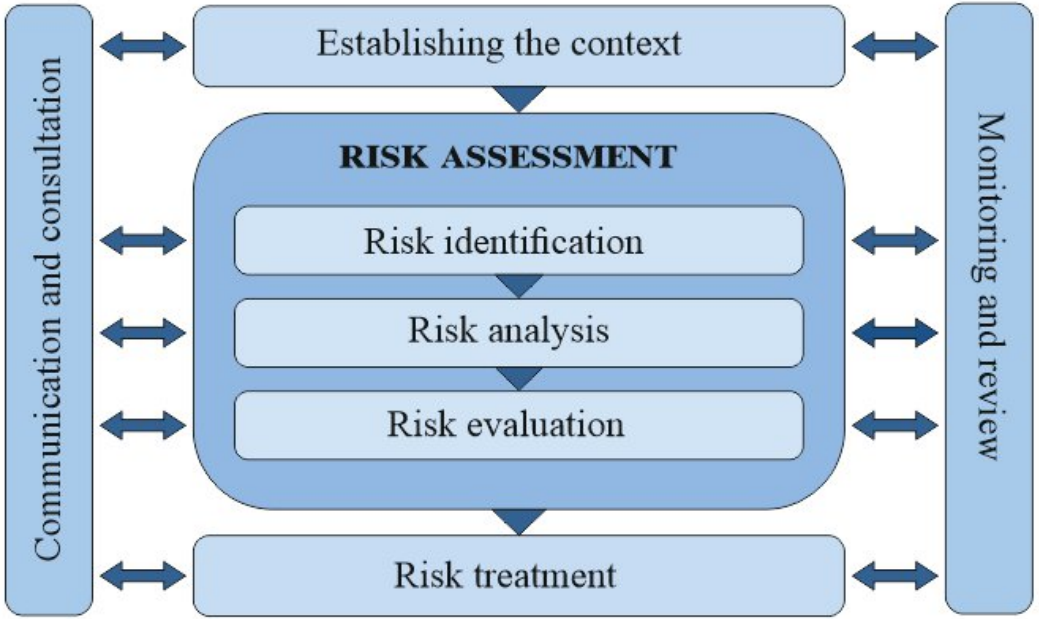
3rd National training session on PILOT FEASIBILITY STUDIES

MAR Risk Assessment and Management

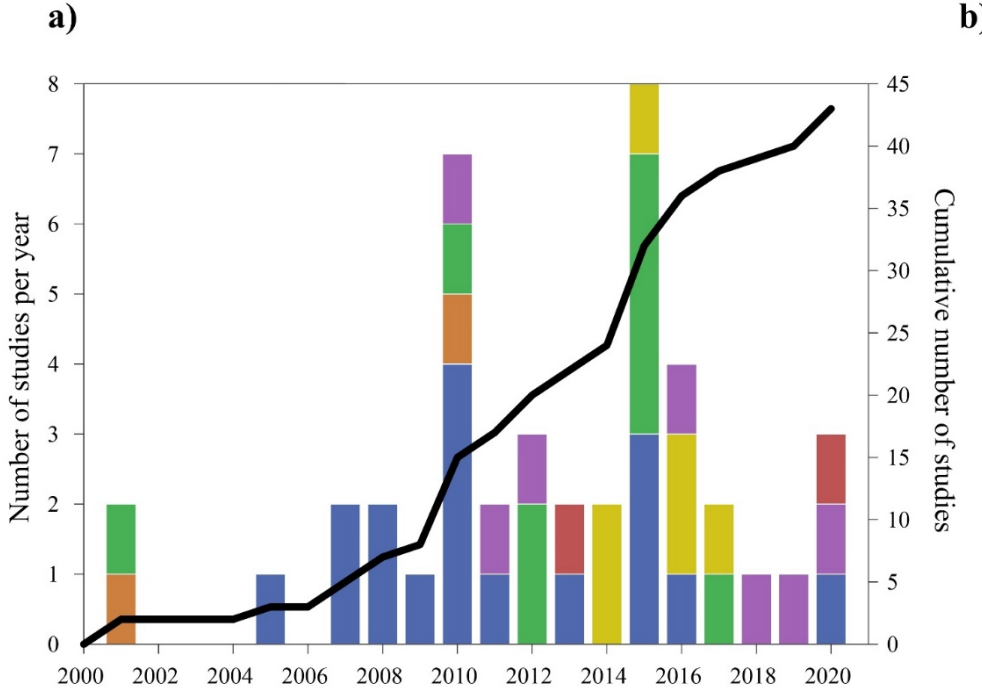
DEEPWATER-CE|PP3|Anne Imig, Arno Rein, Maria Vrachioli and Olha Halytsia

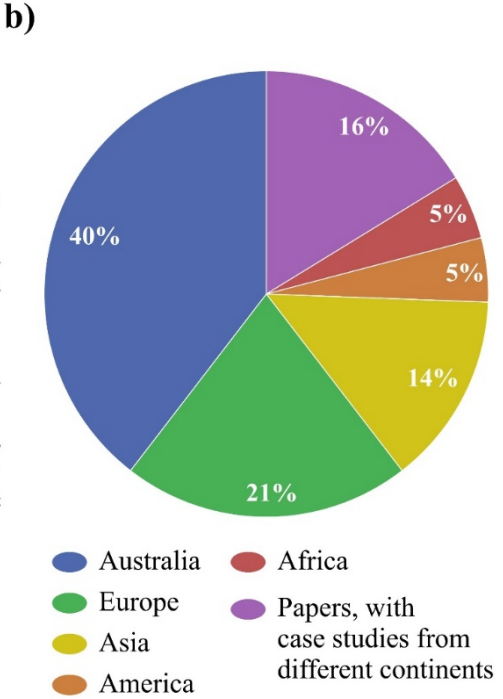
RISK MANAGEMENT AFTER ISO 20426



RESULTS OF LITERATURE RESEARCH

43 papers/publications, 138 case studies from 23 countries





Imig et al. (under review). A review on risk assessment in Managed Aquifer Recharge. Integr. Environ. Assess. Manag.

EXISTING GUIDELINES AND METHODOLOGIES

MAR Risk

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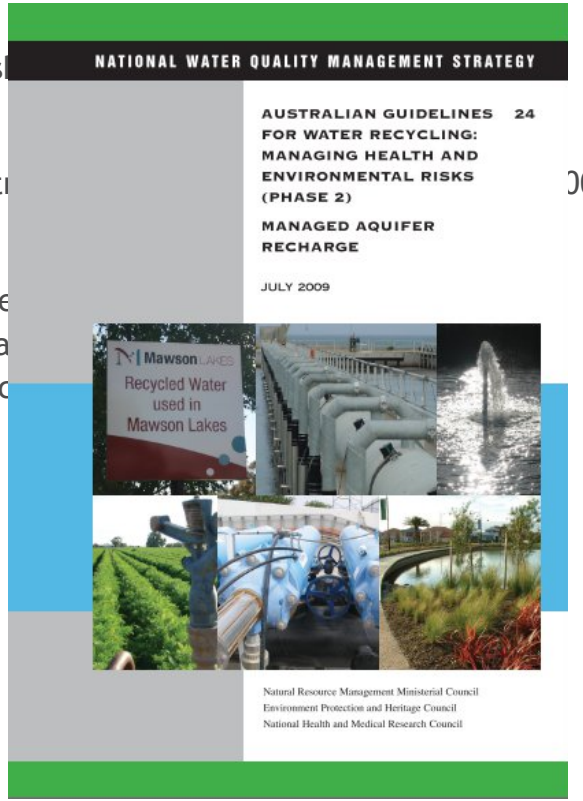

MAR Risk Assessment Methodologies

1. Qualitative risk assessment
2. Quantitative microbial risk assessment
3. Quantitative risk assessment
4. Integrated human health risk framework for MAR *Assmuth et al. (2016)*
5. Pollutant release and transfer register *Ji and Lee (2016a, 2016b, 2017)*
6. Probabilistic risk assessment based on fault trees *Rodríguez-Escales et al. (2018)*
7. Screening-level assessment of human health risks arising from micro-pollutants *Rodriguez et al. (2007b, 2007a)*
8. Public health and economic risk assessment *Juntunen et al. (2017)*
9. Assessment of economic risks arising from clogging *Dillon et al. (2016)*

EXISTING GUIDELINES AND METHODOLOGIES

MAR Risk Assessment Guidelines

1. Australian	2006/2009
I. Indian	2014
II. Chilean	2020
2. Water Safety Plans	2004
3. Hazard Analysis and Critical Control Points	1960s

MAR Risk Assessment Methodologies

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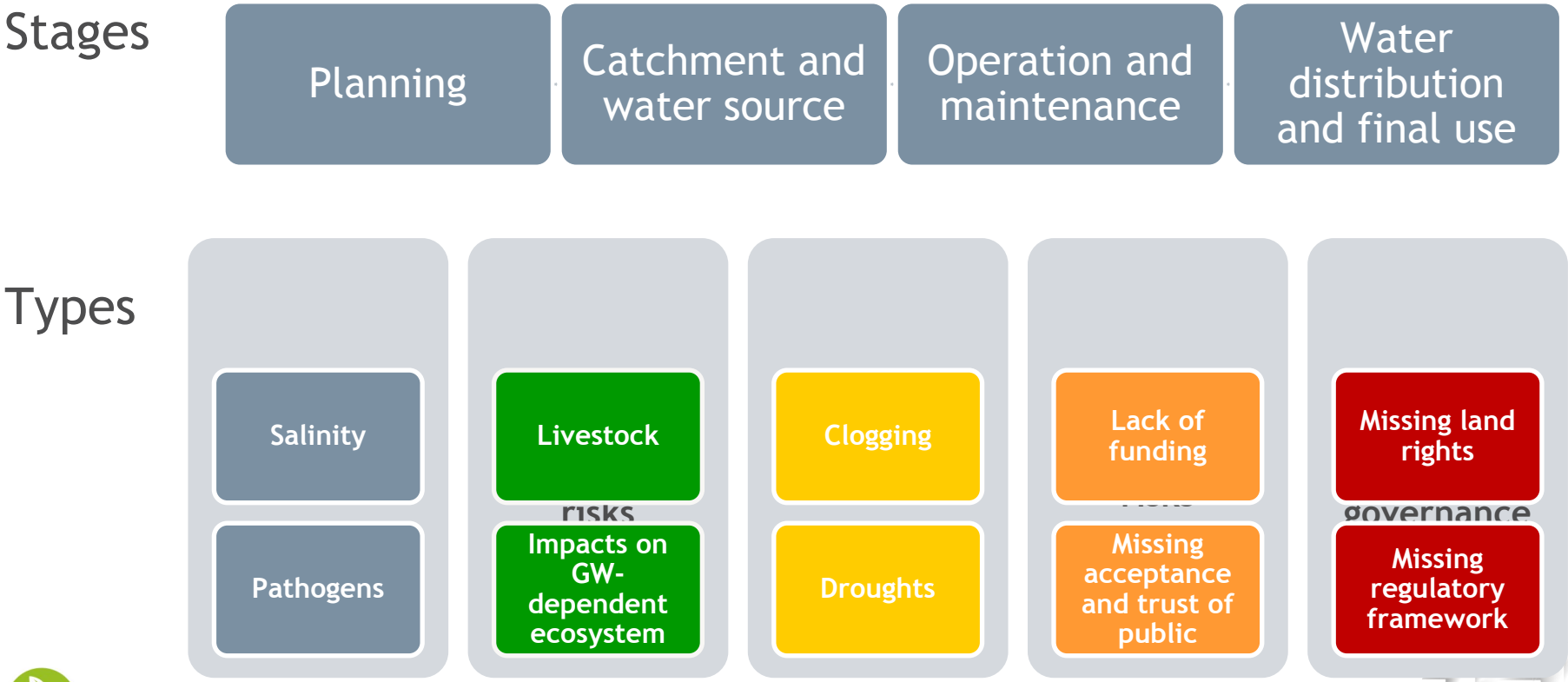
RISK TYPES AND STAGES MAR IMPLEMENTATION



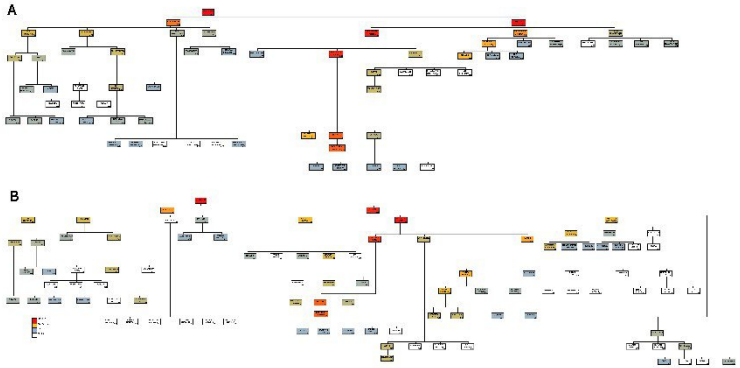
EXAMPLE POLISH PILOT SITE

Quantitative risk assessment

Probabilistic RA based on fault trees

Rodríguez-Escales et al. (2018)

Risk Factor Matrix	Severity of consequences				
Likelihood of occurance	Insignificant *rating: 1*	Minor *rating: 2*	Moderate *rating: 3*	Major *rating: 4*	Catastrophic *rating: 5*
Rare *rating: 1*	low	low	moderate	high	high
Unlikely *rating: 2*	low	low	moderate	high	very high
Possible *rating: 3*	low	moderate	high	very high	very high
Likely *rating: 4*	moderate	high	high	very high	very high
Almost certain *rating: 5*	moderate	high	very high	very high	very high



EXAMPLE POLISH PILOT SITE

Combined risk assessment outcome

Hazard	Quantitative RA	Fault Tree RA	Risk treatment
Turbidity during planning and operation	Low	0,75	Improvement of water treatment
Droughts and Rainfall event periodicity during operation	Medium	0,25	Water retention in storage tanks
Clogging during planning	High	0,5	
Clogging during operation	Medium	0,25	Change design: determine residence time /monitoring

EXAMPLE POLISH PILOT SITE

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INTERACTION: MENTIMETER

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Legislations and Policies on MAR

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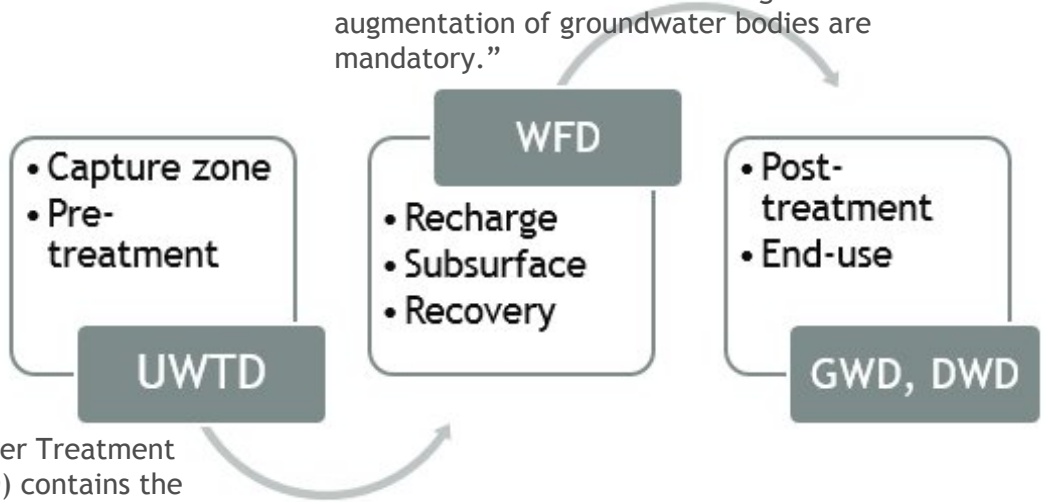
TRANSNATIONAL REGULATIONS WITH RELEVANCE FOR MAR

The article 11(3f) of Water Framework Directive (WFD) states that "controls, including a requirement for prior authorisation of artificial recharge or augmentation of groundwater bodies are mandatory."

The Groundwater Directive (GWD) does define WQ values for groundwater. Differences in partner countries.



Urban Wastewater Treatment Directive (UWTD) contains the provision of the legitimacy of water reuse in general and specifically, that treated wastewater shall be reused whenever appropriate.

The Drinking Water Directive (DWD) contains the most stringent limit values for water end-use, thus need to be considered when establishing regulations for possible additional monitoring, in case of MAR systems. Also, DWD does not explicitly define requirements for the source of water.

modified after Fig. 2 in Miret et al. 2012 (deliverable of the DEMEAU Project)

MAR REGULATIONS IN NATIONAL AND REGIONAL LEGISLATIONS

Explicit MAR specific regulations	Regulatory issues	Germany	Hungary	Poland	Slovakia	Croatia
MAR (artificial recharge) related EU regulations transposed into national and/or regional legislation and (WFD, GWD, EIA)	Prior authorisation of artificial recharge or augmentation of GW bodies (rules regulating the MAR-specific permitting procedure as prescribed in WFD)	✓	✓	✓	✓	✓
	Periodical review and update of controls of artificial recharge or augmentation of GW bodies (rules regulating the MAR-specific control/ monitoring regime as prescribed in the WFD	✓	✓			✓
	EIA requirement for artificial groundwater recharge schemes (larger than 10M m3)	✓	✓	✓	✓	
	WQ standards set specifically for MAR schemes for water to be injected or infiltrated (source water)					
	WQ standards for the GW body (receiving medium)	✓				
Any other direct MAR-specific regulations besides the above EU legislative requirements, in national/ regional legislation that explicitly refer to artificial recharge (but not reinjection)?						

LOCAL REGULATIONS AND SOFT RULES

Local regulations and soft rules	Germany	Hungary	Poland	Slovakia	Croatia
Local level MAR regulations, including rules of operators of MAR schemes that might be considered as a good policy practice and has a potential for a national level roll-out	✓				
Soft rules elated to MAR scheme planning, development or operation, such as guidelines or technical recommendations?	✓		✓		

GAPS IN MAR RELATED LEGISLATION IN THE DEEPWATER-CE PP COUNTRIES IN CE

- Lack of explicit national legislations
- Rules for water quality for reinjection are too strict
- Differentiation between MAR water for irrigation and drinking water necessary (DWD and GWD)

- ☾ lot of work going on in the moment, future needs for MAR regulations for sustainable GW management

Thank you for your kind attention

https://www.interreg-central.eu/Content.Node/DEEPWATER-CE.html

FUTURE COLLABORATION

- water quality
- monitoring
- drought prevention with MAR

Follow up: DEEPWATER-CE 2 ☾ DEEPQuality-CE
Pilot site in Germany

FEEDBACK