IWA YOUNG WATER PROFESSIONALS GERMANY

DWA Klare Konzepte. Saubere Umwelt.

IWA YOUNG WATER PROFESSIONALS ITALY

IWA YOUNG WATER PROFESSIONALS

BUILDING BRIDGES

ONLINE EVENT SERIES

Wastewater Reuse In Agriculture

Tuesday, 22 Nov ‘22 2 PM (Central European Time)

AGENDA (Duration 1.5 hrs)

. 15’ Introduction

. 15’ Guest Speaker Italy: **Luca Pensirini** (Politecnico di Milano)

. 15’ Guest Speaker Germany: **Max Zimmermann** (RWTH Aachen)

. 45’ Networking Discussion

info@ywp-germany.com
international@junge-dwa.de

ywpitaly@gmail.com

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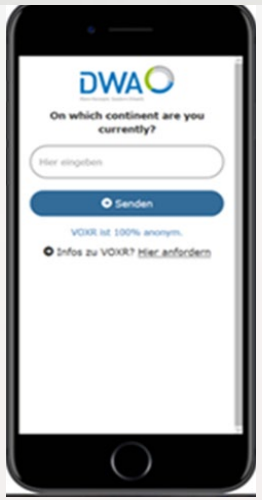
Tell us about yourself!

LINK VOXR: https://voxr.com/dwa



QUESTION 1

What sector are you currently in?

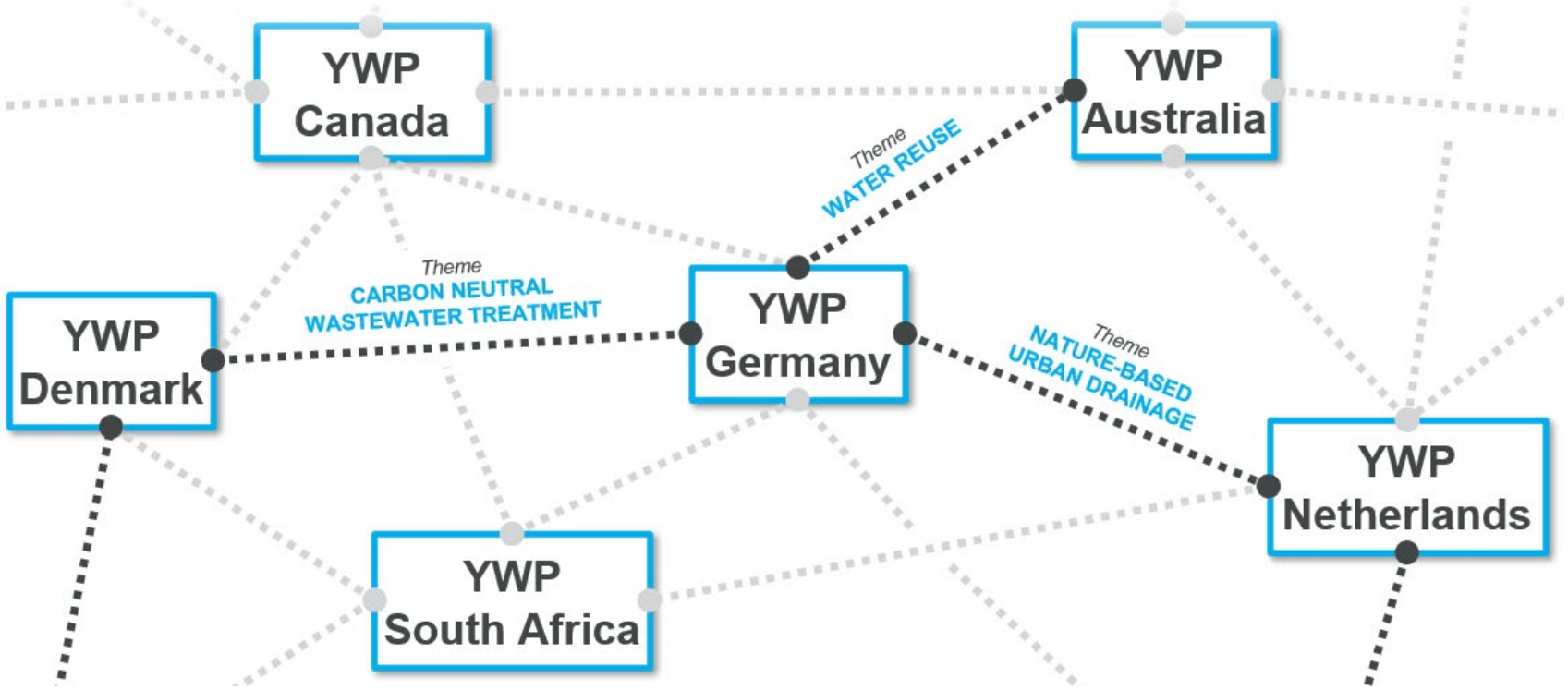
MULTIPLE CHOICE

A. Academia,
B. Industry,
C. Policy/Government,
D. Research,
E. Engineering Consultancy/Design,
F. Other

BUILDING BRIDGES ONLINE EVENTS

Concept in a nutshell

- International Roundtables part of IWA endorsed **Building Bridges Online Event Series**
- Regular get-togethers connecting YWP across the globe in **bilateral dialogue**
- Platform to network and **engage over a topic** relevant to both countries
- Platform **empowering YWP** to present insights and to **learn** from peers



INTRODUCING OURSELVES!

JUNGE DWA (YOUNG DWA)

Connect - Roundtables

Exchange - Network Meetings

Grow - Circles & Inclusion

international@junge-dwa.de

https://en.dwa.de/en/jungedwa.html

XING-Gruppe > JungeDWA

INTRODUCING OURSELVES!

IWA YWP GERMANY (YWPGER)

We connect (young) water professionals in Germany with the world, and the world with Germany.

- Organisation of **roundtables** & network events
- **Publications** (national & international)
- **Representing** GER abroad within IWA events and at international conferences
- **Connecting** with other IWA chapters

info@ywp-germany.com

https://ywp-germany.com/ @YWP_Germany

https://www.linkedin.com/company/ywp-germany/

INTRODUCING OURSELVES!

IWA YWP ITALY

the international water association

YOUNG WATER PROFESSIONALS ITALY

- **Born** in February 2022
- **Aims** to connect and empower YWPs from academia and industry
- **Organizes** several activities for networking and professional growth within YWPIT and with other chapters
- **Future activities** include:
  - Mentoring
  - Webinars
  - YWP meetup in Milan (June 2023)

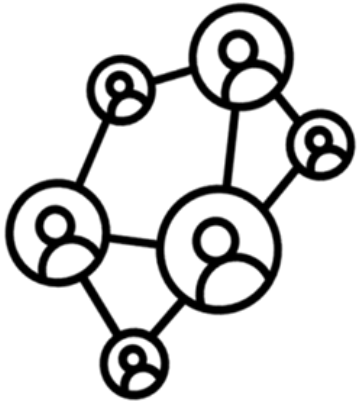
SIDISA (Torino) 30/06/2021

YWPs Regional Call 02/03/2022

Global Coordination Call 30/03/2022

Call with YWP-Sweden 09/05/2022

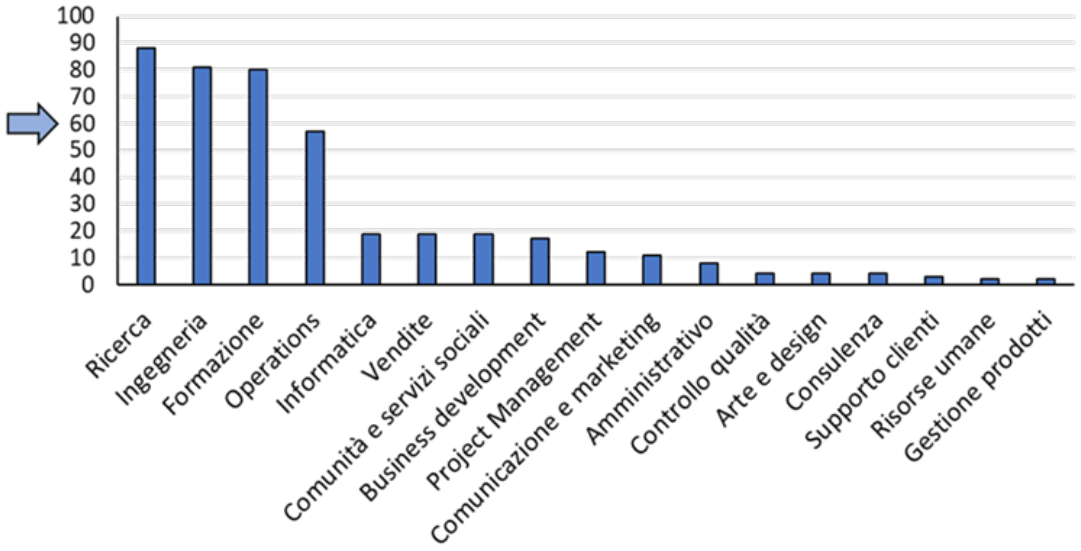
YWPIT in numbers



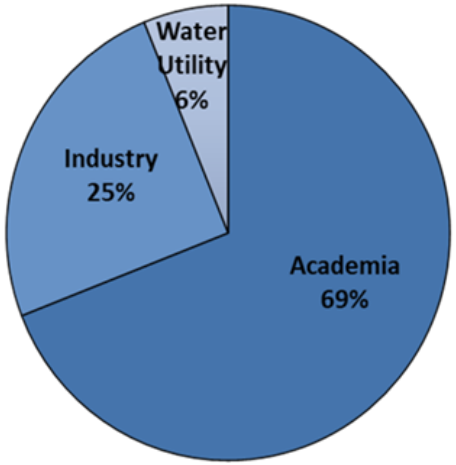
772 Follower from 27 countries

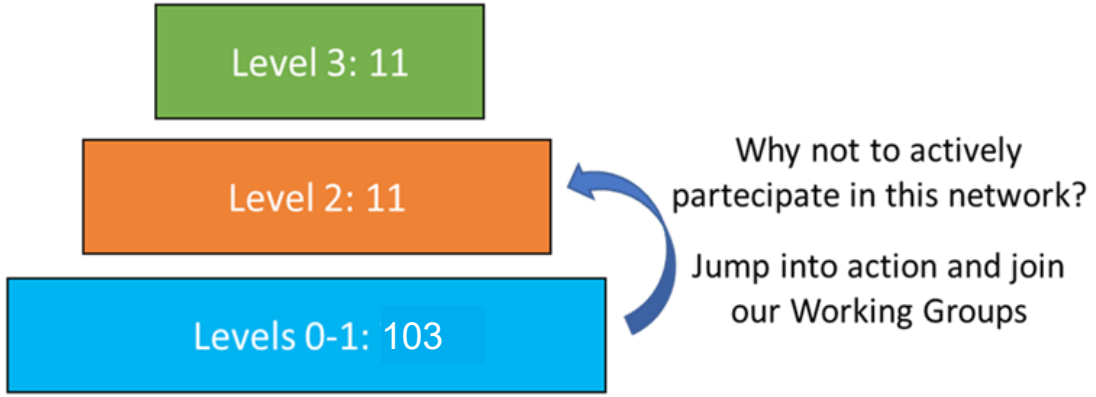
4th most followed YWP group

142 Followers from 11 countries



125 Members from 9 countries





Why not to actively partecipate in this network?

Jump into action and join our Working Groups

Let’s keep in touch!

Email: ywpitaly@gmail.com

LinkedIn: Young Water Professionals Italy

Twitter: @ItalyYwp

Slack:

Website: **STAY TUNED!**

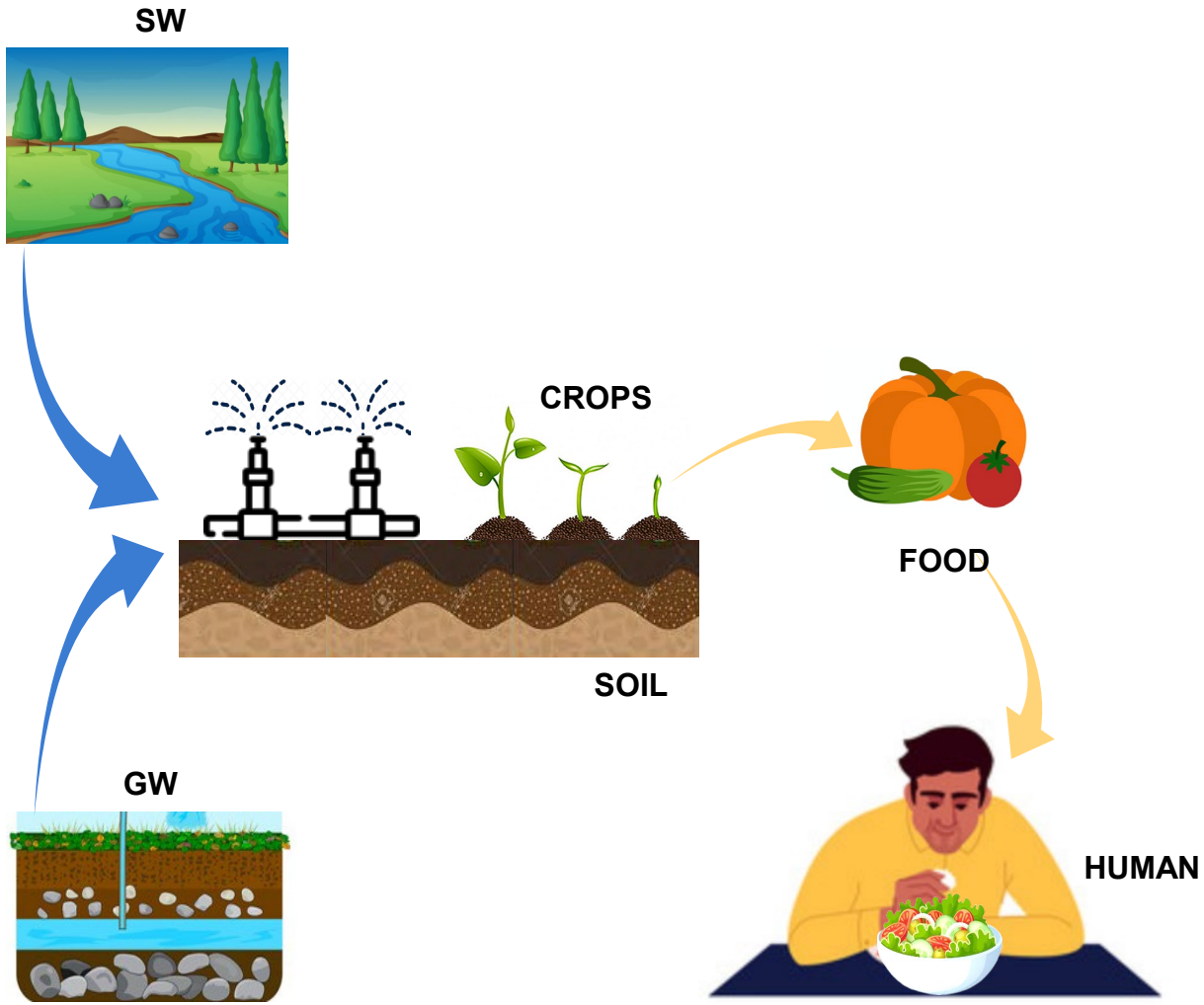
GUEST SPEAKER

YWP ITALY

- **LUCA PENSERINI**
  PhD Student, Politecnico di Milano

BACKGROUND

WW reuse in agriculture impacts



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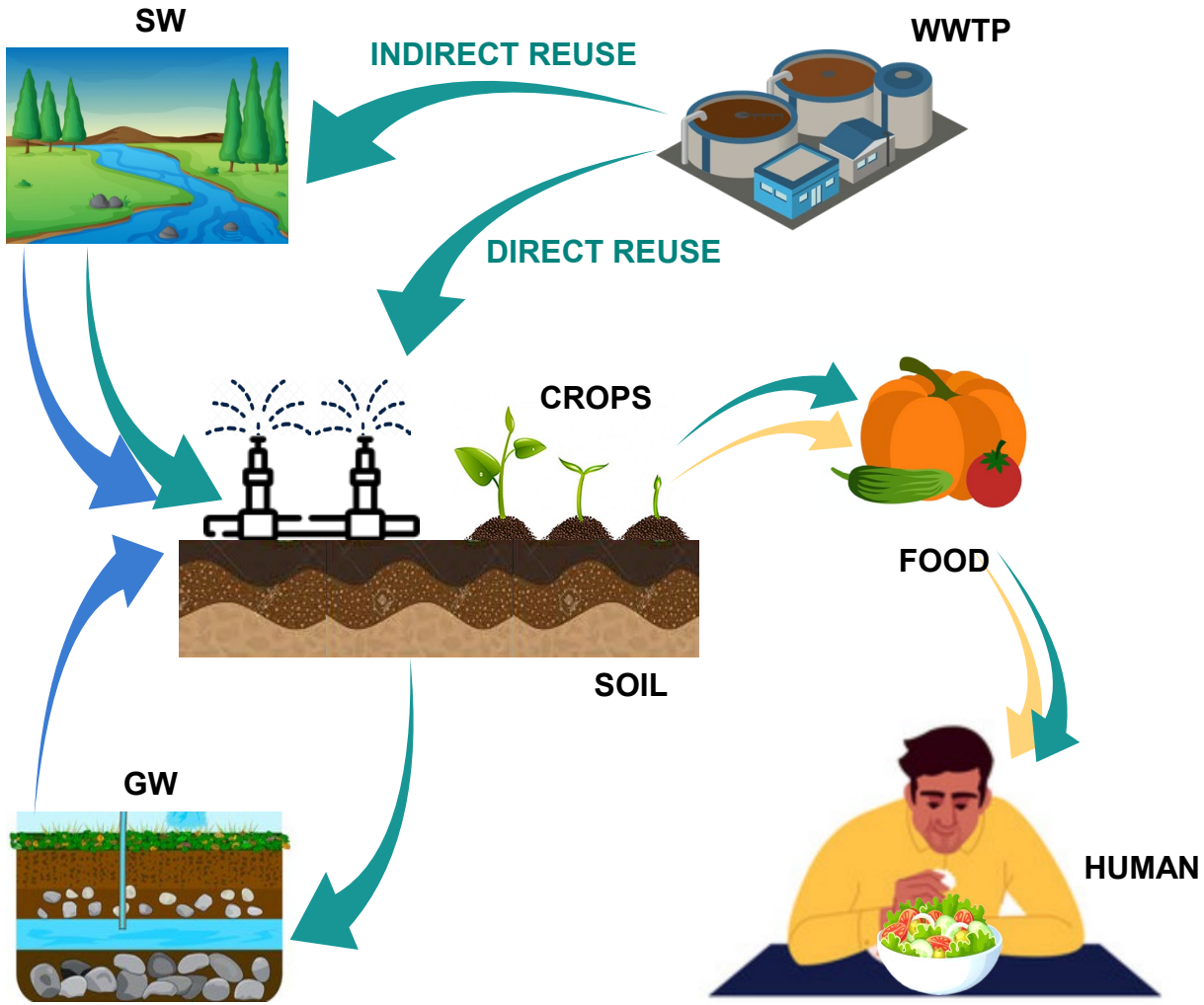
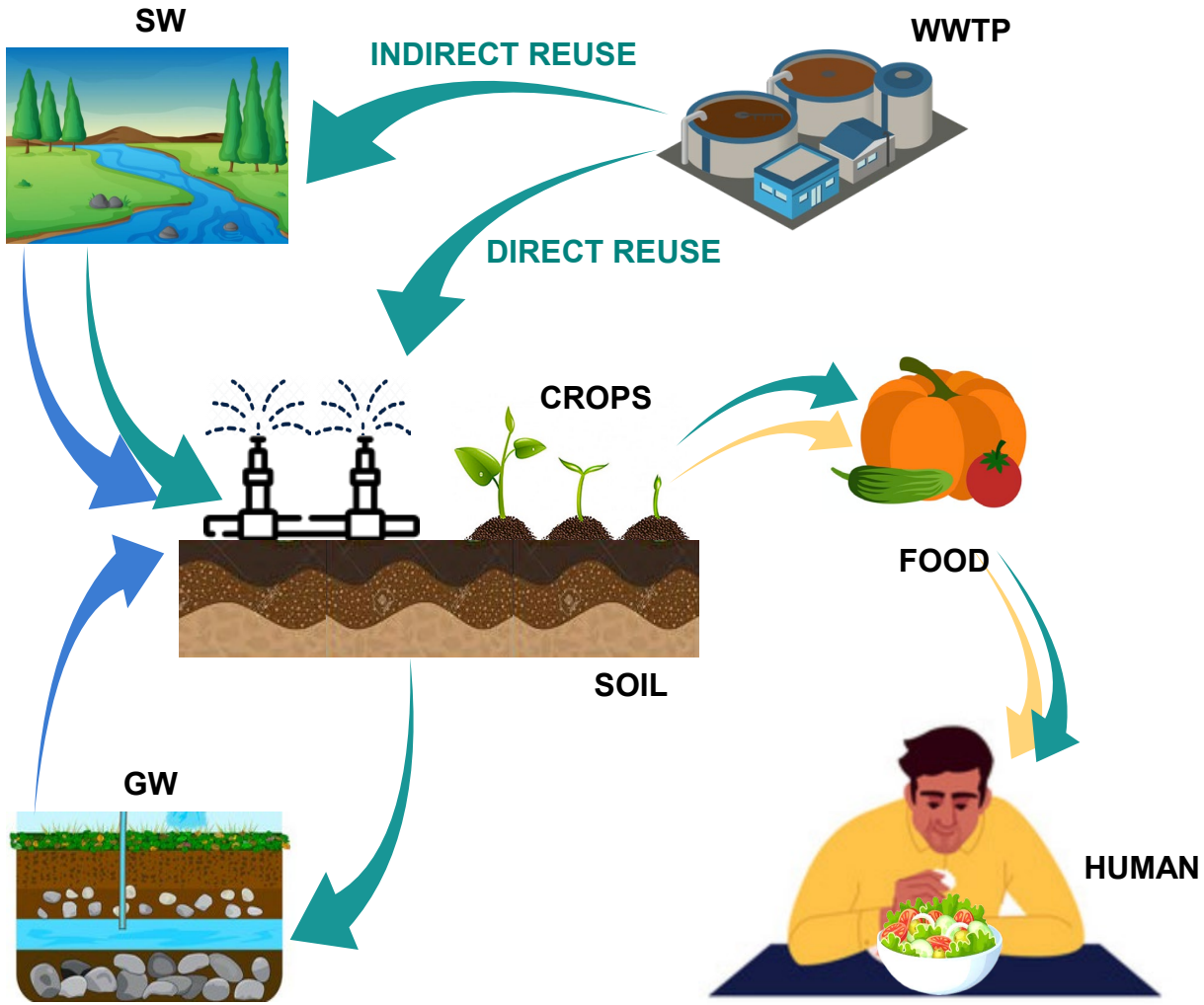
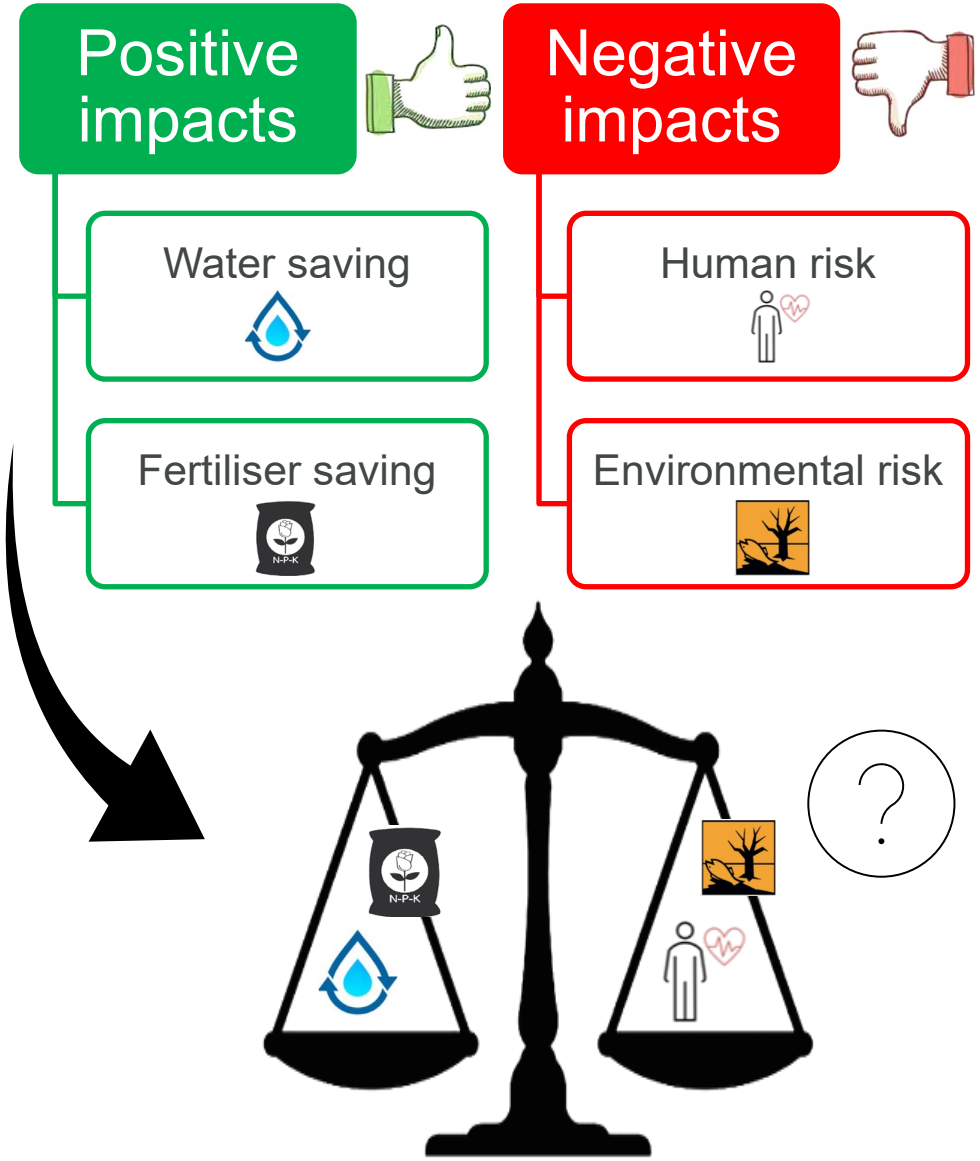
WW reuse in agriculture impacts



BACKGROUND

WW reuse in agriculture impacts





BACKGROUND

Risk assessment as a preventive approach

EUROPEAN COMMISSION

Drinking Water Directive

23.12.2020 EN Official Journal of the European Union L 435/1

DIRECTIVE (EU) 2020/2184 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 16 December 2020

on the quality of water intended for human consumption

(recast)

Water Reuse Regulation

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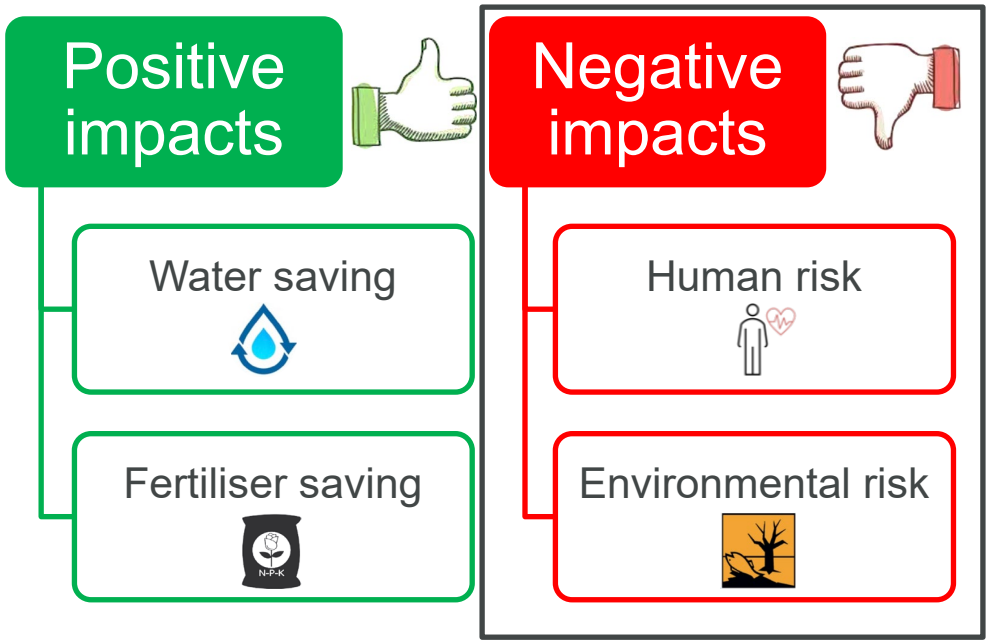


SHIFT IN THE APPROACH:

MIND THE GAP

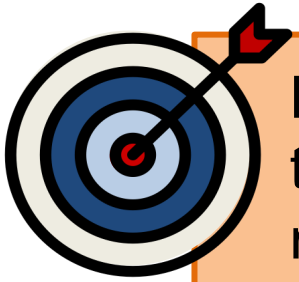
Controlling limits exceedance

↓

Risk assessment for preventive measures

BACKGROUND

Risk assessment as a preventive approach



Need for a risk–based framework for the integrated evaluation of WW reuse practices' impacts

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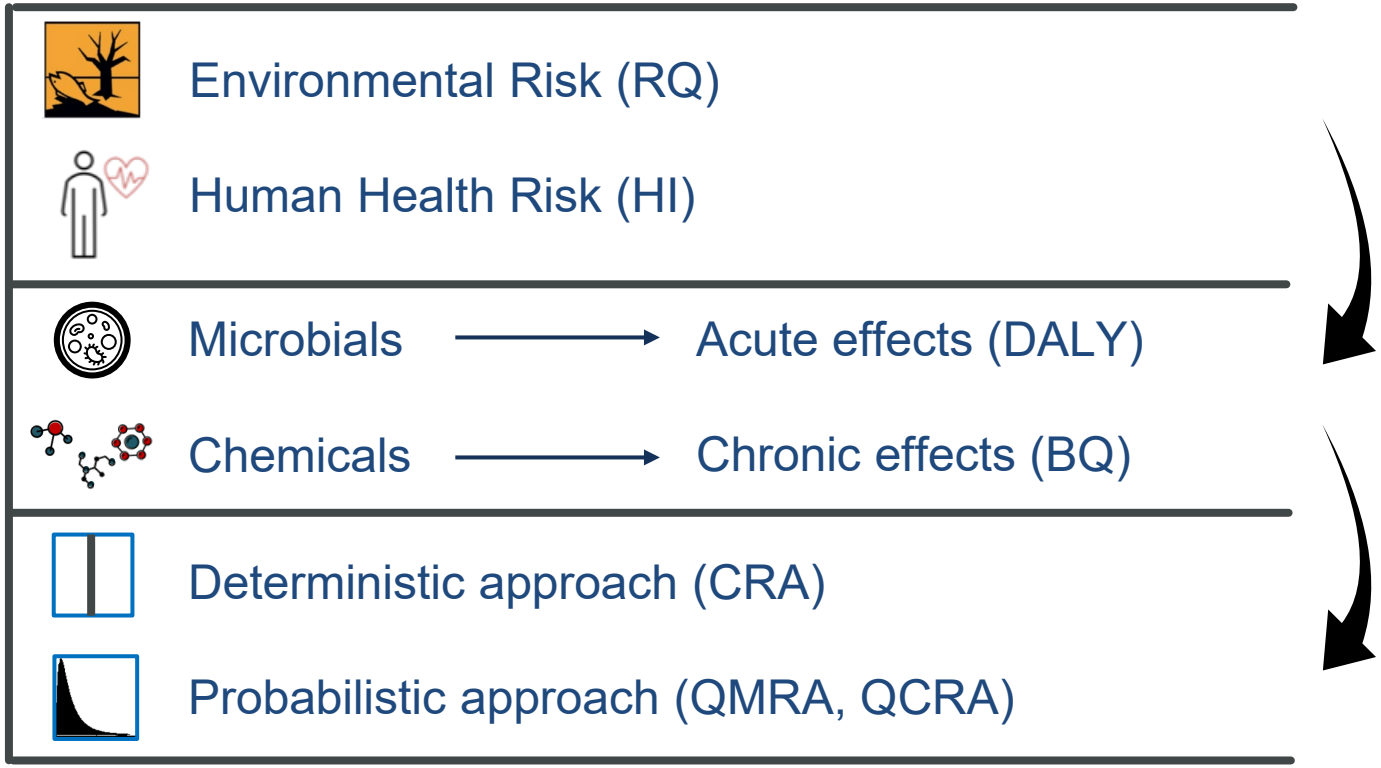
Risk assessment for preventive measures

BACKGROUND

Risk assessment procedures

Different risk assessment approaches available

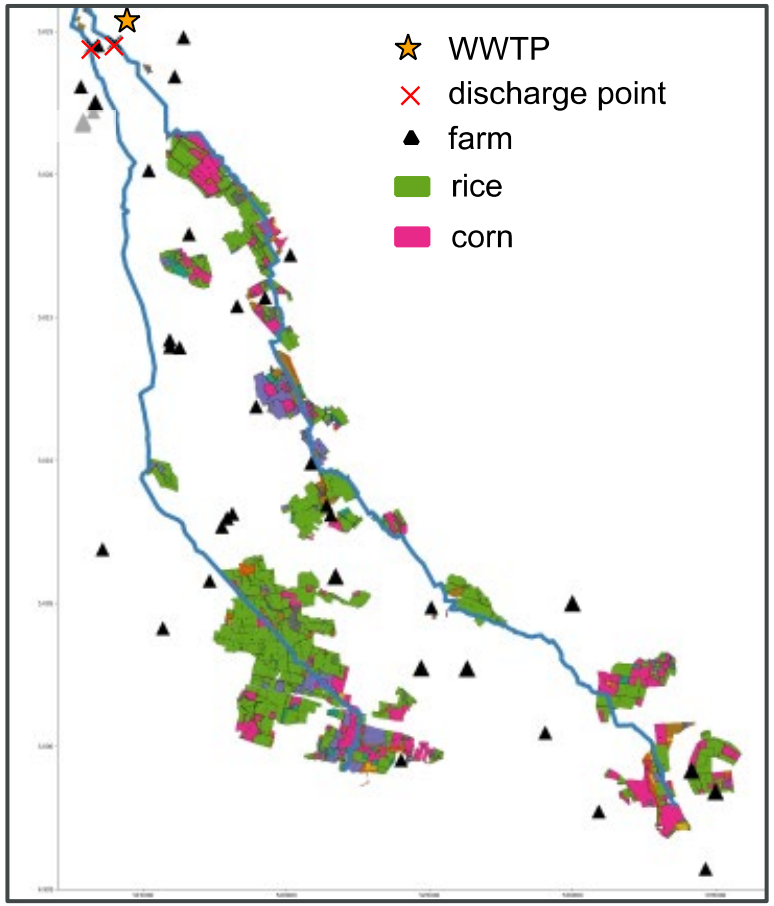


RISK ASSESSMENT PROCEDURES

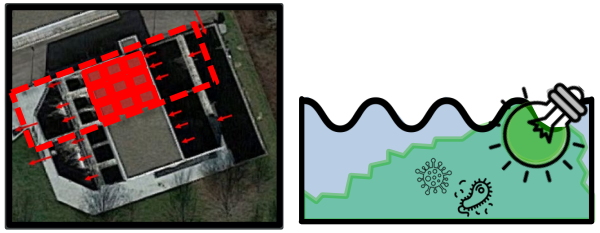
QMRA for human health

Negative impacts

Human risk



Treatment scenario:
active UV disinfection



Exposed population:
workers in agriculture

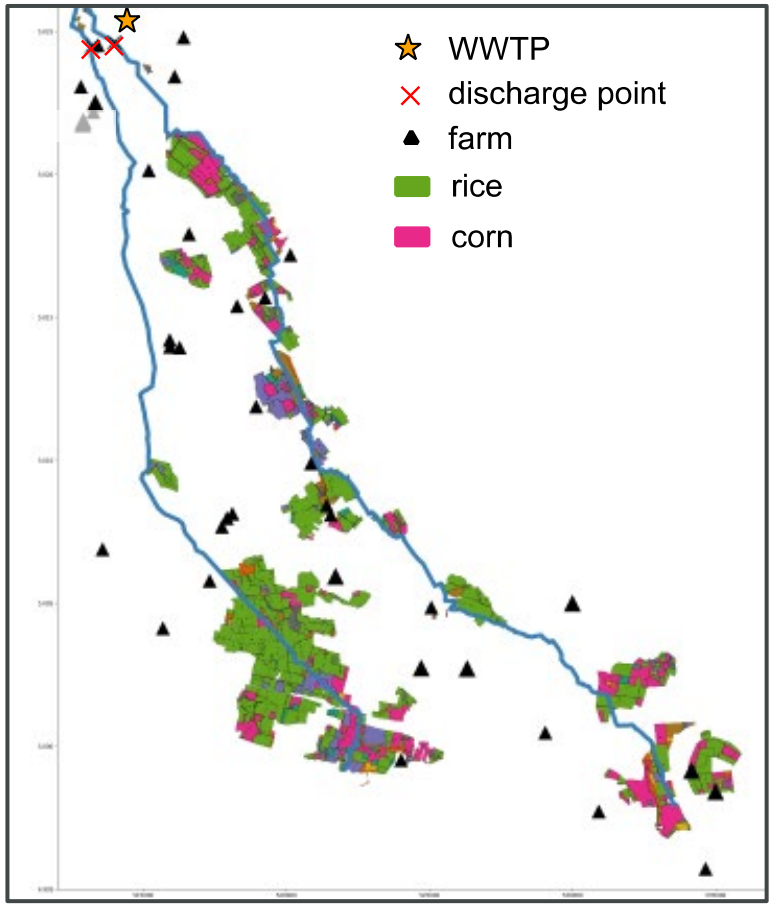
RISK ASSESSMENT PROCEDURES

QMRA for human health

Negative impacts

Human risk

POLITECNICO MILANO 1863



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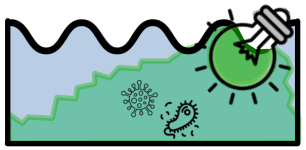
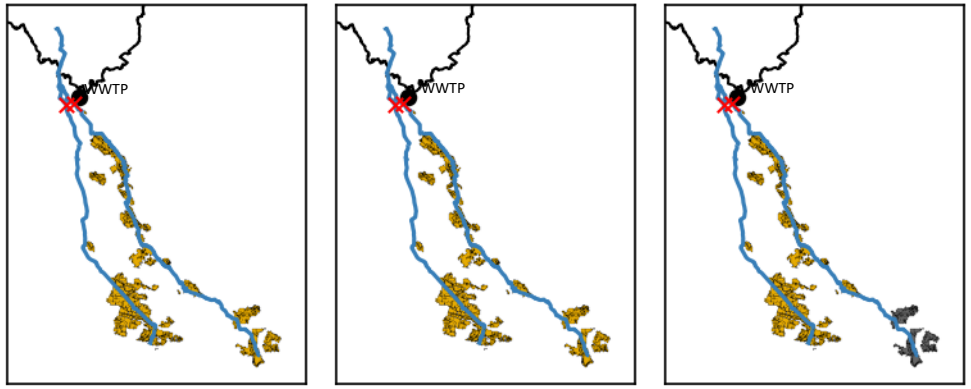
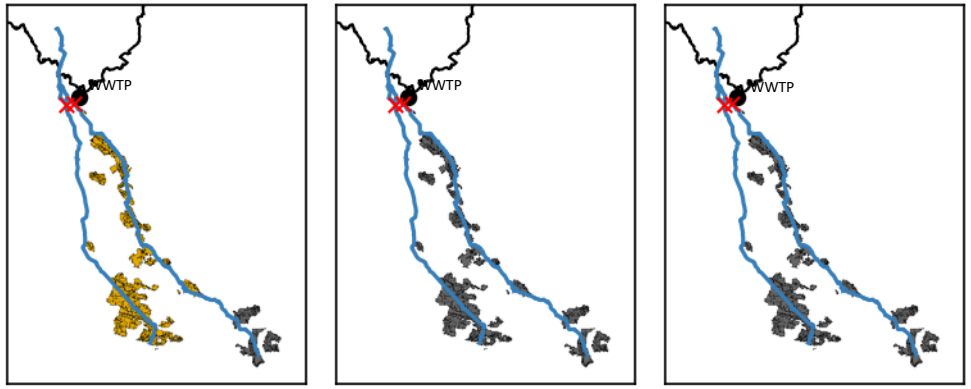


Exposed population:
workers in agriculture

salmonella



norovirus



DALY
$> 10^{-6}$

DALY
$\leq 10^{-6}$

33% 66% 100%

UV dose

RISK ASSESSMENT PROCEDURES

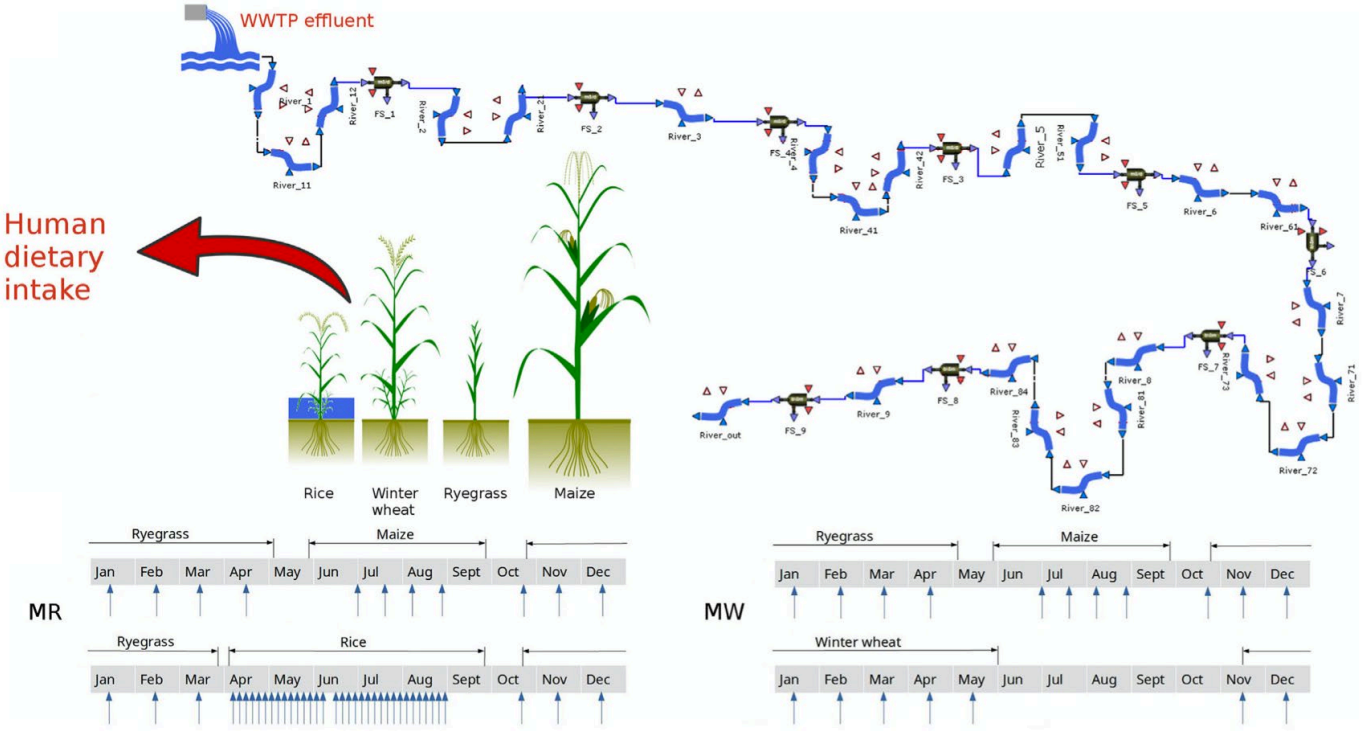
Chemical Risk Assessment for human health and environment

Negative impacts

- Human risk
- Environmental

Conceptual model:
mechanistic fate models from the sewer to the crops

Exposed population:
crops' consumers



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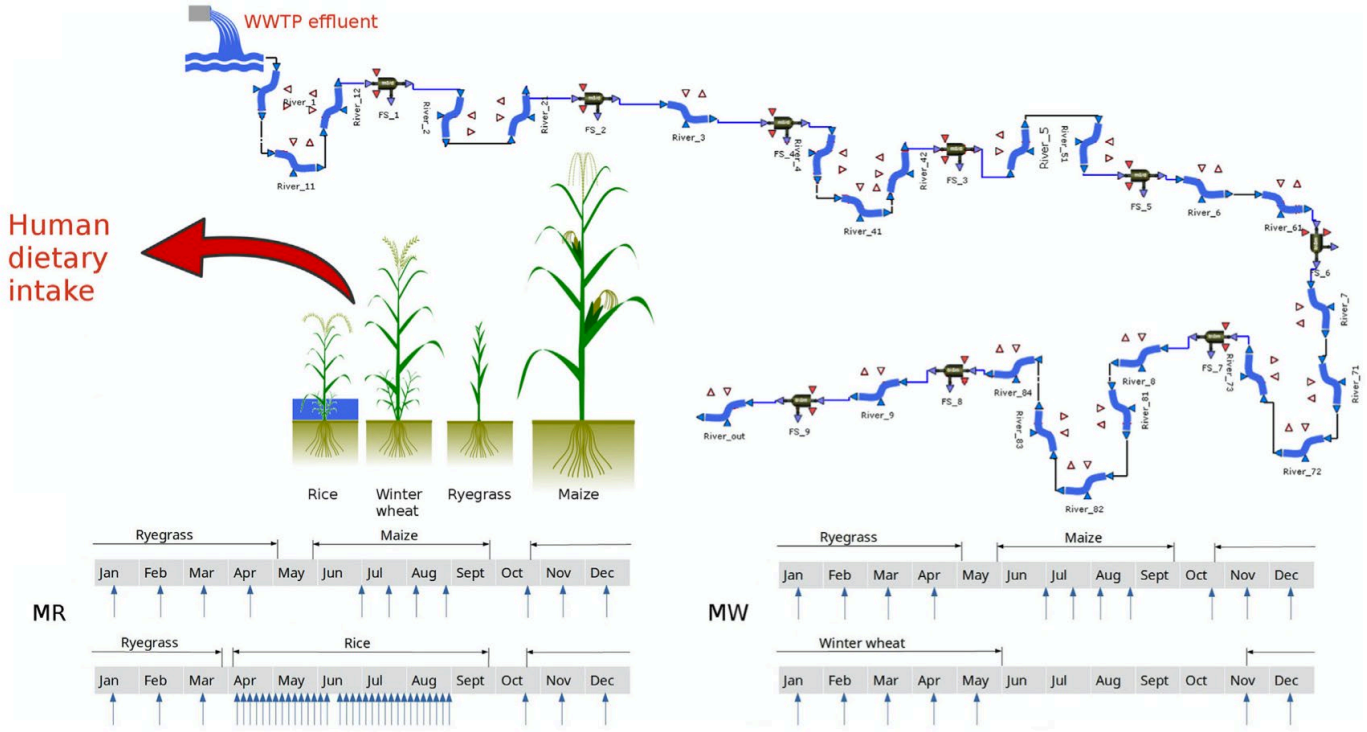

Environmental risk

CEC	Max/Median/Min RQ	Monthly frequency of exceedance (%)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
RQ above 0.1													
SMX													
	0.42/0.16/0.018	74.1	73.9	73.5	73.5	73.4	72.7	72.4	72.6	73.7	73.9	74.2	74.1
IBU													
	0.15/0.07/0.021	16.9	16.7	16.5	16.4	16.3	15.9	15.8	15.9	16.2	16.4	16.7	16.8
E1													
	0.25/0.14/0.046	91.7	91.5	91.3	90.8	90.5	89.2	88.4	88.8	90.6	91.2	91.5	91.7

Human health risk

ECs	Rice		Wheat		Total	
	Median	P97.5	Median	P97.5	Median	P97.5
Infants						
SMX	2.94E-03	2.03E-02	1.86E-04	1.58E-03	3.12E-03	2.19E-02
DCF	2.66E-06	6.35E-04	6.14E-08	1.26E-05	2.72E-06	6.48E-04
IBU	1.12E-09	5.27E-07	1.21E-10	5.94E-08	1.24E-09	5.86E-07
PAR	7.12E-07	1.05E-06	5.64E-08	9.08E-08	7.69E-07	1.14E-06
CBZ	2.62E-03	3.91E-03	2.21E-03	2.80E-03	4.84E-03	6.71E-03
FUR	5.37E-08	8.49E-05	1.25E-07	9.82E-05	1.79E-07	1.83E-04
EE2	2.77E-02	2.57E-01	1.95E-03	3.85E-02	2.97E-02	2.95E-01
E2	1.07E-05	2.53E-05	8.72E-07	2.02E-06	1.15E-05	2.73E-05
E1	5.23E-04	4.82E-03	4.06E-05	7.80E-04	5.63E-04	5.60E-03
PFOS	6.98E-06	2.75E-04	5.44E-06	1.24E-04	1.24E-05	4.00E-04
PFOA	2.23E-08	1.22E-04	1.17E-06	2.66E-04	1.19E-06	3.88E-04
TCS	6.19E-09	1.79E-08	2.57E-09	1.04E-08	8.76E-09	2.83E-08
			Hazard Index		3.82E-02	3.31E-01

RISK ASSESSMENT PROCEDURES

Chemical Risk Assessment for human health and environment

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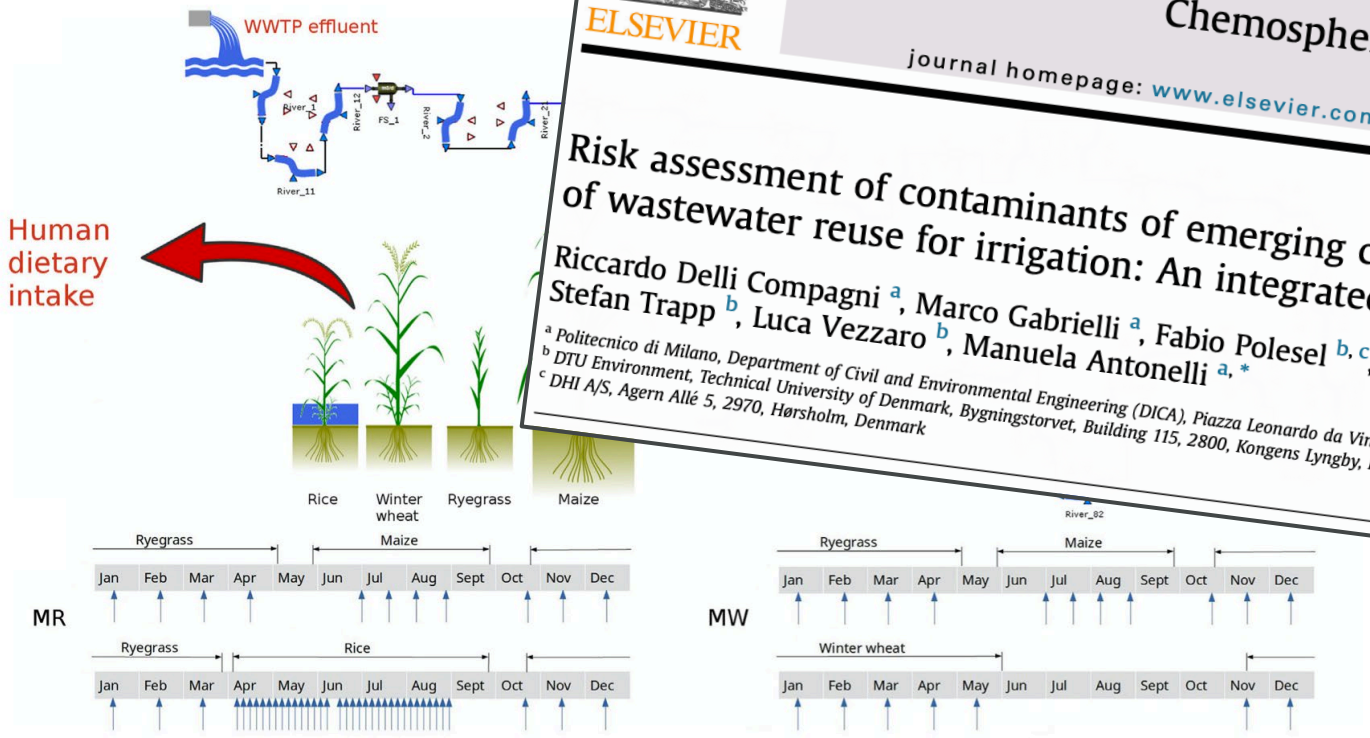
- Human risk
- Environmental

Conceptual model:
mechanistic fate models from the sewer to the crops

Exposed population:
consumers



Chemosphere 242 (2020) 125185
Contents lists available at ScienceDirect
Chemosphere
journal homepage: www.elsevier.com/locate/chemosphere

Risk assessment of contaminants of emerging concern in the context of wastewater reuse for irrigation: An integrated modelling approach

Riccardo Delli Compagni [a], Marco Gabrielli [a], Fabio Polesel [b, c], Andrea Turolla [a], Stefan Trapp [b], Luca Vezzaro [b], Manuela Antonelli [a, *]

[a] Politecnico di Milano, Department of Civil and Environmental Engineering (DICA), Piazza Leonardo da Vinci 32, 20133, Milano, Italy
[b] DTU Environment, Technical University of Denmark, Bygningstorvet, Building 115, 2800, Kongens Lyngby, Denmark
[c] DHI A/S, Agern Allé 5, 2970, Hørsholm, Denmark

Environmental risk

CEC	Max/Median/Min RQ	Monthly frequency of exceedance (%)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
							72.7	72.4	72.6	73.7	73.9	74.2	74.1
							15.9	15.8	15.9	16.2	16.4	16.7	16.8
							89.2	88.4	88.8	90.6	91.2	91.5	91.7

				Total	
			P97.5	Median	P97.5
				1.58E-03	3.12E-03	2.19E-02
				1.26E-05	2.72E-06	6.48E-04
				5.94E-08	1.24E-09	5.86E-07
				9.08E-08	7.69E-07	1.14E-06
				2.80E-03	4.84E-03	6.71E-03
				9.82E-05	1.79E-07	1.83E-04
				3.85E-02	2.97E-02	2.95E-01
				2.02E-06	1.15E-05	2.73E-05
				7.80E-04	5.63E-04	5.60E-03
PFOS	6.98E-06	2.75E-0[illegible]		1.24E-04	1.24E-05	4.00E-04
PFOA	2.23E-08	1.22E-04	1.17E-06	2.66E-04	1.19E-06	3.88E-04
TCS	6.19E-09	1.79E-08	2.57E-09	1.04E-08	8.76E-09	2.83E-08
			Hazard Index		3.82E-02	3.31E-01

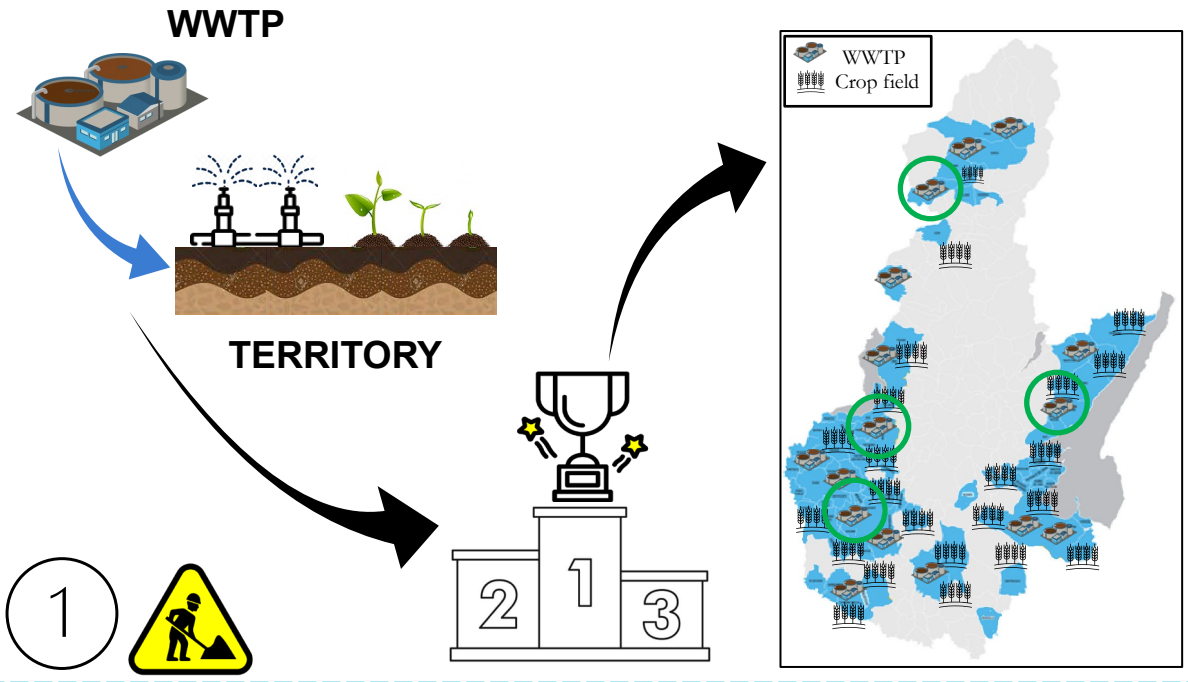
MODELS FOR WW REUSE IMPACTS' EVALUATION

Case studies

Scope: Ranking of characteristics related to WWTPs and their nearby territory to determine where to implement WW reuse practices

Positive impacts

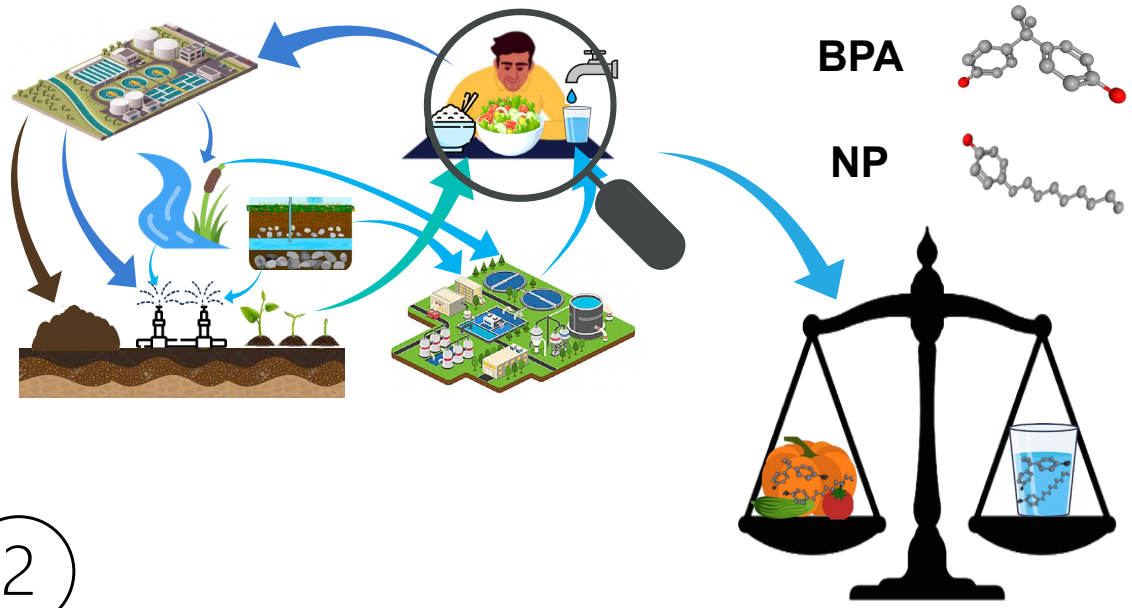
- Water saving
- Fertiliser saving



Scope: Risk-based comparison between DW and food from edible crops consumption

Negative impacts

- Human risk

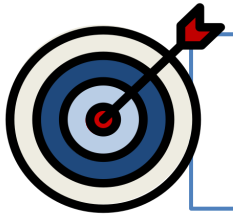


POSITIVE IMPACTS MODELS

Conceptual framework

How?

How to prioritize in which WWTPs implement WW reuse? Based on which criteria?



Ranking of characteristics related to WWTPs and their nearby territory to determine where to implement WW reuse practices

Positive impacts

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POSITIVE IMPACTS MODELS

Conceptual framework

MIND THE GAP

How to prioritize in which WWTPs implement WW reuse? Based on which criteria?

Ranking of characteristics related to WWTPs and their nearby territory to determine where to implement WW reuse practices

How?

DATA COLLECTION FOR WWTPs AND TERRITORY CHARACTERISTICS

TECHNO-ECONOMIC MODEL UPGRADING

TECHNO-ECONOMIC MODEL APPLICATION TO SELECTED WWTPs

SENSITIVITY ANALYSIS

TECHNO-ECONOMIC MODEL RESULTS

PARAMETERS WEIGHTS AND SCORES

Positive impacts

- Water saving
- Fertiliser saving

POSITIVE IMPACTS MODELS

Techno-economic model

INPUT

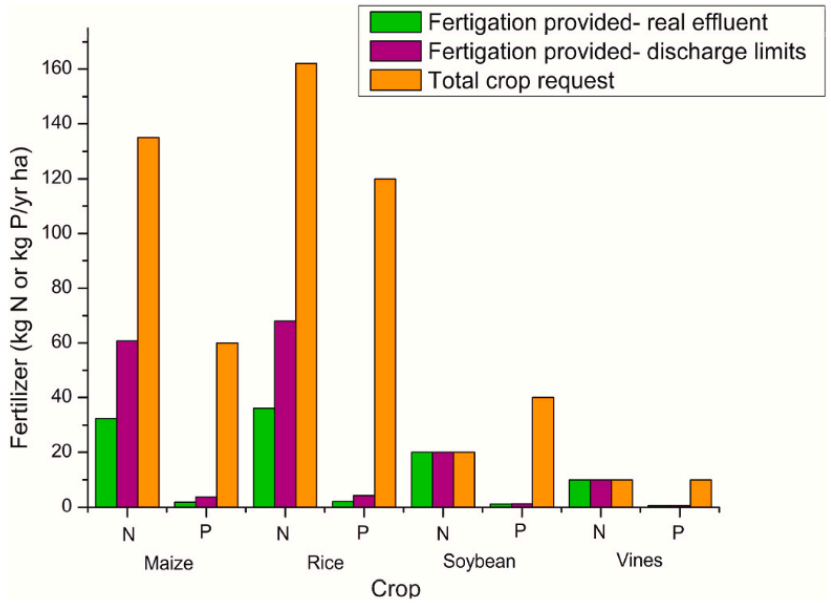
- WWTP's effluent parameters
  - Flowrate
  - COD
  - TSS
  - N
  - P
  - Salinity
- Territory parameters
  - Type of crop
  - Metereological data
  - Cost of irrigation water and fertiliser

MODEL

- Determination of:
  - Water and nutrient deliverable from the WWTP
  - Water and nutrients crops requirement
  - Cost savings
  - Salinity cumulation
  - GHGs emissions

OUTPUT

Example



Mainardis et al., 2022

POSITIVE IMPACTS MODELS

Techno-economic model

INPUT

- WWTP's effluent parameters
  - Flowrate
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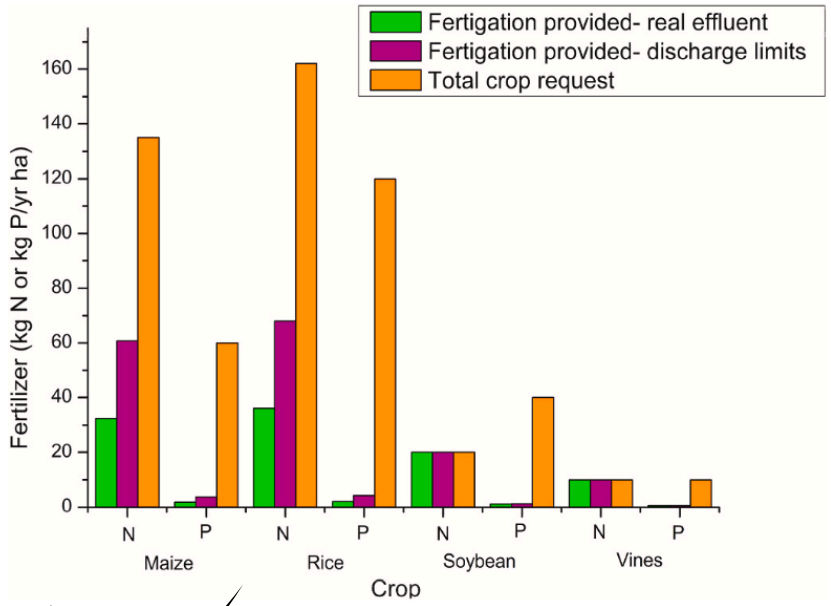
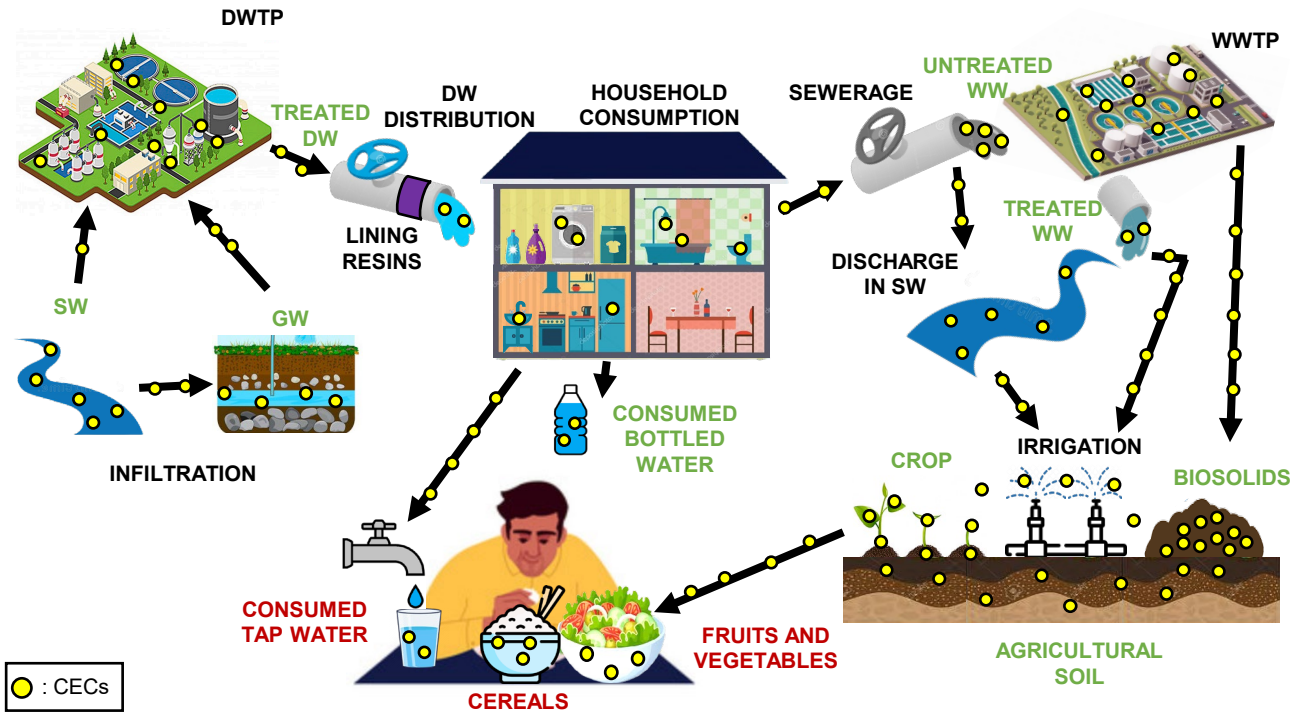


Mainardis et al., 2022

SENSITIVITY ANALYSIS

NEGATIVE IMPACTS MODEL

Health risk apportionment



MIND THE GAP

What is the contribution of WW irrigated crops' consumption compared to other sources of risk?

Negative impacts

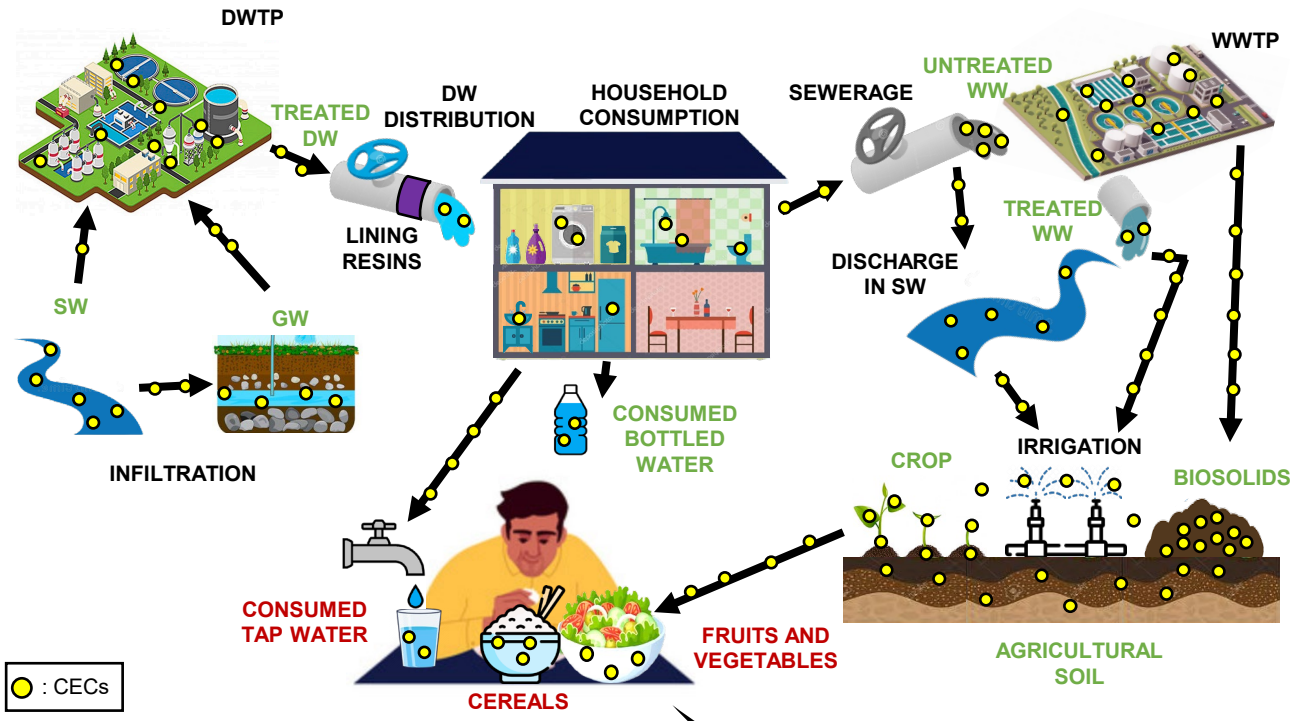
Human risk

2022 EU CONFERENCE one HEALTH • ENVIRONMENT • SOCIETY

DICA Soil Group

NEGATIVE IMPACTS MODEL

Health risk apportionment



MIND THE GAP

What is the contribution of WW irrigated crops' consumption compared to other sources of risk?

Apportionment of human health risk between the consumption of food originating from WW irrigated crops and DW

BPA

NP

Negative impacts

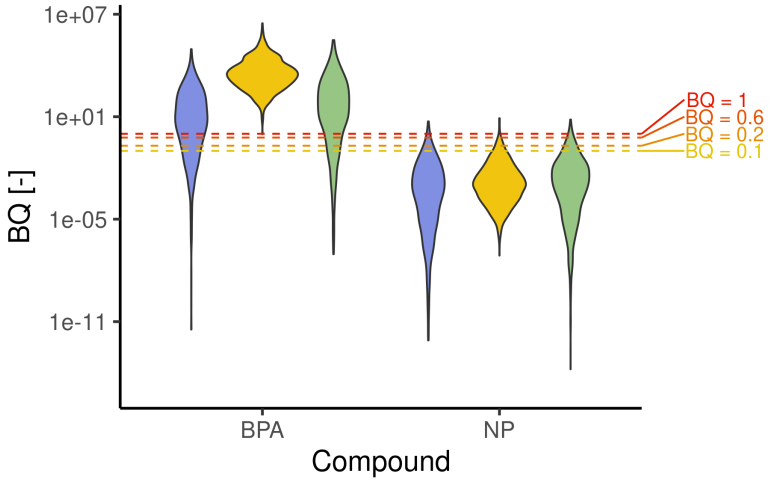
Human risk

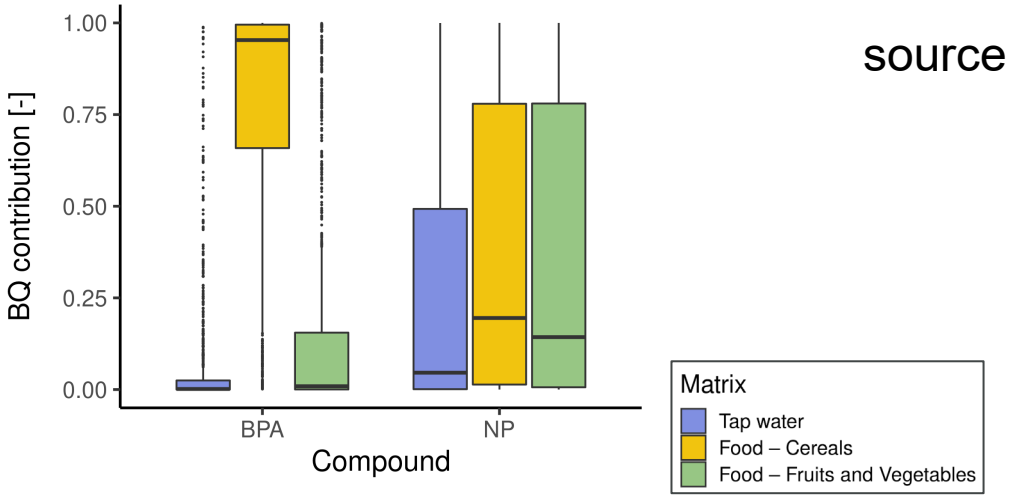
2022 EU CONFERENCE one HEALTH • ENVIRONMENT • SOCIETY

DICA Soil Group

NEGATIVE IMPACTS MODEL

Health risk apportionment



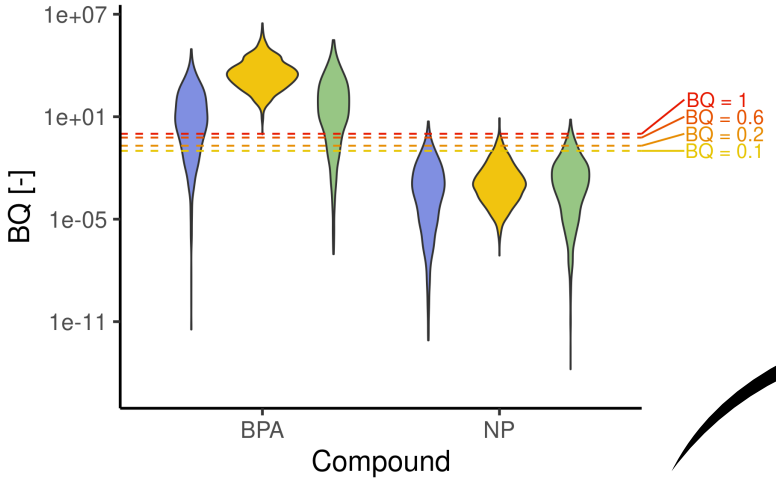


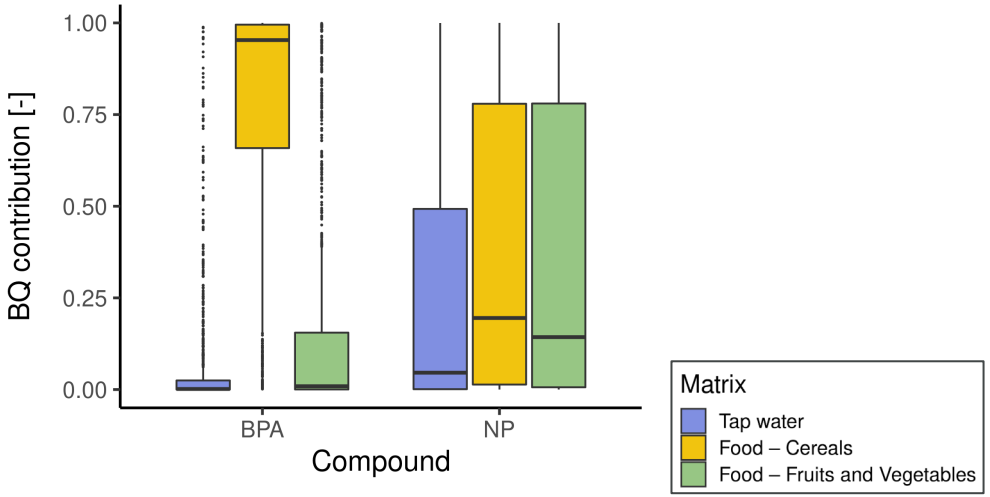
- Health risk due to NP is not negligible, but BPA risk is significantly higher
- Crops' food intake is the main alkylphenols exposure source compared to tap water

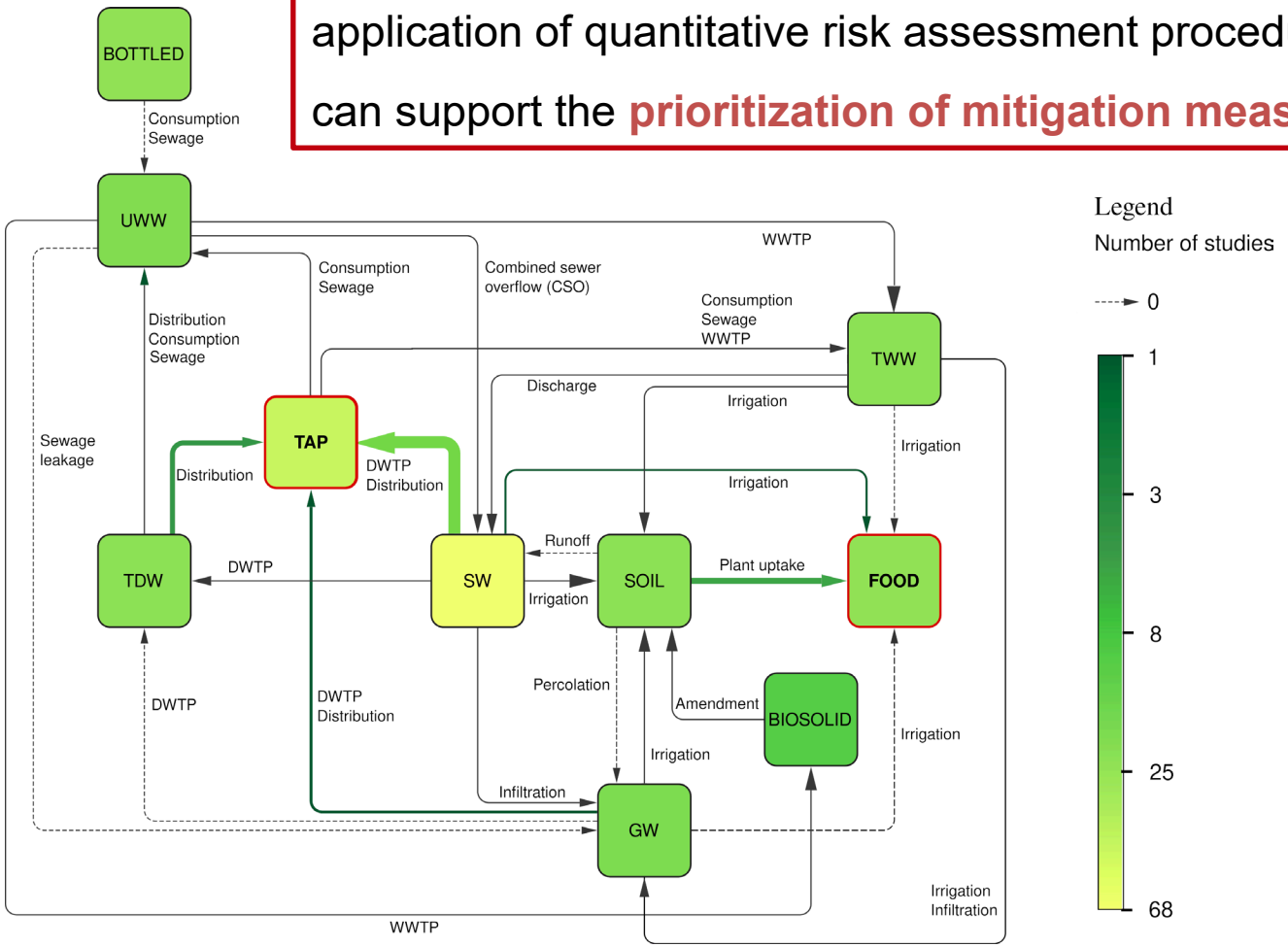
NEGATIVE IMPACTS MODEL

Mitigation measures

In such a **complex and interconnected system**, the application of quantitative risk assessment procedures can support the **prioritization of mitigation measures**



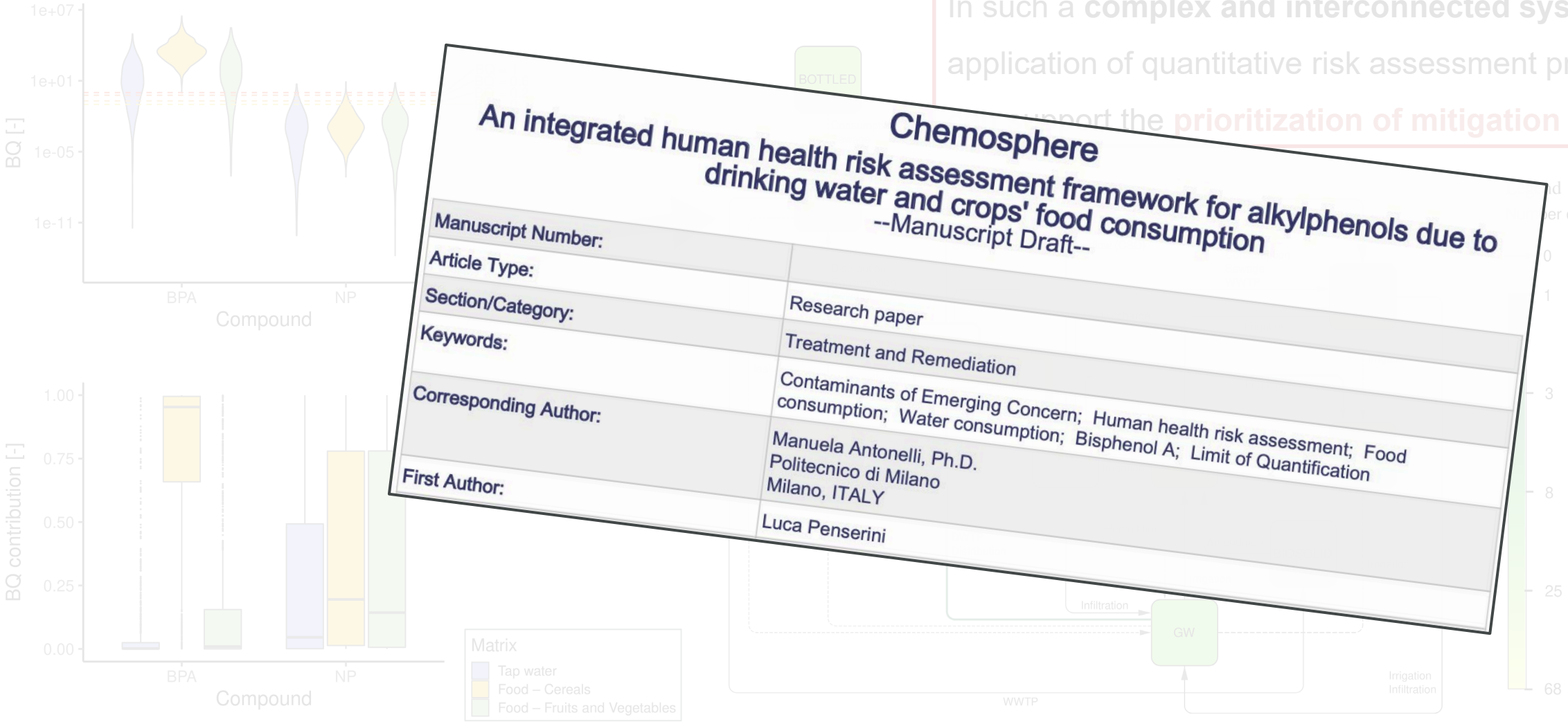




NEGATIVE IMPACTS MODEL

Mitigation measures

In such a **complex and interconnected system**, the application of quantitative risk assessment procedures support the **prioritization of mitigation measures**



Chemosphere

An integrated human health risk assessment framework for alkylphenols due to drinking water and crops' food consumption

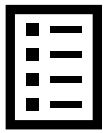
--Manuscript Draft--

Manuscript Number:	
Article Type:	Research paper
Section/Category:	Treatment and Remediation
Keywords:	Contaminants of Emerging Concern; Human health risk assessment; Food consumption; Water consumption; Bisphenol A; Limit of Quantification
Corresponding Author:	Manuela Antonelli, Ph.D. Politecnico di Milano Milano, ITALY
First Author:	Luca Penserini

FURTHER DEVELOPMENTS

Next steps

- Development of a univocal framework to uniform the risk assessment procedures to comply with the most recent regulation



- Integration and combination of the different risk assessment approaches

- Integration and combination of positive and negative impact models

THANK YOU FOR YOUR ATTENTION!

Luca Penserini, Ph.D. student

luca.penserini@polimi.it

GUEST SPEAKER

YWP GERMANY

- **MAX ZIMMERMANN**
  PhD Student, RWTH Aachen

Agricultural water reuse in Germany:

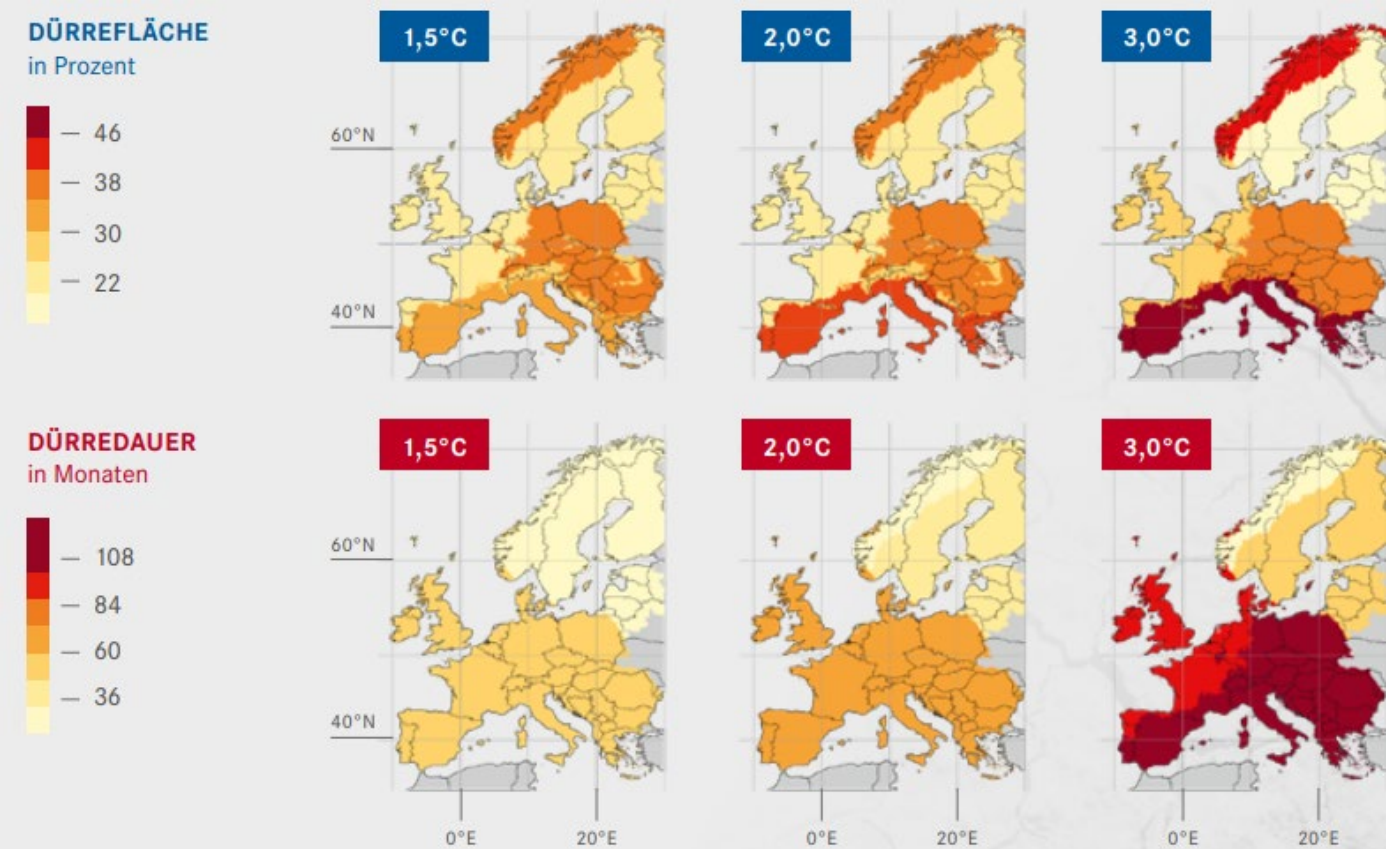
Insights into *Flex*Treat

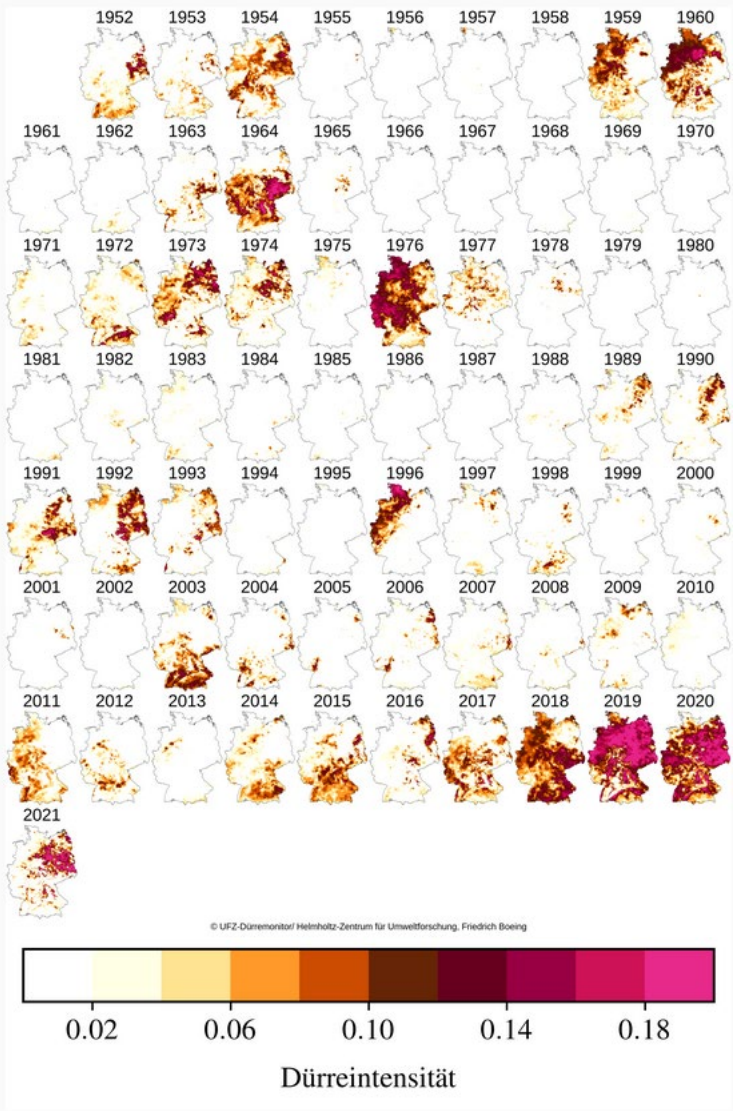
M.Sc. Max Zimmermann

Institute of Environmental Engineering
RWTH AACHEN UNIVERSITY

Prof. Dr. Thomas Wintgens
Dr. Benedikt Aumeier (Group Leader Water Reuse)

Context: Drought in Germany and Europe





Helmholtz UFZ Droughtmonitor (2021)

Water Reuse in Europe

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Shown:
„Number of schemes practising reuse“

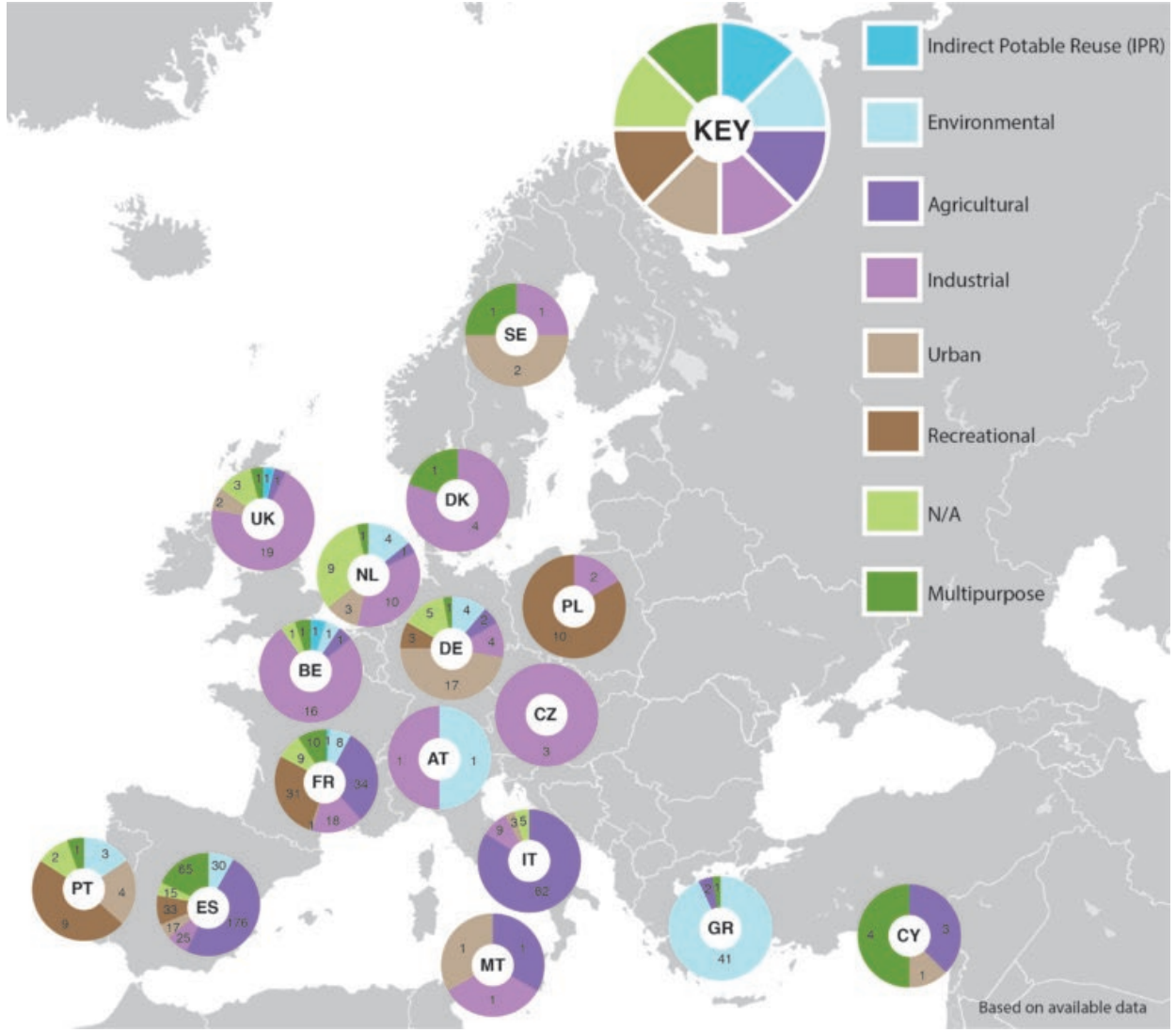
North

SWE: ~ 4

GER: ~30

IT: ~80

South



Water Reuse Europe (2017)

EU minimum requirements for water reuse

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EU Ordinance 2020/741

- Quality classes
- Quality requirements

Table 1 – Classes of reclaimed water quality and permitted agricultural use and irrigation method

Minimum reclaimed water quality class	Crop category (*)	Irrigation method
A	All food crops consumed raw where the edible part is in direct contact with reclaimed water and root crops consumed raw	All irrigation methods
B	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	All irrigation methods
C	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	Drip irrigation (**) or other irrigation method that avoids direct contact with the edible part of the crop
D	Industrial, energy and seeded crops	All irrigation methods (***)

Table 2 – Reclaimed water quality requirements for agricultural irrigation

Reclaimed water quality class	Indicative technology target	Quality requirements				
		E. coli (number/100 ml)	BOD_5 (mg/l)	TSS (mg/l)	Turbidity (NTU)	Other
A	Secondary treatment, filtration, and disinfection	≤ 10	≤ 10	≤ 10	≤ 5	*Legionella* spp.: < 1 000 cfu/l where there is a risk of aerosolisation Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage
B	Secondary treatment, and disinfection	≤ 100	In accordance with Directive 91/271/EEC (Annex I, Table 1)	In accordance with Directive 91/271/EEC (Annex I, Table 1)	-	
C	Secondary treatment, and disinfection	≤ 1 000			-	
D	Secondary treatment, and disinfection	≤ 10 000			-	

An Initiative of the Federal Ministry of Education and Research

WavE
Water Technologies: Reuse

SPONSORED BY THE

Federal Ministry of Education and Research

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Flexible und reliable concepts for sustainable water reuse in agriculture

ISA | RWTH AACHEN UNIVERSITY

KOMPETENZZENTRUM WasserBerlin

bfg Bundesanstalt für Gewässerkunde

xylem Let's Solve Water

ihph

ukb universitätsklinikumbonn

AUTARCON

Erft Verband

Abwasserverband Braunschweig

inge heart of pure water a DuPont brand

PEGASYS Gesellschaft für Automation und Datensysteme mbH

analytikjena An Endress+Hauser Company

p2mberlin

YWP Building Bridges | 22.11.2022

Project goals

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Work packages:

1. Innovative advanced treatment chains
   - Synergies with stages for organic micropollutant removal
2. Digital Green Tech
   - Innovative process control concepts / Digital Twin
3. Risk Management and Integrated Evaluation
   - Water quality, health risks, system resilience, economical and ecological dimensions
4. Pro-active implementation of project outcomes

Context Goals:

- „Guideline risk management“ for EU Ordinance
- Guideline „Technologies for save water reuse“

Technical Innovations

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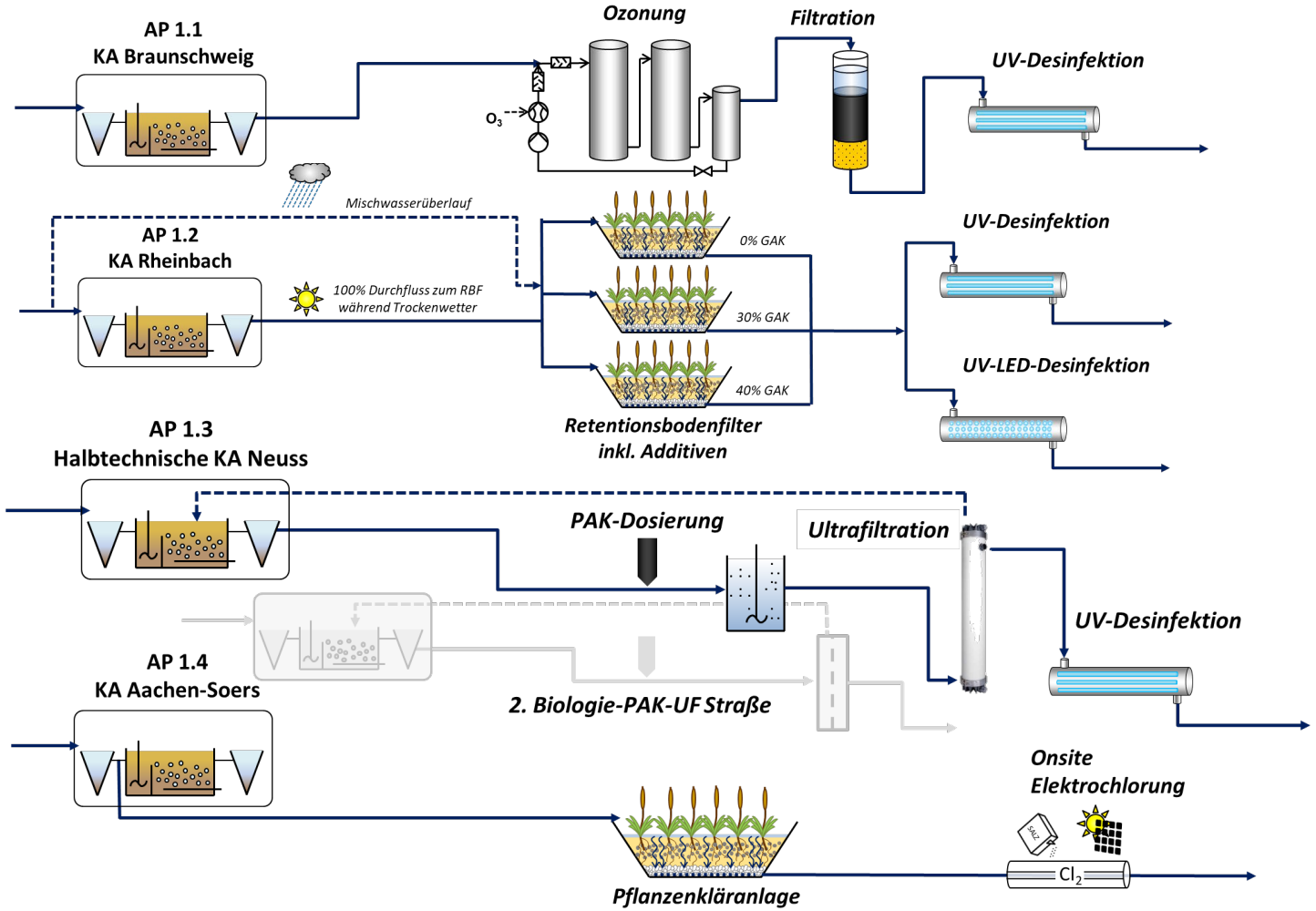
Extension of *Best Available Technologies* (BAT) for agricultural water reuse



TECH1 Ozonation + Biofiltration + UV

TECH2 RBF$^+$ + UV

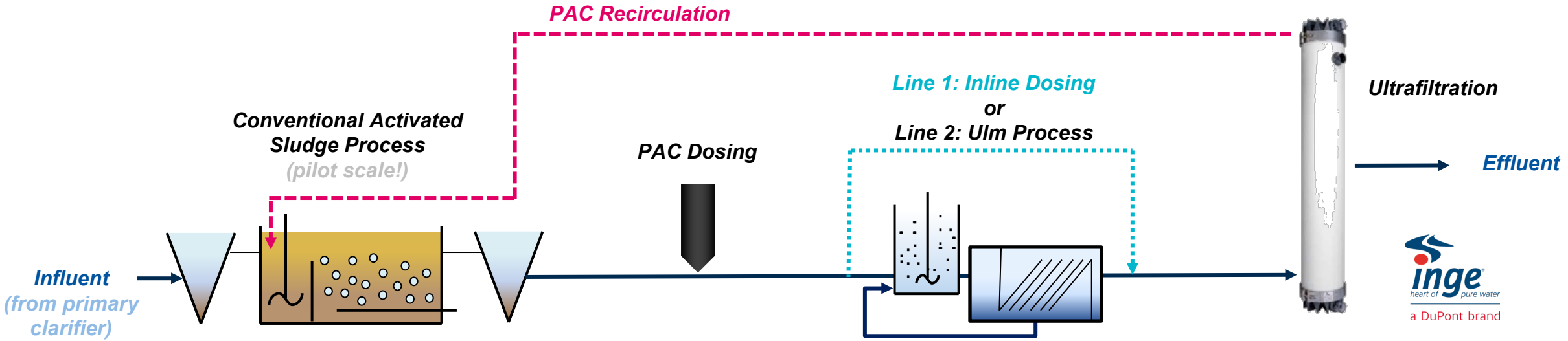
TECH3 UV-LED

TECH4 inline-PAC + UF

TECH5 „Low-Tech“ + eChlorination

Optimization of PAC + UF Processes

FlexTreat



Micropollutant removal (in PAC + UF stage only)			
	PAC Size	Contact Time	Removal**
Ulm Process*	D_{50} = 28µm	60 min	77 %
Inline Process*	D_{50} = 5µm	60 sec	72 %

* no PAC recirculation to CASP

**according to KomS-BW 2018

Zimmermann et al. in preparation

Risk Management

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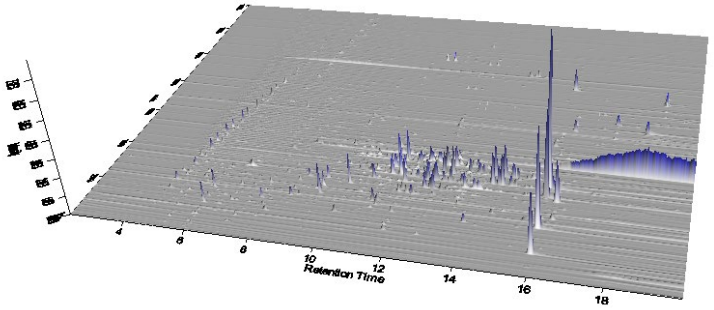
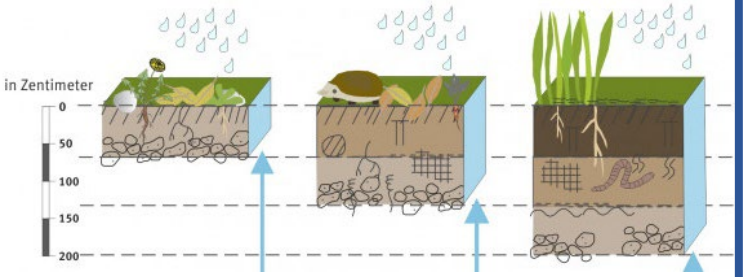
chemical risks

target- & non-target-methods



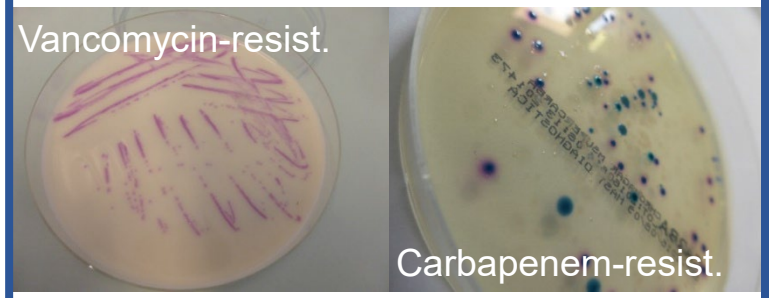
crop analyses &
infiltration prediction



salt management

microbiological risks

ARB- und ARG-abatement



regrowth potential

mobile qPCR-system

integrated evaluation

Invest- & operation cost, LCA,
ecological footprint, water quality,
resilience

based on WavE I:
concept with KPIs & KUOIs

Utilisation and transfer of results and technologies

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- Stakeholder dialogue
  - Farmers / Chamber of Agriculture
  - Operators/water companies
  - Federal Environment Agency

- Case studies
  (for potential market expansion)
  - Spain
    - Murcia
    - Talavera
  - Egypt
  - Bahrain

Wikipedia.org

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FlexTreat

Thank you for your attention!

www.flextreat.de

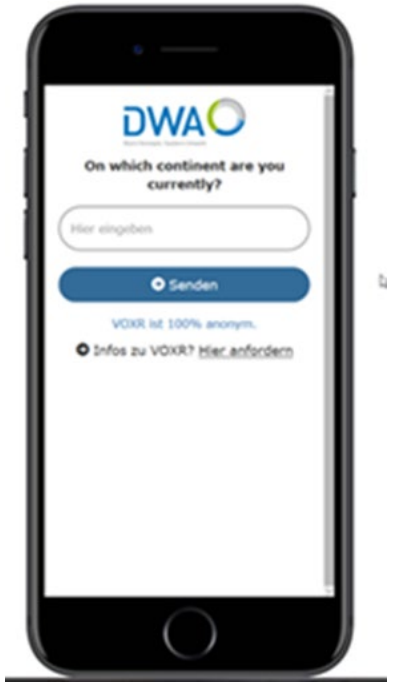
Name: Max Zimmermann
Mail: zimmermann@isa.rwth-aachen.de
Tel.: +49 241 80 25535

SESSION FEEDBACK

QUESTION 2

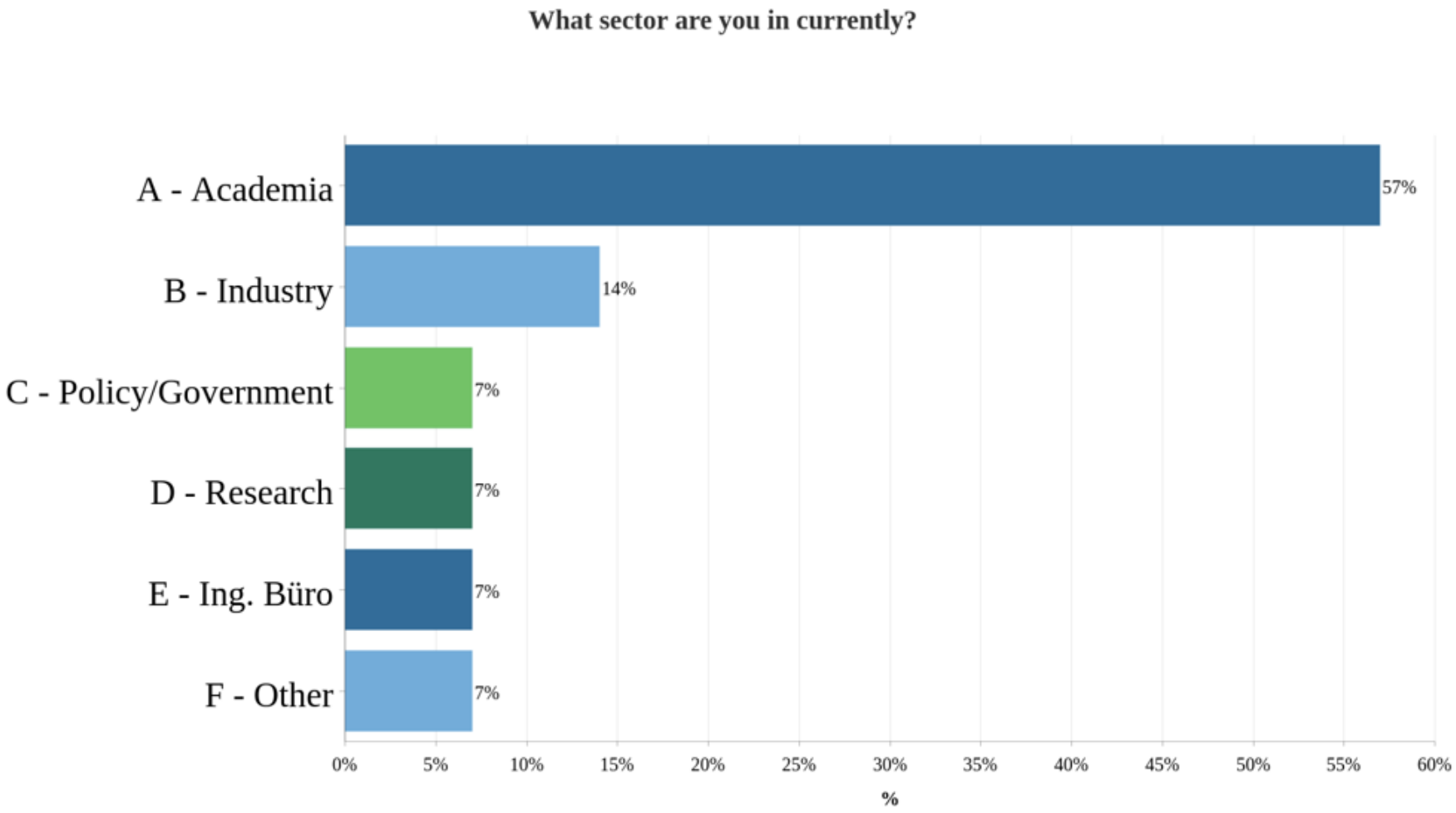
Presentations! Which word stuck with you the most?

Link VOXR: **https://voxr.com/dwa**



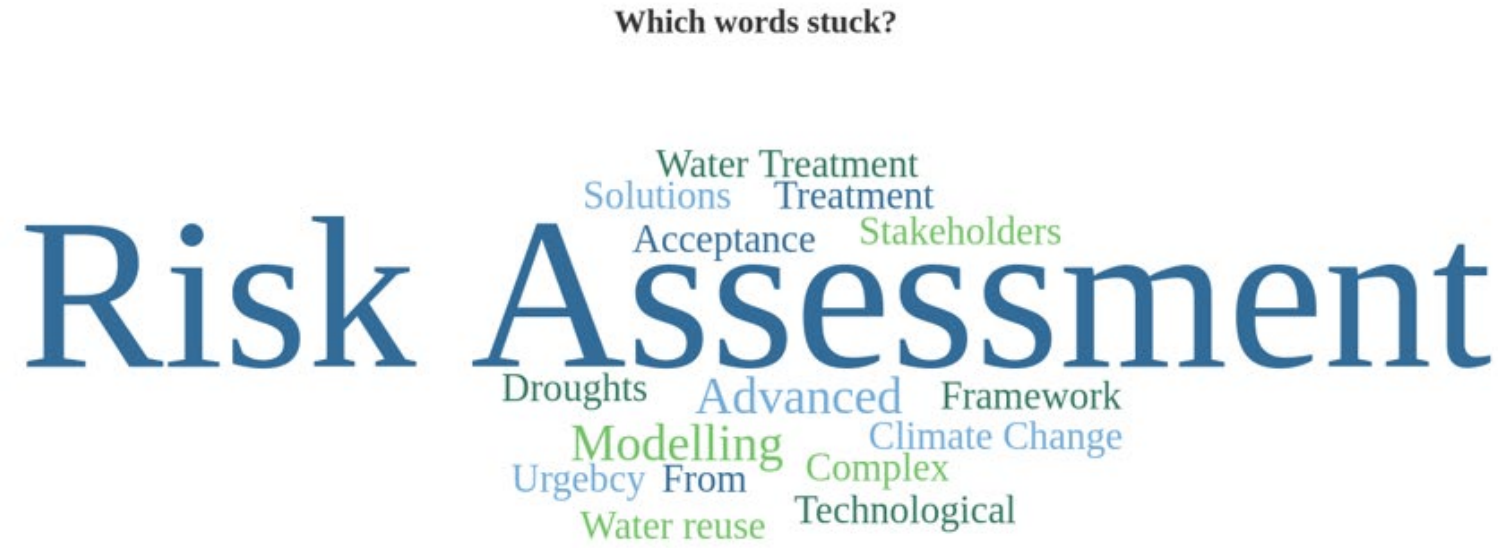
SESSION FEEDBACK

Results



SESSION FEEDBACK

Results



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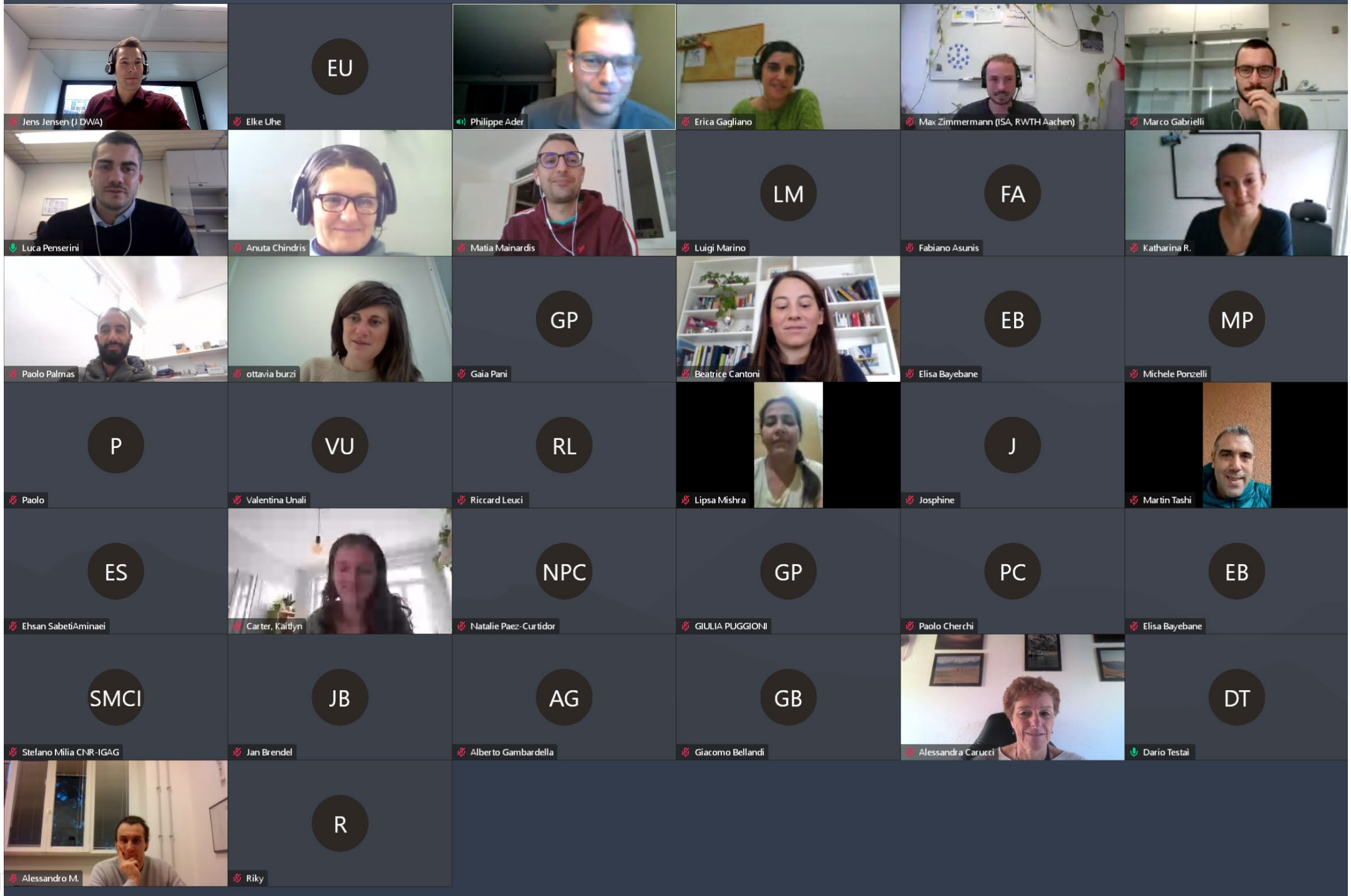
THANK YOU

FOR YOUR PARTICIPATION


Jens Jensen (J DWA)
EU
Elke Uhe
Philippe Ader
Erica Gagliano
Max Zimmermann (ISA, RWTH Aachen)
Marco Gabrielli
Luca Penserini
Anuta Chindris
Matia Mainardis
LM
Luigi Marino
FA
Fabiano Asunis
Katharina R.
Paolo Palmas
ottavia burzi
GP
Gaia Pani
Beatrice Cantoni
EB
Elisa Bayebane
MP
Michele Ponzelli
P
Paolo
VU
Valentina Unali
RL
Riccard Leuci
Lipsa Mishra
J
Josphine
Martin Tashi
ES
Ehsan SabetiAminaei
Carter, Kaitlyn
NPC
Natalie Paez-Curtidor
GP
GIULIA PUGGIONI
PC
Paolo Cherchi
EB
Elisa Bayebane
SMCI
Stefano Milia CNR-IGAG
JB
Jan Brendel
AG
Alberto Gambardella
GB
Giacomo Bellandi
Alessandra Carucci
DT
Dario Testai
Alessandro M.
R
Riky

USE NEXT SLIDE AS PROMO FLYER

IWA YOUNG WATER PROFESSIONALS GERMANY

DWA Klare Konzepte. Saubere Umwelt.

IWA YOUNG WATER PROFESSIONALS ITALY

IWA YOUNG WATER PROFESSIONALS

BUILDING BRIDGES

ONLINE EVENT SERIES

info@ywp-germany.com
international@junge-dwa.de

ywpitaly@gmail.com

Wastewater Reuse In Agriculture

Tuesday, 22 Nov ‘22 2 PM (Central European Time)

Join via GoToMeeting! https://meet.goto.com/800060645

AGENDA (Duration 1.5 hrs)

. 15’ Introduction

. 15’ Guest Speaker Italy: **Luca Penserini** (Politecnico di Milano)

. 15’ Guest Speaker Germany: **Max Zimmermann** (RWTH Aachen)

. 45’ Networking Discussion