Interreg Danube Region

Co-funded by the European Union

MicroDrink

# Output 3.3
# Testing of DMST in drinking water obtained from karst 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:** | 3.3 Testing of DMST in drinking water obtained from karst water resources in Danube region |
| **Version:** | 01 |
| **Availability:** | Public |
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# 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 Objective 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 Croatian Geological Survey, Environment Agency Austria and Institute for Public Health of the Federation Bosnia and Herzegovina representing karst 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 karst 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.

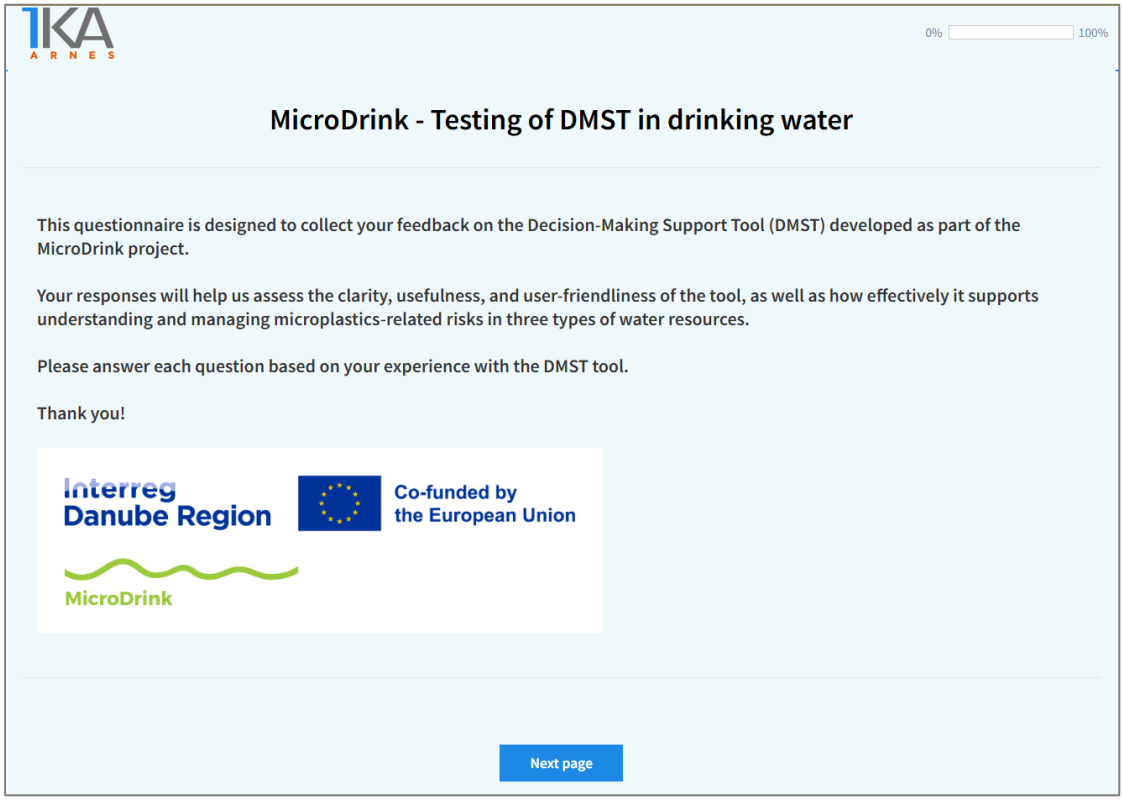


*Figure 1: Questionnaire introductory page*

# 2. Testing of DMST in karst water resources

Overall, 11 complete responses to the DMST survey were provided, of which 5 responses were recorded for karst water resources (Figure 2).

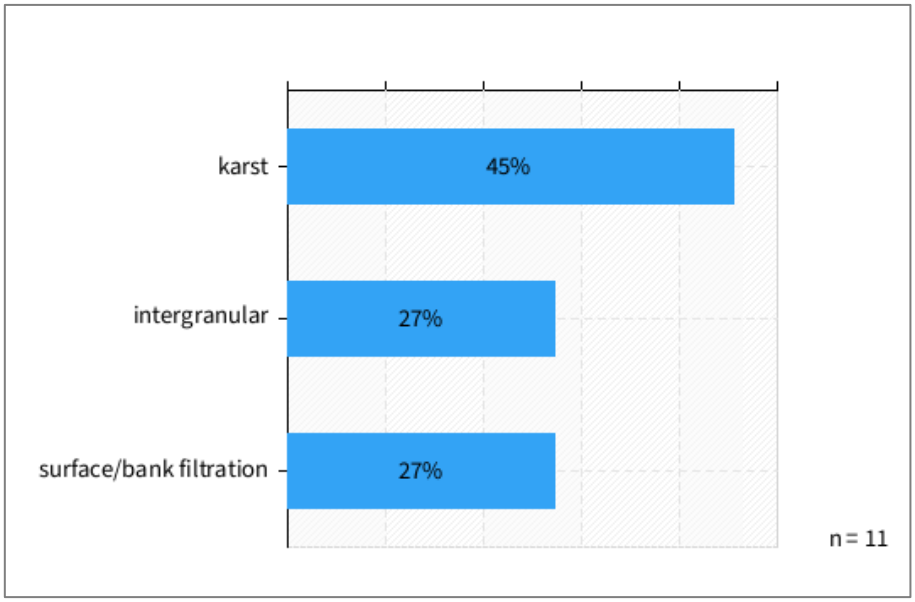


*Figure 2: Complete responses for all three water resources*

## 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.

For karst water resources, the results are similar, (Figure 4) showing a clearly positive overall impression of the tool. Most respondents rated it as “useful” (40%) or “very useful” (40%), while the remaining respondent selected the neutral option. No negative ratings were given. With a mean score of 4.2, the results indicate that karst-focused users found the tool well designed, supportive, and relevant to their work.

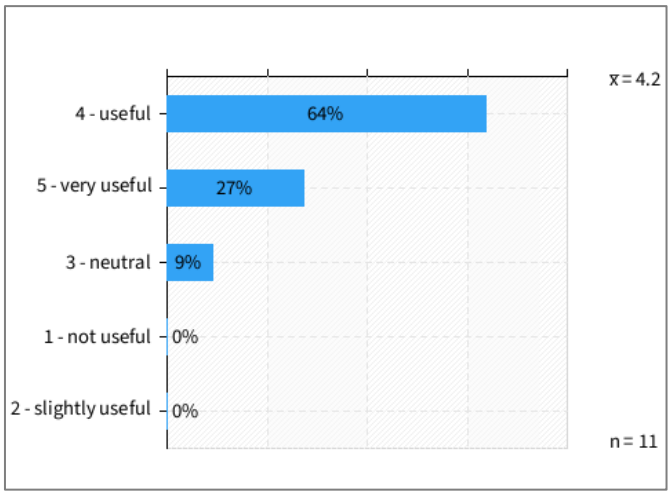


*Figure 3: Overall impression of the tool from responses from all three water resources*

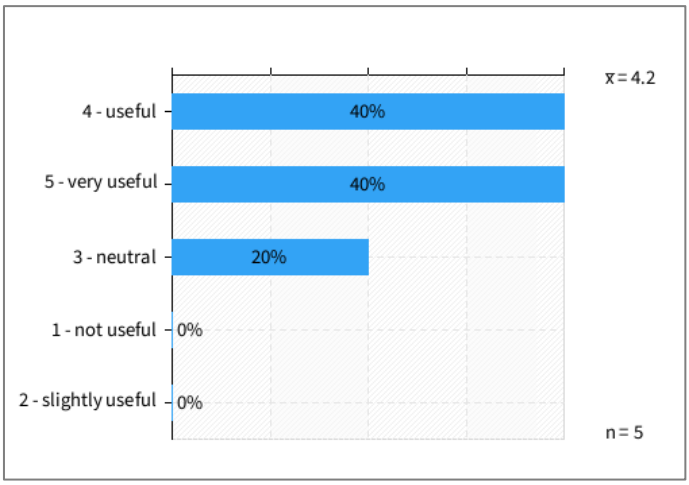


*Figure 4: Overall impression of the tool from responses with karst water resources*

## 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 found the tool intuitive and straightforward to use.

For karst water resources, the results (Figure 6) show that respondents generally found the tool easy to navigate when building scenarios. Most selected either "easy" (40%) or "neither hard nor easy" (40%), while one respondent rated the process as "very easy" (20%). No one reported difficulties. With a mean score of 3.8, the results indicate that karst-focused users experienced the tool as intuitive and straightforward to use.

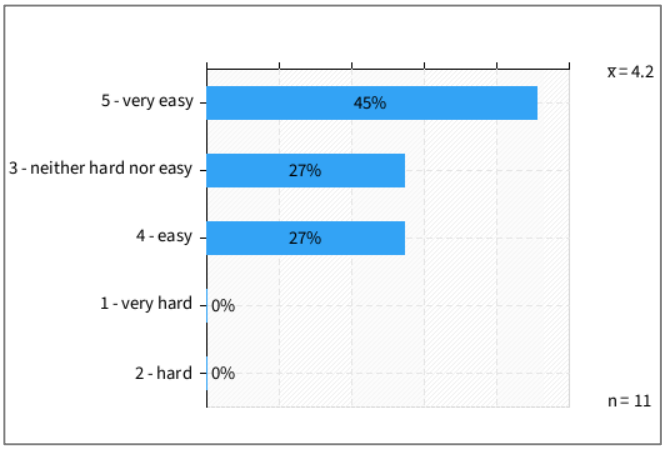


*Figure 5: Ease of navigating the tool and building the scenarios for all water resources*

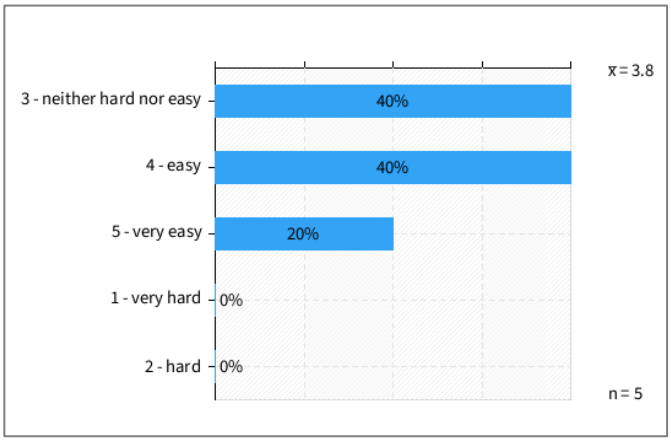


*Figure 6: Ease of navigating the tool and building the scenarios for karst water resources*

## 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.

For karst water resources, the results (Figure 8) show that respondents generally found the content in individual parts of the tool clear. Most responses were divided between “clearly” (40%) and “neither unclear nor clear” (40%), while one respondent rated the content as “very clearly” (20%). No one selected the unclearly or very unclearly categories. With a mean score of 3.8, the results indicate that karst-focused users found the content understandable overall, though there was some variation in how clearly different parts of the tool were perceived. This is likely part due to the significant complexity of karst systems compared to the other water resources, rather than the functions of the tool itself.

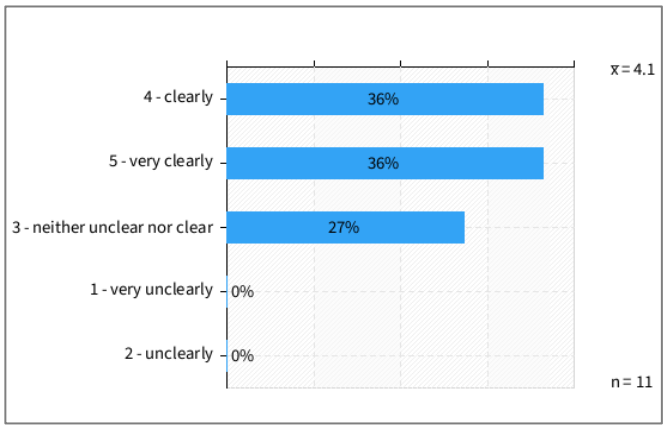


*Figure 7: Clarity of content presentation for all water resources*

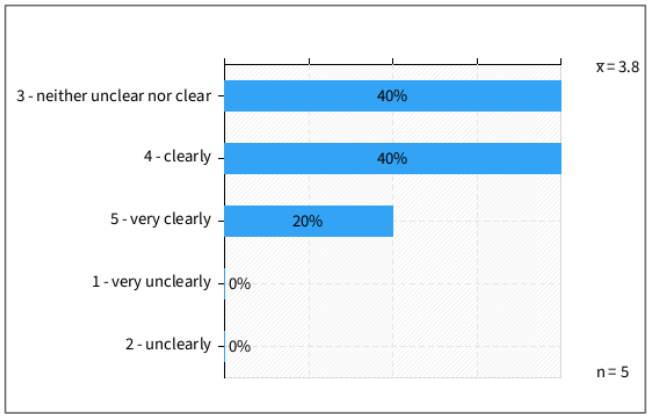


*Figure 8: Clarity of content presentation for karst water resources*

## 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.

For karst water resources, the results (Figure 10) show that respondents generally perceived the decision-tree structure as clear and logically organised. Most answers were split between “very clear” (40%) and “neither unclear nor clear” (40%), while one respondent selected “clear” (20%). No

one rated the structure as unclear or very unclear. With a mean score of 4.0, the results indicate that karst-focused users were largely able to follow the decision-making steps, although some respondents found the structure only moderately clear. As in the previous question, this is partly caused by significant complexity of karst systems, which constrain decision-making under ordinary circumstances, exacerbated even further when dealing with a novel subject such as microplastics.

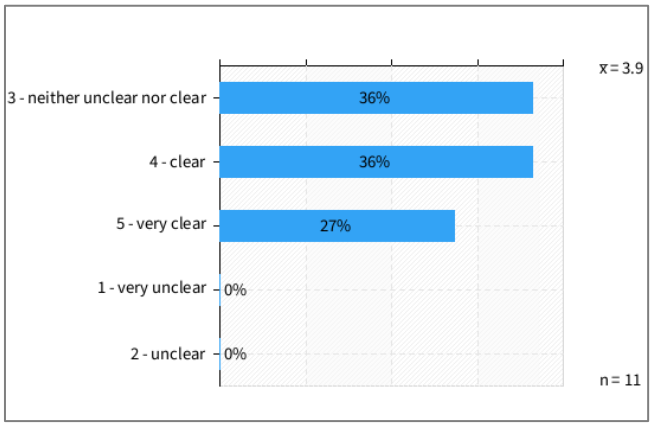


*Figure 9: Clarity and logic of the decision-tree structure for all water resources*

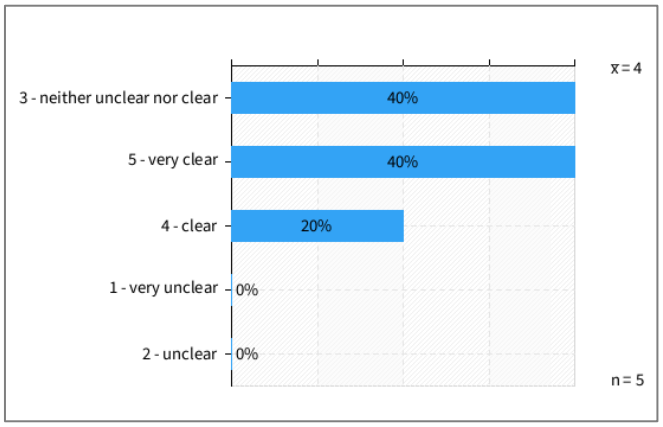


*Figure 10: Clarity and logic of the decision-tree structure for karst water resources*

## 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.

For karst water resources, the results (Figure 12) show that respondents gained a significant amount of new knowledge from the tool. Most selected "a moderate amount" (60%), while the remaining respondents chose "a large amount" (40%). No one reported gaining little or no new knowledge. With a mean score of 3.4, the results indicate that the tool effectively supported learning for users focused on karst water resources.

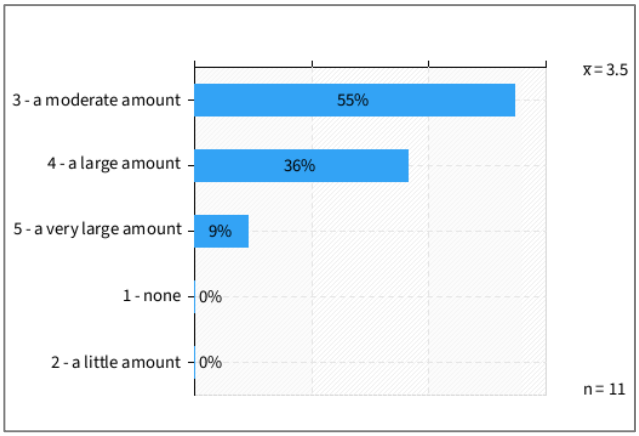


*Figure 11: New knowledge gained for all water resources*

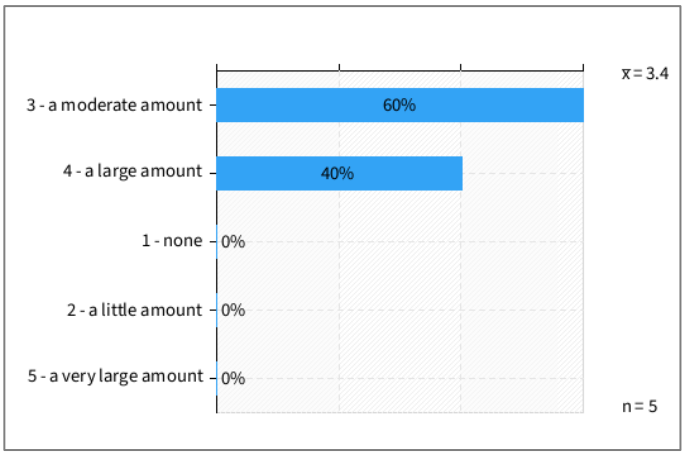


*Figure 12: New knowledge gained for karst water resources*

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

For karst water resources, the results (Figure 13) show that respondents generally considered the tool adequate and helpful for assessing microplastic risks. Most responses were divided between "agree" (40%) and "strongly agree" (20%), while the remaining respondents chose the neutral option (40%). No one disagreed with the statement. With a mean score of 3.8, the results indicate that karst-focused users found the tool supportive in evaluating microplastic risks.

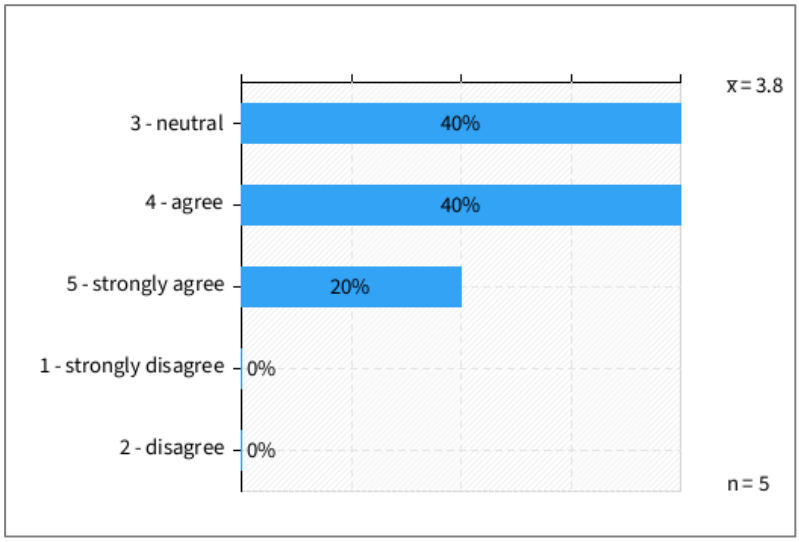


*Figure 13: Adequacy and helpfulness of the tool for assessing microplastic risks in karst water resources*

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

For karst water resources, the results (Figure 14) show a strongly positive perception of how well the tool supports understanding of microplastic vulnerability. Most respondents selected “strongly agree” (60%), while the remaining respondents chose the neutral option (40%). No one disagreed with the statement. With a mean score of 4.2, the results indicate that the tool is highly effective in helping karst-focused users understand the specific vulnerability of karst systems to microplastics, reflecting its clarity, relevance and practical value.

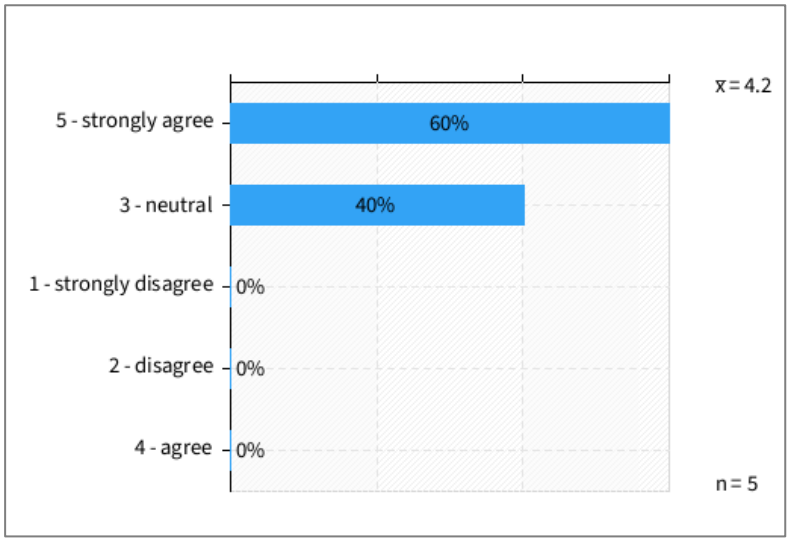


*Figure 14: Respondents' assessment of how the tool supports understanding of microplastic vulnerability in karst water resources*

## 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.

For karst water resources, the results (Figure 16) show that users found a diverse range of information in the DMST useful, with the highest interest expressed in the EU Act (60%). Several

topics were selected by 40% of respondents, including the microplastics cycle, laboratories performing microplastics analysis, microplastics hotspots, risk assessment, and requirements and best practices for sampling and analysis. A smaller group (20%) highlighted definitions and classification, the MicroDrink sampling system, monitoring strategies, measures to reduce microplastics input and hotspot analysis. Overall, the results indicate that karst-focused users valued content supporting practical understanding, regulatory context and methodological guidance.

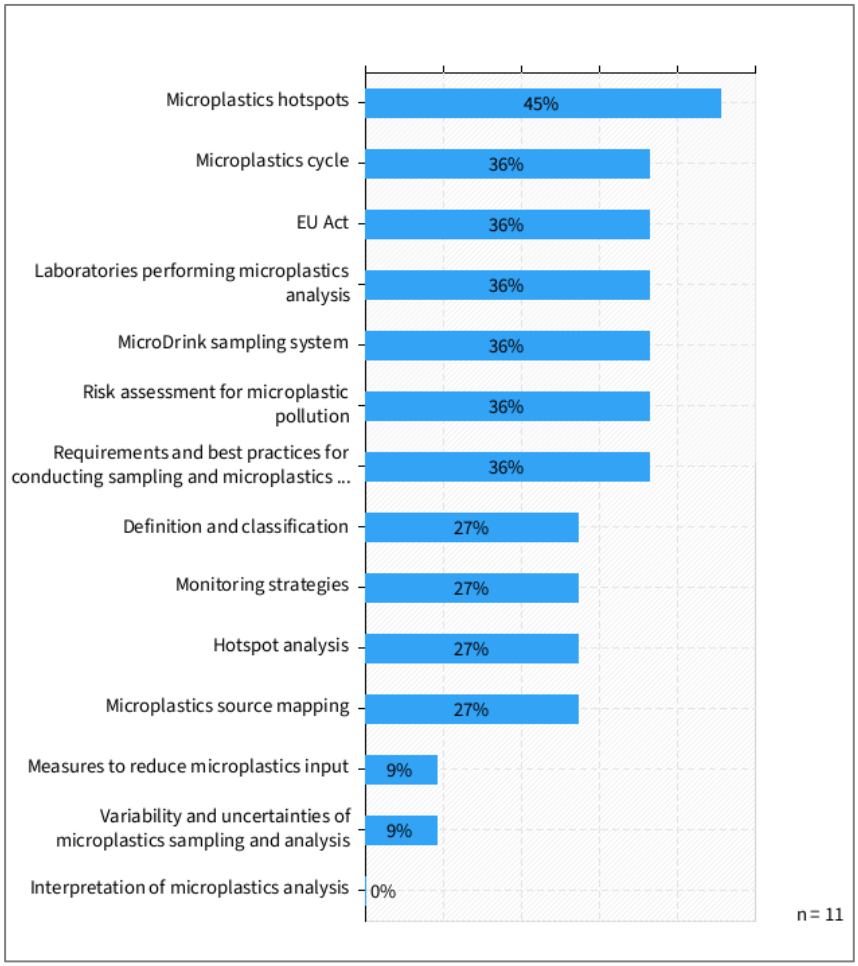


*Figure 15: Most useful information provided by the DMST asross all water resources, as identified by users*

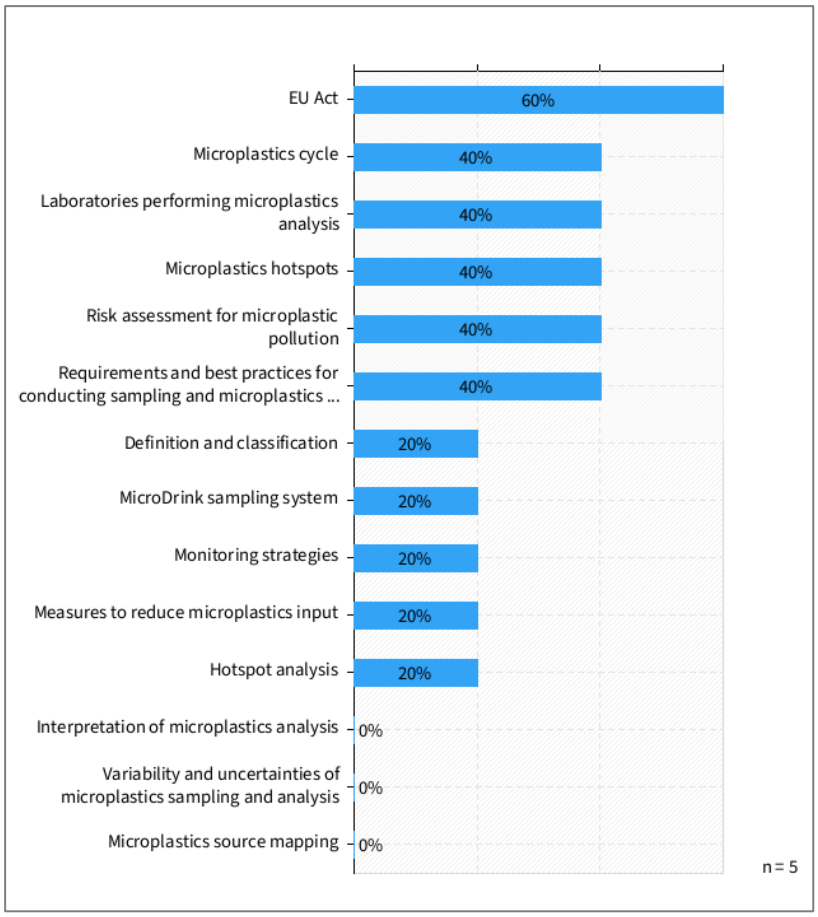


*Figure 16: Most useful information provided by the DMST for karst water resources, as identified by users*

## 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.

For karst water resources, the graph (Figure 18) shows that respondents generally felt able to define their next steps for microplastics management after using the tool. Most selected “agree” (75%), while one respondent chose the neutral option (25%). No one disagreed or strongly agreed. With a mean score of 3.8, the results indicate that the tool provides solid support for planning follow-up actions in karst water sources, although a small proportion of users expressed only moderate confidence. This was not unexpected, as karst systems are generally more challenging for decision-making. Nevertheless, the tool’s value in providing support in decision-making is

highlighted, as even in complex systems such as karst, stakeholders still reported an increase in their ability to define next steps as a direct result of using the Decision-making support tool.

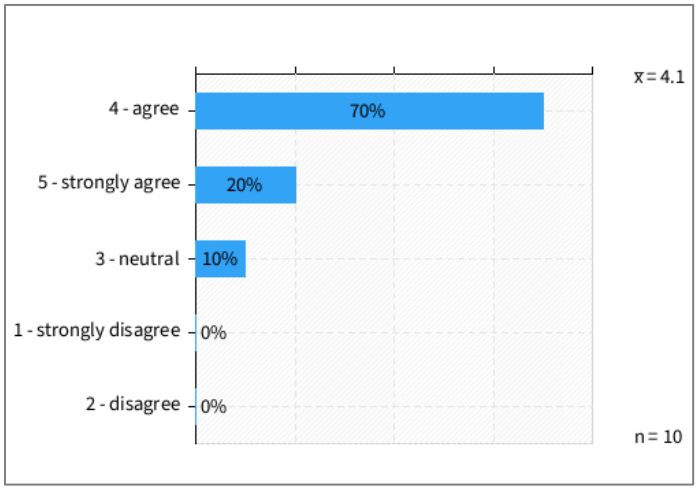


*Figure 17: Ability to define next steps for microplastics management after using the tool for all water resources*

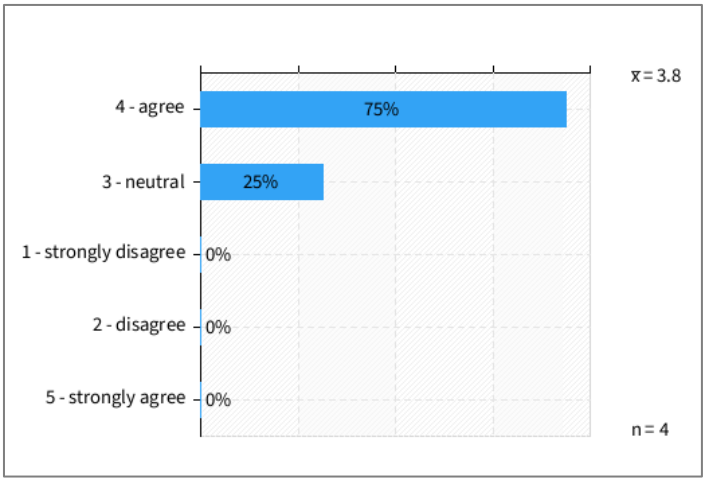


*Figure 18: Ability to define next steps for microplastics management after using the tool for karst water resources*

# 3. Conclusion

The evaluation of the DMST for karst water resources demonstrates a consistently positive user experience across all question asked. Respondents rated the tool as useful and well designed, with a strong overall impression and no negative feedback. Navigation and scenario building were generally perceived as intuitive, and the clarity of content presentation, while showing some variability, was still rated positively. The decision-tree structure was viewed as clear and logical, supporting users in following the recommended steps.

The tool also proved effective in enhancing users' understanding: respondents reported gaining a moderate to large amount of new knowledge, particularly in areas related to microplastics vulnerability, regulatory context, and methodological guidance. Its adequacy for assessing microplastic risks in karst systems, reflecting both confidence and recognition of the tool's practical value. Users highlighted a broad range of information as useful, with especially strong interest in the EU Act and several operational and analytical topics.

Finally, the tool supported users in defining next steps for microplastics management, with most respondents agreeing that it provides clear direction for follow-up actions. With an overall evaluation score of 3.9, the DMST demonstrates solid performance and a generally positive user experience among karst water resource operators. Respondents highlighted the tool's clarity, structured guidance, and practical relevance as key strengths, noting that it helps them better understand microplastic vulnerability and navigate the decision-making process with greater confidence. Overall, the results indicate that the DMST is a valuable and effective resource for karst water resource operators, offering clarity, structure, and relevant knowledge to support informed decision-making.

# Annex I.

# Questionnaire

**Karst 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 karst 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 karst 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)*