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Research article

Inclusion of social indicators in decision support tools for the selection of sustainable site remediation options

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ABSTRACT

Sustainable remediation requires a balanced decision-making process in which environmental, economic and social aspects of different remediation options are all considered together and the optimum remediation solution is selected. More attention has been paid to the evaluation of environmental and economic aspects, in particular to reduce the human and environmental risks and the remediation costs, to the exclusion of social aspects of remediation. This paper investigates how social aspects are currently considered in sustainability assessments of remediation projects. A selection of decision support tools (DSTs), used for the sustainability assessment of a remediation project, is analyzed to define how social aspects are considered in those tools. The social indicator categories of the Sustainable Remediation Forum – United Kingdom (SuRF-UK), are used as a basis for this evaluation.

The consideration of social aspects in the investigated decision support tools is limited, but a clear increase is noticed in more recently developed tools. Among the five social indicator categories defined by SuRF-UK to facilitate a holistic consideration of social aspects of a remediation project only "Human health and safety" is systematically taken into account. "Neighbourhood and locality" is also often addressed, mostly emphasizing the potential disturbance caused by the remediation activities. However, the evaluation of 'Ethics and Equality', Communities and community involvement', and 'Uncertainty and evidence' is often neglected. Nevertheless, concrete examples can be found in some of the investigated tools. Specific legislation, standard procedures, and guidelines that have to be followed in a region or country are mainly been set up in the context of protecting human and ecosystem health, safety and prevention of nuisance. However, they sometimes already include some of the aspects addressed by the social indicators. In this perspective the use of DST to evaluate the sustainability of a site remediation project, should be tuned to the legislation, guidelines and procedures that are in force in a specific country or region.

1. Introduction and background

1.1. From environmental impact assessment to sustainability appraisal

Over the next several decades, governments and private industry will spend a huge amount of money to clean up sites contaminated with hazardous substances from a variety of industrial, mining, waste management and other anthropogenic sources. The amount of potentially contaminated sites across Europe, which need to be investigated, is estimated at 2.5 million. Of these sites, approximately 14% (340,000 sites) are expected to be contaminated

Abbreviations: ABC, Assessment, Benefits and Costs; BATNEEC, Best Available Techniques Not Entailing Excessive Costs; CBA, Cost-Benefit Analysis; CLARINET, Contaminated Land Rehabilitation Network for Environmental Technologies; CF, Common Forum; DARTS, Decision Aid for Remediation Technology Selection; DECERNS, Decision Evaluation for Complex Risk Network Systems; DESYRE, DEcision support System for REhabilitation of contaminated sites; DST, Decision Support Tool; EEA, European Environment Agency; EPA, US Environmental Protection Agency; GIS, Geographic Information System; GOSA, Goal Oriented Sustainability Assessment; GRI, Global Reporting Initiative; ISO, International Organization for Standardization; LCA, lifecycle assessment; MAVT, Multi-Attribute Value Theory; MCA, MultiCriteria Analysis; MCEA, MultiCriteria Effect Analysis; MCDA, MultiCriteria Decision Analysis; NICOLE, Network for Industrially Contaminated Land in Europe; OVAM, Public Waste Agency of Flanders; OVAM SB, OVAM Sustainability Barometer; REC, Risk reduction, Environmental Merit and Cost; SADA, Spatial Analysis and Decision Assistance; SRAM, Sustainable Remediation Assessment Matrix; SBR, Sustainable Brownfields Redevelopment; SMARTe, Sustainable Management Approaches and Revitalization Tools, electronic; SPeAR®, Sustainable Project Appraisal; SRT, Sustainable Remediation Tool; SURF, Sustainable Remediation Forum.

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and likely to require remediation (EEA, 2014). Moreover, an 50% increase of the number of sites to be remediated is expected in Europe by 2025 (EEA, 2014). In 2004, The US Environmental protection Agency (US EPA) estimated that in the US, 350.000 contaminated sites will require cleanup over the next 30 years, assuming current regulations and practices remain the same (US EPA, 2004).

Environmental impact assessment is required by the EU Directive 85/337/EEC, which states that member States "*shall adopt all measures necessary to ensure that projects likely to have significant effects on the environment are made subject to an assessment with regard to their effects*". Whereas initially a site remediation project was seen as completely beneficial to the environment, taking away the risks for human and ecosystem health, potential negative impacts of site remediation only became of concern more recently. During the last 15 years, the environmental impact of site remediation projects has won the attention of policy makers, site owners, remediation experts and researchers, as shown by the increasing number of publications dealing with life cycle assessment (LCA) of site remediation (see Lemming et al. (2010a) and Cappuyns (2013a) for an overview), carbon footprint (e.g. Praamstra, 2009; Cappuyns, 2013b) and environmental footprint calculations (US EPA, 2012) of contaminated site remediation. Several tools, such as the Sustainable Remediation Tool (SRT, US AF Centre for Engineering and Environment, 2010) and SiteWise™ (US) (Naval facilities Engineering Command, 2011) have been developed to calculate the environmental footprint of different phases of a site remediation project, expressed as GHG emissions, NO_x, SO_x, PM_{10}, and water and energy usage.

Whereas legislation on site remediation originally mainly focused on the protection of human health and the environment, the term sustainable remediation found its entrance in EU regulation during the last decade (CL:AIRE and NICOLE, 2015). At EU level, some legislative passages support the embedding of sustainability throughout the process of investigating, assessing and remediating contaminated land (Bewley et al., 2015). The Environmental Liabilities Directive (2004) makes reference to criteria for remediation options requiring consideration of "*the effects … on public health and safety, the cost of implementation, the degree of benefits to each component of the natural resource and/or service, and finally the extent to which each option takes account of relevant social, economic and cultural concerns and other relevant factors specific to the locality*" (Annex 2, Article 1.3.1). This is also reflected in the decision support tools (DSTs) on site remediation, where, since the beginning of the 21st century, the initial focus on environmental impacts and costs moved towards a more holistic approach, also including socio-economic impacts of site remediation projects, introducing the concept of sustainable development in contaminated site management, referred to as "sustainable remediation" (Bardos et al., 2016).

1.2. Sustainable remediation

CLARINET (Contaminated Land Rehabilitation Network for Environmental Technologies) was one of the first initiatives in Europe, bringing together the combined knowledge of academics, government experts, consultants, industrial land owners and technology developers. It provided a thematic network on interdisciplinary research, integrating technological, societal and economical aspects for contaminated land management, in which more than 16 European countries were participating (Vegter et al., 2002).

In 2006, the Sustainable Remediation Forum (SURF) was established, as a collaboration between professionals in the soil remediation sector in the USA. SURF adopts sustainable approaches to remediation that provide a net benefit to the environment by (1) minimizing/eliminating energy consumption or the consumption of other natural resources; (2) reducing/eliminating releases to the environment; (3) applying or mimicking a natural process; (4) resulting in the reuse or recycling of land or otherwise undesirable materials; and/or (5) Encouraging the use of remedial technologies that permanently destroy contaminants (Ellis and Hadley, 2009). SURF provides an international forum for representatives of government, industry, consultancy, and academia, promoting '*the use of sustainable practices during the investigation, construction, redevelopment, and monitoring of remediation sites, with the objective of balancing economic viability, conservation of natural resources and biodiversity, and the enhancement of the quality of life in surrounding communities*" (SURF, 2016).

Several definitions of sustainable remediation are used in literature and research reports. The US Sustainable Remediation Forum (SURF-USA) uses the term "Sustainable Remediation" (SR) to indicate the practice of protecting human health and the environment while maximizing the environmental, social, and economic benefits throughout the remediation project life cycle" (ITRC, 2011). This definition is broader than the definition on "Green Remediation" (GR), described as "*the practice of considering all environmental effects of remedy implementation and incorporating options to maximize net environmental benefit of cleanup actions*" (US EPA, 2008).

The definition proposed by SuRF-UK is even more elaborated than the definition of SURF-USA, defining sustainable remediation as "*the practice of demonstrating, in terms of environmental, economic and social indicators, that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected through the use of a balanced decision-making process*" (CL:AIRE, 2010; Bardos et al., 2011). Whereas all the definitions mentioned above have in common that the impact on the environment should be minimized, the use of indicators to evaluate the impact and the selection of remediation options by using a balanced decision-making process are additional essential aspects in the SuRF-UK framework. This also takes into consideration that the relative sustainability of a site remediation project is site-specific and also depends on the view and preferences of different stakeholders (Harbottle et al., 2008), so it is almost impossible to give an overall sustainability score to a specific site remediation technique.

In July 2013, the Common Forum on Contaminated Land in the European Union (CF) and the Network for Industrially Contaminated Land in Europe (NICOLE) issued a Joint Position Statement on Sustainable Remediation of contaminated soil, sediment and groundwater. CF and NICOLE recognize that as a society, people need to be sure that money is well spent remediating sites, and that the benefits achieved by remediation outweigh the impacts. CF and NICOLE consider stakeholder engagement as crucial to ensure that a sustainability assessment minimizes uncertainties in its consideration of project-specific issues and concerns, and allows stakeholders to provide their perspectives on the balance of potential impacts and benefits (NICOLE, 2013). This is also reflected in their definition of 'sustainable remediation': "*A sustainable remediation project is one that represents the best solution considering environmental, social and economic factors –as agreed by the stakeholders*" (NICOLE, 2013). Finally, the ISO/DIS 18504 Soil quality — Guidance on sustainable remediation (ISO, 2016), that is currently being developed, defines sustainable remediation as "*the elimination and/or control of unacceptable risks in a safe and timely manner whilst optimising the environmental, social and economic value of the work*". A more detailed timeline of the evolution of the sustainable remediation concept is given in Bardos et al. (2016).

1.3. Sustainability indicators

Sustainability is difficult to assess in a completely quantitative