Wetland-BASED SOLUTIONS: tESTING AND TRANSFER OF METHODOLOGIES TO SUPPORT CLIMATE CHANGE ADAPTATION AND MITIGATION IN WETLAND ECOSYSTEMS

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1. Introduction and objetives

Recent policies at EU and national level have provided the background for more active intervention to restore a significant part of degraded aquatic ecosystems, protect biodiversity and address the effects of Global Change. In this context, adaptation to the consequences of climate change is a key challenge in the Euro-Mediterranean territory. Several opportunities arise to reinforce adaptation by shifting our attention to Nature-based Solutions (NbS) and among them "wetland-based solutions". Wetland loss and degradation is a sign that the recognition of the wetland climate services as a catalyst for the improvement of the quality of human life and sustainable growth, is probably weak at the various governance levels. The Interreg Euro-MED funded project Wetland4Change (2023-2025) aims to validate transferable solutions based on wetland conservation and restoration for climate adaptation and mitigation, to accelerate the capacities of wetland managers and of policy makers to cope with the climate crisis at local and transnational level, by improving take up of science-based knowledge and governance mechanisms, through assessments, guidance, capacity building and experience exchange. The main project outputs are two wetland-based solutions tested and validated in 5 pilot sites in 5 Euro-Mediterranean countries, namely Bulgaria, Greece, Italy, France and Spain These solutions include carbon-sequestration and flood regulation. The project goes beyond existing practices through the novelty in assessing carbon sequestration and flood regulation capacities of wetlands for national authority obligations (i.e GAEC 2 for the agriculture sector). As a result, the project will improve the knowledge and the management capacities of the involved stakeholders to promote and plan wetlands protection and conservation as nature-based solutions in climate change adaptation, mitigation and risk prevention.

This oral presentation will highlight the methodological approaches for the two wetland solutions and provide an overview of the envisaged outputs of the project.

2. Methodology

The consolidation of the methodology of the two wetland solutions, carbon sequestration and flood regulation is a key part of the project.

2.1 Carbon Sequestration

Quantifying the benefits of wetlands in terms of carbon sequestration is crucial for acknowledging values of these ecosystems. The effective communication of this ecosystem service to decision-makers aligns with EU adaptation strategy goals, emphasising the importance of environmental assessments, guidance, capacity building, and funding. Essential for informed decision-making is to have availability of environmental carbon-related data, integrated with comprehensive inventories of wetland typification and ecological status. This involves measuring and modelling carbon flows within wetlands, incorporating baseline rates and evaluating its variation in response to disturbances. Finally, this will allow us to assess, in terms of the climatic regulation service of the wetland, the effectiveness to implement different management strategies of restoration and/or conservation. These strategies could, for instance, involve the maintenance of natural hydrological regimes, minimise eutrophication, or protect the development of vegetation (Valach et al., 2021; Camacho-Santamans et al., 2024).

The proposed approach involves delineating the extent and dynamics of main functional compartments within the wetland, namely, flooded surface, unflooded sediment, bare soil, and emergent vegetation. Subsequently, a weighted carbon exchange balance for each of these components should be quantified. The precision of this calculation may vary depending on the methodology employed. This is because the rates of carbon exchange can either be directly measured in the pilot site or approximated from estimates based on available data. Regardless of the approach, the procedure relies on the following foundations:

- Parameterization of carbon exchange
- Wetland type definition and ranges
- Wetland ecological status
- Spatial variability, wetland compartmentation
- Temporal variability

Taking in consideration the previous foundations, the capacity of warming mitigation in wetlands can be assessed adopting different levels of methodological complexity. The level is

selected based on the availability of data, requirements, and other constraints. As an initial scheme, three complexity levels (i.e., Tiers) are proposed which are supposed to cover all the scenarios of data accessibility.

Tier 1: the simplest approach using default values of carbon exchange. Simplest implementation. Applicable across a wide range of scenarios, but with low specificity and accuracy.

Tier 2: Higher level of specificity, incorporating carbon exchange factors and additional environmental data. The method advances beyond the previous level by considering environmental conditions, ecological status, land uses practices, etc., to adjust carbon exchange factors.

Tier 3: methods are advanced techniques for carbon dynamics assessment, employing intricate models and. Based on in situ measurements at pilot sites and modelling frameworks. Requires the higher specialised expertise and resources for implementation.

2.2 Flood regulation

Flood protection is one of the most important regulating ecosystem services that affect water-related disasters. Policies are shifting towards calling for and investing in Nature-based Solutions (NbS) in their attempts to reduce flood risks on the population, namely in settlements close to water bodies and in previous heavily modified flood plains. Forests, floodplains, riverbanks, alluvial wetlands, riparian vegetation and other densely vegetated areas normally provide natural flood mitigation and water regulation services as they reduce the water flow and influence water retention capacities. These ecosystems affect the water balance mainly through interception and infiltration. Interception depends on the structure of the ecosystem above ground (land cover and vegetation density) while the infiltration is strongly determined by the soil properties. The surface runoff, being the main factor influencing flood formation, also depends on abiotic factors like soil, lithology and topography.

The importance of the regulating services to human wellbeing relies on their preventive or mitigating functions. Flood hazards prevention is an important function of some ecosystems such as wetlands or forests, known as the capacity to redirect or absorb part of the incoming water from precipitation, reducing the surface runoff and consequently the amount of water or river discharge. This ecosystem service is essential before flood occurrence and in some cases it could even prevent it. The other important role of floodplain ecosystems and alluvial wetlands is flood mitigation, being the role they play when the flood is already formed ensuring a retention mechanism of the water surplus preventing its spill or superficial flow, thus reducing flood's destructive power.

A flood regulation indicator should therefore consider the damage mitigation role of eco systems by measuring their water storage capacity as well as their flood prevention role which does not only depend also on several other factors and functional processes such as interception and infiltration, surface parameters like roughness and slope as well as external factors like rainfall quantity and intensity, seasonal state of the vegetation and initial soil saturation.

To assess the flood regulation capacity of wetland ecosystems, three main hydrologic parameters should be considered: the infiltration rate, the surface runoff and the peak flow. The first one is important to estimate the regulation function of the soils. As the flash floods are formed predominantly by the surface runoff, the soils with highest infiltration capability have the highest water regulating capacity as they "absorb" more water, thus reducing the amount of the surface runoff and the flood hazard. The other two parameters represent the function of the ecosystem to redirect part of the incoming water and to delay the movement of the surface runoff. The relationship in this case is the opposite, in the sense that areas with lower surface runoff and peak flow will have a higher water regulation capacity. The topography also has a significant influence on flood regulation functions. Areas in the higher parts of the catchment usually show higher amounts of precipitation, where there are increases in the number of extreme precipitation cases recorded. The steeper slopes in these areas also facilitate a faster downward movement of the water reducing their retention capacity.

The demand for the flood regulation service is related to the benefits from the society. In this case, the benefit is life security and protection of goods and properties. A flood regulation indicator considering supply and demand as defined previously and applied spatially would identify areas where efficient natural flood protection and mitigation are to be achieved, i.e. where the supply of flood regulating ecosystem services by nature on the one hand and the societal demand on the other hand match spatially. Unlike other ecosystem services, the flood regulation service must be provided in the same area where the demand is located as flood regulating services cannot be imported from other regions (Nedkov and Burkhard, 2012). Water retention in regulating ecosystem service supply areas prevents excessive water flows during flood events, providing direct benefits to people living in affected regions.

3. Expected Results

With the activities and the outputs of the Wetland4Change project it is expected to (a) create information products related carbon sequestration and flood regulation (maps, statistics) and (b) to transfer these tools to a wide range of stakeholders. . This will be achieved through the common testing and validation of the two wetland solutions at 5 pilots by each partner, following common methodological approach and determining similarities and differences in governance and policy barriers.

4. Discussion and conclusions

Climate change mitigation and adaptation are key in the current situation of climate crisis. Even though relatively small in total extension, wetlands play an enormous role in these processes through their provision of key ecosystem services. The project will map and quantify the degree to which these ecosystem services can provide a contribution to the situation at global, regional and local scale.

The case of flood regulation is of particular interest in the context of the latest extreme flooding events in Greece, Spain and Italy. The work to be developed in the project on this topic may provide information to support decisions about restoration activities and the establishment of natural water retention measures, requested as part of the EU Flood Directive. Hence, the work has a clear policy context and may trigger the uptake of its results at local and regional level.

5. References

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