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**Brief Report on ECOTUN 2022 and Demosite Proposal in
Ghar El Melh Lagoon**

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Introduction

The coasts are under the pressure of urban expansion since the mid-19th century. Providing information on present coastal evolution, from the yield source to sink, and relationships with the marine environment behaviours, helps to understand how this system operates. In Mediterranean areas, there is an increasing need to protect coastal landscapes, appearing highly dependent to water and soil resources. Given the very high vulnerability of Mediterranean countries to the projected impacts of climate change, it cannot afford inaction on either the global, regional, nor national scales.

Based on the above background, the 1st Ecohydrology workshop in North Africa (ECOTUN 2022) *“Towards a North African Ecohydrology Demosite”* was held between 4th and 7th, October 2022 in Carthage, Tunisia (Figure 1).



Figure 1: Group photo of workshop participants at INSTM premises, Carthage Tunisia

The objective of the event was to collect the available data and coordinate multidisciplinary scientific teams around projects based on Ecohydrology. The workshop focused on coastal wetlands ecosystem evolution and their roles in carbon sequestration and important biotope as strategically response to climate change mitigation.

In accordance with the attached program, ECOTUN 2022 gathered 11 countries, with 57 participants of which 48 (84%) from 8 African countries (Tunisia, Tanzania, Algeria, Morocco, Egypt, Benin, Cameroon, Senegal), 7 from France, 1 from USA and 1 from Lebanon (Figure 2). Other participants (including Dr Rahma Elfithri) attended via zoom.



Figure 2: Photos of participants listening to the opening speech from the guest of honor

Field work

After a sequence of presentations, workshop participants were exposed to the real field conditions where they visited the Ghar El Melh Lagoon (Figure 3).

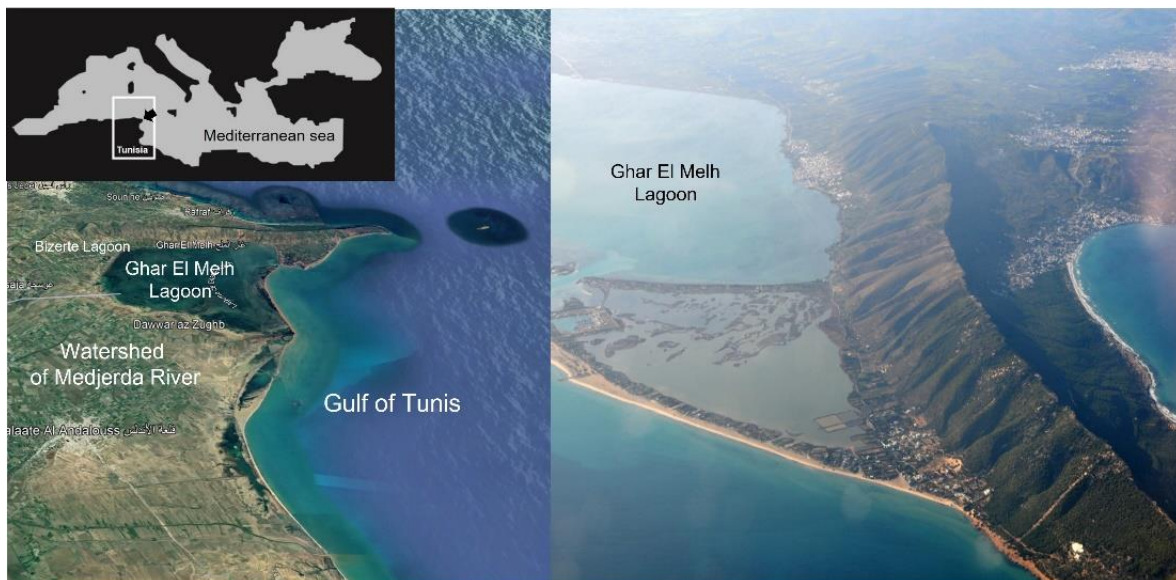


Figure 3: Ghar El Melh Lagoon which is proposed to be a demosite. Gar El Melh means "salt cave."

The coastal lagoon of Ghar El Melh (GEM) covers a total of 3000 ha and is 6.45 km in width, and 10.6 km in length with a maximum depth of the water level of 3 m. Since the mid-century, 4 coastal jetties and 10 river damming altered flow discharge quantity and quality and associated materials delivered to the coast, inducing the wetland ecosystem degradation. Additionally, variations in associated nutrient fluxes can have irreversible ecological damage in the coastal zone. The climate change drivers (sea level rise, heatwaves, fluctuation of the rainfall, etc.,) have a hot spot effect on the semi-arid wetland ecosystem already classified as high-ranked vulnerable to natural hazard. The GEM lagoon, a rich wetland habitat for migratory bird is classified under Ramsar Convention (2007) and the Agriculture Ramli are classified under SIPAM (Systèmes Ingénieux du Patrimoine Agricole Mondial) certification (2020, FAO)."

The presentations on the lagoon have helped to understand the history and context of the study site is that of a lagoon of Ghar el Melh (GEM). This lagoon is in the process of reconnection to the sea because of the cutting of its sedimentary contributions by the establishment of dams on the main stream of the Medjerda River which originally flowed there. To this must be coupled the detour of the Medjerda via a flood discharge channel originally built to avoid flooding of agricultural land in the delta.

The progressive reduction of its coastline under the combined effects of marine erosion and lack of sediment is a particularly interesting case study of ecosystems in rapid transition. Several research programs (national and international¹) are underway around this site. Physico-chemical measurements precede bacteriological measurements. Isotopic measurements on soil cores in the Medjerda river plain have identified two tsunamis that have affected the Mediterranean rim over the past centuries and millennia. This gave a depth of geological analysis of the site and its evolution.

The presentations made by the people working off-site allowed to glimpse the potential of hydrodynamic and biogeochemical modelling of lagoons (example of Lake Nokoué near Cotonou, example of lagoon monitoring) but also the consequences of the incision of the barrier beach (case of Saint Louis in Senegal) on the protection against marine swell. The hydrogeological context, which raises questions about the freshwater sources that feed the lagoon via sandstone layers, will be studied with the help of the metrological observation device OMELIE, which is being installed by the INSTM and the IRD.

The objective of the workshop was also to bring the participants to think about the co-construction of a GDRI (International Research Group Project) led by the IRD (FR) to collaborate on the demonstration site and create a network of demonstration sites in Africa. This aspect was discussed rather from the point of view of priorities: to ensure that the GEM demonstration site can provide long-term data in order to monitor its evolutionary dynamics under the combined effects of human actions and climate change, as well as the effect of ecohydrological solutions that could be tested.

The issue of data banking and sharing was discussed through the "integrated ecosystemic observatory" OMELI which is organized around the metrological device recently acquired by the IRD (autonomous multi-parameter measurement probes, motorized boat, piezometer equipment, meteorological station).

A Strength, Weakness, Opportunities and Threats (SWOT) analysis was initiated with all participants to identify shared and achievable objectives for this site. This analysis took up the different socio-economic aspects that were presented during the field visit. The four SWOT characteristics were summarized. It remains to bring out the shared objectives.

In order to judge the feasibility of this demonstration site, we used the WBSR reading grid:

Water

The GEM site concerns a transitional littoral aquatic environment (ecotone) known to be productive for animal biomass and where the dynamics of water and material flows are regulators. The presence of an invasive species such as the blue crab raises the question of the alteration of flows.

Biodiversity

The RAMSAR classification of the GEM lagoon confirms its high biodiversity value and the need to protect it. A biofilter project to treat the wastewater that arrives in the old bed of the Medjerda was mentioned during the presentation of Didier Orange (IRD) who works on this type of ecohydrological solution.

Ecosystem Services for Society

The fishery production of the lagoon feeds the local population estimated at 400 fishermen and the port partly supplies the city of Tunis. The "coco" beach located on the coastline of GEM attracts a large tourist population during the summer. The demonstration site project proposes to develop an

¹ (ECOBAM, ECOVAL, ECOCLIM, SICMED, ECODROPAMED, ANR MEDJERDA, AMZOC, ECOMEL et EDNET, LMI COSYSMED 2)

ecotourism approach to preserve the barrier beach. Sociological surveys have already allowed us to understand certain practices. These surveys are necessary to integrate the participatory social dimension of ecohydrology into the demonstration site project.

Resilience to climatic changes

The SIPAM (FAO, 2020) certification (Ingenious World Agricultural Heritage Systems) shows the ingenuity of the local farming population who grow vegetables on sandy mounds, amended with powdered limestone from the surrounding landforms and crushed eggshells. The elevation allows the roots not to be burned by the brackish waters of the lagoon.

Culture, education and law

The village is home to 3 old forts, the National Wetlands Center "Dar El Bhira" and the Professional Fishing Training Center (promotion of about 60 people per year). The existing partnership with the Professional Fishing Training Center provides local support for data collection in the bay and an office to host a dedicated computer. In return, the INSTM provides a marine weather monitoring module through the station installed on the roof of the center, and on the ecological quality of the lagoon once the observatory is installed. Trainings organized by INSTM will be aimed at student fishermen who are following a professional training in the center. We will integrate a module on the monitoring of the marine weather thanks to the station installed on the roof of the center, and on the ecological quality of the lagoon once the observatory is installed.

Given the "anarchic" urbanization that is developing in this protected area, contacts will be made with the authorities in charge of controlling urbanization rules.

Experts' opinion

- The GEM demonstration site seems to meet the different points required to develop a WBSR strategy;
- In terms of representativeness, the GEM demo site is an example among many lagoons on the African coast. Its interest is to be able to observe an accelerated evolutionary process within which it will be possible to measure the effect of ecohydrological solutions, and to propose the most effective ones to protect other lagoons.
- The sources of pressure are well identified. The trajectory of the erosion of the barrier beach is well highlighted. The analysis of hydrogeological connections and the hydraulic and biogeochemical modelling are steering tools that need to be developed to ensure the follow-up of ecohydrological actions.
- Finalize the SWOT analysis
- The fact that the INSTM is in charge of the demonstration site project is a guarantee of the involvement of decision makers. Dr. Oula Amrouni is a very dynamic person who seems to have created a real adhesion of his team around this project.
- Consequently, we are very much in favour of the entry of this demonstration site on the UNESCO platform.

Way forward

It is already planned that one student from INSTM and one from the University of Dakar will participate in the training in Tanzania, which indicates the beginning of a network activity. Makarius, Pascal & Didier are involved in the upcoming 4th Ecohydrology Training to be held in February 2023 in Tanzania and in the 9th FRIEND -Water World Conference and Ecohydrology Training to be held in Dakar in June 2023.

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