Social, Economic and Environmental Analyses for Sediment Reuse Applications

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Introduction: There remain significant challenges associated with dredged sediment management and reuse. The EU Interreg-funded SURICATES project has contributed to addressing this challenge by studying the potential to upscale sediment use. Successful upscaling of sediment use is not only a technical challenge but also a socio-economic one. The project has developed and applied a number of modelling and analysis tools to assess social, economic and environmental aspects of sediment management projects. This paper focuses on the application of these tools to a range of sediment management projects.

Methods: Four tools (GIS, Direct Cost, Economic and Environmental) have been developed to support the decision-making process and have been applied to dredge sediment management projects in the SURICATES Project partner countries of Ireland, Scotland, France and the Netherlands. The sediment management projects chosen represent a range of different applications of the reuse of dredged sediment.

The RAIES (Repulsion – Attraction – Included - Excluded - Sanctuarised) GIS tool developed by the University of Lille provides stakeholders with a GIS solution to support selection of the best location(s) for sediment reuse. The tool uses a spatial decision support system, which determines the best location available based on inputs from a range of different stakeholders. The strength (and weakness) of this model is that the biasing of stakeholders (for or against sediment use) is considered. Economic cost/benefits are also based on stakeholders' opinions.

The USAR Direct Cost Model developed by IMT Douai Nord Europe allows selection of the most suitable sediment management option based on criteria including sediment granulometry, physical and chemical characteristics, project costs, environmental criteria, site location and local and national regulations. USAR uses mathematical laws to simulate treatment applications of sediment to ensure the correct sediment properties for the targeted use. This model is the most accurate for cost comparison but needs detailed information for the source material and the type of application. It does not consider social constraints.

The Economic Model developed by Munster Technological University estimates the direct, indirect and induced impacts of a sediment management project in terms of Gross Domestic Product (GDP) and jobs created and is based on industry specific economic multipliers and coefficients, derived for each of SURICATES partner countries. The economic and employment contributions were downscaled to a regional EU NUTS3 level. This model is the most accurate in calculating secondary costs and benefits. The direct project cost calculation depends on stakeholder input.

The BROADSEAT (Beneficial Reuse Of Any Dredged Sediment Environmental Assessment Tool) Environmental Model developed by the University of Strathclyde is designed to analyse the environmental merits of a beneficial use dredging project. It compares a real or hypothetical Beneficial Reuse Option (BRO) to the Business as Usual (BAU) Case. It provides a qualitative assessment on a binary scale. i.e., 'the better'/'the same'/'worse'. The model can be used for a wide set of variables (social, economic,

environmental), but the ranking is based on a user-defined awarding of points.

Results: The four tools have been applied to analyse the impacts of a range of different sediment management projects and techniques, including at a number of SURICATES pilot sites. The results presented in this paper are based on the following sediment management projects and techniques applied across the SURICATES Partner Countries: sediment bioremediation, Falkirk Pilot Site, Scotland; in-water sediment reallocation, Port of Rotterdam Pilot Site, The Netherlands; breakwater construction and land reclamation, Port of Calais, France and wetland creation and dyke construction, Port of Fenit, Ireland. The dredge sediment volumes involved range from approximately 500 m^3 to 500,000 m^3.

The detailed analyses undertaken allow an overview of the different potential impacts of specific sediment management approaches in a site-specific context and allow, as appropriate, comparison of the 'Business as Usual' case with one or more beneficial use options. It also shows that for different projects and beneficial use techniques that the impacts can vary across social, economic and environmental criteria emphasising the complexity of the analyses undertaken and ultimately the challenges faced by stakeholders in managing dredge sediments in the context of the Circular Economy.

Discussion: This paper applies a new integrated modelling approach allowing assessment of the social, economic and environmental aspects of a range of beneficial use approaches to the management of dredged sediment.

Each individual model has strengths and weaknesses when it comes to the economic, social and environmental assessment of sediment use. The combined application of this suite of integrated tools provides valuable new insights into the analysis of the potential benefits of sediment reuse projects at a local and a regional scale in the context of the circular economy and also provides the stakeholder community and the overall decision-making process with the potential capacity to assess sediment management strategies and projects using multi-criteria analyses.

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- Sediment, Beneficial, Reuse, Economic, Environmental, GIS, Decision Making, Stakeholder.