Water4All
Water security for the planet

European Partnership

OPEN SCIENCE / OPEN DATA / OPEN SOURCE POLICY FOR WATER4ALL

Data sharing strategy

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LIST OF ACRONYMS

DMP	Data Management Plan
EOSC	European Open Science Cloud
EC	European Commission
EU	The European Union
FAIR	Findability, Accessibility, Interoperability, and Reuse
JTC	Joint Transnational Call
Water4All	European Partnership on Water Security for the Planet

OPEN SCIENCE / OPEN DATA / OPEN SOURCE POLICY FOR WATER4ALL

1. INTRODUCTION

The Water4All Partnership focuses on delivering sound knowledge to address global water challenges, and recognizes the significance of sharing knowledge and data to achieve its objectives. In line with the Horizon Europe Model Grant Agreement (Article 17-Communication, Dissemination, Open Science and Vsibility), the partnership emphasizes the application of open science, open data practices, and adherence to the FAIR principles (Findability, Accessibility, Interoperability, and Reuse), while considering the principle of "as Open as Possible, as Closed as Necessary" to allow for intellectual property rights protection when required.[1]

Open data and open science principles are of utmost importance both when performing the additional activities of the partnership and funding research via joint transnational calls (JTCs). Data management plans (DMP) that incorporate these principles are expected to be developed and efficiently implemented by all projects funded under Water4All. Pillar C, specifically Subtask C.4.2: Developing Open Science and Open Innovation across the different partners of Water4All, is dedicated to promoting open science practices in water research and innovation projects. The task will provide guidance on data management in the context of Open Science and support funded projects by using the recommended tools. In Subtask C.4.3: Toolbox for managing water related data, the sharing of water-related data will be implemented through the development of interoperable interfaces for Open Access, Open Data, and Open Innovation. These interfaces will support the banking, storage, and access of products associated with Water4All activities. The aim is to connect various data sources that are produced by the projects funded by Water4All through a single access point and provide guidance for analysis and interpretation of the data. This platform is expected to contribute to water-related decision-making by simplifying access to a large volume of data. The partnership plans to expand the toolbox's user base and the amount of connected data to enhance its impact.

Overall, the Water4All Partnership prioritizes open science, open data, and the application of FAIR principles to facilitate the sharing and utilization of water-related data for informed decision-making. This report sets out the main drivers at EU level that shape the open data and open science policy of Water4All and proposes the Partnership's approach to realize its strategy. It strives to do that by mainly focusing on eight core ambitions of open science as described by the European Commission and underlines the specific Water4All activities that correspond to these ambitions. In the conclusions section the report puts forward a set of recommendations for the attention of the Governing Board of Water4All to be considered in designing and implementing future activities to promote open science in water research and innovation.

[1] European Commission (2021). Model Grant Agreement V1.1
https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/agr-contr/unit-mga_he_en.pdf

2. Relevance of Open Data and Open Science for Water4All Partnership

Water and water data has its own charecteristics that are often related to regulatory monitoring settings (e.g. for Water Framework Directive – WFD, and daughter directives) and sectoral nexuses such as water & energy, water & biodiversity, water & urban planning and water & food. This requires taking into consideration a broad spectrum of environmental data and sectors. There are three primary domains for water data producers; **water in aquatic ecosystems** (lakes, rivers, aquifers, coastal areas etc.) is mainly handled by public monitoring actors; **water in pipes and distribution systems** is monitored by utilities and entreprises; and **the excess surface water in cities** related to cloudbursts and floods is in the domain of hydrometeorologists and municipalities. As water flows across several domains and administrative structures, data sharing may involve a large number of stakeholders.

Given this intersectoral nature of water data, the organization, formatting, collecting, sharing, and reuse of data have become extremely important in water-related sciences, especially as research and innovation practices continue to evolve rapidly. The advancement of digital technologies has made science more collaborative, global, and accessible to a wider audience. Researchers, research programmers, and funders need to adapt to these changes. One significant aspect of this shift is the promotion of Open Science, which emphasizes systematic and open access to scientific data and processing tools.

Horizon Europe mandates that publicly funded research project data should be freely accessible to everyone as soon as possible and within the deadlines set out in DMPs. Beneficiaries of Horizon Europe funding must ensure Open Access to their peer-reviewed scientific publications immediately. All projects participating in Horizon Europe calls are required to develop a DMP. Researchers should also adhere to the data management rules and requirements set by their national funding agency and national-level policies. Besides, it is increasingly becoming the norm for national funding agencies to expect funded projects to comply with FAIR data principles in their research activities.

In the Horizon Europe Model Grant Agreement, “data” is used in a broad context of research outputs as results to which access can be given in the form of scientific publications, data or other engineered results and processes such assoftware, algorithms, protocols, models, workflows and electronic notebooks (Model Grant Agreement, p. 86).

The Water4All Partnership shares this vision and encourages funded projects to make their data as open as possible, while also recognizing the need for restricted or closed access when necessary. The Partnership explicitly states in its Grant Agreement that it supports the application of open science and open data practices in all its activities. More specifically open science and open data practices are relevant for Water4All activities on these key aspects:

- **Data sharing and accessibility:** Open data practices enable sharing and accessibility of water-related data, including information on water availability, quality, usage patterns, as well as related geo-location of the data and metadata. By working towards making water data openly available, Water4All can contribute towards an enhanced understanding of water resources, identify gap areas , and facilitate evidence-based decision-making for effective water management.

- **Collaboration and innovation:** Open science encourages collaboration among researchers, experts, and stakeholders from diverse backgrounds. By openly sharing research findings, methodologies, and best practices, Water4All can foster innovation and encourage the development of new solutions, technologies, and approaches to address water challenges.
- **Replicability and scalability:** Open science and open data facilitate the replication and scalability of successful water management initiatives. By openly documenting and sharing project outcomes, methodologies, and lessons learned, Water4All enables other organizations and communities to replicate and adapt successful interventions to their own contexts, thereby maximizing the impact of collective efforts.
- **Stakeholder engagement and accountability:** Open science and open data promote stakeholder engagement and accountability in water management. By involving a wide range of stakeholders, including local communities, water resources managers, researchers, policymakers, authorities, water utilities,entreprises and NGOs, in the generation and use of data, Water4All can ensure that decision-making processes are inclusive, transparent, and accountable.
- **Policy influence and advocacy:** Open data and open research findings can serve as a powerful tool for policy influence and advocacy. By openly sharing evidence-based research, Water4All can inform policymakers, raise awareness among the general public, and influence policies and regulations related to water management. Openness can help drive systemic change and create an enabling environment for sustainable water solutions. At the same time, Water4All calls for National Monitoring Programmes for Water Quality and Quantity issues (in relation to the implementation of the Water Framework Directive and related daughter directives, national regulations,etc.) to make their data findable and accessible, based on FAIR principles to ensure interoperability.

3. Open Data and Open Science Policy of the EU and Horizon Europe

The European Union (EU) has prioritized open science as a policy objective, aiming to improve the quality, efficiency, and responsiveness of research. The EU believes that sharing knowledge and data early in the research process with relevant stakeholders facilitates the dissemination of the latest findings. By involving partners from academia, industry, public authorities, and citizen groups in the research and innovation process, creativity and trust in science are enhanced.

To enforce these principles, the European Commission requires recipients of research and innovation funding to make their publications available through open access ensuring that their data is as open as possible while still considering the need for limited access. The Commission also values the participation of citizens and end users and recognizing their involvement. The level of ambition at EU level regarding the importance of data sharing and reuseability is manifested clearly in **the EU Digital Strategy** that was presented in March 2020, which calls for wider data sharing and data spaces as building blocks for a Digital Economy in Europe. As a key pillar of the strategy, **the Data Governance Act** has been applicable since September 2023 to make more data available and facilitate data sharing across strategic domains including environment by establishing European

Data Spaces.[2] Complementary to the Data Governance Act, a new Data Act is entering into the legal stage that describes who can create value from data and under which conditions.[3] **The Data Act** defines all publicly funded data to be shared and aligned with FAIR principles. Currently, an overall EU strategy for water data sharing including standards and use of same classification systems doesn't exist. Howeverthere are clear indications that water data will increasingly be more public; on January 2023 the European Commission has published a list of high-value datasets that public sector bodies will have to make available for re-use, free of charge, within 16 months. The Regulation is set up under **the Open Data Directive**, which defines six categories of such high value dataset, including earth observation and environment.[4]

Data sharing do take place within some trans-European and national monitoring platforms, but examples are few and scattered, and no overview analysis of this exists, thus a catalogue of available data doesn't exist. It has been difficult to identify success stories regarding research data sharing. However, research funders are increasingly demanding it. Furthermore interoperability between the various initiatives has not been an issue until now and virtually no standards directly relevant for water related data exists. Some recent initiatives such as the **European Open Science Cloud** (EOSC, created in 2020) is being developed to provide a platform for researchers from different disciplines and countries to store, curate, and share research data, services and e-infrastructures. The creation of this cloud infrastructure will facilitate collaboration and data sharing among researchers including in the domain of water research and innovation. Water4All is planning to co-operate with EOSC as well as other key organizations to strive for a joint, European approach to data-sharing in the water sector.

However, the effective integration of open science practices with innovation and business models necessitates careful consideration of various issues, including Intellectual Property Rights (IPR), licensing agreements, interoperability, and data reuse tools and practices. Moreover, costs for maintaining and upgrading data services and infrastructures on the long run and after the lifespan of the HE programme should be taken into consideration. These factors need to be addressed to ensure a harmonious relationship between open science and the commercialization of research and innovation outcomes.

To develop its open science policy, the European Commission collaborates closely with two expert groups. The **Open Science Policy Platform** advises the Commission on the further development and practical implementation of open science policies. This group offers guidance and recommendations on how to promote and integrate open science practices across the EU. The **Expert Group on Indicators** focuses on proposing indicators that measure researchers' engagement with open science and assess its impact. By identifying and acknowledging open knowledge practices, these indicators support the advancement of open science and its positive outcomes. Water4ll will also consider potential demands and evolution of practices at EU level during the lifetime of the Partnership.

[2] Regulation (EU) 2022/868. https://digital-strategy.ec.europa.eu/en/policies/data-governance-act
[3] European Commission (2023). Press Release on Data Act.
https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3491
[4] Regulation EU 138/2023.
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4. CORE AMBITIONS OF THE EU'S OPEN SCIENCE POLICY AND HOW WATER4ALL PARTNERSHIP ADHERES TO THEM

With the support of the two expert groups mentioned above, the European Commission has identified eight core ambitions to support open science around European scientific communities: 1) rewards and incentives, 2) indicators & next-generation metrics, 3) future of scholarly communications, 4) European Open Science Cloud (EOSC), 5) FAIR data, 6) research integrity, 7) skills & education, 8) citizen science.[5]

Below is a summary of each of these ambitions and how can Water4All Partnership's activities can be aligned with them.

4.1 Rewards and incentives

Rewards and incentives relate to recognition of open science by policy makers and funding organizations, as well as the co-funded partnerships like Water4All to promote broad sharing of best practices of open science. This is a core principle of Water4All JTCs as they make it an obligation for funded projects to make their research results openly accessible as soon as possible when published. Data-sharing, however, should take place throughout the lifespan of the funded projects, including both raw, elaboratedand enriched data. Water4All also encourages publishing the metadata for the results achieved, in order to allow for replication of the digital part of projects and to promote the correct acknowledgment of their authorship. The grant applications in Water4All JTCs are evaluated -among others- according to their capacities to openly publish their results. The projects will be monitored to the extent that their practices of open science.

4.2 Indicators & next-generation metrics

It is necessary to create additional metrics that can supplement the traditional measures of research quality and impact in order to accurately evaluate and recognize the value of open science methodologies and practices. In practice this means that improving the ways in which research outputs are evaluated. Water4All will contribute to this area by valorising the research outputs in different formats with the collective action of funded researchers via knowledge hubs. Based on Water JPI experiences in the last years and starting within Water4All with the 2nd JTC, knowledge hubs will be formed that are composed of experts from funded projects who will work collaboratively to produce research synthesis as policy briefs, state of the art reports and position papers to enhance the research valorisation capacity. The ambition is to increase the added-value of research outputs for end-users and policy makers. Furthermore, the Water4All community works collectively to develop key performance indicators to assess the impact of activities both in qualitative and quantitative terms beyond the conventional metrics.

4.3 Future of scholarly communications

The accessibility of scientific publications and research data should be unrestricted, and there should be a strong encouragement for the timely sharing of various types of research outputs via various channels. However, the paths to full accessibility of research are many and varied. Water4All develops and utilizes various channels to disseminate and exploit research outputs, including its web page, social media accounts

[5] The EU's Open Science Policy. Retrieved from: https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en

and newsletters. Through its various pillars, the Partnership enables scaling up new innovations, supports start-ups and incubators, coordinates collaboration of water oriented living labs/research infrastructures/observatories, performs training and capacity building activities for water professionals. Last but not least, one of the strongest ambition of the Partnership is to understand the needs of water data sharing stakeholders and develop a Water4All water data sharing platform and associated tools.

4.4 European Open Science Cloud (EOSC)

The EOSC is a reliable and collaborative digital space that transcends geographical and disciplinary boundaries, facilitating the storage, sharing, processing, and reuse of research publications, data, and software. The EOSC serves as a platform connecting stakeholders, initiatives, and infrastructures at institutional, national, and European levels. EOSC is listed in the first Grant Agreement of Water4All as a relevant initiative to collaborate with in the field of water data; research infrastructures and observatories. The communication shall be initiated imminently to explore the potential areas of collaboration between two initiatives.

4.5 FAIR data principles

The results of scientific research funded by the EU should adopt FAIR principles and open data sharing as a standard approach. The first step in supporting FAIR principles in all Water4All activities was identified in the Partnership DMP as a deliverable (D3.1) in December 2022. The Water4All DMP constitutes the formal framework for data sharing, while also interpretating the ambition level for the Water4All data sharing platform and approach regarding the community of data producers/users. It points to certain data sharing obligations for data of Water4All partners, data from projects granted funds via calls, and of data from activities generated by the different Pillars. The projects funded under Water4All JTCs should apply the FAIR principles through developing and efficiently implementating DMPs, which should be compliant with the Partnership DMP. The overall recommendations for the projects' DMP are also listed in the final section of this document.

4.6 Research integrity & reproducibility of scientific results

Reproducibility of research results is valuable for ensuring the integrity of scientific claims and fostering new discoveries and innovations. The factors contributing to the lack of reproducibility include bias, inadequate experimental design and statistical analysis, problems with reporting scientific findings, research culture, career-related influences, and economic factors.[6] Water4All aims to overcome the challenges of reproducibility by incorporating research integrity considerations in the call evaluation criteria. It is also expected that project DMPs encompass measures to address reproducibility concerns. The issue of reproducibility will be addressed also in the stakeholder consultations and assessments performed by Task C4.3. Moreover, data sharing should be seen as a vital element of a value chain leading to digitalization as a key outcome for addressing Europe's water challenges.

[6] European Commission (2020). Reproducibility of scientific results in the EU. https://op.europa.eu/en/publication-detail/-/publication/6bc538ad-344f-11eb-b27b-01aa75ed71a1

4.7 Skills & education

It is essential to provide the Water4All community (partners and funded researchers) with the required training and assistance to effectively implement open science research methods and protocols. Although the topics and focus vary broadly, vocational training activities, PhD schemes and mobility activities under Task C.3 can address issues related to skill development in data management. More specifically the constant exchange of information and dialogue between partners involved in Task C4.3 target at building capacities for FAIR water data sharing within the Water4All Partnership. Furthermore, a wider community of water professionals will experience substantial benefits in a longer perspective when the Water4All data platform and toolbox become available (Task C4.3).

4.8 Citizen science

Citizen science recognizes the collaboration between researchers and the public in research initiatives, acknowledging the valuable role the public plays in generating new research insights. It is important to enable the general public to make substantial contributions and to be acknowledged as producers of scientific knowledge in Europe. Water4All acknowledges citizen engagement as a distinct objective. Alongside the inclusion of NGOs on the Advisory Board, this goal will be accomplished through complementary measures such as capacity building, collaborative design and implementation of activities within Living Labs, and the promotion of stakeholder and citizen science integration in funded projects.

5. Overall recommendations for Data Management Plans by the funded projects under Water4All calls

In addition to the Partnership's overall liability towards European Commission's open science priorities and ambitions, Water4All aspires to improve the capacities of funded projects to comply with FAIR principles at the best of their capacities. DMPs are the main sources for projects to elaborate their strategies in this regard. The DMP expectations from the projects funded by the Water4All JTCs have been detailed in the Water4All DMP (D3.1). An updated DMP version 2.0 will be elaborated prior to the initiation of phase 2 of the Partnership, including specific elements for data formats, standards, classification lists etc to be followed. Input for this will be identified during the work of Task C.4.3 (A prototype of the data sharing platform will be ready by May 2024), which will be based on selected use cases and the related identification of barriers for data sharing.

Below is a summary of key aspects for Water4All funded projects to consider when drafting their DMPs.

Baseline Structure of DMPs

A full DMP is a living document that outlines the data management process for collected, processed, or generated data. It should include information on the types of data, materials, and standards used. The DMP should also cover the handling of research data during and after the project, policies for access and sharing, provisions for re-use and derivatives, plans for archiving, authorship and contact information for updates. Applicants must include a budget for the implementation of the DMP in their proposals.

Content of research data

To facilitate data sharing, the research funding organizations participating in JTCs require the development and implementation of project-specific DMPs. Research data encompasses digital information created during research activities and data resulting from analysis and modelling. DMPs should adhere to relevant standards and best practices specific to each subject or disciplinary area. In general, research data should be open by default, discoverable through catalogues and search engines, and made available with minimum time delay. Data with long-term value should be preserved in sustainable and trustworthy repositories to ensure future accessibility.

Reuse and accessibility of research data

To enable effective reuse of research data, sufficient metadata should be recorded and openly available for other researchers to understand the research and its potential for reuse. Published results should include information on how to access supporting data and other research materials to promote transparency and reproducibility. The development of data infrastructures should leverage existing resources, platforms, standards, and recognized practices. Collaboration with international networks, infrastructures, and standards organizations is encouraged. DMPs should clearly indicate how the projects adheres to FAIR principles and detail the meausures to be taken into this trajectory.

Applicants of Water4All JTCs are strongly recommended to follow these guidelines when developing their DMPs. They are expected to cooperate with the Water4All Partnership, who will provide support to funded projects to further refine their DMPs and ensure compliance with the guidelines. These efforts aim to foster open data sharing, improve research transparency, and facilitate cross-disciplinary collaboration in addressing global water challenges.

In line with these recommendations, a Water4All DMP template will be developed and shared with the projects during the first quarter of 2024.

6. RECOMMENDATIONS, SUCCESS CRITERIA AND HOW TO GET THERE

Water4All recognizes the importance of sharing knowledge and data as foundation for developing adequate digital tools to address global water challenges. The partnership prioritizes open science, open data practices, and adherence to the FAIR principles. We need an effective approach to involving Water4All partners in data sharing. It is recommended, that the Water4All Partnership acts proactively and decides on a joint strategy related to data sharing and work together with external organizations. In line with this,some recommendations for Water4All to promote open science and data sharing in water research and innovation are given here:

- **Make data from all Water4All funded projects findable and accessible:** Data from funded research and innovation projects, should be made findable and accessible, interoperable and reusable, and shared smoothly within Water4All. This will require the implementation of a search function, based on overviews of what can be found and where, subsequently guidelines on how this can be accessed and, finally, but not least, a shared approach to data management ensuring interoperability. Water4All

will address the requirements of how funded projects will expose the data and metadata they have by starting the work on use cases.

- **Support interoperability and standardization:** Promote the use of a common approach to best practices in Water Data Management and use of open standards for data and metadata formats to ensure interoperability and seamless integration of data from diverse sources. Encourage researchers to follow guidelines on data sharing, especially standards and classifications. Water4All guidelines and tools will be developed to support this.

- **Increase awareness and build capacity on open science and open data:** Develop training programs and capacity-building initiatives to equip scientists and researchers with the necessary skills and knowledge to apply open science practices. This will enable them to effectively manage and share their research data. Water4All partners should be well informed about the changes at the EU level (EU Digital Strategy, Data Spaces, Data Governing Act, Data Act etc.) and we should take action to disseminate knowledge about this.

- **Support researchers in establishing clear DMPs:** All projects funded under Water4All are required to develop comprehensive and robust DMPs that incorporate open data principles. The DMPs should outline strategies for data collection, storage, sharing, and preservation, while adhering to FAIR data principles.

- **Encourage collaborative research:** Promote collaboration among researchers, stakeholders, and citizens through the establishment of Living Labs, coordination across Research Infrastructures/Observatories and other participatory research approaches. This will not only enhance the quality of research but also encourage public engagement and contributions to scientific knowledge.

- **Engage stakeholders:** Despite some inspiring best practices on water data sharing, a strong data sharing community does not exist in this sector. Water4All should promote active involvement of stakeholders, including NGOs, water resources managers, entreprise partners, policymakers and authorities, and citizens, in the research and innovation process. Water4All willseek their input, feedback, and involvement in data collection, analysis, and decision-making processes.

- **Collaborate with relevant initiatives:** Water4All will explore collaboration opportunities with the EOSC and other relevant initiatives that focus on data sharing and research infrastructures. This collaboration can contribute to the development of interoperable platforms and tools for water-related research.

- **Monitor and Evaluate:** Establish mechanisms to monitor and evaluate the implementation of open science and data sharing practices within Water4All funded projects. Assess the impact and effectiveness of these practices in achieving the partnership's objectives.

As these recommendations are taken into account, Water4All will need a series of success criteria that are measurable and observable. Although tailor-made key performance indicators would serve for this purpose thoroughly, the below list probes the main success criteria for key actors:

- **Research and innovation stakeholders** express that it has become much easier for them to find and access data, as well as new partners;
- **Service providers** express that it has become much easier to set up new business based on data sharing and a water data space approach and their products have improved due to more and better data sources;
- **Utilities and water-related industries** express that they have improved their performance due to joint analysis based on smooth access to more data from different sources;
- **Authorities** express that they can base water management on more advanced tools (eg AI) due to the availability of more,better and more timely data.

In line with these general recommendations and success criteria, the following steps are identified to enable Water4All's contribution to establishing a water data sharing culture in Europe:

1. Initially circulate a questionnaire to all Water4All partners to understand data sharing experiences and related IT capacity of partners, including the barriers and landscape for data sharing and data access, as part of a broader outreach to all partners.

2. Integrate data sharing aspects in the updated SRIA by making the best use of the outcome of the SRIA 2024 seminar on digitalization. Develop White Papers on "Best Practices in Water Data Management" and "Design of a Full Water Cycle Data Model" in order to use these as promoting a Water Data Sharing Community as a key element in promoting data-driven research and innovation.

3. Define data sharing elements in the Water4All DMP 2.0, for Water4All Pillars and/or for those receiving funding from JTCs, in line with the EU Data Act based on interpretation of implications for water sector by defining common standards, APIs and use of classification systems.

4. Define new objective for Task C4.3 to keep Water4All partners informed about important developments at EU level within Data Sharing and Reuse and to convey our observations to the European agenda.

5. Strengthen co-operation with external organizations e.g. EOSC (AquaINFRA) and EC. Invite external parties to attend Water4All events on data sharing (e.g. Ghent University, EMODNet, GREAT-Green Deal Data Space, WaterVerse, BlueCloud, GSEU – A Geological Service for Europe, European Environmental Agency – EEA, Inspire Directive, Biodversa+ etc.). Promote Water4All approach and position reg Water Data Sharing at key international events e.g. World Water Forum.

6. Start considering the post-project situation for the Water4All Data Sharing platform. Develop a roadmap for long-term vision and outcome of the platform.

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