

The Adrion Project MUHA—Multi-hazard Framework for Water Related Risks Management: Linking Water Utilities and Civil Protection Mechanisms through Water Safety Plans [†]

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Abstract: In the EU Drinking Water Directive (EU DWD) 2020/2184, the approach of the “water safety plan”, as suggested by the WHO, has been individuated as the correct tool for water utilities to ensure safe, drinkable water. The ADRIATIC-IONIAN Interreg project, MUHA—MultiHazard Framework for water related risks management, has become the necessity to effectively link different aspects of the water related risks management in an improved response system, integrating the functions of analysis, forecasting, and incident command systems. This paper aims to describe the rationale of the MUHA project and present some of the main outcomes.

Keywords: water supply system; water safety plan; risk analysis

1. Introduction

The revised EU Drinking Water Directive (EU 2020/2184) [1] “on the quality of water intended for human consumption”, whose legal framework is set by the Directive 98/83/EC [2], explicitly mentions the “water safety plans” (WSP) as the correct tool for water utilities to provide safe drinkable water, together with standard EN 15975-2 concerning the security of the drinking water supply. WSPs, according to the approach suggested by the World Health Organization, are based upon a comprehensive risk assessment and risk-management approach, which addresses all the steps in the water supply, from the catchment to the consumer. In order to support and harmonize WSPs drafting

and implementation, the WHO provided specific guidelines [3,4] that drive the risk analysis through 11 detailed modules. In particular, the “system assessment” is based on four modules: “Describe the water supply system” (module 2), “Identify the hazards and assess the risks” (module 3), “Determine and validate control measures, reassess and prioritize the risks” (module 4), and “Develop, implement and maintain an improvement/up-grade plan” (module 5).

The concept of the MUHA project the “Multi-Hazard Framework for Water Related Risks Management”, funded by the INTERREG V-B Adriatic-Ionian ADRION Programme of 2014–2020 (implemented by institutions from Italy, Slovenia, Croatia, Serbia, Montenegro, and Greece), moved from two main premises: (1) the correct approach for a drinking water supply systems (DWSS) risk analysis requires a multi-hazard perspective, encompassing all the components of the system and possible superposition of different hazards; (2) in addition to water utilities, the DWSS risk analyses involvement of various sectors/institutions is necessary to harmonize the monitoring and response procedures. Based on these premises, the main goal of the MUHA project is to connect hazards and risks related to the integrated water management with the existing and improved coping capacity developed by civil protection mechanisms on a national, international, and EU level. Four water-related risks are mainly addressed within the project framework: accidental pollution, floods, droughts, and earthquakes.

2. Structure of the MUHA Project

The MUHA project is organized in the three technical work packages shown in Figure 1.

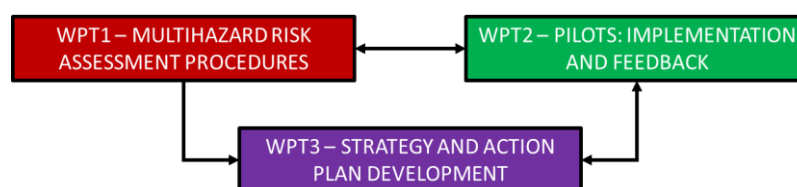


Figure 1. MUHA project technical work packages: objectives and interlinkage.

2.1. WPT1

In WPT1, a comprehensive data and information review of the current status of the implementation of WSPs within the project area has been performed through specific surveys carried out at national level. These surveys highlighted the necessity to firstly characterize the water supply system under consideration by structuring the analysis in a shared scheme which is able to represent all the components of the WSP, crossing each component with possible hazardous events and multi-hazard impacts.

This evaluation drove the development of WASSP-DSS (Water Safety Planning Procedures Decision Support System), an informative platform, available online (<http://muha.apps.vokas.si/home>, accessed on 17 October 2022), developed by the University of Ljubljana with all of the project partners’ involvement. WASSP-DSS supports the WHO guidelines modules 2 and 3 for development.

The tool incorporates the catalogue of hazardous events and the related risks possibly effecting each component (or sub-component) of a generic DWSS. Each hazardous event is described in a specific box summarizing the related trigger, consequences, and potential measures. For each hazardous event, the user is required to evaluate the probability of occurrence by selecting the estimated return period among some pre-defined categories (from weekly to 30 years or more) and the severity of the impacts. It is worth stressing that the first one needs a quantitative estimate, while the second one is qualitative. A combination of two components provides a risk estimation for each hazardous event within the following categories: very low, low, medium, high, and very high.

Once the “catalogue of events” has been completed through all the components and possible related hazards, the overall risk assessment is dynamically represented through a multi-dimensional approach where the outcomes are given in terms of the number of hazardous events per component and the hazard category, the severity of the consequences, and the category of the risk, represented by the component and by the hazard. This approach drives the first and complete DWSS components risk assessment, resulting in a rough but complete overview of the actual DWSS vulnerability.

It is worth stressing that the new methodology adopted in the WASSP-DSS allows for performing a risk analysis addressed to the WSPs implementation based on a matrix approach that crosses a comprehensive catalogue of hazardous events with the structure of the entire DWSS, described component by component. Such an approach somehow completes the general guidelines on WSP provided by the WHO [5].

2.2. WPT2

The WASSP-DSS has been extensively tested on the six pilot sites of the MUHA project, as shown in Figure 2. The testing phase focused in particular on four hazards: drought, flooding, earthquake, and accidental pollution, all potentially impacting the pilots.

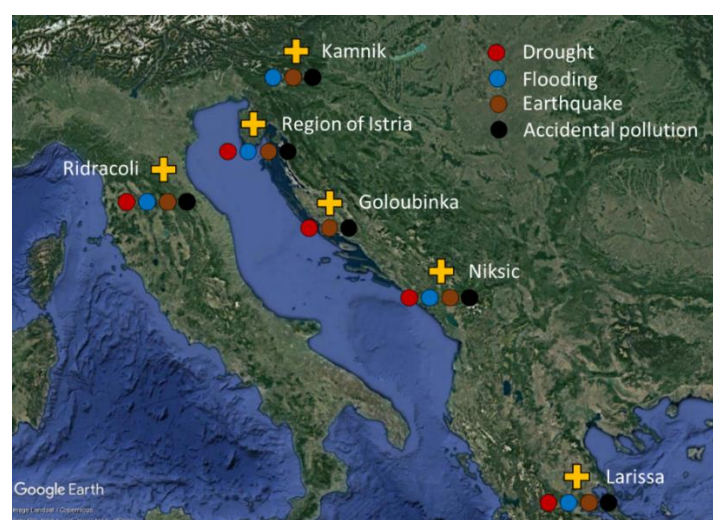


Figure 2. Pilot sites of the MUHA project.

Along with the testing phase of the tool on the pilots, in the framework of the WPT2 activities specific, tabletop exercises have been carried out on the six pilots. Tabletop exercise (TTX) can be defined as an artificial environment that reproduces all or part of event scenarios to test decision-making processes that refer to civil protection plans or existing intervention models. A TTX can be used to test and/or develop the operational plans and procedures. Participants, over a predefined time span of a few hours or a day, examine or discuss together how they intend to manage different types of problems or assigned tasks. A specific hazard has been assigned to each pilot (Ridracoli-IT: drought; Kamnik-SLO: flooding; region of Istria-HR: accidental pollution; Goloubinka-HR: accidental pollution; Nisic-MNE: drought; and Larissa-GR: earthquake) and each exercise has been previously set up by defining in detail the event’s scenarios as well as the emergency procedures.

The surveys on the current status of the implementation of WSPs (WPT1), along with the testing phase of the WASSP-DSS tool and the outcomes from the TTX (WPT2), allowed us to get several hints for the development of robust and effective water safety plans, individuating bottlenecks and the possible solutions. These hints have been organized in the framework of the WPT3 activities and will support the development of action plans

for the implementation of the procedures and tools, increasing the safety of the water supply in key institutions: (1) water utilities, (2) civil protection authorities, (3) water authorities.

2.3. WPT3

The activities of WPT3 moved from an extensive SWOT analysis based on the outcomes of the WASSP-DSS testing phase (thus at a local level) and on the outcomes of the WPT1 (thus at a national level). The analysis aimed at identifying the main elements that can foster or prevent from an effective development of the water safety plans by the water utilities. A SWOT analysis has been performed separately for each hazard considered by the MUHA project (drought, flooding, accidental pollution, and earthquake) and finally merged in a single table (Table 1).

Table 1. SWOT analysis on the development of Water Safety Plans by water utilities.

STRENGTHS	WEAKNESSES
• High-level of know-how and technical skills in the medium and large water utilities, leading to a continuous technical innovation • Experience and knowledge related to previous hazardous events • Adoption of a National Strategy for Climate Change Adaptation • Effective monitoring of water quality at the end of a water pipe • Good level of national monitoring of quantity and quality status of water bodies • Availability of hazardous maps, mainly for specific hazards (drought, flooding, earthquake) • Clear allocation of responsibilities among various sectors and institutions involved in emergency management at local, regional, and national level	• Low-level of know-how and technical skills in small water utilities • Operation of large number of small water utilities, resulting in an overall fragmentation of the water supply systems • Lack of effective integration of different databases from several data providers • Lack of financial resources, available specifically for the development of WSPs • Delays in the implementation of regulatory acts for water management (including measures adopted by RBMPs, e.g., water safety plans)
OPPORTUNITIES	THREATS
• EU funds available for water resources management • Financial resources planning is in place under the pressure of climate change adaptation • Implementation of the new EU Drinking Water Directive • Climate change mitigation measures are highly prioritized in the European water policy agenda, reflected also in the institutional developments for the water resources sustainability • General public awareness increases in environmental issues and society's initiatives (Non-Governmental Organizations)	• Increase of hazardous events related to climate change • Lack of political willingness and issues with inter-institutional cooperation • Unstructured interactions with other institutions and water utilities • Climate crisis impacts • Economic crisis in the Member states, resulting from the COVID-19 pandemic • Lack of funding • Water quality detriment after an earthquake event

3. Conclusions: The UNAS Network

The MUHA project (INTERREG V-B Adriatic-Ionian ADRION Programme 2014–2020) aims to connect the hazards and risks related to the integrated water management with the existing and improved coping capacity developed by civil protection mechanisms proposing innovative tools and guidelines for the implementation of robust and effective water safety plans. In this framework, a decision support system tool, named WASSP-DSS, has been developed to support the water utilities through a guided procedure, allowing for a multi-hazard risk analysis. The main innovation of the tool relies on its methodology, based on a matrix approach, that crosses a comprehensive catalogue of hazardous events with the structure of the entire DWSS described component by component. It is worth stressing that the tool will be supported and constantly improved by a specific network called UNAS.

UNAS, an acronym for “User Network of Adrion water Safety plan”, will be constituted by the users of the WASPP-DSS tool and is expected to foster interactions among the many actors involved in water resources management (identified during the previous MUHA activity), both during ordinary and emergency conditions, but also during the water safety plan (WSP) preparatory phase. UNAS takes the form of a community forum hosted by the MUHA toolbox server with (<http://muha-unas.apps.vokas.si/>, accessed on 17 October 2022) the aim of giving the users an easy, efficient, and safe transnational platform for sharing knowledge and experiences on MUHA toolboxes and the WSP elaboration. It is accessible to all the potential users after registration and the signature of a simple “memorandum of understanding” to accept the goals and finality of the network.

Author Contributions: Conceptualization, methodology, and software: P.B., B.C.C., and E.R.; data curation, investigation, validation, and writing—review and editing: P.B., I.B., E.C., B.C.C., D.D., A.D., V.K., D.K., J.L.R., B.M., A.P. (Anastasia Papadopoulou), and A.P. (Argiris Papakonstantinou), E.R., S.T., and B.V.; writing—original draft preparation and supervision: E.R.; and project administration: A.S. All authors have read and agreed to the published version of the manuscript.

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