Interreg Danube Region

Co-funded by the European Union

MicroDrink

Output 3.4
Testing of DMST in drinking water obtained from intergranular water resources in Danube Region

Drafted by University of Ljubljana, Slovenia

with input provided by all project partners

This project is supported by the Interreg Danube Region Programme co-funded by the European Union.

Project MicroDrink	
Lead Partner:	Croatian Geological Survey
Specific objective:	3. Capacity building for management of microplastics in drinking water facilities (from source to tap)
Objective Leader:	University of Ljubljana
Output:	3.4 Testing of DMST in drinking water obtained from intergranular water resources in Danube region
Version:	01
Availability:	Public
Editors:	Dr. sc. Anja Torkar, Ines Vidmar, Mateja Jelovčan

Project partners:

Project Partner Institution	Contributors, name and surname
Croatian Geological Survey	Ana Selak Mirna Švec Jasmina Lukač Reberski Ivana Boljat
Institute of Public Health Zadar	Jadranka Šangulin Tajana Pijaca
University of Ljubljana	Mihael Brenčič Anja Torkar Ines Vidmar Mateja Jelovčan
Public company Kovod Postojna, water supply, sewerage, Ltd.	Edi Šibenik
Environment Agency Austria	Helga Lindinger Uta Wemhöner
T. G. Masaryk Water Research Institute	Zbyněk Hrkal Marek Polášek
Eurofins Analytical Services Hungary Kft	Gábor Bordós Bence Prikler
University of Belgrade, Faculty of Mining and Geology	Saša Milanović Ljiljana Vasić Branislav Petrović Veljko Marinović
Institute for Public Health of the Federation Bosnia and Herzegovina	Branimir Drinovac Nino Brajković Slađana Šarac
Public Utility Service Company "Drugi oktobar" Vršac	Aleksandar Šmit
Friedrich-Alexander-Universität Erlangen-Nürnberg	Gabriele Chiogna Mohammad Al-qadi

Table of contents

List of figures

1. Introduction

Project MicroDrink “Capacity building for management and governance of MICROplastics in DRINKing water resources of the Danube Region”, was approved under the 1st call of the Interreg Danube Region Programme, beginning in January 2024 and ending in June 2026. Within Specific Objective 3 “Capacity building for management of microplastics in drinking water facilities (from source to tap)” led by the University of Ljubljana, which focuses on strengthening capacities for microplastics management in drinking water facilities, the project developed methodological approaches to support operators, authorities, and policymakers in addressing microplastics challenges across the region.

Building on the transnational knowledge generated under Specific Objecitve 1 “Developing transnational knowledge base on microplastics in Danube region drinking water resources“ and Specific Objective 2 “Occurrence of microplastics in the water environment used for drinking water supply”, and informed by stakeholder consultations held in 8 Danube Region countries (AT, BA, CZ, DE, HU, HR, SI, RS), the MicroDrink Board created the Decision Making Support Tool (DMST) as Output 3.2. The DMST is a practical, scenario-based tool designed to guide users through assessing MP-related vulnerabilities, identifying relevant pathways, and selecting appropriate mitigation and management measures. Its development and refinement relied on close collaboration with Associated Strategic Partners and testing at nine pilot sites representing key drinking water resource types across the Danube River Basin, karst, intergranular and surface/river bank filtration. The DMST provides stakeholders across the drinking water sector with a structured, evidence-based framework for understanding and managing microplastics risks. Its value lies in translating complex scientific knowledge and diverse operational experience into practical, actionable guidance tailored to real-world water supply conditions.

This output summarises the findings and outcomes of testing the Decision-Making Support Tool (DMST) in pilot actions carried out by the Eurofins Analytical Services Hungary Kft, Public Utility Service Company “Drugi oktobar” Vrsac and Friedrich-Alexander-Universität Erlangen-Nürnberg representing intergranular drinking water resources of the Danube River Basin. The tool was tested in close collaboration with Associated Strategic Partners, ensuring that practical experience and real-world operational knowledge were incorporated into the evaluation. Feedback from water practitioners provides essential insights into how well the DMST performs in various water-supply scenarios and how effectively it supports decision-making for microplastics management.

This evaluation of the DMST is based on a questionnaire (Figure 1, Annex I.) consisting of nine questions designed to capture user experience, clarity, usefulness, and practical value. Seven questions apply to all water resource types included in the pilot testing, while two questions specifically address the assessment of microplastics-related risks in intergranular drinking water resources. The collected feedback provides an important real-world perspective that supports the refinement and practical viability of the tool across diverse water-supply scenarios.

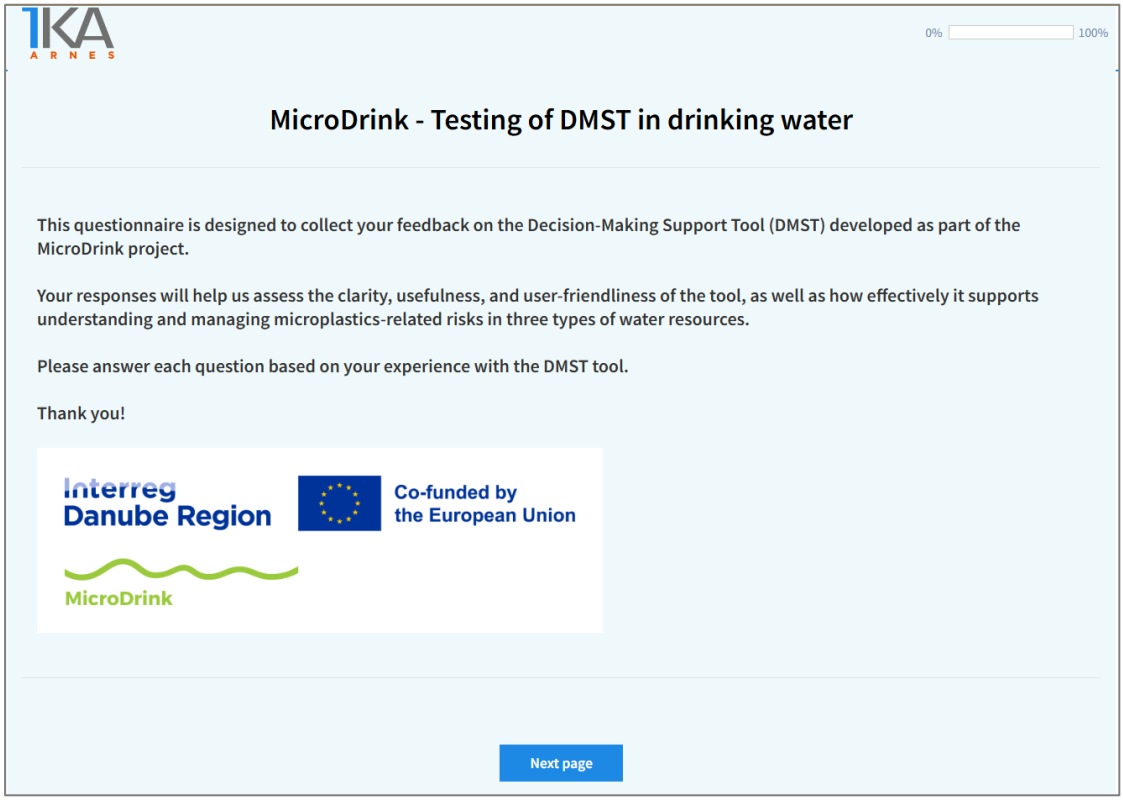

Figure 1: Questionnaire introductory page

2. Testing of DMST in intergranular water resources

Overall, 11 complete responses to the DMST survey were provided, of which 3 responses were recorded for intergranular water resources (Figure 2).

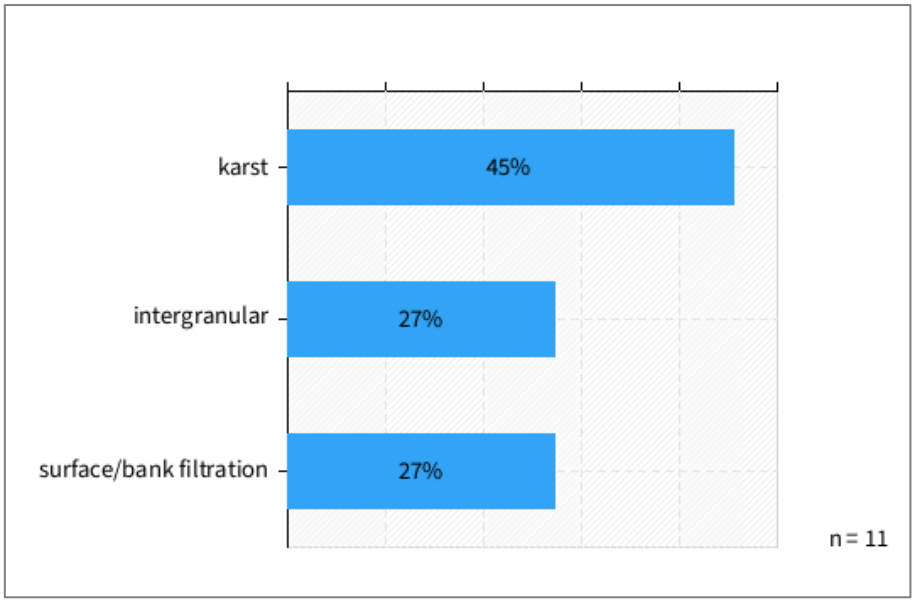

Figure 2: Complete responses for all three water resources

2.1. Overall impression of the tool

The results (Figure 3) show a strongly positive overall impression of the tool across all three water source types. Most respondents rated the tool as “useful” (64%), followed by “very useful” (27%). Only a small proportion selected “neutral” (9%), and no negative ratings were given. With a mean score of 4.2, the results indicate that users across karst, intergranular and surface/river bank filtration found the tool consistently helpful and well designed.

The next graph (Figure 4) presents the results specifically for intergranular water resources and similarly shows positive ratings with respondents selecting either “4 – useful” or “5 – very useful.” This confirms the favourable overall impression observed among all water source users, indicating that intergranular source users also found the tool clear, supportive, and effective for their work.

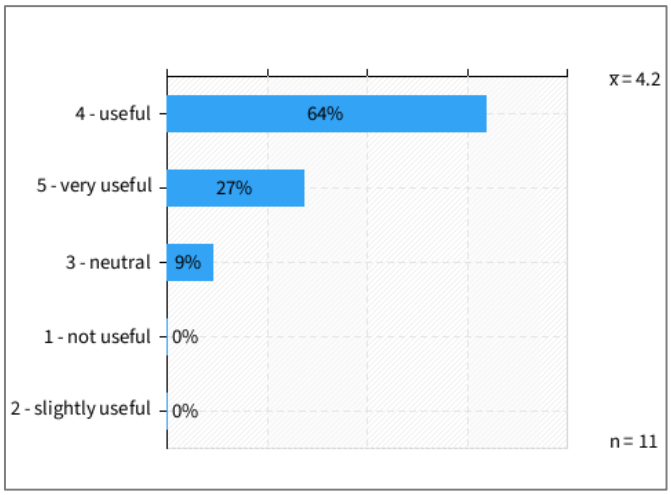

Figure 3: Overall impression of the tool from responses from all three water resources

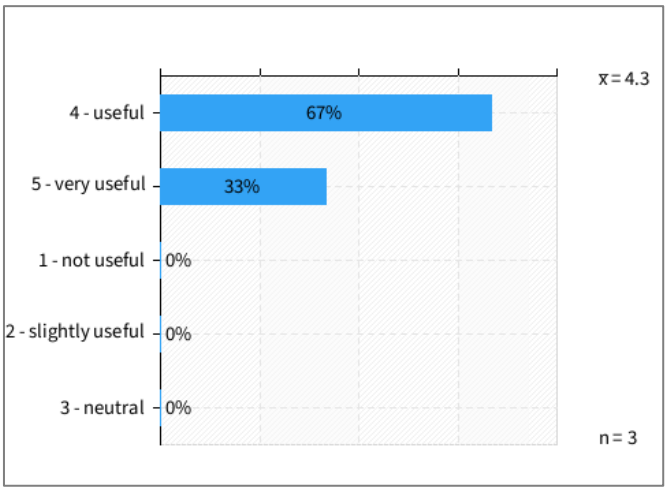

Figure 4: Overall impression of the tool from responses with intergranular water resources

2.2. Ease of navigating the tool and building scenarios

For all water resources, the results (Figure 5) show that respondents generally found the tool easy to navigate when building scenarios, with most selecting "very easy" or "easy", and no one reporting difficulties. The mean score of 4.2 indicates that users across karst, intergranular and surface/river bank filtration contexts found the tool intuitive and straightforward to use.

For intergranular water resources, users' results (Figure 6) also show exclusively positive experiences, with respondents rating the process as either "very easy" or "neither hard nor easy". This confirms that users working specifically with intergranular water resources found the tool accessible and simple to navigate when constructing different scenarios.

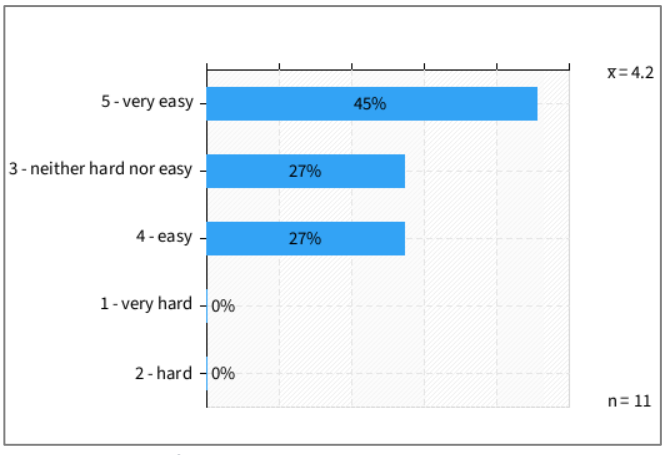

Figure 5: Ease of navigating the tool and building the scenarios for all water resources

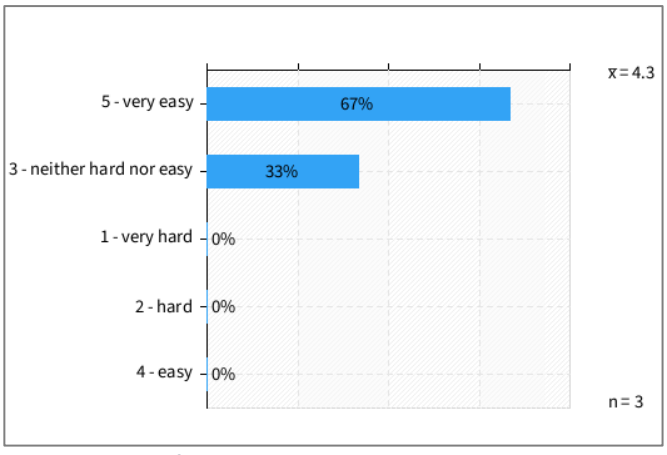

Figure 6: Ease of navigating the tool and building the scenarios for intergranular water resources

2.3. Clarity of content presentation in individual parts of the tool

For all water resources, the results (Figure 7) show that respondents generally found the content of individual parts of the tool clearly presented. Most selected “clearly” or “very clearly”, while a smaller proportion chose the middle option, and no one rated the content as unclear. With a mean score of 4.1, the results indicate that users across all three water resources understood the tool’s content well.

The intergranular-only results (Figure 8) show a similarly positive pattern, with responses evenly distributed across “neither unclear nor clear”, “clearly”, and “very clearly”, and no unclear ratings. This confirms that users working specifically with intergranular water resources also perceived the content as clearly structured and easy to understand.

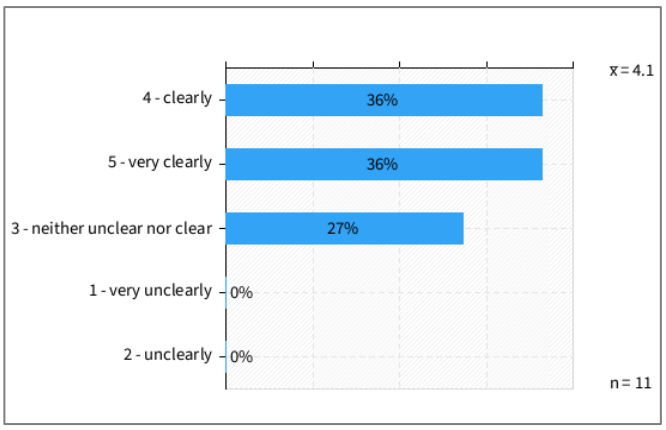

Figure 7: Clarity of content presentation for all water resources

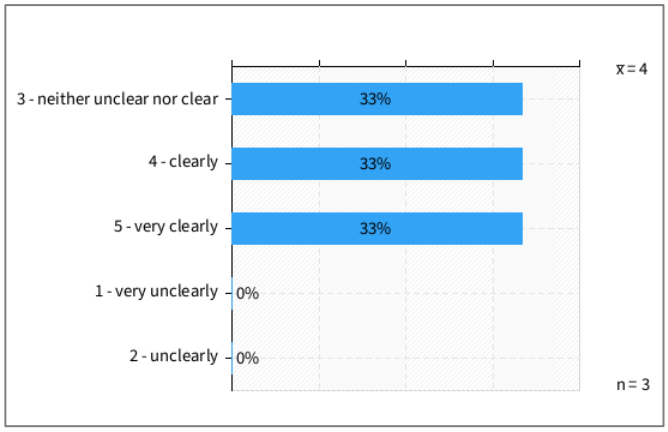

Figure 8: Clarity of content presentation for intergranular water resources

2.4. Clarity and logic of the decision-tree structure

For all water resources, the results (Figure 9) show that respondents generally perceived the decision-tree structure as clear and logical. Most ratings were in the “clear” and “very clear” categories, while a smaller proportion selected the middle option, and no one rated the structure as unclear. With a mean score of 3.9, the results indicate that users across all three water resources were able to follow the decision-making steps without difficulty.

The intergranular-only results (Figure 10) show a similarly positive pattern, with responses distributed between “neither unclear nor clear” and “very clear,” and no unclear ratings. This confirms that users working specifically with intergranular water resources also found the decision-tree structure understandable and sufficiently logical for guiding them through the different steps.

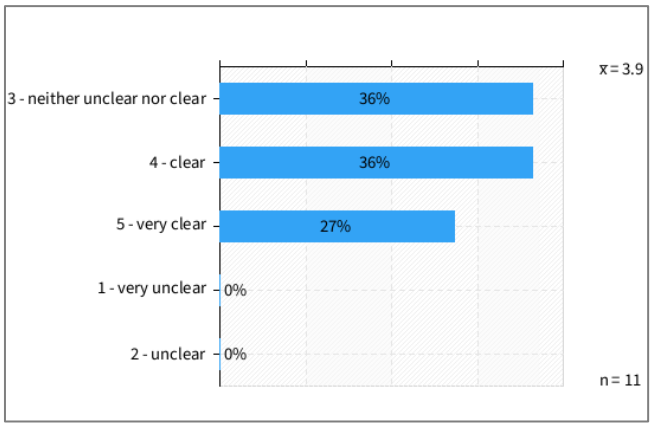

Figure 9: Clarity and logic of the decision-tree structure for all water resources

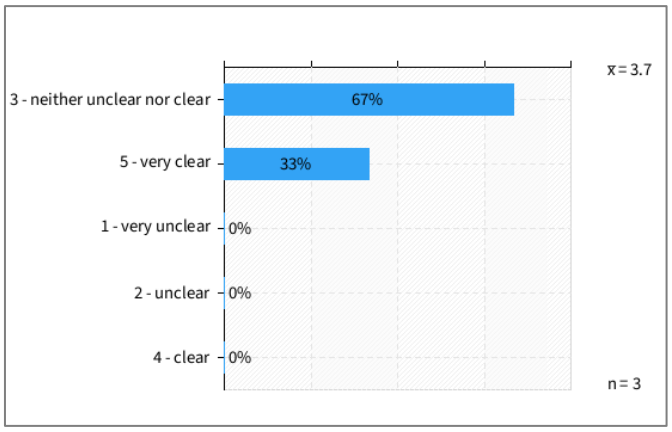

Figure 10: Clarity and logic of the decision-tree structure for intergranular water resources

2.5. New knowledge gained through the tool

For all water resources, the results (Figure 11) show that respondents generally felt they gained a meaningful amount of new knowledge from the tool. Most selected "a moderate amount" or "a large amount", with a smaller proportion choosing "a very large amount", and no one reporting little or no new knowledge. With a mean score of 3.5, the results indicate that the tool effectively supported learning across all three water resources.

The intergranular-only results (Figure 12) reflect an equally positive experience, with responses evenly distributed across "a moderate amount", "a large amount", and "a very large amount". This confirms that users working specifically with intergranular water resources also perceived the tool as informative and valuable for expanding their understanding of microplastics-related issues.

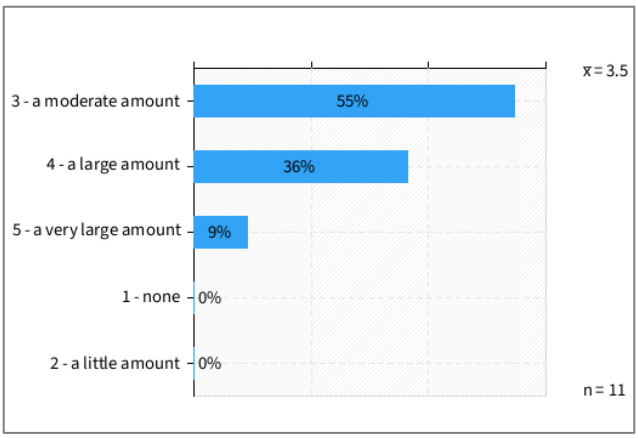

Figure 11: New knowledge gained for all water resources

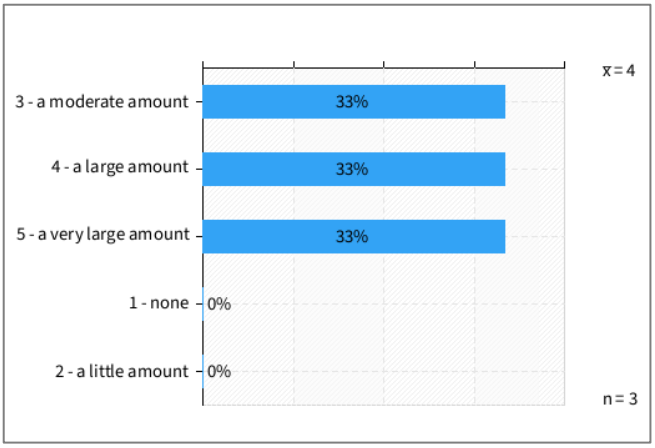

Figure 12: New knowledge gained for intergranular water resources

2.6. Adequacy and helpfulness of the tool for assessing microplastic risks in intergranular water resources

The results (Figure 13) show that respondents rated the tool very positively for its adequacy and helpfulness in assessing microplastic risks in intergranular water resources. All ratings were in the "agree" or "strongly agree" categories, with no neutral or negative responses. The high mean score of 4.7 indicates that users found the tool well prepared, reliable, and effective in supporting risk assessment in intergranular water resources.

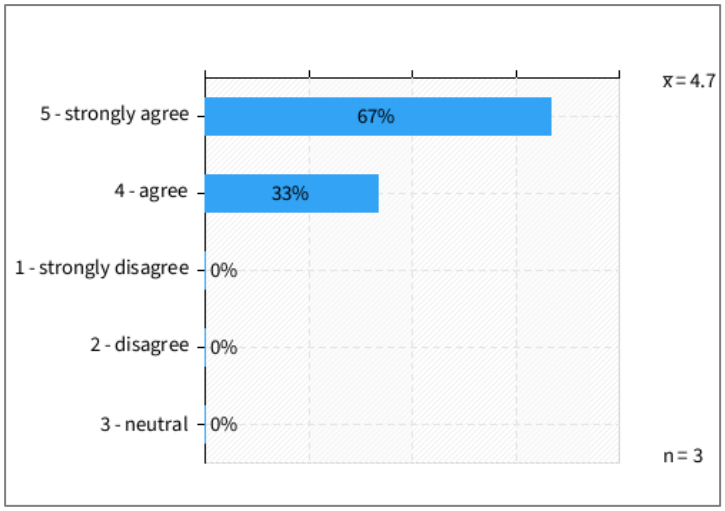

Figure 13: Adequacy and helpfulness of the tool for assessing microplastic risks in intergranular water resources

2.7. How the tool supports understanding of microplastic vulnerability in intergranular water resources

The results (Figure 14) show that respondents evaluated the tool very positively regarding its support for understanding microplastic vulnerability in intergranular water resources. All ratings were either "agree" or "strongly agree," with no neutral or negative responses. With a high mean score of 4.7, the results indicate that users found the tool clear, informative, and effective in helping them understand vulnerability-related aspects specific to intergranular water resources.

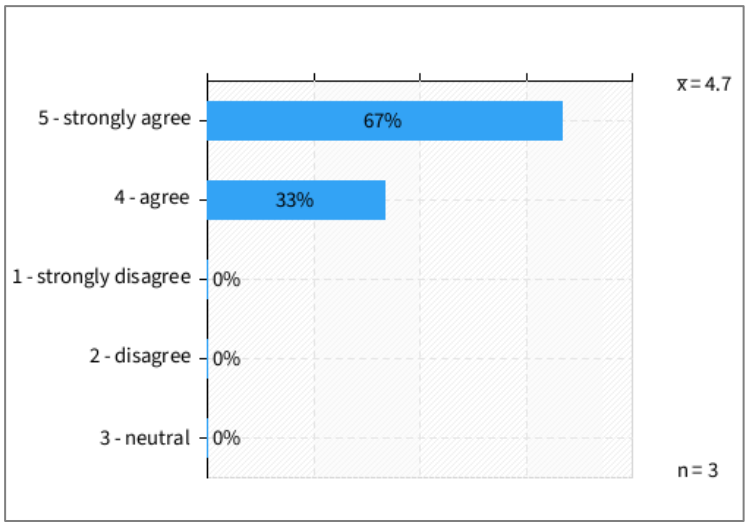

Figure 14: Respondents' assessment of how the tool supports understanding of microplastic vulnerability in intergranular water resources

2.8. Information in the DMST users found most useful

For all water resources, the results (Figure 15) show that users found a broad range of DMST content useful, with the highest interest in microplastics hotspots, followed by several equally valued topics such as the microplastics cycle, laboratory information, sampling systems, risk assessment, and best practice requirements. Lower but still notable interest was expressed in definitions, monitoring strategies, source mapping, and hotspot analysis, while only a few respondents selected measures to reduce microplastics input or interpretation-related topics. Overall, the results indicate that users most appreciated content directly supporting practical assessment and scenario development.

The intergranular-only results (Figure 16) show a similar pattern, with the MicroDrink sampling system standing out as the most useful element, while several other topics; definitions, the microplastics cycle, laboratory information, hotspots, monitoring strategies, best practice requirements, hotspot analysis, and source mapping, were all selected equally. Topics related to EU act, risk assessment, measures, and uncertainties were not selected. This suggests that intergranular-only users primarily valued operational and methodological information that directly supports sampling, analysis, and understanding of microplastic dynamics.

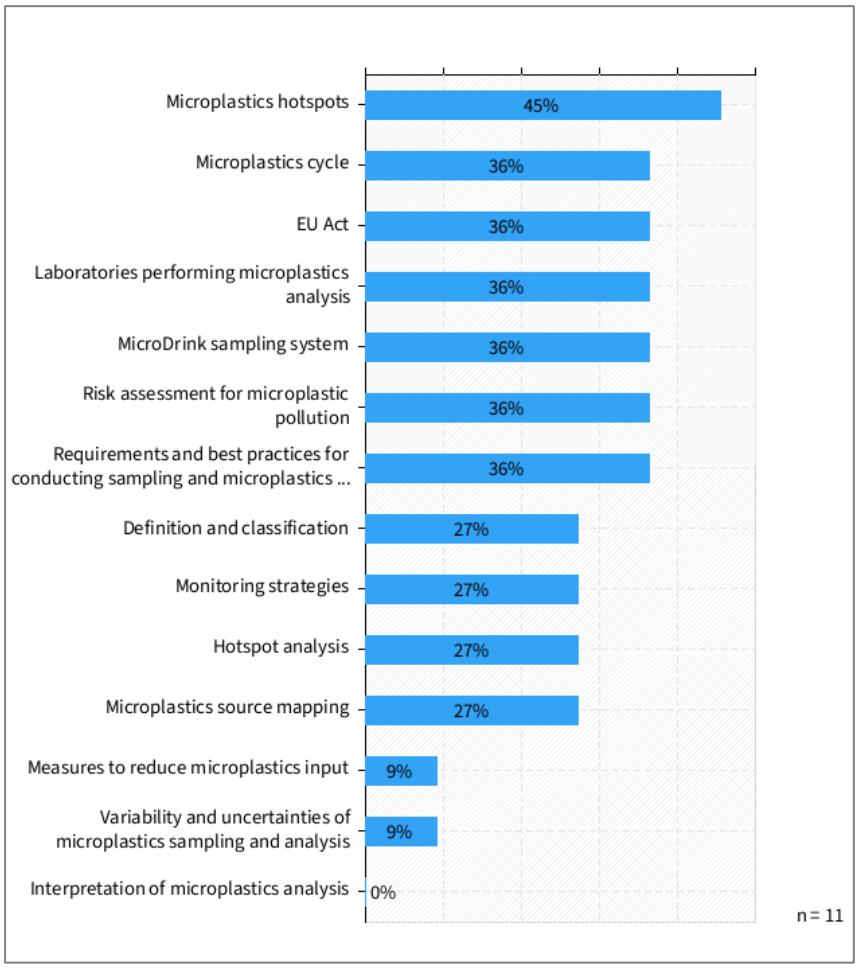

Figure 15: Most useful information provided by the DMST asross all water resources, as identified by users

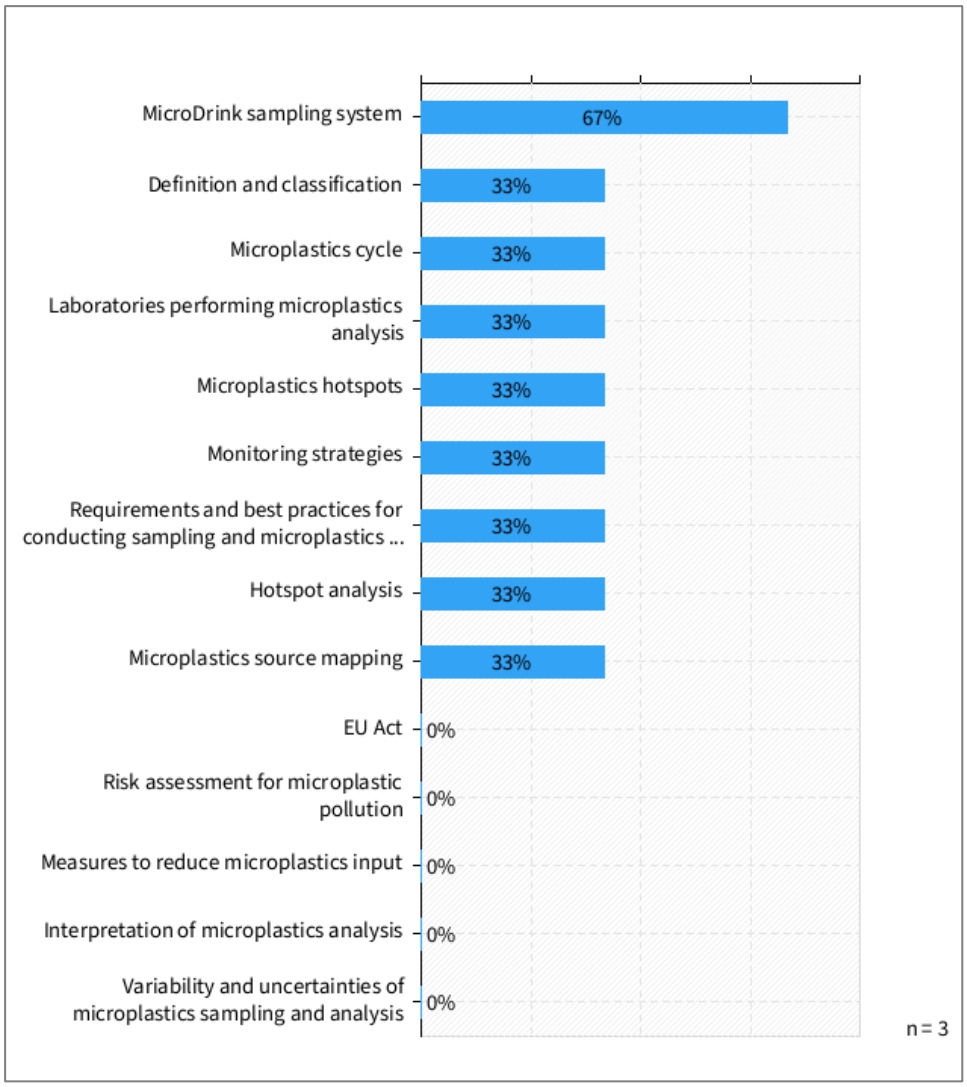

Figure 16: Most useful information provided by the DMST for intergranular water resources, as identified by users

2.9. Ability to define next steps for microplastics management after using the tool

For all water resources, the results (Figure 17) show that respondents generally felt confident in defining their next steps for microplastics management after using the tool. Most selected “agree” (70%) or “strongly agree” (20%), with only one neutral response and no disagreement. With a mean score of 4.1, the results indicate that the tool effectively supports users in translating its outputs into clear, actionable follow-up measures.

The intergranular-only results (Figure 18) reflect an equally positive experience, with all respondents choosing either “agree” or “strongly agree”. This confirms that users working specifically with intergranular water resources also found the tool highly supportive in identifying appropriate next steps for microplastics management.

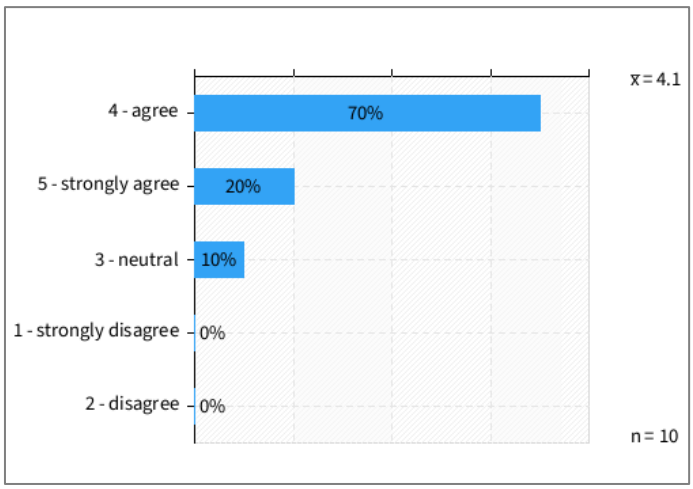

Figure 17: Ability to define next steps for microplastics management after using the tool for all water resources

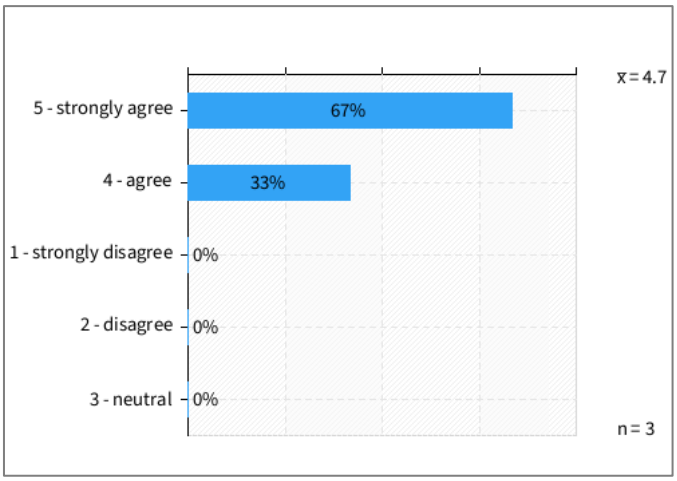

Figure 18: Ability to define next steps for microplastics management after using the tool for intergranular water resources

3. Conclusion

Based on the questionnaire, the DMST performs exceptionally well for intergranular water resources, with respondents consistently providing positive feedback and no negative ratings in any category. Users found the tool useful, easy to navigate, and clearly structured, indicating that its design aligns well with the needs of those working with intergranular water resources.

The tool's overall impression was highly favourable, with respondents rating it as useful or very useful. Its navigation and scenario-building functions were also well received, demonstrating that users could move through the tool intuitively and construct scenarios without difficulty. The clarity of content presentation and the logic of the decision-tree structure were both positively evaluated, confirming that the tool's internal organisation supports understanding and decision-making in a coherent and user-friendly way.

Users reported gaining meaningful new knowledge, with responses ranging from moderate to very large amounts of learning. The most valued information related to sampling systems, definitions, microplastics cycles, laboratory processes, hotspots, monitoring strategies, and best-practice requirements, reflecting the practical and methodological needs of intergranular-focused stakeholders.

The tool was rated very highly for its adequacy and helpfulness in assessing microplastic risks in intergranular water resources, as well as for its ability to support understanding of microplastic vulnerability. Respondents also expressed strong confidence in their ability to define next steps for microplastics management after using the tool, demonstrating that the DMST not only informs but also empowers users to act.

Overall, the evaluation indicates that the DMST is a clear, practical, and effective decision-support tool for intergranular water resources. With an overall score of 4.3, the tool demonstrates strong performance and a high level of user satisfaction. It improves understanding, supports scenario development, strengthens risk assessment, and assists users in translating insights into concrete management actions. Respondents identified the tool's clarity, logical structure, and practical relevance as particular strengths, noting that it provides a well-organised and accessible framework for addressing microplastic challenges in intergranular aquifers. The consistently positive feedback confirms its strong relevance and usability for operators and authorities working with intergranular water resources.

Annex I.

Questionnaire

Intergranular water resources:

1. What is your overall impression of the tool?
   Rate your answer from 1 (not useful) 2 (slightly useful) 3 (neutral) 4 (useful) 5 (very useful)

2. How easy is it to navigate the tool and build different scenarios?
   Rate your answer from 1 (very hard) 2 (hard) 3 (neither hard nor easy) 4 (easy) 5 (very easy)

3. How clearly is the content of individual parts of the tool presented?
   Rate your answer from 1 (very unclearly) 2 (unclearly) 3 (neither unclearly nor clearly) 4 (clearly) 5 (very clearly)

4. Is the decision-tree structure clear and logical in guiding you through the different steps?
   Rate your answer from 1 (very unclear) 2 (unclear) 3 (neither unclear nor clear) 4 (clear) 5 (very clear)

5. How much new knowledge did the tool help you acquire?
   Rate your answer from 1 (none) 2 (a little amount) 3 (a moderate amount) 4 (a large amount) 5 (a very large amount)
   Explain which new knowledge you gained.

6. I believe this tool provides an adequate and helpful assessment of the risks posed by microplastics in intergranular water resources.
   Rate from 1 (strongly disagree) 2 (disagree) 3 (neutral) 4 (agree) 5 (strongly agree)

7. I believe this tool helps to understand vulnerability of intergranular water resources to microplastics pollution.
   Rate from 1 (strongly disagree) 2 (disagree) 3 (neutral) 4 (agree) 5 (strongly agree)

8. Which of the following information included in the DMST did you find most useful? Choose up to three:
   - *Definition and classification*

- *Microplastic cycle*
- *EU Act*
- *Laboratories performing microplastics analysis*
- *MicroDrink sampling system*
- *Microplastics hotspots*
- *MicroDrink sampling results*
- *risk assessment for microplastics pollution*
- *monitoring strategies*
- *measures to reduce microplastics input*
- *interpretation of microplastics analysis*
- *requirements and best practices for conducting sampling and microplastics analysis*
- *variability and uncertainties of microplastics sampling and analysis*
- *hotspot analysis*
- *microplastics source mapping*

9. After using the tool, I can define my next steps in decision-making for microplastics management.
   Rate from 1 (strongly disagree) 2 (disagree) 3 (neutral) 4 (agree) 5 (strongly agree)