Novel scenarios for sustainable waterway sediments management deduced from a decision-support tool

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Introduction: Sediments accumulating in waterways represent a triple threat: for fluvial navigation, for flooding hazards, and for their pollutant contents. Waterways dredging releases millions of m3 of sediments, from which a large part is contaminated or even polluted enough to be considered as hazardous waste. Temporary or final storage on land is no longer a sustainable option.

Methods: The GeDSeT decision support tool (DST) aims to provide sediment management options with quantitative data, in order to evaluate various scenarios taking into account cost and sustainability and consequently to highlight good practice. It allows to evaluate different scenarios of sediment management based on several indicators, in order to take into account all the consequences (effects, fig. 1) of the chosen options ("what-if" tools, [1]). As it is aimed at assessing all consequences of a chosen option (environmental, economic…), the tool is based on multicriteria analysis [2].

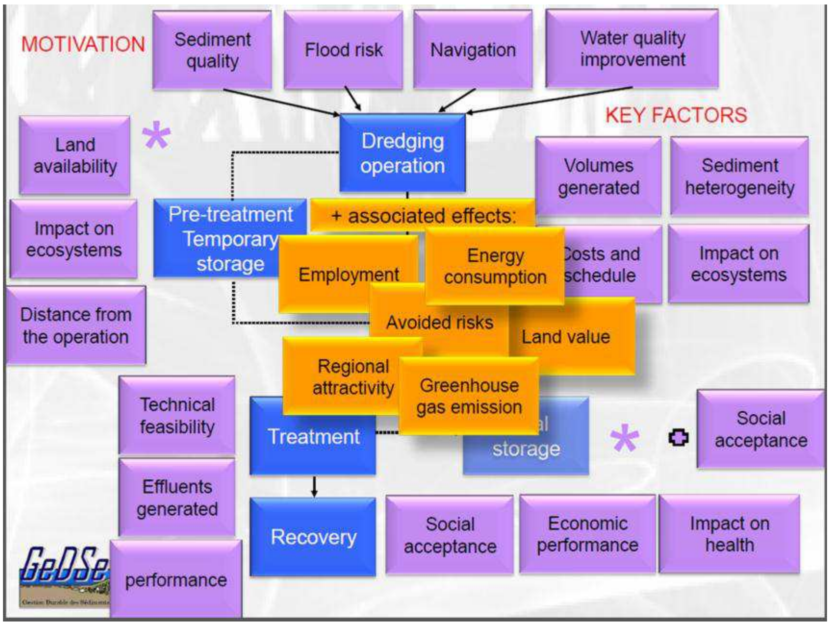

Fig. 1: Data and indicators for the GeDSeT tool.

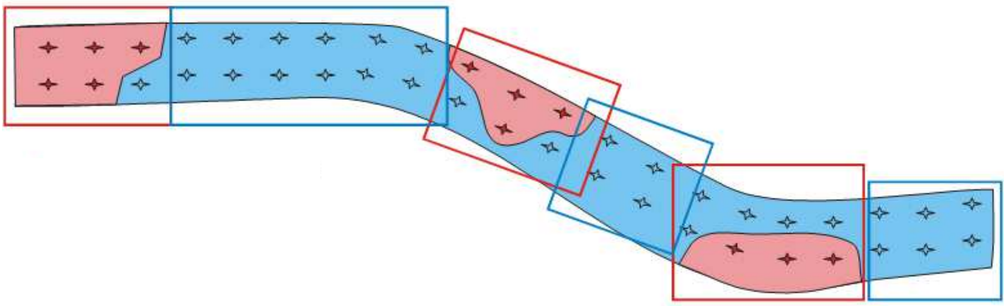

Fig.2: Selective dredging and detail characterisation. Crosses: sampling points. Boxes: contour of composites currently used for lab characterisation for bulk dredging. Field characterisation of individual samples would allow selective dredging of hotspots (pink) and subsequent valorisation of less contaminated sediment (blue).

Results: Scenarios were developed using databases and focused research results [2] through discussions with operators, communities and industries [3].
Scenario 1: *selective dredging* is a 2-phase scheme in which pollution hotspots are removed before bulk dredging, to improve reusability of sediment (fig. 2).
Scenario 2: *on-site treatment* implies processing as much as possible the sediment at a ship-borne plant. On-site dehydration benefits include output material with easier handling properties, and reduction of the dredged volume to be managed. Water can be returned to the waterway after treatment.
Scenario 3: *selective treatment* refers to directing sediment loads to a treatment procedure adequate for their pollutant contents (inorganic and/or organic).
This scenario is applicable to sediment treatment facilities currently developed near canals. Treatment may be aimed at reducing contamination under critical levels for less polluted sediments, or at concentrating the pollutants in a low volume fraction for safe disposal. Reusable sediment loads may be shipped to reuse sites.

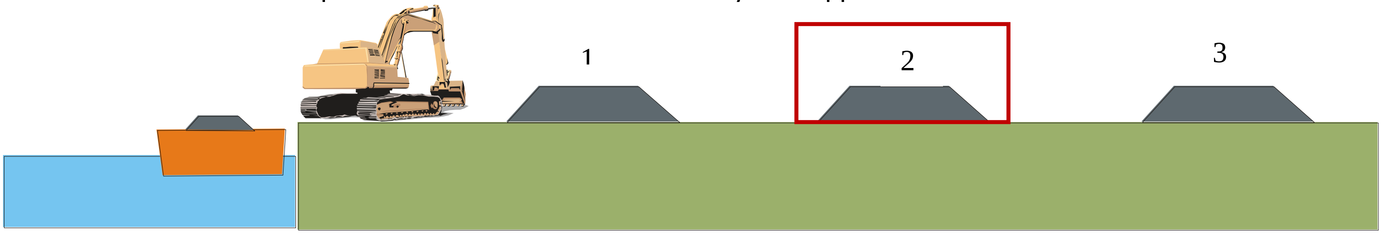

Fig.3: Selective processing of dredged sediment loads (left) in canal-side treatment plant: uncontaminated, direct shipping to reuse site; low contamination: dehydration or landfarming until reuse (1); medium contamination: treatment and separation (2); high contamination: concentration and disposal as hazardous waste (3).

Scenario 4: *alternative use of sediment*
Selectively dredged or treated sediments may be directed to reuse according to contamination level and regulatory constraints. Potential uses comprise:
- bulk use where applicable (landfill cover, civil works, excavation backfill),
- composite use (mix with concrete demolition aggregate),
- use as an alternative mineral resource (cement production).

Benefits include the reduction of primary minerals extraction and of sediment storage, hence increase of possible waterways dredging operations.
Scenario 5: *alternative use of disposal sites*. Sediment deposits are highly vegetated due to abundant organic matter, but they are unfit for food crops. Their use for energy crops (wood pellets, seeds) would reduce undesirable land use and allow energy crops on fertile soil without competition for land with food crops.

All these scenarios are aimed at increasing the reuse of sediments, and reducing their disposal as waste. Scenarios 1 and 3 require the availability of field analytical methods, currently in development.

Discussion: The benefits of alternative and novel scenarios (environmental, land use, employment and economic activity) are not properly accounted for if dredging projects are evaluated through a tendering process. Benefits are identified by enlarging system boundaries [1].
The benefits of sediments reuse, at constant budget, are to reduce land pressure and to improve waterways maintenance, offering therefore more possibilities to sustainable fluvial transport.

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[3] Lemière, B, et al. (2012) L'outil d'aide à la décision GeDSeT. Recyclage et Valorisation (Société de l'Industrie Minérale, Paris) 36, 52-58.