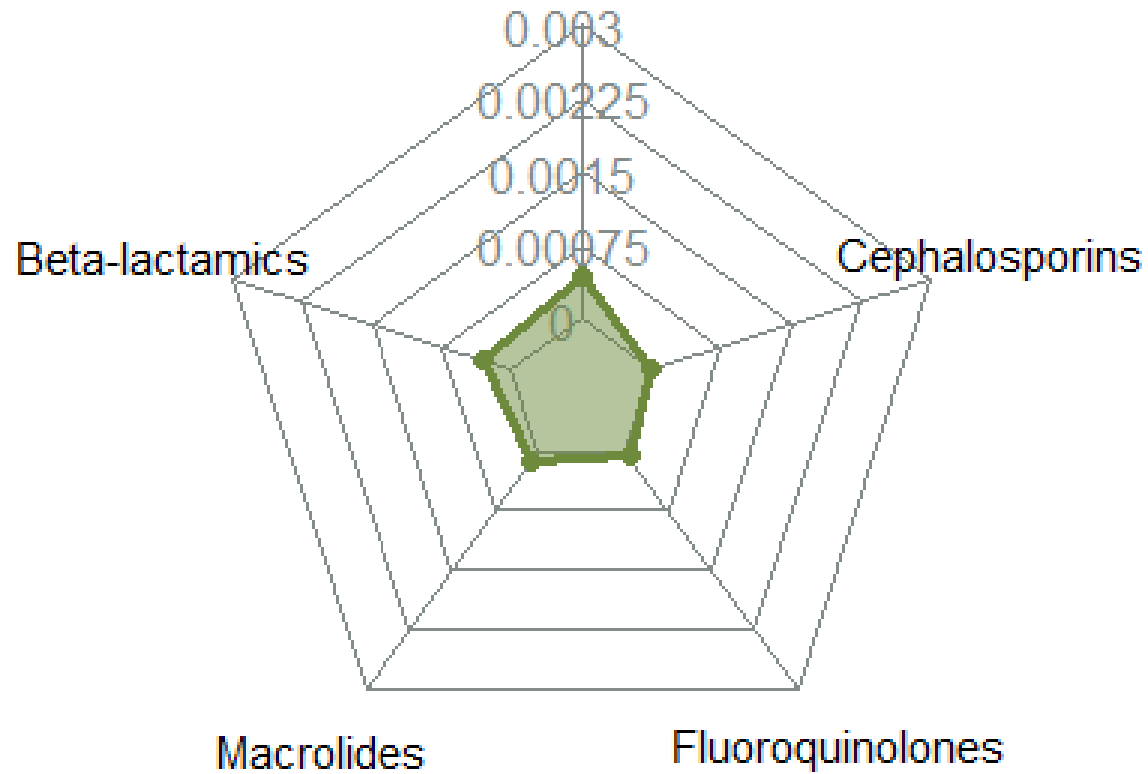
Vulnerability =  
Release x Exposure x Consequence



# Mean vulnerability by antibiotic types

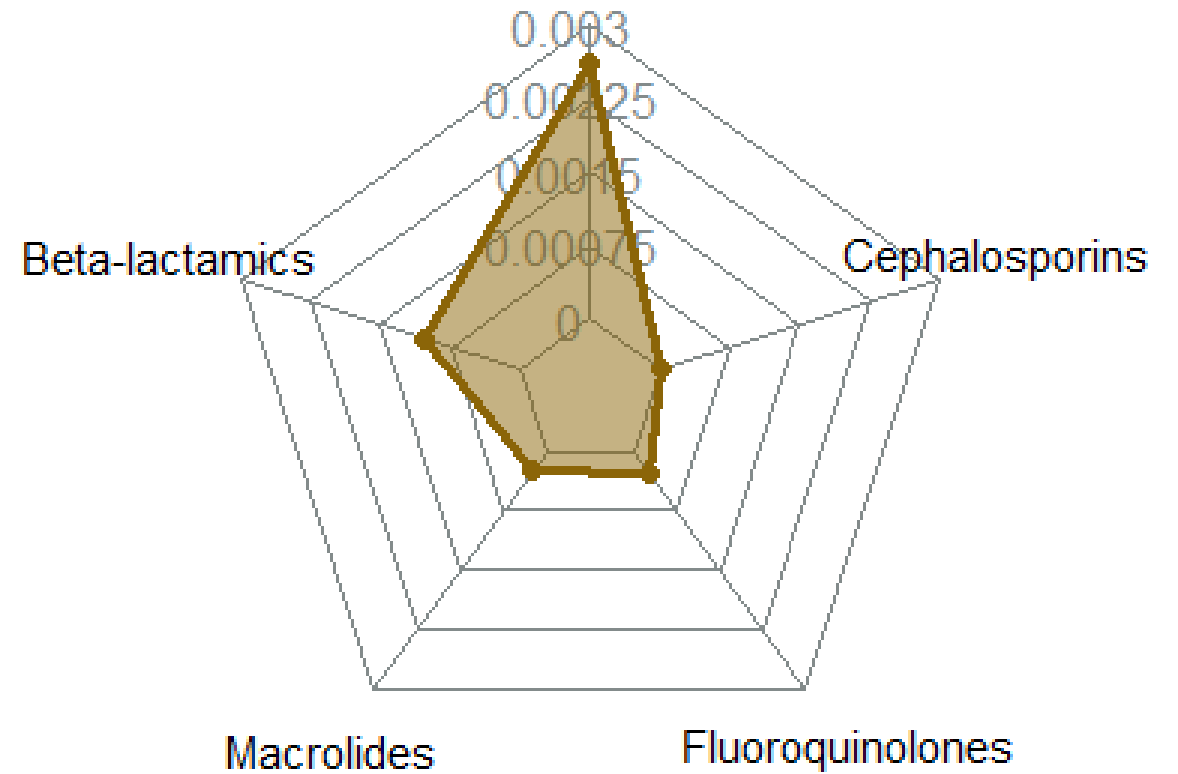
## Pasture

Tetracyclines



## Agriculture

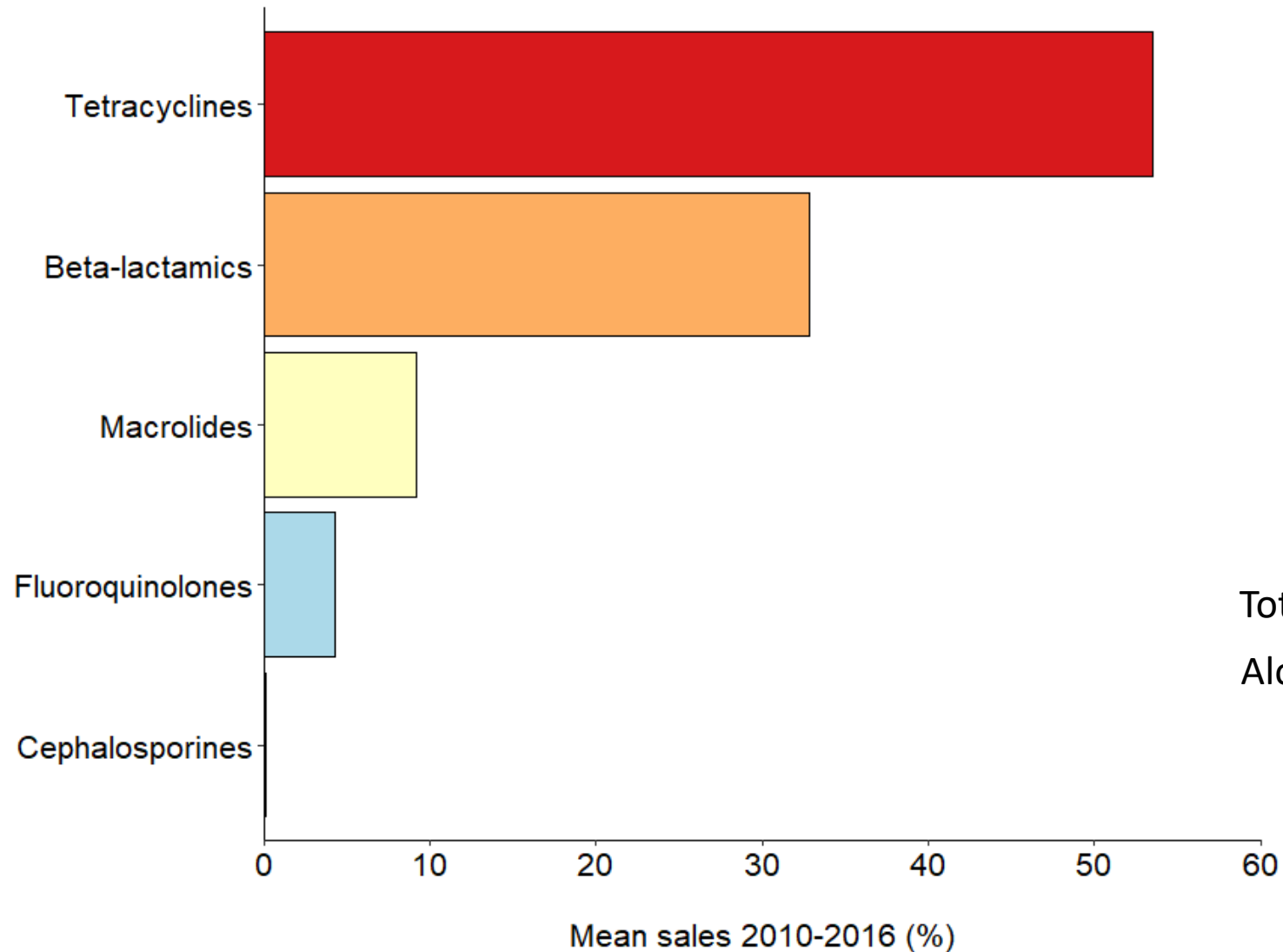
Tetracyclines







## Use of veterinary antibiotics in Spain

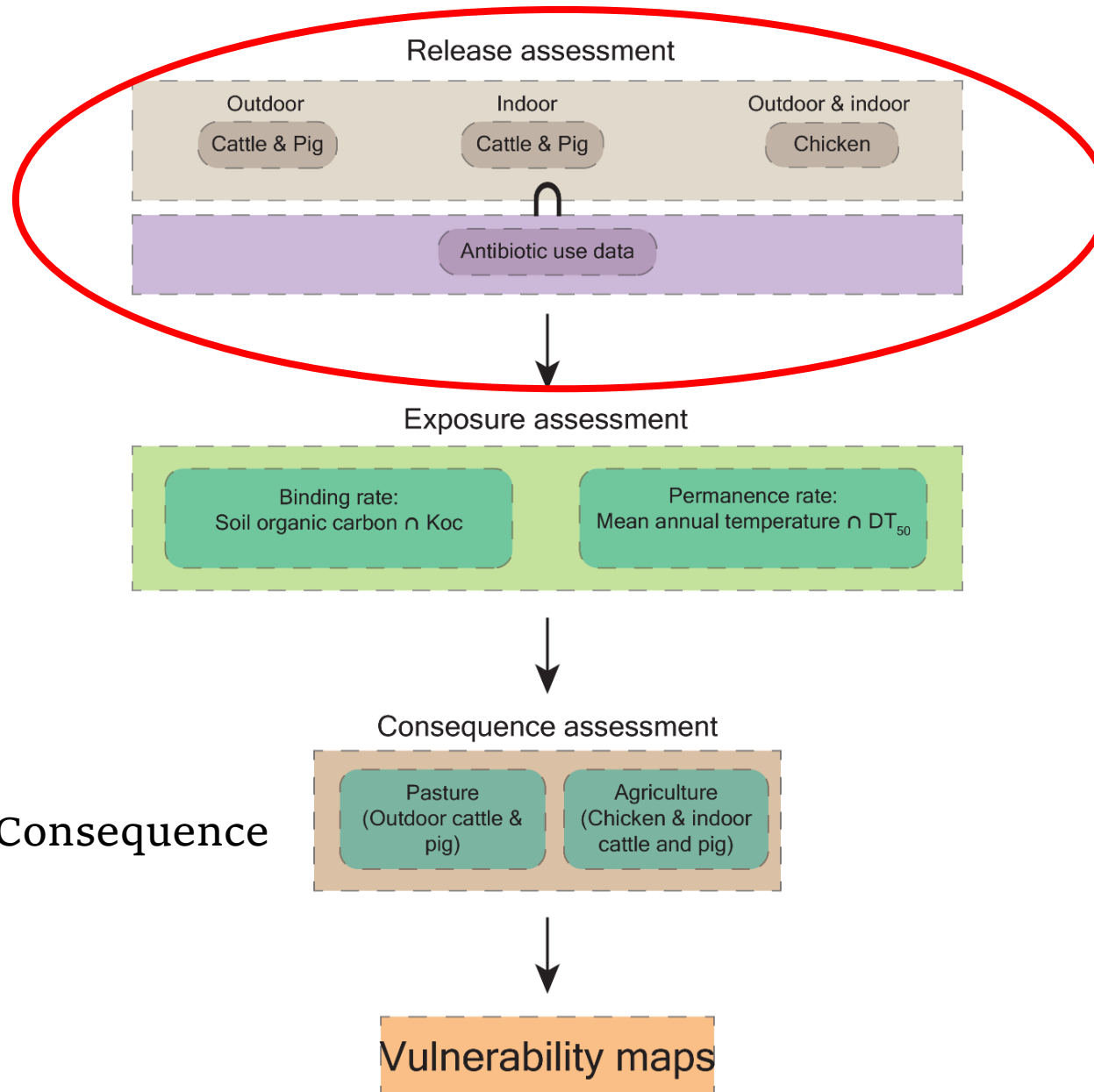


Total sales : 230.2 mg/PCU  
Alonso Herreras et al. (2018)



## 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?

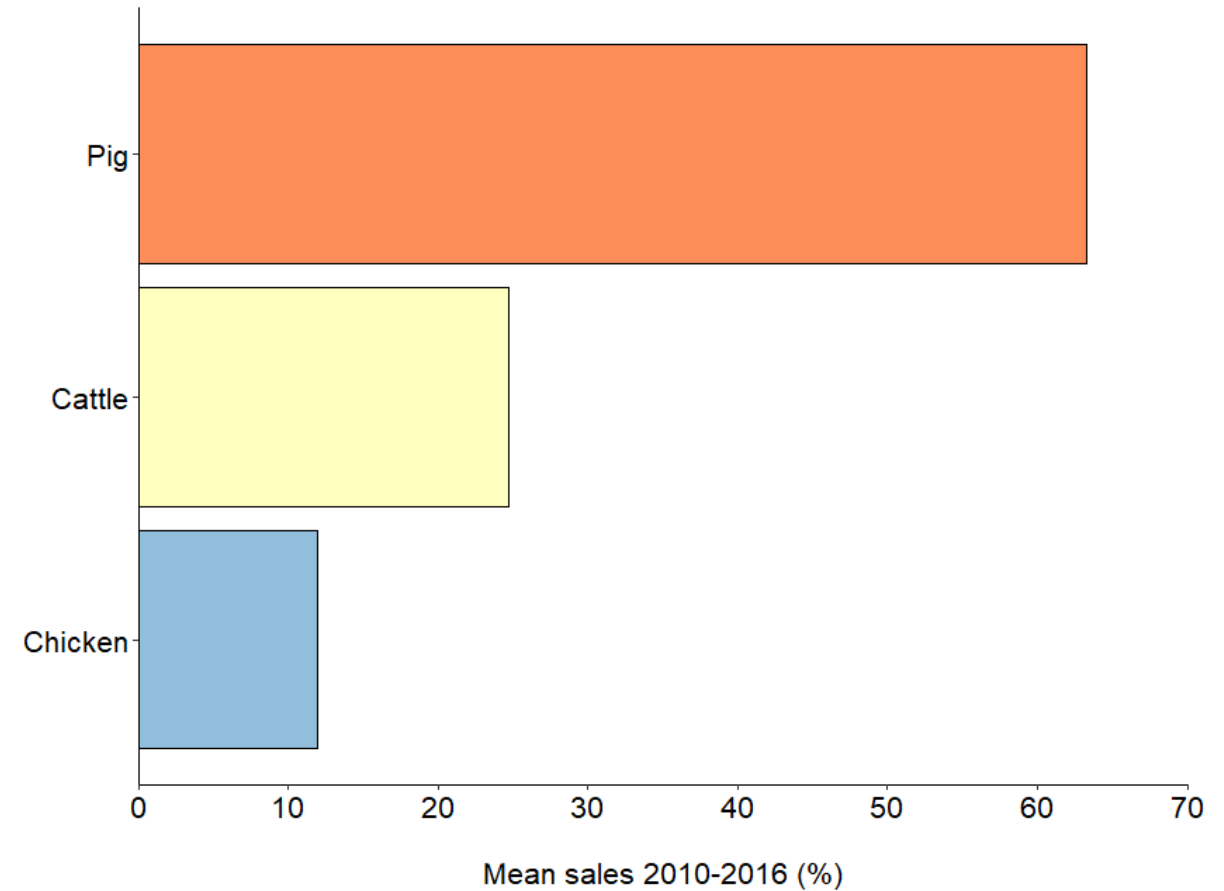
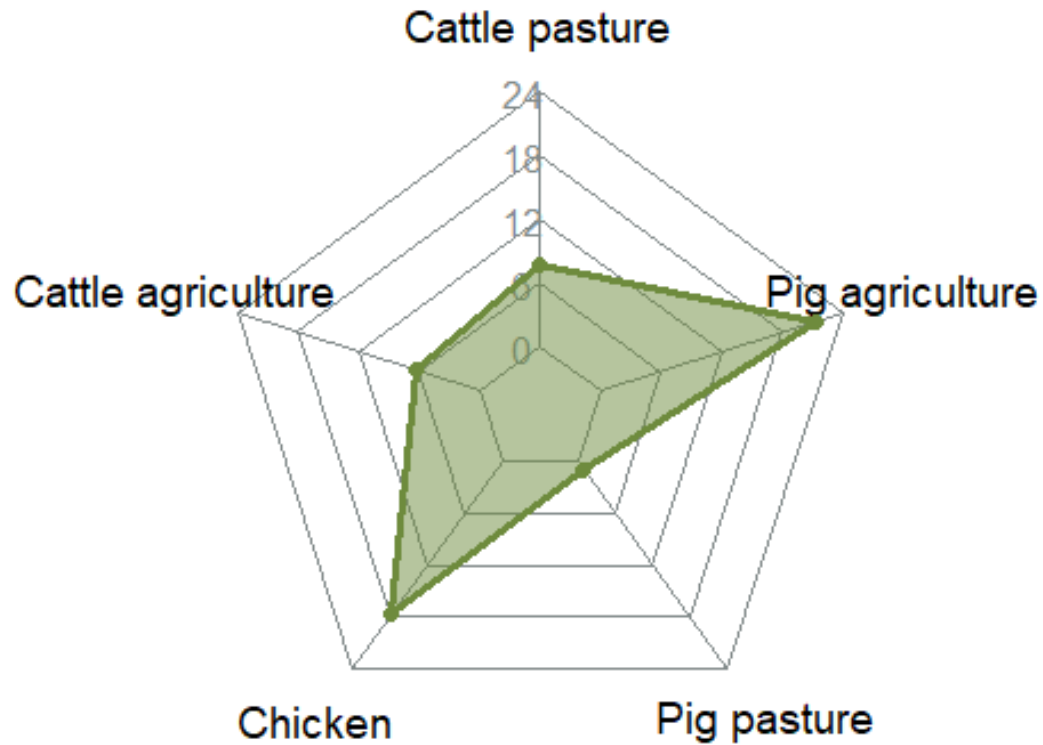


Vulnerability =  
Release x Exposure x Consequence



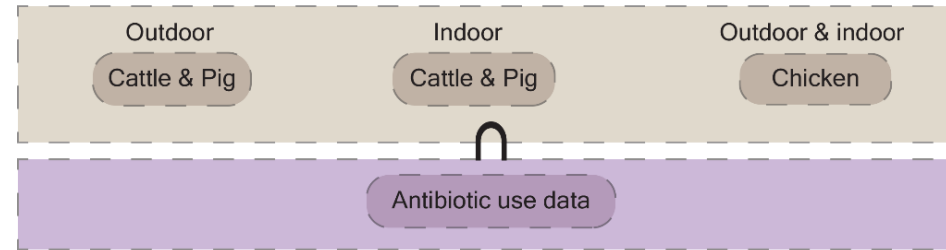
## Sales of veterinary antibiotics in Spain

### Mean livestock kernel values





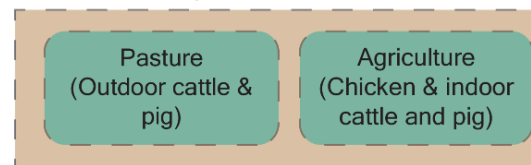
### Release assessment



### Exposure assessment



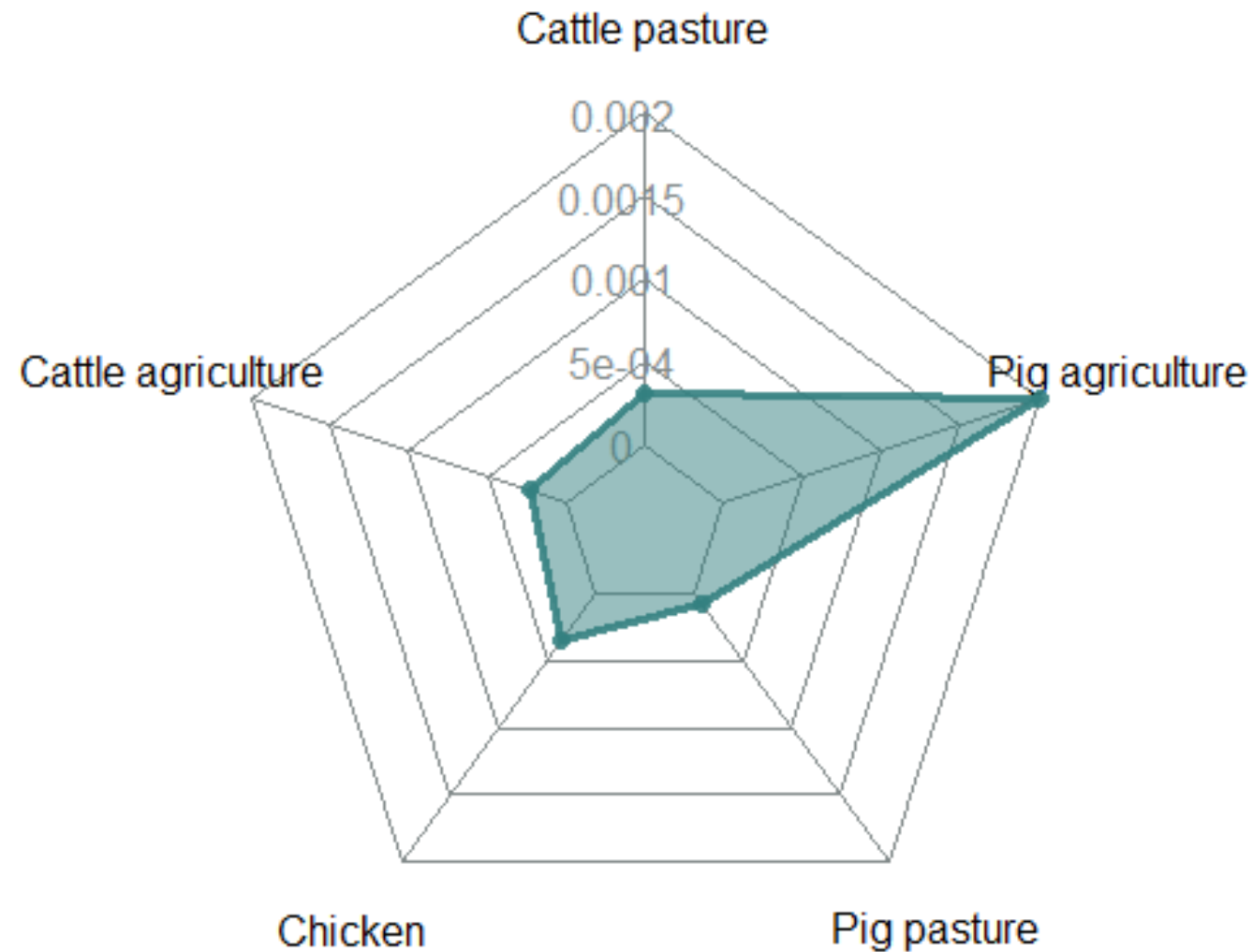
### Consequence assessment



Vulnerability maps

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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