

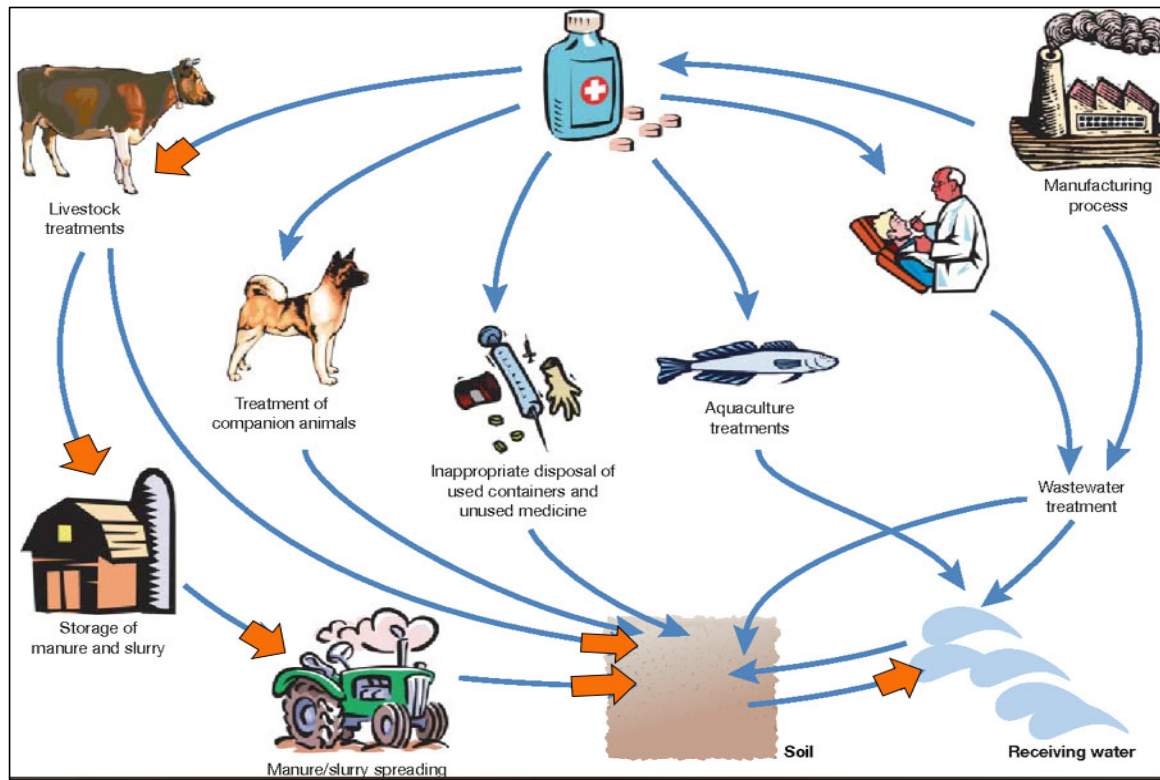
Veterinary pharmaceuticals (VPs) in manure, soil, and water

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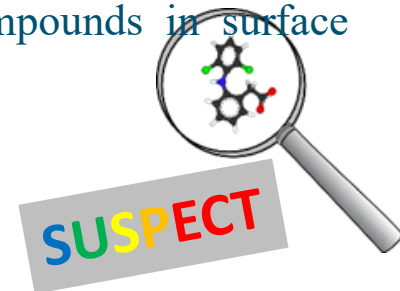
Problem description

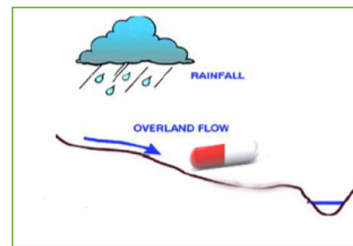
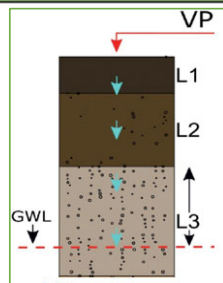
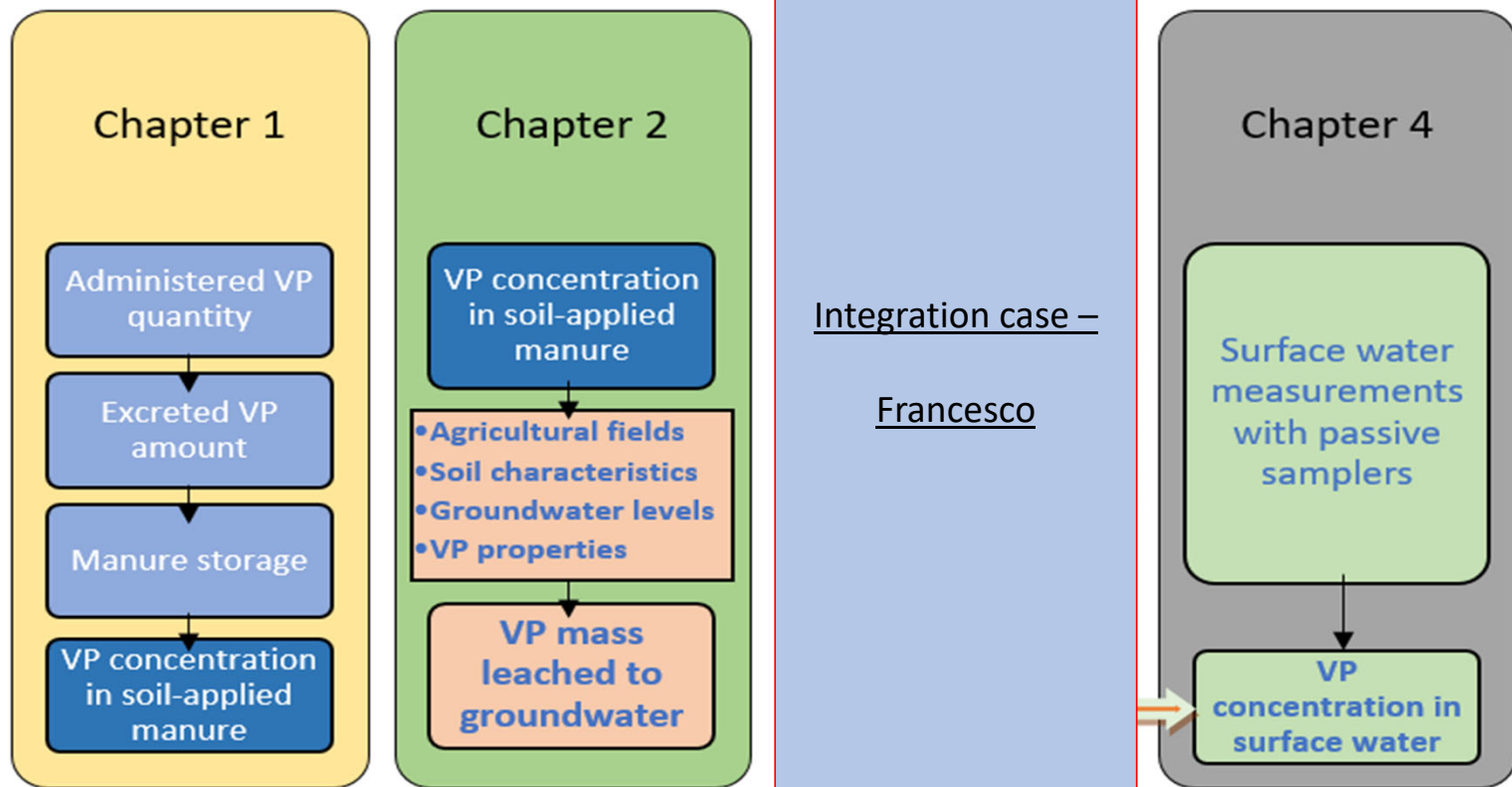


Source: Kadam et al., 2016.

Research objectives

1. Understand and quantify the chain of processes that lead to VPs concentrations in soil-applied manure.
2. Generate a modelling approach to investigate VPs transport towards groundwater.
3. Generate a modelling approach to investigate VPs transport towards surface water.
4. Quantify these compounds in surface water via sampling.





Chapter 1 – results

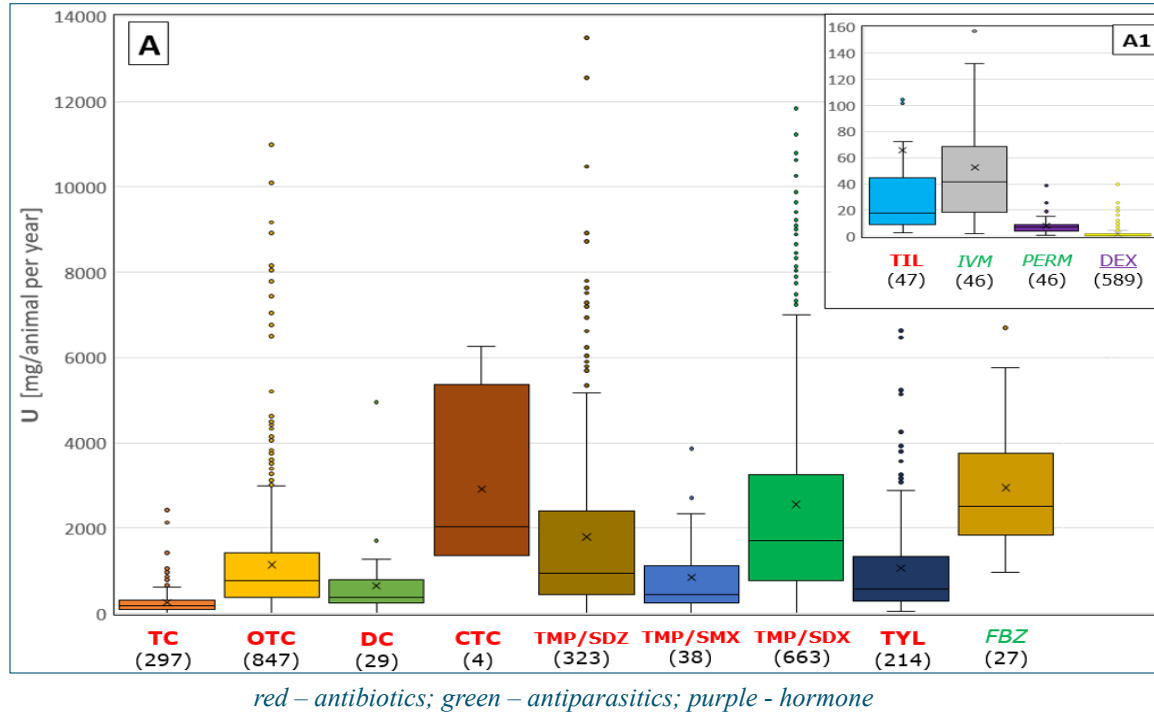
Usage of VPs for the period 2015-2018

Based on the yearly data coming from:

- 250 dairy cow farms, 60 sow farms, and 70 fattening pig farms (2-5% of the farms in the NL).



MASS USED



Distribution of use data in the dairy cow sector; Numbers in the legend indicate on how many farms the distribution is based on.

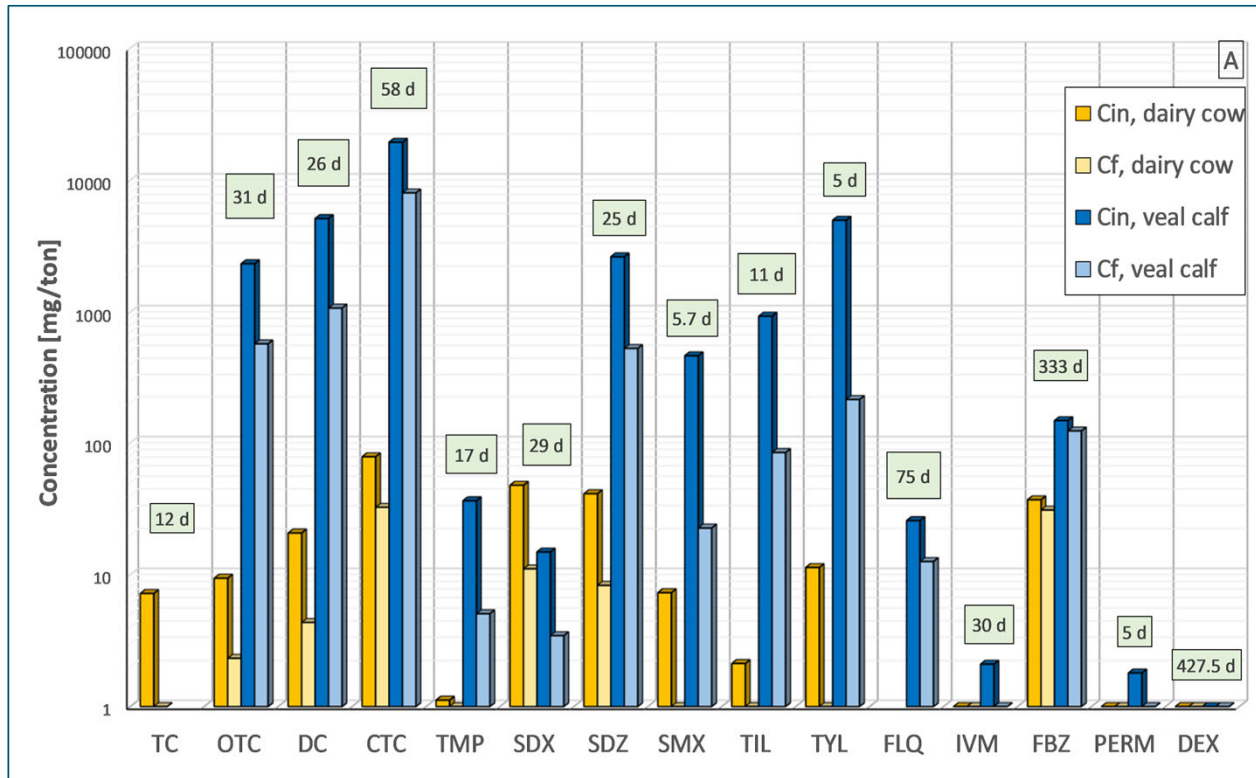


VPs concentrations in soil-applied manure

(based on used quantities, excretion rates, and modeled dissipation in storage)



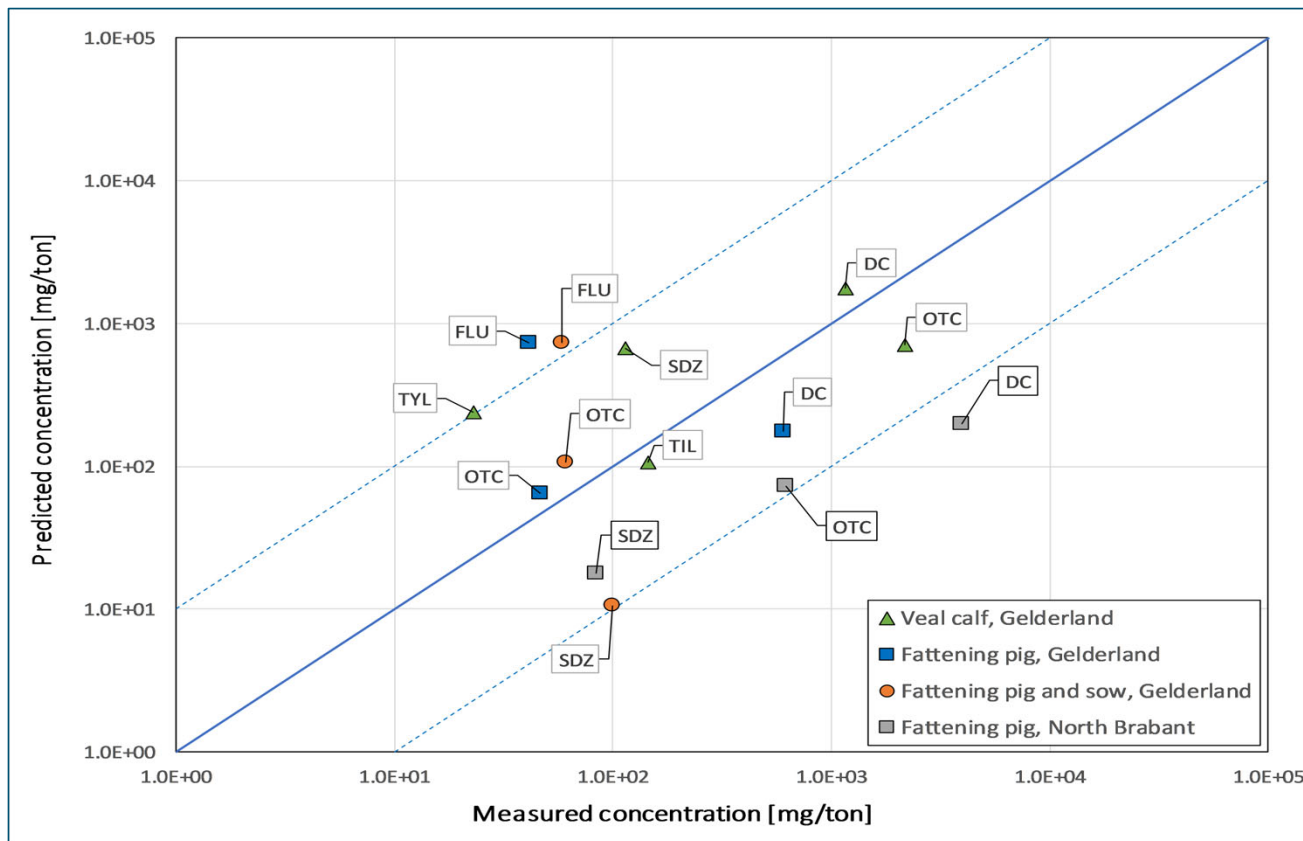
MASS IN MANURE



Concentrations of VPs in manure prior to storage (Cin) and after 6 months of storage (Cf). On the x axis are compound names.



Validation – comparison with measured concentrations from literature



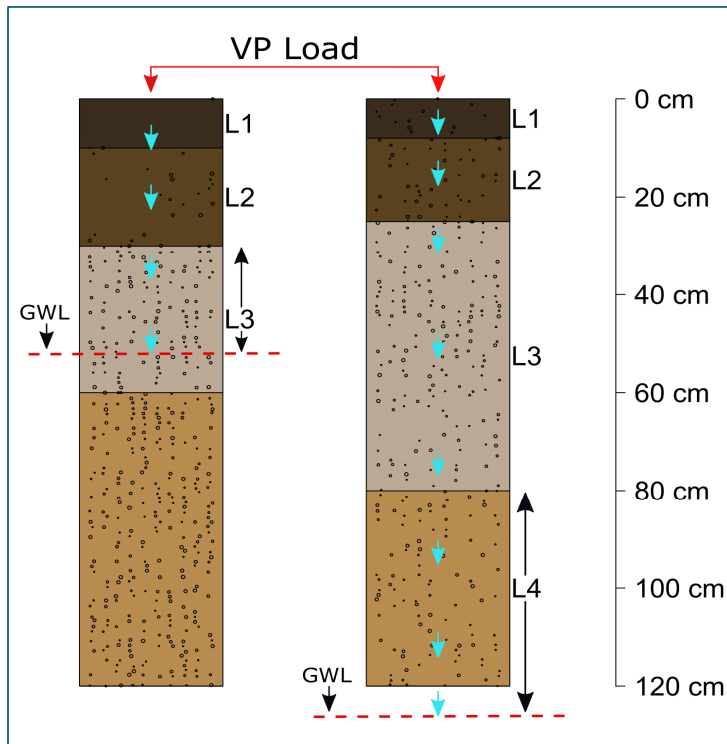
The solid line marks the ratio of 1:1, dotted lines differ a factor 10 from 1:1.



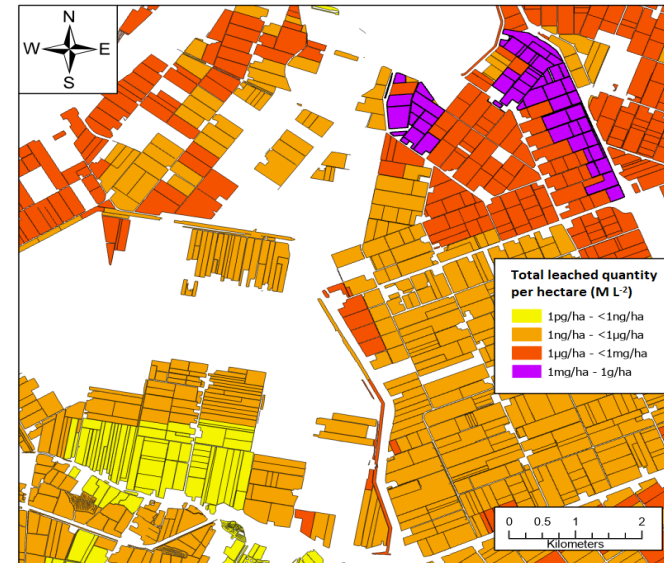
VALIDATED



Chapter 2 – approach



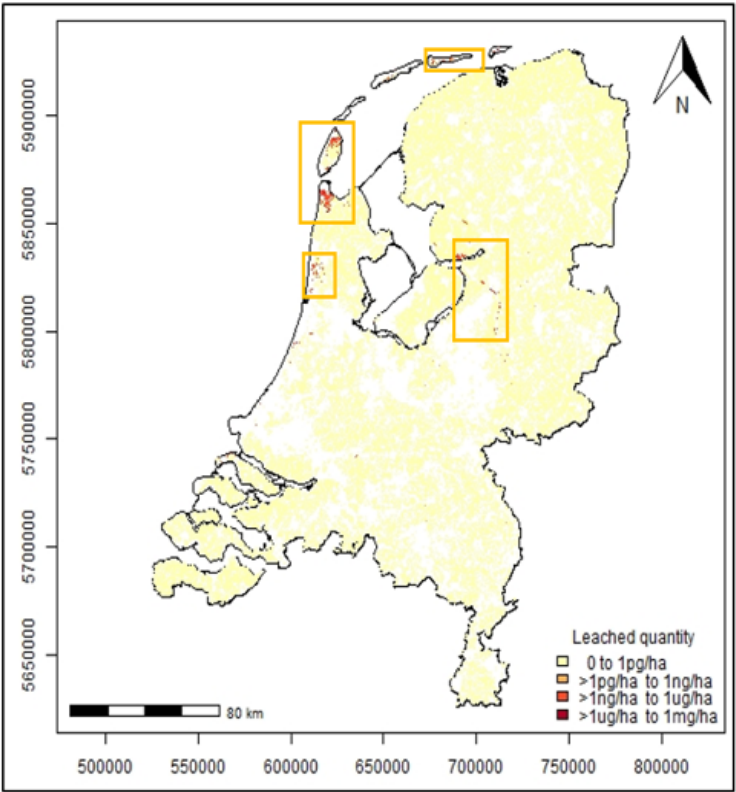
Conceptual model



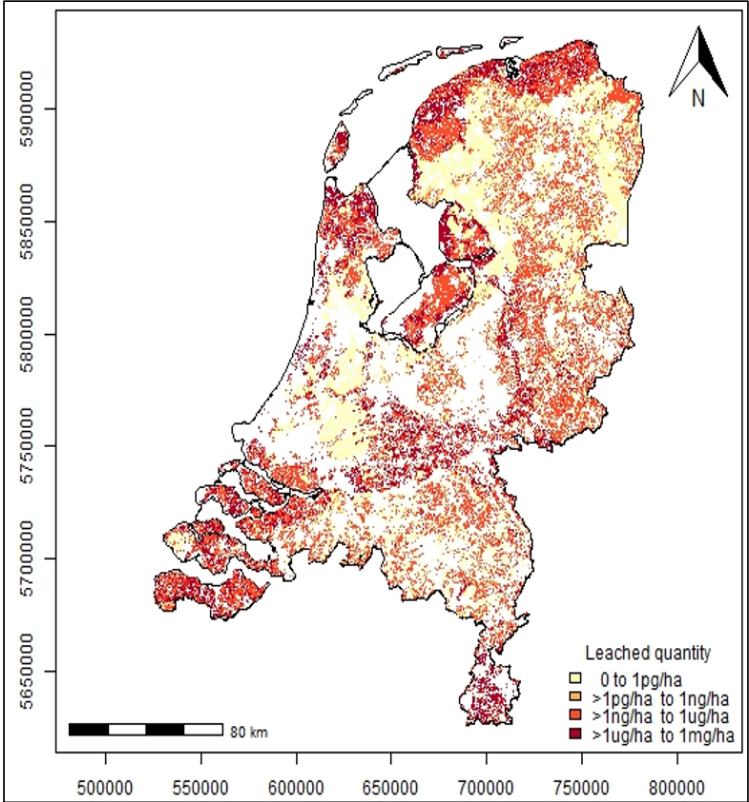
- Spatially distributed. Variability in use, manure types, soil/crop types, and groundwater level.
- Model applied at national scale;
- 1.1 million fields simulated;
- Relevant VPs are selected based on prioritization done in the Chapter 1.



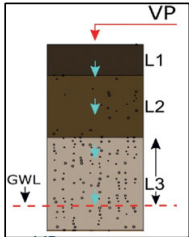
Chapter 2 – results



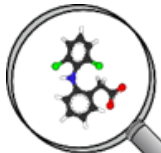
Sulfadiazine – national leaching map



Dexamethasone - national leaching map

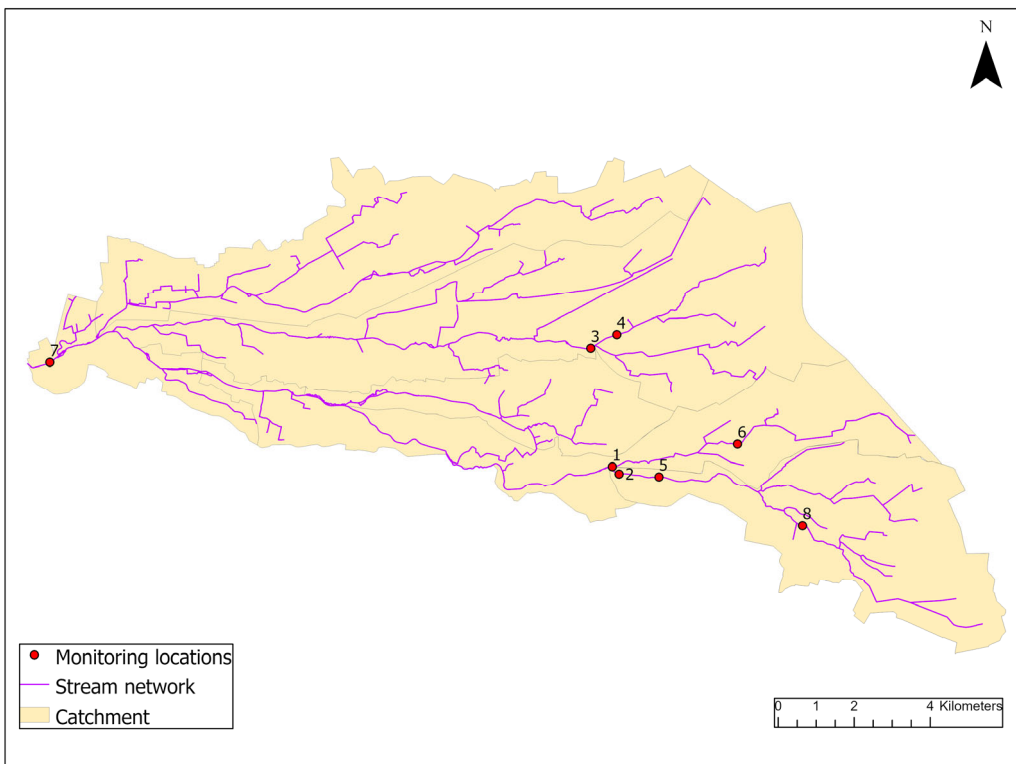


SOIL/GROUNDWATER TRANSFER



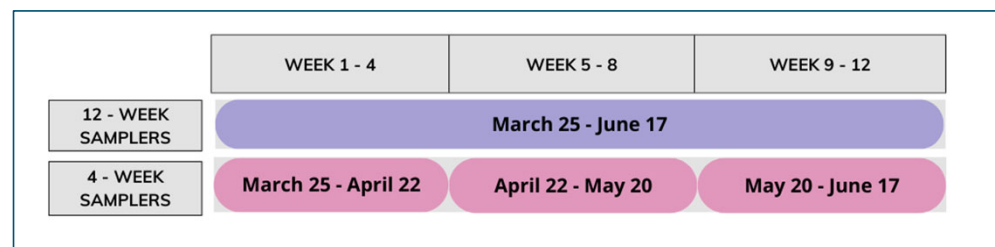
SUSPECT

Chapter 4 – approach



Selected agricultural catchment

- Passive sampling with Speedisk® ;
- Barneveld region, mid March to mid June 2020;
- 8 locations, 46 targeted compounds;



Sampling scheme

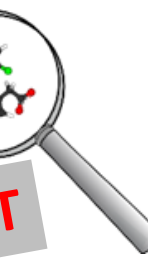




Passive sampler

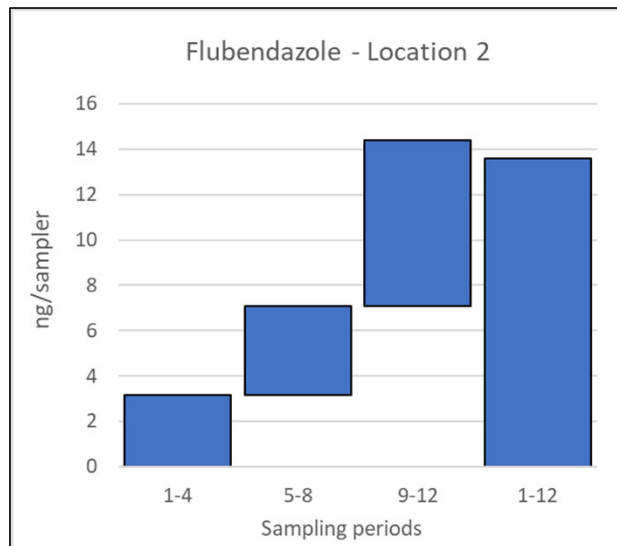


SUSPECT

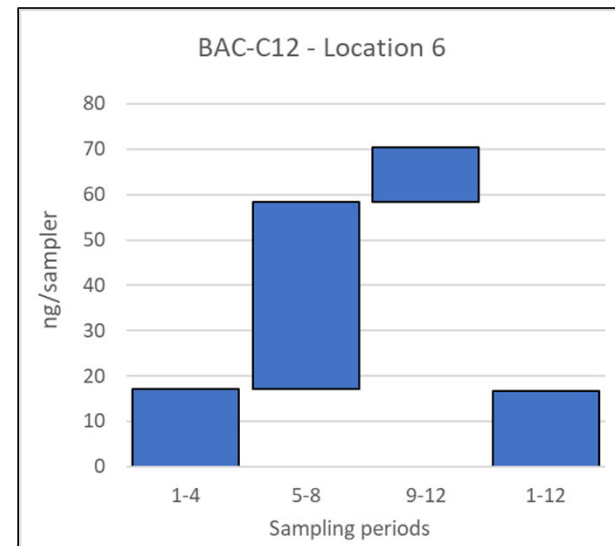


Chapter 4 – results

- From the 46 targeted compounds, 22 accumulated in passive samplers in amounts above the LOQ in at least one sampling period on one of the eight locations.
- The remaining compounds (24) may have been present in streams but undetected due to low recovery rates (passive sampling was found to be unsuitable for their detection).
- Several compounds originating from animal husbandry activities were quantified for the first time in Dutch surface waters, such as Flubendazole and Tilmicosine.



Time-integrative uptake in time (good performance)



Non-integrative uptake in time (poor performance)



Chapter 4 – results

Compound	Type	Cas no.	No. of detected locations
Flumequine	Antibiotic	42835-25-6	8/8
Sulfadiazine	Antibiotic	68-35-9	8/8
Sulfamethoxazole	Antibiotic	723-46-6	8/8
Tilmicosine	Antibiotic	108050-54-0	8/8
Trimethoprim	Antibiotic	738-70-5	7/8
Flubendazole	Antiparasitic	31430-15-6	8/8
Fipronil sulfone	Metabolite	120068-36-2	7/8
Estrone	Hormone	53-16-7	8/8
Benzyl dimethyl - dodecyl ammonium chloride (BAC-C12)	Biocide	139-07-1	8/8
Benzyl dimethyl - tetradecyl ammonium chloride (BAC-C14)	Biocide	139-08-2	8/8
Benzyl dimethyl - hexadecyl ammonium chloride (BAC-C16)	Biocide	122-18-9	8/8
Didecyl dimethyl - ammonium chloride (DDAC-C10)	Biocide	7173-51-5	8/8

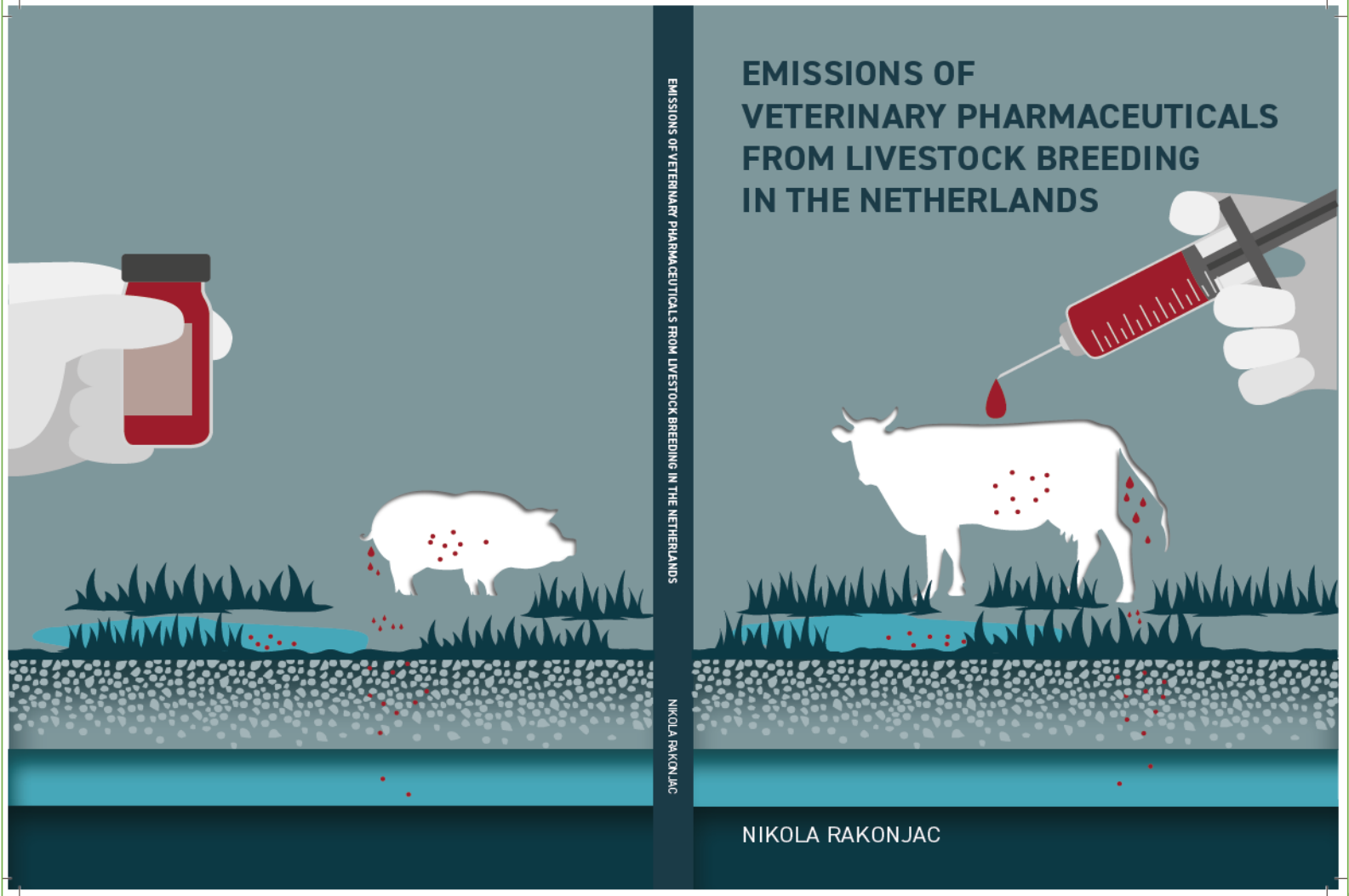


Summary

- VPs that are commonly used may not necessarily be the ones that end up with high concentrations on the soil.
- Various processes impact the spatial distribution of VPs leaching to groundwater, and their relative significance varies between different VPs.
- The temporal distribution of VPs occurrence in a stream is significantly impacted by the timing of manure application.
- Presence of several compounds in Dutch surface waters is reported for the first time with this work.

It is crucial to establish a more targeted monitoring program for VP residues in environmental compartments. This would provide valuable information for responsible authorities, while also supplying useful data for the respective models.





EMISSIONS OF VETERINARY PHARMACEUTICALS FROM LIVESTOCK BREEDING IN THE NETHERLANDS

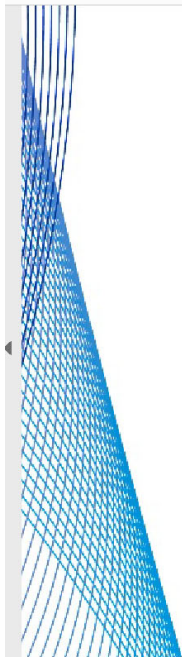
EMISSIONS OF VETERINARY PHARMACEUTICALS FROM LIVESTOCK BREEDING IN THE NETHERLANDS

NIKOLA RAKONJAC

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SUSPECT – onderdeel van:



stowa

KWR Watercycle
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Partnership
connecting innovators

