

Für Mensch & Umwelt

Umwelt   
Bundesamt

Workshop “Act now - Antibiotics and  
Antimicrobial resistance in the environment”

## **Options to minimize antibiotics and antibiotic resistances in the environment**

Jutta Klasen

Head of Chemical Safety Division, German Environment Agency

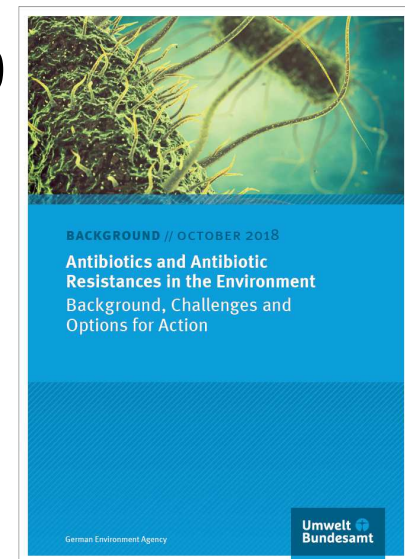
**Brussels, 07 November 2018**

## The EU One Health Action Plan against AMR prospects: *Concrete actions* to better addressing the role of the environment in tackling AMR.

The German Environment Agency (Umweltbundesamt, UBA)  
prepared a **background paper**:  
*Antibiotics and Antibiotic Resistances in the Environment.*

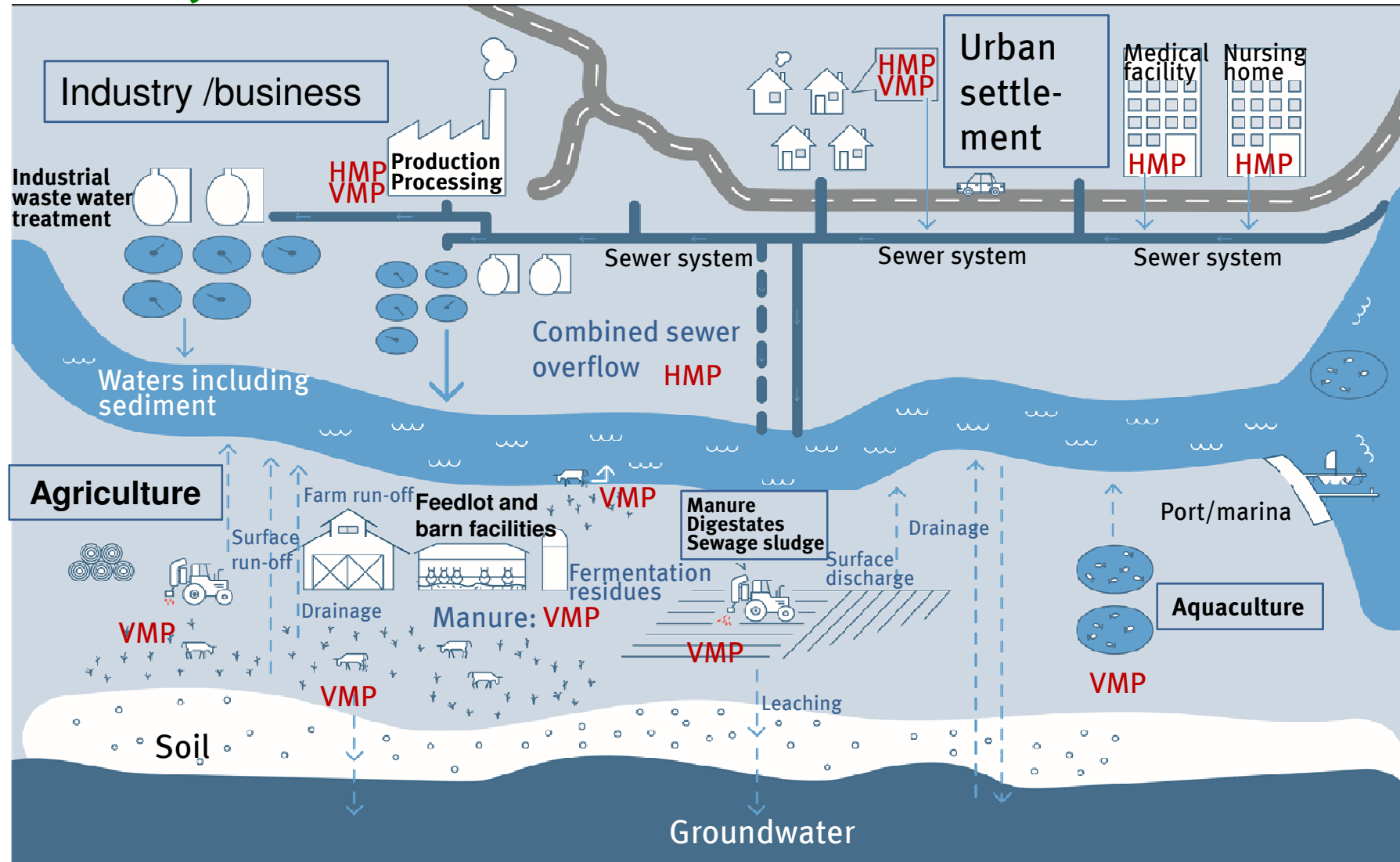
➤ four sections:

- General introduction
- **Comprehensive scientific background:**
  - How do antibiotics enter the environment?
  - How do antibiotic-resistant bacteria develop in the environment and where can they be found?
- The **interface between people and the environment** – what needs to be taken into account?
- **Research needs and options for action**



<https://www.umweltbundesamt.de/publikationen/antibiotics-antibiotic-resistances-in-the>

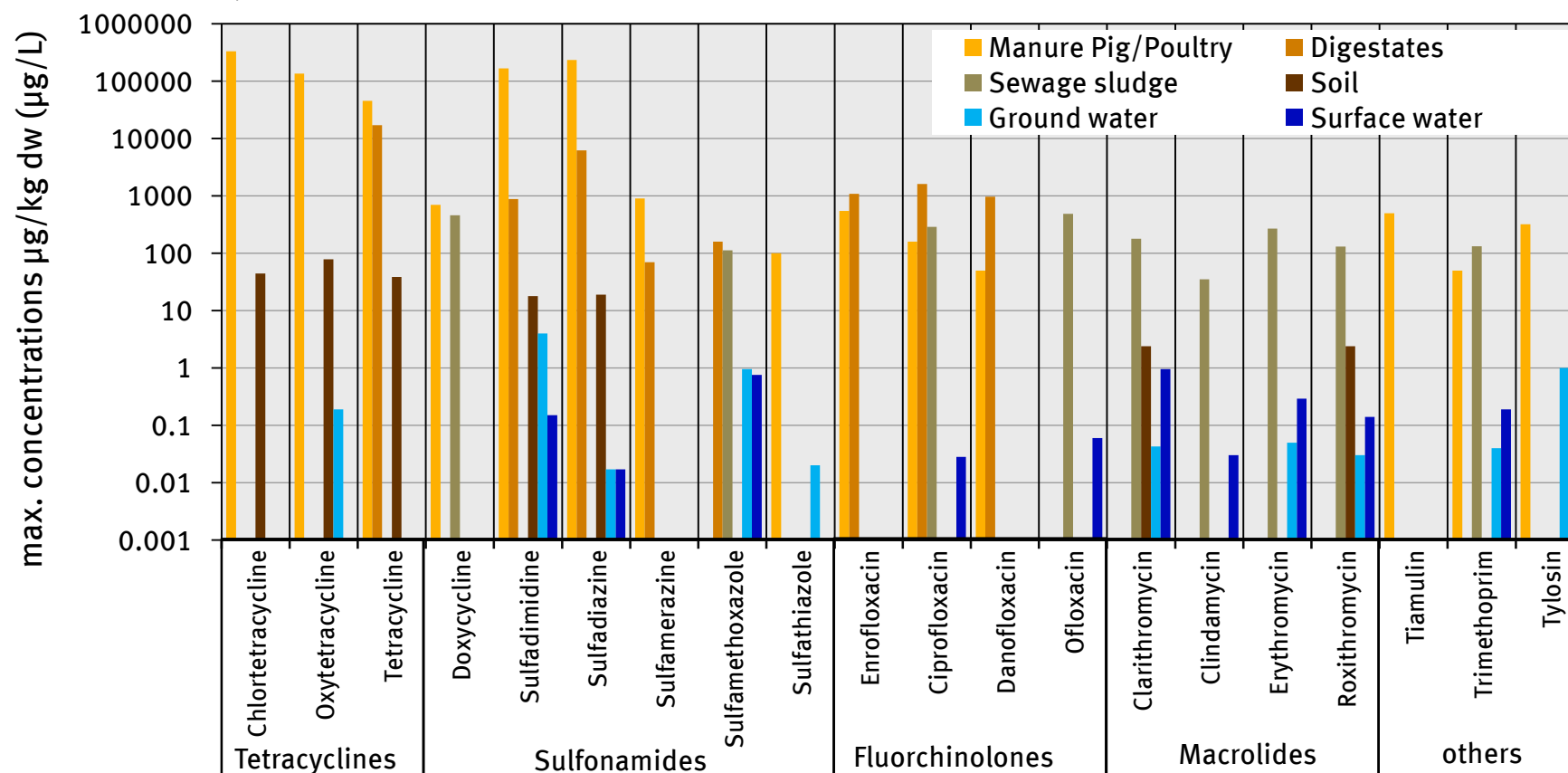
# Entry pathways of antibiotics into the environment from human and veterinary medicine



<https://www.umweltbundesamt.de/publikationen/antibiotics-antibiotic-resistances-in-the>

## Findings in environmental samples

- Antibiotic agents are found in almost every environmental compartment  
→ due to high amounts in manure, digestates and sewage sludge
- some antibiotics exceed suggested environmental quality standards (EQS)  
currently under discussion in the water framework directive



Source: Schönfeld, J. Konradi S. Berkner S. Westphal Settele K.. UMID 2/2017 [https://www.umweltbundesamt.de/sites/default/files/medien/3240/publikationen/umid\\_02-2017\\_uba\\_antibiotika\\_0.pdf](https://www.umweltbundesamt.de/sites/default/files/medien/3240/publikationen/umid_02-2017_uba_antibiotika_0.pdf)

## Antibiotics also pose risks to environmental ecosystems

- Inhibition of growth of algae, cyanobacteria and plants already at low concentrations ( $\mu\text{g/L}$ )



Green algae



Cyanobacteria



Aquatic plants

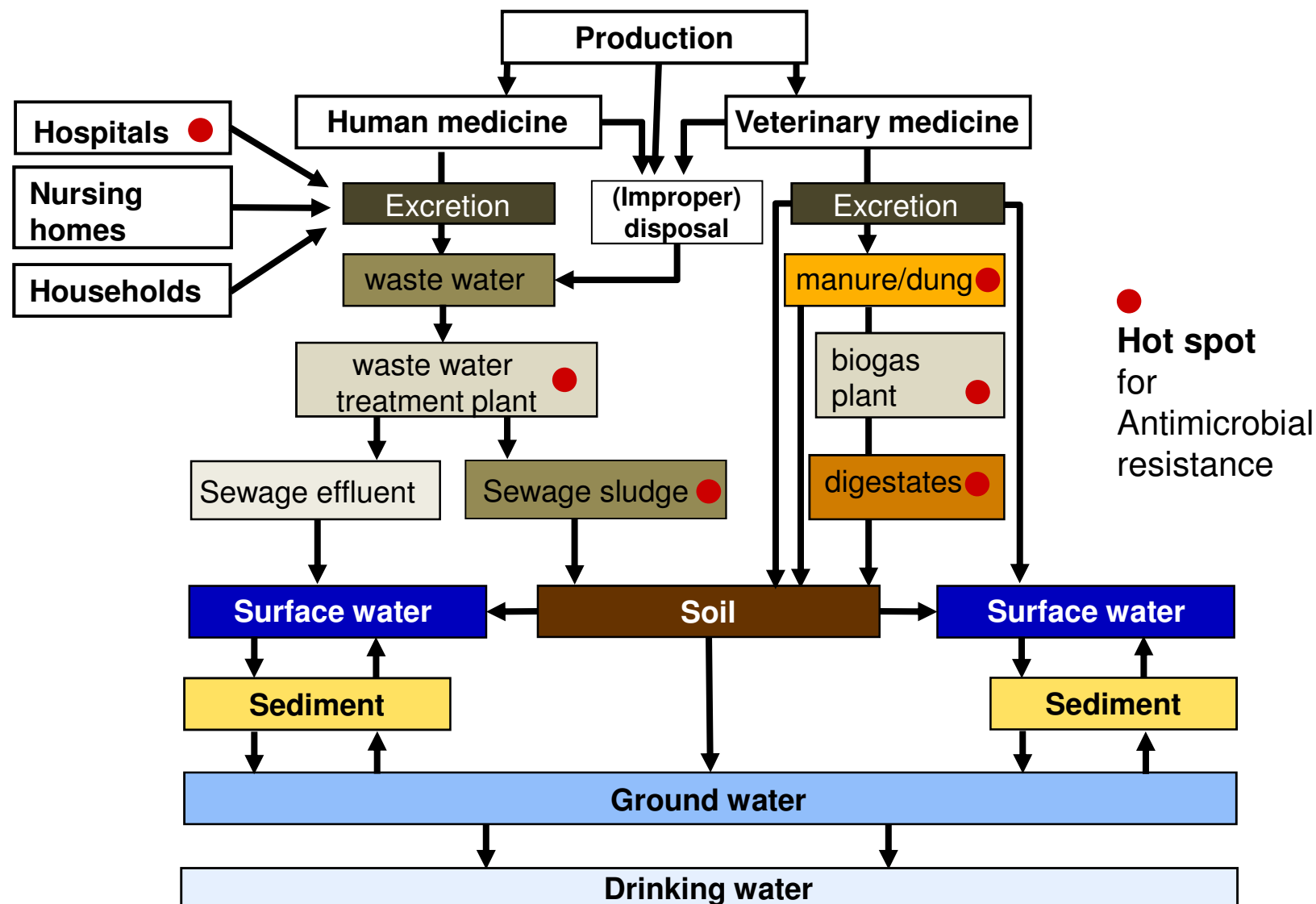


Terrestrial plants

- Impairment of primary producers
- Impact on food webs of ecosystems
- Mixture toxicity of antibiotics and effects on soil microorganisms
- Uptake of antibiotics in terrestrial plants

Source: Umweltbundesamt

# Environmental hot spots of AMR development and spreading



Source: Schönfeld, J. Konradi S. Berkner S. Westphal Settele K.. UMID 2/2017 [https://www.umweltbundesamt.de/sites/default/files/medien/3240/publikationen/umid\\_02-2017\\_uba\\_antibiotika\\_0.pdf](https://www.umweltbundesamt.de/sites/default/files/medien/3240/publikationen/umid_02-2017_uba_antibiotika_0.pdf)

## Main drivers for the emergence and dissemination of AMR in the environment:

- Transmission of resistance genes between different bacterial species, i.e. **horizontal gene transfer** (HGT).

- **Natural selection** and **co-selection** of resistance.

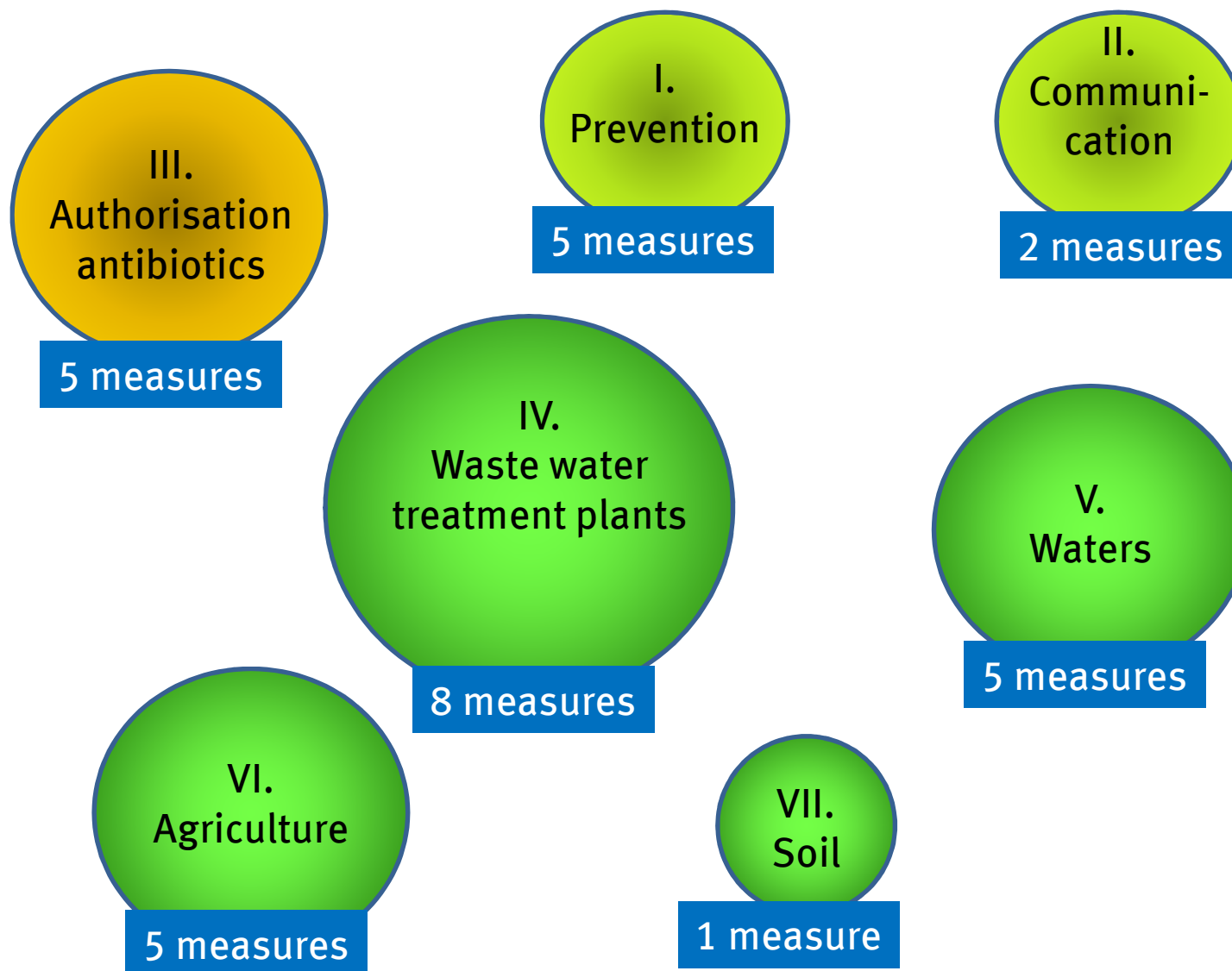


Even extremely low concentrations of antibiotic residues are sufficient for giving antibiotic-resistant bacteria a **selection advantage** compared with non-resistant bacteria (selection pressure).

This selection can also be fostered by other environmental pollutants, such as biocides, heavy metals (zinc, copper) and antibiotic mixtures.

- **Monitoring** of environmental matrices for antibiotic residues (and co-selecting agents) and resistant bacteria is crucial to fill the existing gaps in knowledge

## Areas of activity: specific measures





## Specific measures: prevention, communication

### I. Prevention:

- **Use of antibiotics should be limited** to the medically necessary level.
- Pharmaceutical forms for application should be adapted to **reduce the residues of antibiotics in excreta.**

### II. Communication:

- Doctors, pharmacists, veterinarians and farmers must be **informed and trained** on the topic of antibiotics in the environment.
- Campaigns on the **correct disposal** of antibiotic residues.

## Specific measures: authorisation of human and veterinary pharmaceuticals

### III. Measures to improve authorisation of antibiotics:

- Develop and implement **assessment methods and criteria** for antibiotics and antibiotic resistances.
- Develop and **implement a risk assessment** for the occurrence of resistances.
- Develop a **substance-based environmental assessment for antibiotics (monographs)** and **publish harmonized endpoints**
- Include **environmental considerations in the risk-benefit analysis** for the **authorization of antibiotics for human medicine**

### Current regulatory situation:

- Environmental risks of veterinary/human medicines only assessed since 2005/2006
- **Lack/incomplete environmental risk assessment data for about 84% of antibiotics**
- Current **environmental risk assessment does not include antibiotic resistance**

## Specific measures: waste water treatment plants, waters

### IV. Direct and indirect discharge of waste water treatment plants (municipal and industrial)/production sites:

- Identify **hotspots for the discharge** of antibiotics and antibiotic resistances.
- Develop **monitoring guidelines** to be able to better monitor the discharge of antibiotics and antibiotic resistances into waste waters.
- **Improve the technology** at waste water treatment plants.
- Compile the **production locations** and examine the **emissions from production facilities**.

### V. Surface waters/bathing waters/groundwater:

- Develop **monitoring guidelines** and assessment concepts for the monitoring of antibiotic resistance in **surface and bathing waters**.
- Include antibiotics and antibiotic resistances in the **Water Framework Directive**.
- **Reduce the input** of antibiotic resistances into surface and bathing waters, e. g. through the widening of riparian strips and the designation of water protection zones.

## Specific measures: agriculture and soil

### VI. Fertilisers used in agriculture:

- **Needs-based fertilization.**
- Prohibit the **application of sewage sludge onto soil** and use sewage sludge for the recovery of phosphorous.
- Introduce the compulsory documentation of the antibiotics used in livestock stables and the co-selectors of zinc and copper used as animal feed.

### VII. Soil:

- **Monitor the dissemination** of antibiotic residues and antibiotic-resistant bacteria at selected arable farmland locations throughout Germany.
- Define **precautionary limit values for antibiotics** as well as **zinc and copper** in the soil.

## Take home messages I

## Environment

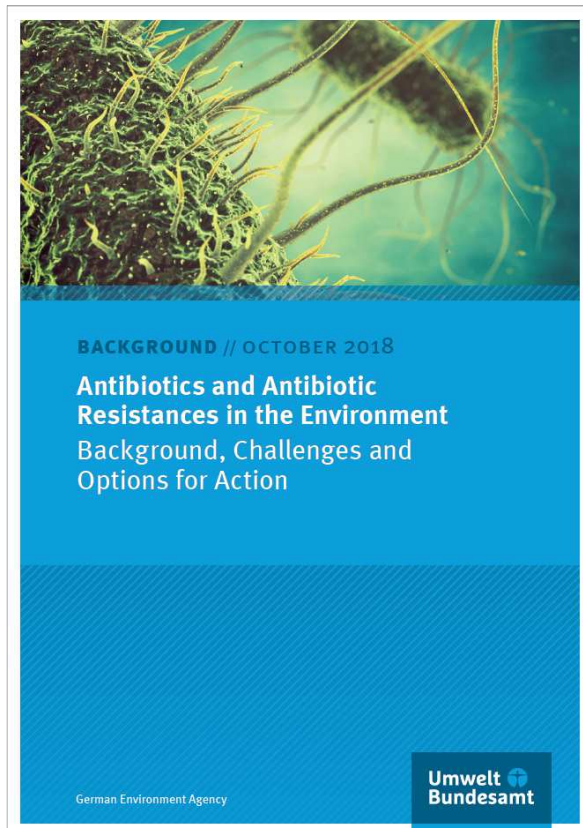
- We have to distinguish between antibiotics and AMR in the environment
- Antibiotics in the environment effect non-target organisms (e.g. plants, algae)
- As a consequence the equilibrium of the ecosystem is disturbed
- Environmental entry paths are often identical for antibiotics and AMR
- The role of the different affected environmental compartments for AMRs is not yet clear

## Take home messages II

## Environment & health

- Even low concentrations of antibiotics can encourage AMR development
- The role of the environment as a reservoir for AMR needs consideration
- Transfer of AMR via drinking water consumption is unlikely
- Antibiotics and AMR spreading have to be considered within the discussions of water-reuse in Europe
- AMR `import` from countries with high antibiotic production needs observation
- Environment plays an important role in relation to AMR
- We should not wait for more data
  - it is important to act now, also at the legislation level

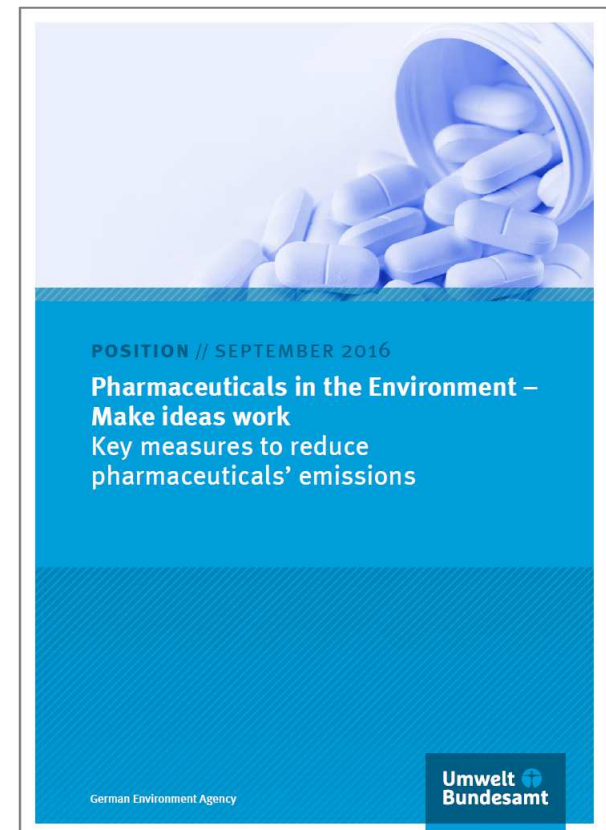
## Related publications by the German Environment Agency



Antibiotics and Antibiotic Resistances in the Environment Background, Challenges and Options for Action, UBA 2018  
<https://www.umweltbundesamt.de/publikationen/antibiotics-antibiotic-resistances-in-the>



Recommendations for reducing micropollutants in waters, UBA 2018  
<https://www.umweltbundesamt.de/en/publikationen/recommendations-for-reducing-micropollutants-in>



Pharmaceuticals in the Environment – Make ideas work Key measures to reduce pharmaceuticals' emissions, UBA 2016  
<https://www.umweltbundesamt.de/publikationen/pharmaceuticals-in-the-environment-make-ideas-work>



# Thank you for your attention !

**Jutta Klasen**

[jutta.klasen@uba.de](mailto:jutta.klasen@uba.de)

[www.umweltbundesamt.de/themen/chemikalien/arzneimittel](http://www.umweltbundesamt.de/themen/chemikalien/arzneimittel)