



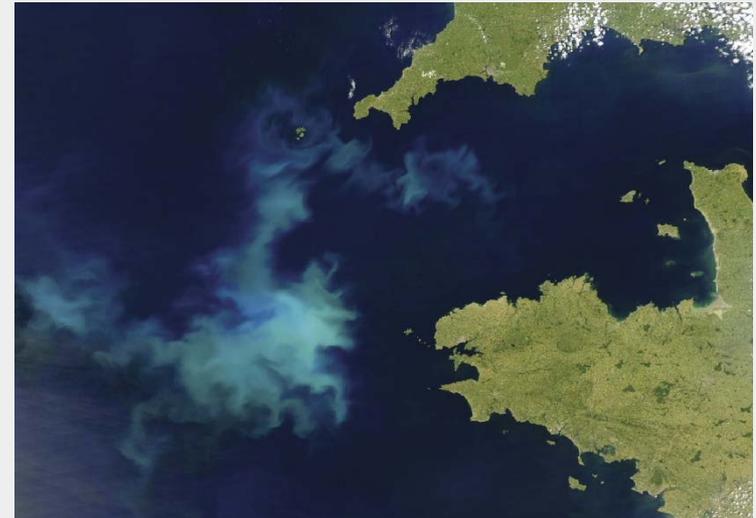
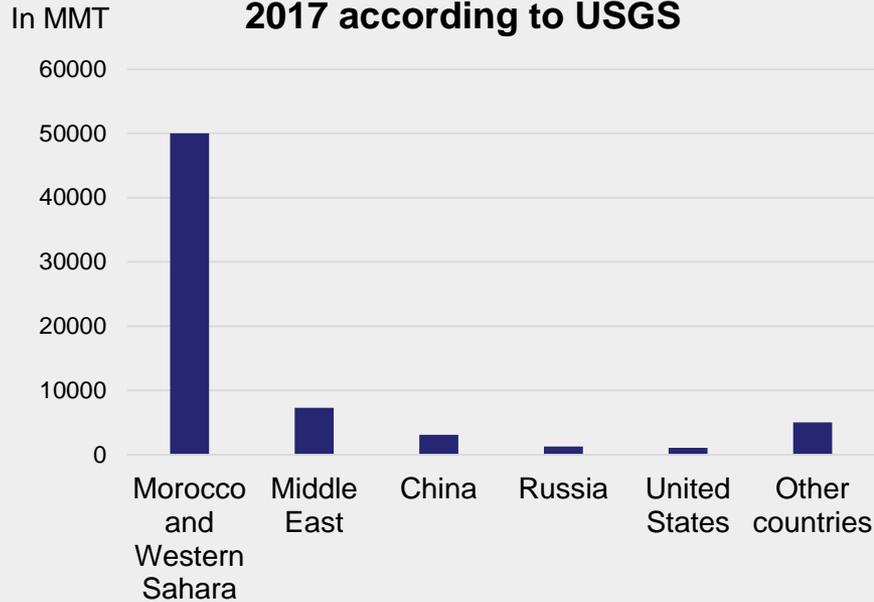
Marissa de Boer

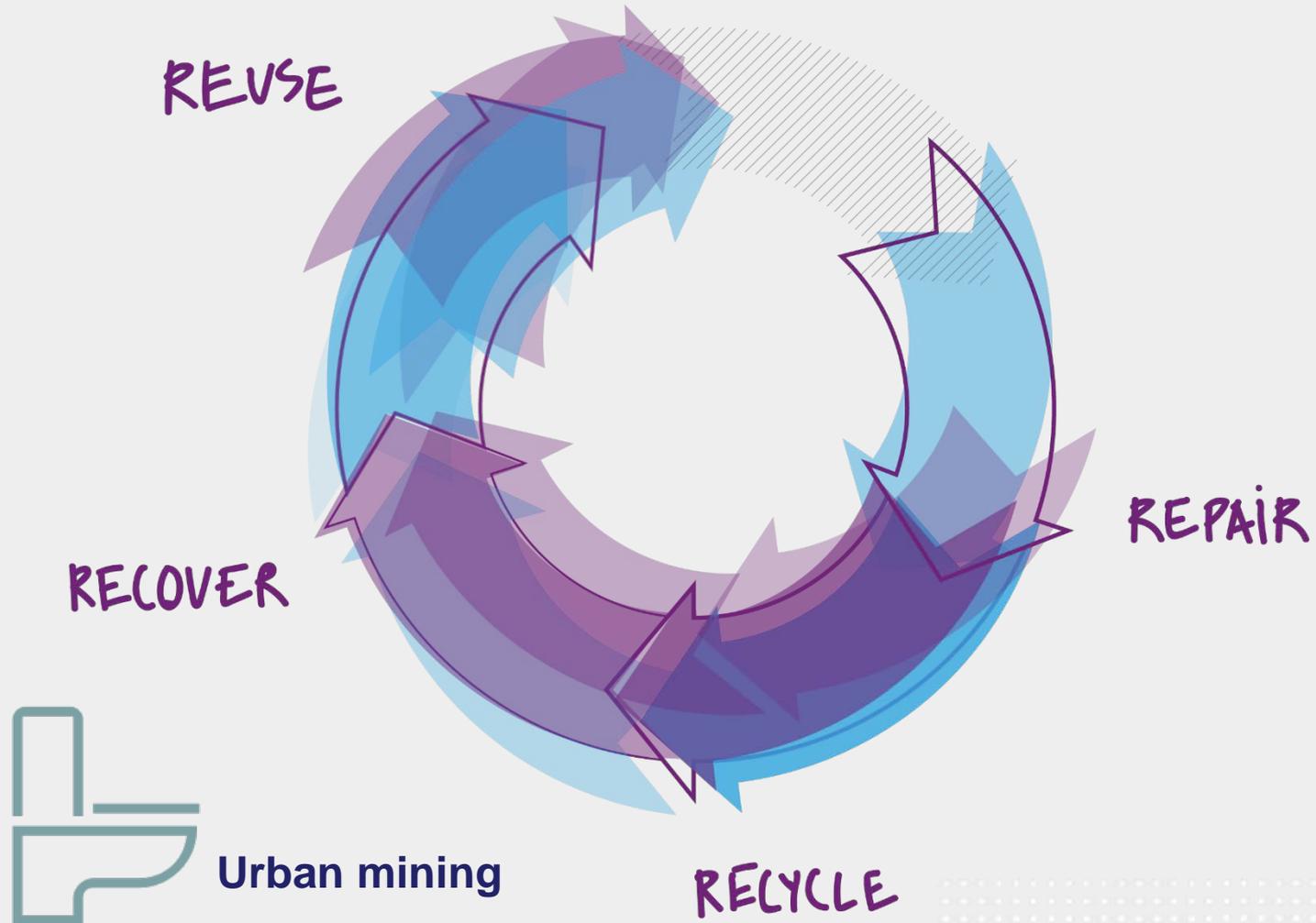
M.A.deBoer@uva.nl

Uptake of pharmaceuticals by sorbent-amended struvite fertilisers recovered from urine and their bioaccumulation in tomatoes

Position European Union

World reserves of phosphate rock in 2017 according to USGS





Reuse of nutrients: Urine



■ Opportunities

- High NP
- Waste water:
>80% of P outflow

■ Barriers

- Micro-pollutants
- Pathogens
- Storage &
Transportation

Reuse of nutrients: Urine



■ Opportunities

- High NP
- Waste water:
>80% of P outflow

■ Barriers

- **Micro-pollutants**
- Pathogens
- Storage &
Transportation

P/N Recovery

■ P recovery

- Struvite¹
 - High P/ Low N
 - Micro-pollutant exclusion



■ N recovery: NH_4^+ adsorption

- Zeolite²
 - 1.5 mol N/kg
- Biochar
 - Variable N uptake

¹ Le Corre et al. (2009) Critical reviews in
 Envir. Sciene & Techn.39(6), 433-477

² Hina et al. (2015) Clean-Soil, Air, Water,
 43(1), 89-91

Urine spiking

Micro-pollutant	Medical function
Carbamazepine	Epilepsy
Diclofenac	Blood pressure
Ibuprofen	Anti-inflammatory
Propranolol	Beta blocker
Sulfamethoxazole	Pain relief



Fertilizer preparation

Fertilizer

Struvite crystallization

Struvite crystallization & N adsorption to zeolite

Struvite crystallization & N adsorption to biochar

N adsorption to zeolite

N adsorption to biochar

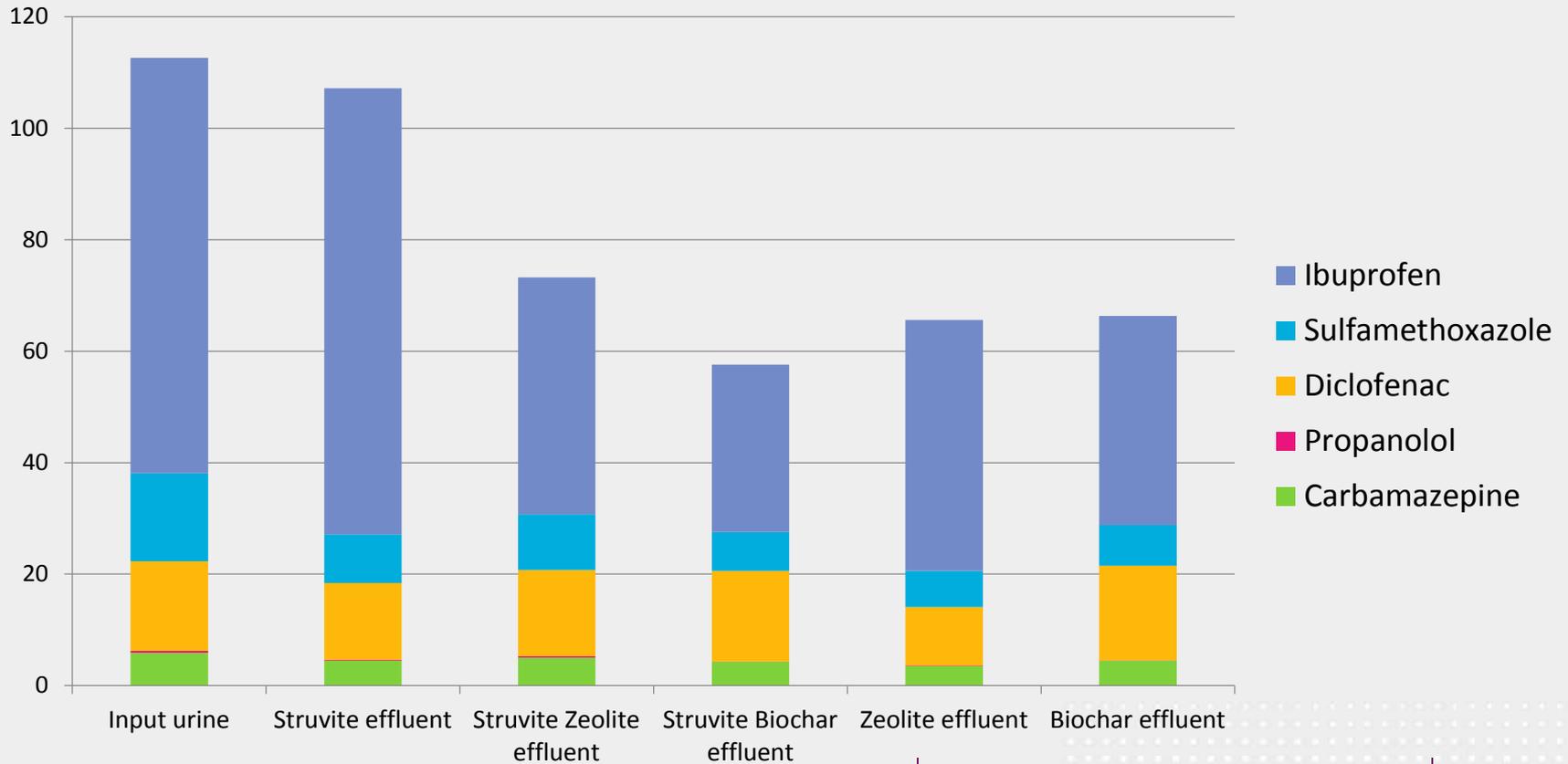


Fertilizer preparation

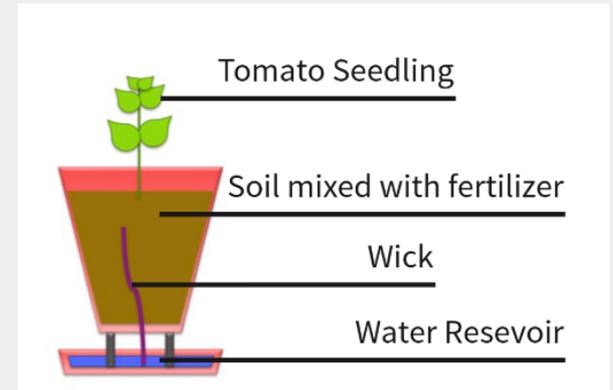
Fertilizer	N recovery %	P recovery %
Struvite crystallization	5.7	96.5
Struvite crystallization & N adsorption to zeolite	9.5	96.9
Struvite crystallization & N adsorption to biochar	9.8	98.1
N adsorption to zeolite	6.1	4.9
N adsorption to biochar	9.2	0.8



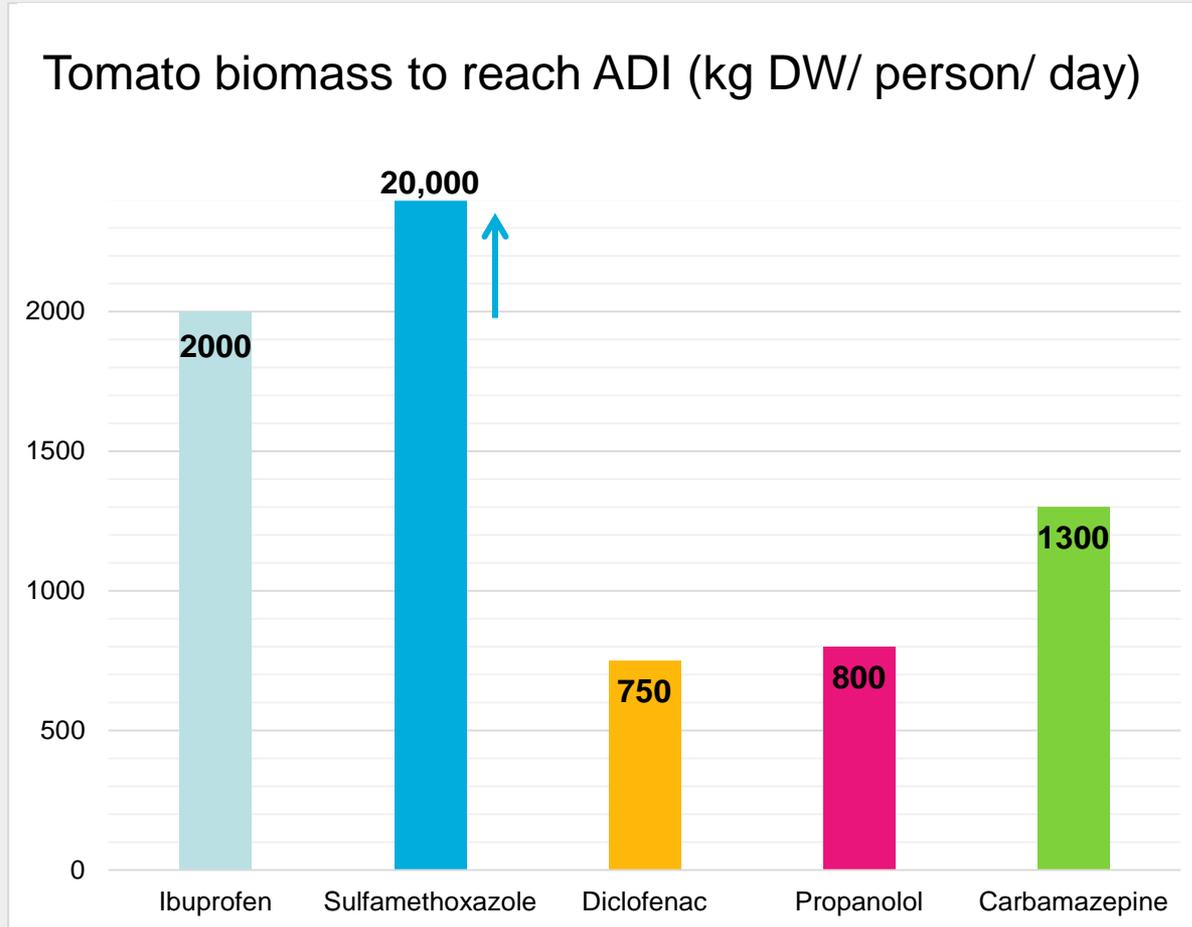
Pharmaceutical concentration in the effluent stream



Crop trial



Possible health risks



* The ADI level is a 100th of the daily therapeutic dose

Conclusion

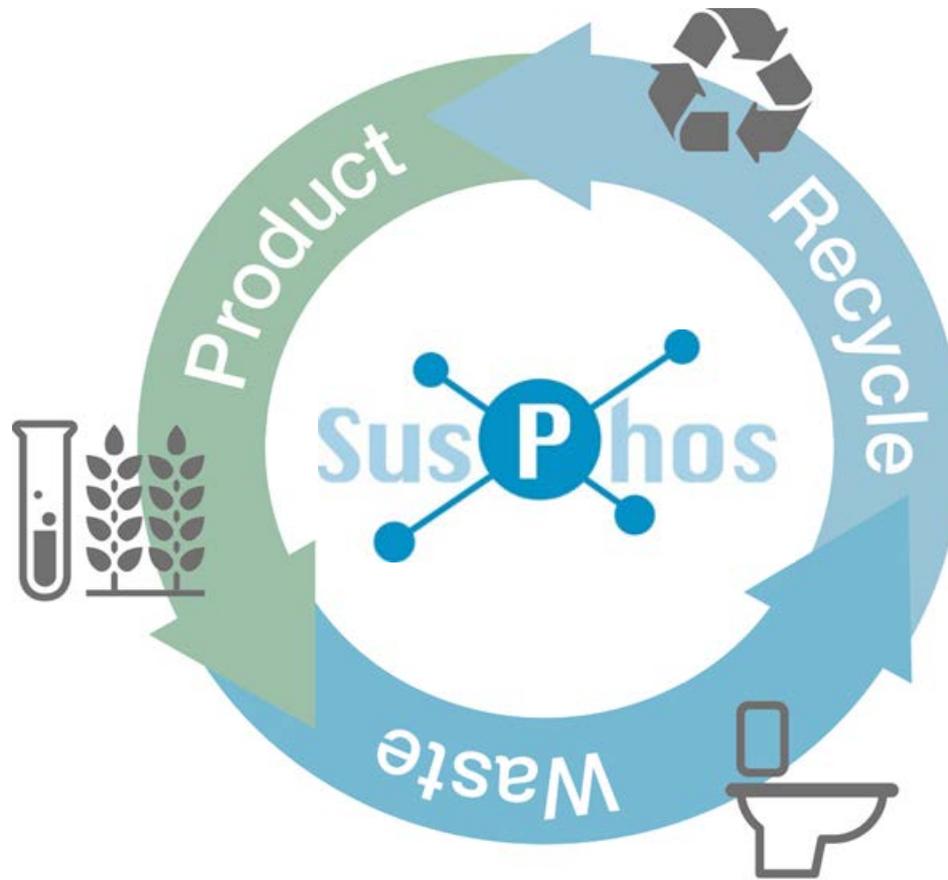
- Variable uptake of pharmaceuticals into sorbent materials
- Health risk is insignificant
- Further work
 - Analysis roots/leaves
 - Long term soil effects
 - Other waste streams



Acknowledgement

- Michelle Hammerton
 - Dr. J. Chris Slootweg
 - Waternet, de Ceuvel,
Metabolic, Mediamatic
-
- Marie Curie ITN SusPhos
 - TKI Watertechnology project





Marissa de Boer
M.A.deBoer@uva.nl
LinkedIn: Marissa de Boer