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Circular management of dredged sediments from port maintenance

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Introduction: The concept of circularity is used as an alternative to linear flow materials in order to protect the environment from potential damage. To determine to what extent a sediment management project contributes to circularity practices, it is necessary to quantify how much of the dredged material is maintained within the system. Hence, defining boundaries for the system and circularity indicators for dredged material plays a vital role in measuring the circularity level of a certain project [1]. This study concentrates on defining circularity indicators for sediment management projects when a certain amount of material is diminished during the pre-processing stage. Besides, the perspectives of different stakeholders (e.g. port authorities, and dredging contractors) influence the selection of strategies for circular maintenance dredging [2].

Methods: To determine how the sediment management project contributed to a circular economy, the total amount of loss in the amount of sediment is measured during the pre-processing phase. The pre-processing operations might include washing, de-watering, treatment, desalination, degradation, etc. A certain tonnage of dried sediment (or cubic meters of slurry) is lost during each stage which reduces the circularity of the system. Figure 1 shows a simple schematic approach for sediment loss.

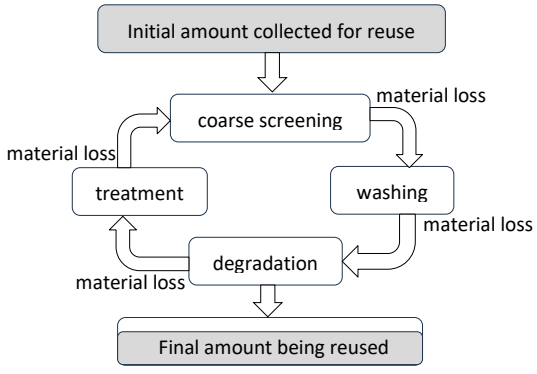

Fig. 1: Circular dredged sediment management [1]

The initial amount of collected sediments diminishes during each stage of pre-processing; therefore, the final amount being reused is relatively lower. As a result, the total contribution of the sediment management project to circularity practices is decreasing during each stage of pre-processing [3].

Results: Case studies of port maintenance are discussed to determine the impact of sediment pre-processing on the total loss before being re-used and the contribution of each project case to circularity practices. First, the pre-processing operations required to be specified for each case to monitor the sediment loss. Second, the amount of sediment loss in each stage is determined by tracking the input and output of each compartment. Third, the initial and final amounts are compared to measure to what extent the project is circular. Meanwhile, the circularity is also affected by sediment reusability and life cycle that are dependent on the sediment properties. Thereafter, other scenarios for dredging are discussed to provide a detailed insight into the optimal sediment management in each case. The scenarios focus on using different types of dredging vessels or vessels of the same type but with different properties. A discrete-event simulation is used to quantify a comparison between different dredging scenarios regarding efficiency and emissions.

Discussion: Scenario comparison is connected to trade-off quantification and the circularity index is studied along with other criteria such as emissions and the time needed to dredge the whole area. This trade-off can help stakeholders with different viewpoints to understand which strategies can be chosen for a certain case. Besides, the theoretical and managerial implications of this study are elaborated.

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