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Sustainable tourism and natural resources management in small islands

The present issue of the magazine *Energia, Ambiente e Innovazione* reports the results obtained through the activities dedicated to the Management of Natural Resources of Eco-innovation Project, focused on sustainable tourism.

Both studies and interventions were carried out between 2012 and 2015 in collaboration with the City Council and the Marine Protected Area of Egadi Islands, within the islets of Egadi Archipelago (few kilometres offshore of the Sicilian west coast). The study area is characterised by many ecological and naturalistic assets, particularly in the underwater environment, where a very high biodiversity is present thanks to the location and its particular hydrologic conditions. Here, the seabed has an irregular morphology with many cliffs, outcrops, sand banks and submarine valleys. It is a natural laboratory where the seasonal anthropic pressure is strongly related to tourism, leisure and professional/illegal fishing, pollution related to urbanisation (more intense in the Island of Favignana); all activities highly impacting the marine ecosystem and main threat for biological resources.

The activities of ENEA were targeted at: monitoring of underground water, analysis and classification of habitats, mitigation of natural risk, valorisation and conservation of natural capital. The actions have been carried out using traditional and innovative techniques, which allowed to better characterise the area, define new procedures for processing and analysing earth observation data, implement new technologies for the management of different natural resources (especially water, sediment and seagrass wrack).

Part of the actions gained the Green Coast Award on 2013, a contest which rewards the project that adopts sustainable solutions in coastal areas, considering the methodological approach, infrastructures, materials and environmental standards, innovation and certification processes. During the project surveys, particular interest was raised for potential reuse of sediments and beached vegetal biomasses. Different scenarios were implemented to foster: reuse of material that must be dredged from the harbour to ensure safety of navigation and encourage sustainable tourism; enlargement of the port layout; realisation of facilities such as beach volley infrastructures; reuse of dredge material in industry; nourishment of beaches and the environmental restoration along the coastline. Some of these solutions have also led to the formulation of legislative proposals, which have been included in a chapter dedicated to the excavated material in the book of the Technical Committee of Contaminated Soil published by the prestigious national editor Sole 24 Ore on July 2015, and presented to the Italian parliament in September 2015.

The seagrass wrack, which consists of residues of *Posidonia oceanica,* has been used for different purposes. First

of all, the transfer of vegetal biomass from the beaches to the foot of cliffs at potential risk of collapse was tested, in order to prevent people from being exposed to rock falls. Secondly, a multipurpose facility built with beached biomass, comprising a casing made of biocompatible fibre and filled with the wrack collected on the shore, has been implemented by ENEA (patent number RM2014A000151). The design implementation of this technology is under development, in collaboration with the University of Rome "Sapienza" (Architecture Science in Product Design), as part of a green building application in coastal areas. Finally, these structures have been used to create a substrate for the re-establishment of seagrass shoots on the seabed, which is essential to maintaining the presence of the meadow and reduce coastal erosion. The first test showed that this technique is potentially applicable whenever the impact of a strategic life-line on the *Posidonia oceanica* meadow must be offset (e.g., by positioning pipelines, powering electric lines, re-gasifying infrastructures, etc...). More in general, we believe that all the achievements performed within the Egadi Archipelago have led to excellent results and high visibility for ENEA, and that the entire project can be immediately replicated in similar environments, where the economic development of these regions can be reached through reuse of natural resources and mitigation of the impacts of human activities or natural hazards.

The present special Issue is dedicated to the memory of our colleague Paolo Massanisso