PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Funded by the European Union

THE ENERGY &WATER AGENCY

Union for the Mediterranean
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الاتحاد من أجل المتوسط

Digital Transformation for advancing Water-Energy-Food-Ecosystems Nexus in the Mediterranean Source to Sea continuum

Second Workshop of a regional consultation process

6-7 February 2025, Malta

ACQUAOUNT

TALANOA - water -

TRANSCEND

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici

institute IMDEA water

Global Water Partnership Mediterranean

Regional consultation on Digital Transformation for WEFE Nexus in the S2S continuum in Med – previous meetings and process

The regional consultation process unfold in the form of a Living Lab.

This is expected to provide related technical background and recommendations to the UfM Ministerial Meeting and other upcoming political fora addressing the subject

The 5th Mediterranean water forum in Tunis, February 05 to 07, 2024, side event on Transformative Water Resources Management. Smart and resilient solutions for climate challenge across the Mediterranean

Lisbon, 14th UfM Regional Platform Water, 5-6 June 2024, Launching Workshop of the regional consultation process on 'Digital Transformation for advancing Water-Energy-Food-Ecosystems Nexus in the Mediterranean Source to Sea continuum

Open questions

- **Ethical questions/property rights of intelligence/public goods/who owns the technologies?**
- **Information overload: Can we cope? Will it drive institutional reform?**
- **Removing technological lock-ins will drive removing institutional lock-ins? Will it drive policy reform?**
- **Is there willingness to use results (by policy makers and users)?Will it drive the changes in the model of water use?**
- **What is the road map? Small and scale up or be ambitious?**
- **Digitalization for policy change implementation or vice versa? The same solutions for all contexts? Will it really scale up? How to evaluate the success of digitalization of WEFE approach?**
- **Unintended effects of WEFE digitalization? (Driving more water use?)**

Objectives: regional consultation, the 2nd Workshop

- **The objectives of the regional consultation process, and of the 2nd Workshop,** are to:
  - identify the strengths, weaknesses, opportunities, and threats (**SWOT Analysis**);
  - highlight related **advancements made**;
  - sharing **experiences** and **best practices;**
  - **provide Recommendations** for promoting digital transformation contributing to the draft Strategy on WEFE Nexus in the S2S continuum and providing input to key regional political fora like the UfM Ministerial on Water, CoP of the Barcelona Convention, etc.

Focus on four sub-themes: governance, financing, digital tools, ecosystems and biodiversity

- Outcomes will help PRIMA ACQUAOUNT, TALANOA-WATER and H2020 TRANSCEND projects to adapt their research agenda towards transformational, actionable science for resilience to water scarcity and other natural resources challenges for climate resilience.

Enriching the SWOT Analysis in three specific themes

- **Sectoral governance and lack of adequate policy tools and financing mechanisms** for integrated approaches among WEFE sectors and the spatial areas along the S2S continuum where the activities are implemented, constitute an unsuitable enabling environment. **What governance and financing shifts we need to assist digitalization advancing?**

- **Digital technologies with transformational potential** already exist and will further evolve. We need R&D to further develop them and a market-oriented approach to deploy them. **How will we make digital technology more available and have them adopted?**

- WEFE Nexus digital transformation provides opportunities for better **ecosystems assessment** and management, including through Nature-based Solutions. **How will we advance use of digital tools for nature protection and how to integrate them with Nexus objectives?**

Digital Transformation

- The Role of Digital Transformation

Real-Time Monitoring

Prescriptive Management and Planning

Data Integration

Integrated Prescriptive Management and Planning

Digital Enablers

Data Analysis - IoT Platform - AI - Blockchain -Dataspaces - Machine Learning - Generative AI - Optimization - Reinforcement Learning - …

Digital Transformation

- Application Examples

Real-Time Monitoring	Data Integration	Prescriptive Management and Planning	Integrated Prescriptive Management and Planning
• Smart meters • Virtual sensors (indirect measurements) • AI-powered Remote Sensing (land use, crop health, soil moisture, water availability & quality, evapotranspiration, air quality, biodiversity, erosion…) • …	• Data Spaces • Blockchain • IoT Platforms • Big & Small Platforms • Interoperability • …	• Smart Irrigation based on weather, crop demand, soil data. • Demand forecasting (water, energy…) • Optimization of water, energy and food infrastructures • Predicting crop growth, yields • …	• Water basin allocation considering agricultural, ecosystem, urban, and energy infrastructure demands. • What-if scenario analysis for climate change impacts on WEFE nexus • What if scenario analysis for policy impacts on WEFE nexus • …

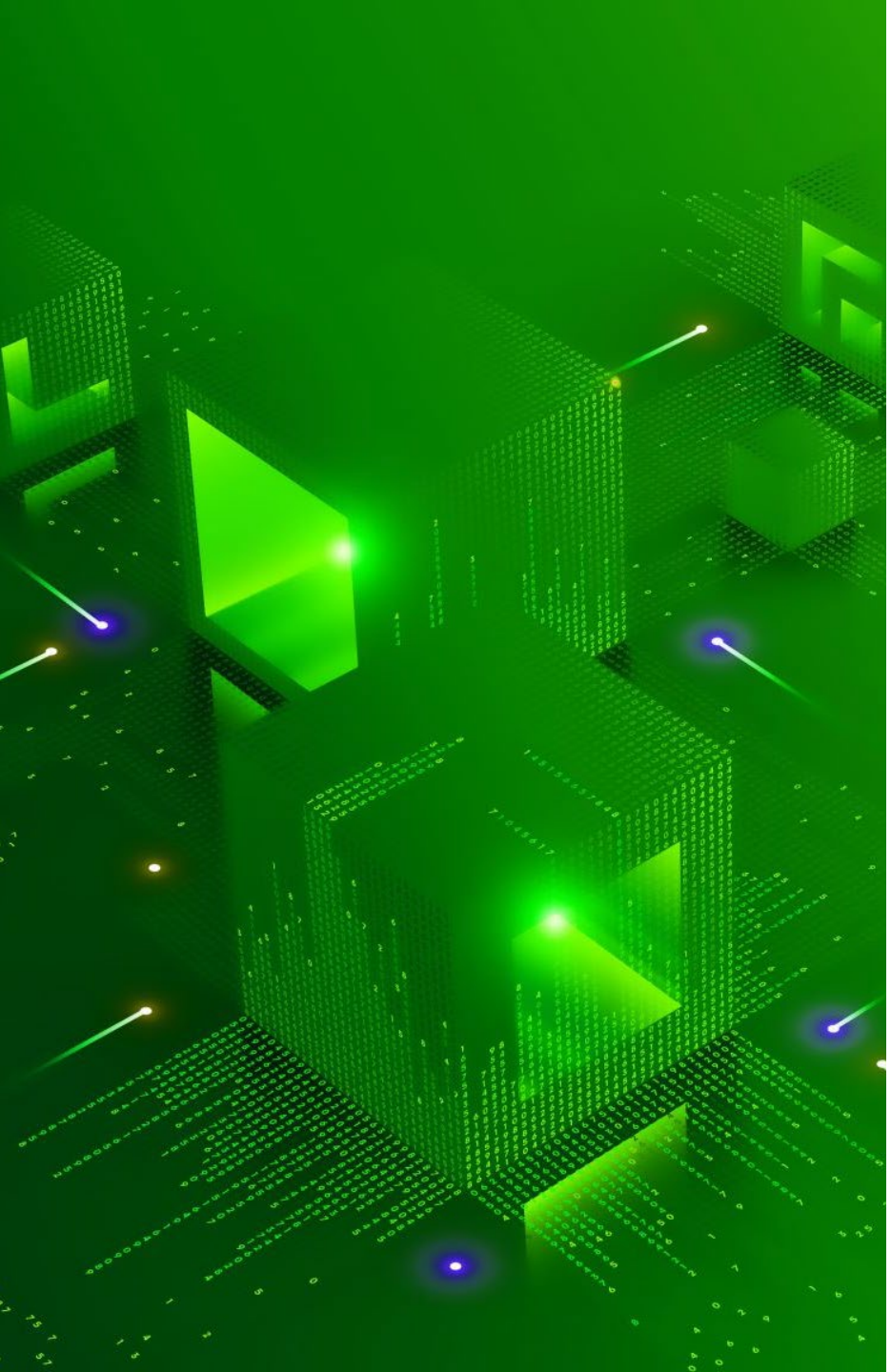
Financing tools

- Sustainable water management requires a **mix of financing instruments**, including pricing mechanisms, risk-based instruments, and trading schemes. **No single tool is sufficient**—combining these ensures financial sustainability, environmental protection, and social equity.

- While economic instruments like water pricing and trading improve efficiency, they must **protect vulnerable populations through affordability** measures such as tiered pricing or subsidies.

- Risk-based instruments like insurance and catastrophe bonds help transfer financial losses from water-related disasters but should also incentivize **proactive risk reduction**.

- Environmental and resource costs **must be internalized** through instruments like pollution charges or payments for ecosystem services to reflect the true value of water and promote sustainable practices.



Ecosystems and biodiversity

Integrating **Biodiversity** into the digital transformation of the **WEFE Nexus** is essential for sustaining ecosystems while addressing resource demands.

Advanced technologies, such as AI, digital twins, blockchain, and remote sensing, offer new opportunities for real-time biodiversity monitoring, predictive conservation, and evaluating ecosystem services.

Predictive Ecosystem Modeling: Simulations forecast biodiversity responses to land use, climate, and resource management changes.

Success relies on **inclusive Governance**, collaboration among multiple stakeholders, and the ethical adoption of AI to balance biodiversity conservation and human development.

Governance

STRENGTHS

+ Making **informed and integrated decisions**/solutions, not based on opinion, but on data
+ **Participatory governance**, decreasing the distance between citizen and policy makers
+ Early warning systems
+ Improvement of citizen engagement
+ Interest of the private sectors for smart agriculture and data collection/digital transformation
+ **Evidence-based decision making**

WEAKNESSES

- Human capital is not ready to deal with intersectoral governance, **fragmentation of competences**
- Communities may be left out
- Susceptible to **cybersecurity risks**
- **Unequal access** to digital systems/tools
- Complexity and gap on the science-policy knowledge exchange
- Resistance to change, existing regulatory frameworks do not adequately support the adoption of nexus digital solutions
- Data monitoring requires follow-up and resources. Projects are often abandoned.

OPPORTUNITIES

+ **Transparency** on the decision making process
+ There are growing initiatives on WEFE Nexus, eg interministerial Nexus committee.

THREATS

- Misconception of digitalization -> digital platform without people engagement
- **Complexity** of the nexus system
- **Lack of collaboration** between ministries
- There are cases where regional political issues may completely override scientific decision making.
- **Resistance to the transparency and democratisation of digital data**
- **Data privacy and property**

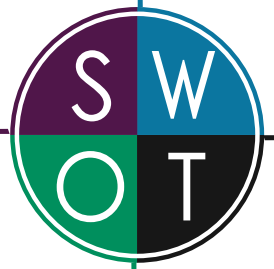
Financing

STRENGTHS

+ New investment,
+ **Job creation & development**.
+ Major donors, such the EU, has prioritized digitalization as well as nexus in its long-term investments
+ **New type of partnerships** are encouraged and supported by donors

WEAKNESSES

— **High investments costs** of the digitalization
— Possible **loss of usual jobs**, false belief about the opportunity of leave behind the field work
— **Economic inequalities**;
— Funding mechanism for SME are complex



OPPORTUNITIES

+ Bringing research efforts (eg Copernicus/ Horizon) to the market after the end of the project.
+ Downscaling to farm level - **room for private initiatives**.
+ Reducing the cost of the use of resources
+ **Public-private schemes**
+ Possible contributions from outsourcing

THREATS

— **Ethical and social risks**
— **Vulnerability** to technical failures
— **Job displacements**
— **Monopolization**

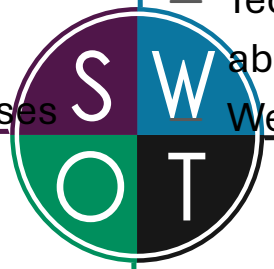
Technical tools

STRENGTHS

+ Support to decision making, they offer huge and widely used database for **enhancing modelling capabilities** to improve decision-making and governance.
+ Many tools already existing and they can **spread the knowledge** and improving the models toward a digital twin.
+ Real time monitoring and assessment/evaluation of resource
+ **Reducing risks, Increased efficiency**,
+ Optimisation of models,
+ Enhances visibility of information, emergency responses

WEAKNESSES

— Need for regional network, **not isolated efforts**
— Currently, there is limited access to spatial data, and in some case high uncertainty
— **Overflow of information**
— **Scalability is a big challenge**. eg many PRIMA projects dealing with digitalization but they face difficulties in upscaling.
— **Interoperability** of technical solutions remains limited
— Technical readiness on nexus digitalization is low given the absence of related skills
— We still need data and measurements from the field/ground



OPPORTUNITIES

+ Remote sensing and in general distance acquisition is **very important for marginal areas** where there is a high lack of data
+ Digital twins, higher efficiency and **improved capacity of understand reality**
+ Improve efficiency and upstream climate services

THREATS

— Risk of forgetting the need of field and practical data
— Fast change is risking **leaving people behind**
— increase of costs and tariffs
— **A lot of data are in the hands of very few people**
— **Possible increasing of digital divide** – unbalanced access to technology
— Risk of rushing, before thinking what data is needed and how it will be used
— **Risk of "maladaptation"**

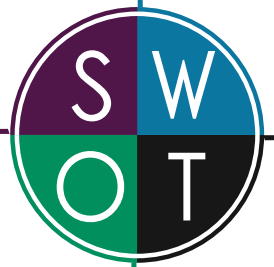
Ecosystems and biodiversity

STRENGTHS

+ Can help monitoring, planning and valuing ecosystem benefits.
+ **Restauration of ecosystems** is essential for water cycle and carbon storage (wetlands, forests)
+ **Green infrastructure and Nature base solutions** are giving practical improvement to the other sectors
+ **Strong synergies** with all the sectors and with the digitalization tools

WEAKNESSES

— Not clear for all the benefits of ecosystem services to the other sector of the WEFE -> **need for monetization of ES**
— Need to include the landscape level



OPPORTUNITIES

+ **Coupling innovative practices with traditional ones** (e.g. water harvesting)
+ Bring the private sector through technological innovations
+ Big data and predictive analysis. IoT, smart sensors - useful for integrating ecosystems into WEFE Nexus
+ Can help view productive units like farms not in a narrow way, but as a functioning multidimensional Nexus system.

THREATS

— If the services to the other sectors are not clearly evaluated and monetarized, **possible conflicts with other sectors**, in particular agriculture

Take home messages

- Digital technologies for the WEFE nexus management are in place and they can help the decision making «**at the right place in the right time**». They can also **reduce the distance** between citizens and policy makers

But…

- There is an issue in terms of **scalability of the initiatives**: a lot of projects sometimes fragmented but lack of long term sustainability and mainstreaming

- There is a **strong regional collaboration** and Mediterranean initiatives,

But…

- there is still a **digital divide** and sometimes a **lack in digital literacy**

Take home messages: what to do?

- Investments in **digital infrastructure** to get data available and accessible, to improve **FAIR data sharing** -> regional Mediterranean platform with open data
- Investments in program to **develop digital skills**, not only in education but also for the technician and field workers
- Improve **public-private partnership** together with research institution -> attract investments from companies for digital development
- **Deconstruct the apparent conflicts** between nature restoration and ecosystem conservation and agricultural production -> monetarization of ES

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