SNOWMAN NETWORK

Knowledge for sustainable soils

Supporting Decision Making on the Contaminated Land – Understanding the Risks and Opportunities

Introduction

Contaminated land is a global issue and many countries have a legacy of contaminated land resulting from historical industrial activities, waste management and the previous regeneration of land[1]. It has been estimated that there are up to 2.5 million potentially contaminated sites in Europe of which approximately 14 per cent are expected to be contaminated and to require remediation or management. Of the known contaminated sites only approximately 15 per cent have been remediated. The most frequent contaminants are mineral oils and heavy metals[2]. Contamination may be ongoing or historic; result from activities on a given site or off site emissions transferred by media such as air or water.

Contaminated land represents a risk to health and the environment, but is also a lost resource. This loss is made all the more acute in light of expanding pressure on land. Land is increasingly being expected to deliver an increasing range of environmental services including biomass for food, feed, energy and materials and to support urban development. Bringing contaminated land back into active use requires a systematic understanding of the risks involved and the opportunities. Decision support tools are important within this process. They help to provide a structure to ensure that all solutions for remediation and use are explored, providing the opportunity and risks associated with each for solution are considered in a systematic way. This *Policy Brief* synthesises analysis, funded by the SNOWMAN network, that further develops two approaches to decision support for the better assessment and future management of contaminated land.

Main findings

The decision support tools were tested through case study applications and improvements made to the existing decision support frameworks. This extended the usability and ease of use of the two decision support tools in question and supported the production of manuals to facilitate the use of the tools by others.

- Crop Based Systems for Sustainable Risk Based Land Management for Economically Marginal Degraded Land, Short Guide for Decision Support Tool *- http://snowmannetwork.com/wp-content/uploads/Rejuvenate-DST-guide_130329.pdf*
- Breaking ecotoxicological restraints in spatial planning (BERISP), Manual for the BERISP-DSS *- http://snowmannetwork.com/wp-content/uploads/BERISP-MANUAL-OCTOBER-2012.docx*

Key policy recommendations

- Contaminated land should be considered a potential resource and decision support tools can assist in this transition and help ensure effective outcomes for all stakeholders.
- There are potential opportunities to change the way land is managed i.e. for energy or non food crop cultivation (rather than for animal feed or grazing), which could help reduce the need for traditional remediation and retain or increase economic and social benefits from the land.
- Decision support tools should be used early within the process of assessing the likely use and management of contaminated land. Such a process of assessment should be iterative with different actors and stakeholders involved to maximise efficiency and quality of outcome.
- Spatially explicit assessments of risk i.e. that demonstrate the interaction between location and exploitation of the land, can help planners and local authorities better manage contaminated land and focus remediation effort.

Supporting Crop Choice and Examining Options for Energy Feedstocks on Contaminated Land

Content and methodology

The Rejuvenate and Rejuvenate II projects (funded by the SNOWMAN network) developed, tested and refined a decision support tool. The goal of the tool is to '*provide a framework for the assessment of the opportunities and risks for using non-food crops as a management method for marginal or degraded land, in particular brownfields and other previously developed or contaminated land*'. There is a particular focus on crops that can be used as feedstocks for bioenergy production. This includes maize, wheat, rape, sunflowers, sugar beet, barley, potato, alfafa and miscanthus. The tool represents a 'stepwise framework' with four key stages3 to assessing crop and site suitability, project value and associated risks. At each stage it might be decided not to proceed further, or adapt the conditions and/or parameters, if no possible options emerge from the analysis. The core elements of the approach are set out below and were tested within three case studies to validate and improve the approach.

Crop suitability

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Stage 1 primarily considers, from a range of possible biomass crops, which crops are able to grow in a region with a potential local market. Crops are systematically assessed to identify: if they meet agreed objectives for the site under consideration; are screened against prevailing local climatic conditions and the sites topographic conditions; and whether opportunities for use of the biomass exist on and/or off site. Each step within this stage of the assessment will progressively reduce the length of the list of potential crop options available. This results in a shortlist of crops both suited to local conditions and that fulfil the objectives of the project team.

Site suitability

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Stage 2 considers whether the specific site conditions are suitable for the different biomass crops that remain under consideration following the crop suitability screening. There are two elements to the second stage assessment. Firstly the onsite environmental conditions, associated risks and management alternatives are identified. Secondly, in the case that on site processing infrastructure is under consideration, the feasibility and impact of such a processing facility is investigated. The site suitability assessment will result in a shorter list of crop options considered able to grow on the land under consideration. It will also set out the soil and management needs associated with their cultivation and the environmental impacts that may result. Separately, if appropriate, the on-site conversion strategies for the crops and the impacts would be set out. This collectively provides a picture of the actions and activities needed on site to cultivate a given crop.

Value – Are the benefits of using the site for bioenergy feedstock production greater to or equal to the investment needed?

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This stage of the assessment interrogates the financial feasibility and viability of using the site for the production of the short listed energy feedstocks. It also, importantly, conducts a sustainability appraisal. This assesses the wider potential benefits and impacts on the environment and society of adopting a specific cultivation or production pathway. The assessment is based on an established framework for sustainable remediation. The output of Stage 3 is one, or potentially more, economically viable project concepts worthy of detailed appraisal.

Project risk

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The final stage of the assessment, based on an elaborated project concept, is to assess the risk associated with the project plan. A project plan should be put in place to ensure viability, as far as possible, before major investment takes place. Three broad considerations are important: technology status, detailed diligence (e.g. of financial partners and project partners) and developing a broad stakeholder consensus.

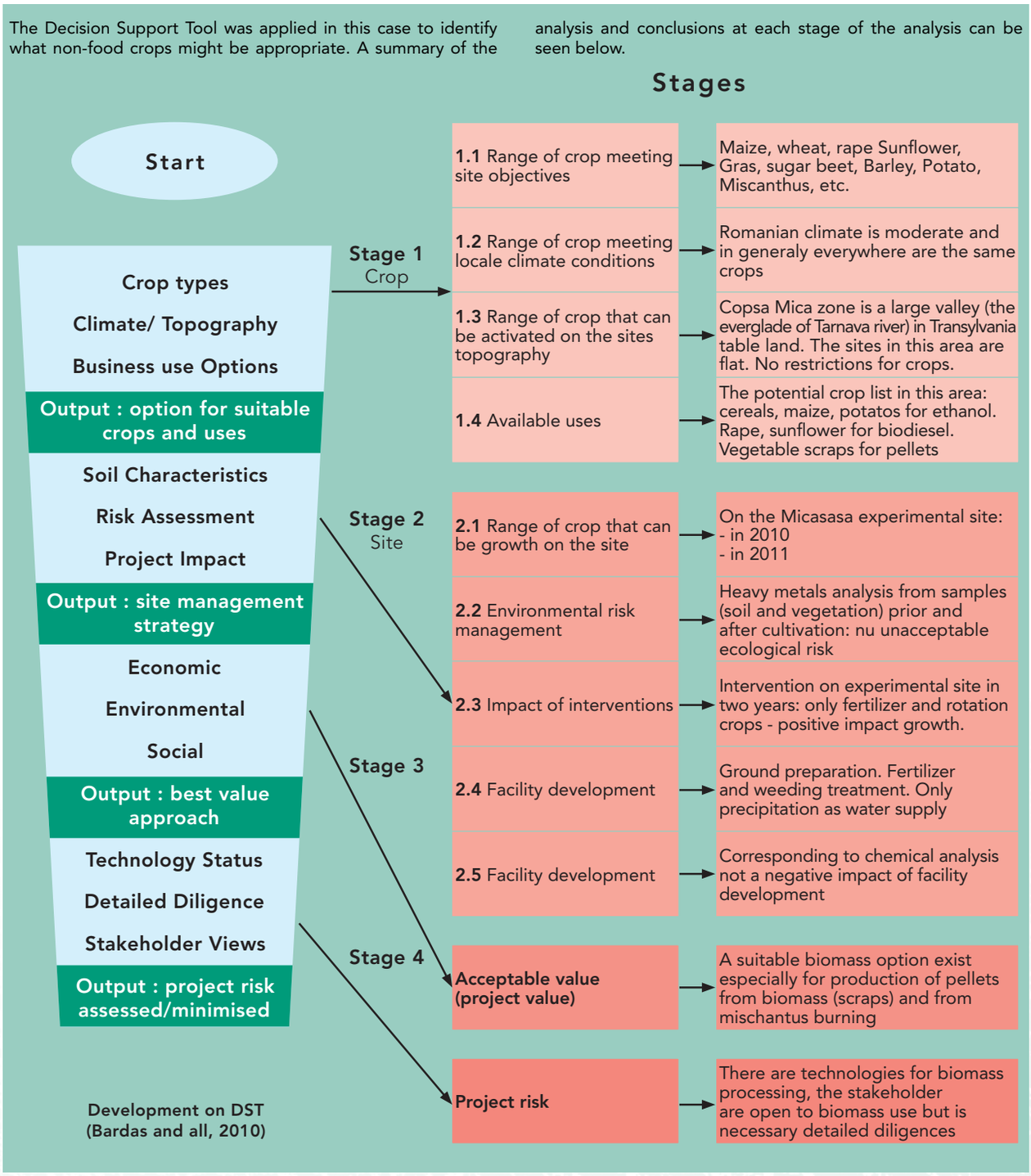
Case Example - Micasasa, in Copsa Mica Romania

Copsa Mica is a town located in Sibiu County in the centre of Romania (Transylvania). It is located in the basin of the Tarnava Mare River. The river basin is surrounded by hills and includes several farming villages. The Rejuvenate demonstration site is located in Micasasa village in the west of this region. The land is favourable for agriculture, but the soil is severely contaminated by deposition of heavy metals from previous metallurgical activities. The metallurgical factory for processing and mining non-ferrous minerals (today SC SOMETRA S.A.) opened in 1939.

Despite elevated heavy metal concentrations in the soil in the area, the current land uses near the and on site are agricultural production. The surrounding hills are used for grazing. While the site itself is not currently grazed, crops grown on site are harvested primarily for use as feed for domestic cattle.

The analysis investigated heavy metal uptake in a selection of non-woody crops, i.e. wheat, barley, maize, sunflower, alfalfa and potatoes and Miscanthus. The analysis found that there was a risk for animals (both cattle and sheep) consuming vegetation and feed grown on the Micasasa, Copsa mica, site (with the exception of corn cob). It is considered that using crops grown on the site (and in the wider area) as a feed crop poses a higher risk than utilising the crops for energy or other non-food and feed purposes.

The Decision Support Tool was applied in this case to identify what non-food crops might be appropriate. A summary of the analysis and conclusions at each stage of the analysis can be seen below.



Synthesis

The Rejuvenate Decision Support Tool was shown by the case study exercises to be systematic, transparent and transferrable. It is useful for assessing the risks, costs and benefits of internalities, environmental risks and externalities. The tool can be used as a checklist to make decisions about the best crop options and the best use of the resulting biomass. An iterative process of assessment is most useful; however, the first iteration is already helpful in excluding the least viable options and understanding the nature of additional information needed to support effective decision-making. The approach performed best when a clearly defined group of stakeholders was involved in the assessment process and when employed early in the planning and decision making process.

Supporting Land Use Planning Decisions

Content and Methodology

Risk assessment is key to assessing and making decisions about the use, management and remediation of contaminated land. It can, however, be difficult to assess spatially the distribution of risks and how this might vary across a landscape or site. The INSPECT (INtegration of SPatially Explicit risks of ConTaminants in Spatial Planning and Land Management) project, funded by the SNOWMAN network, sought to validate and extend the use of a spatially explicit decision support system named BERISP[4]. The BERISP approach seeks to bring together spatial data on habitats, pollutants, and risks posed by pollutants to living organisms. Based on this information it provides a platform that allows planning authorities, in particular, to test different types of landscape uses and habitat management solutions.

For a given local the BERISP approach can be applied by inputting mapped data on habitats, contaminants, soil conditions and topography. The output is an assessment of the risk posed to a particular species by the contamination based on their foraging patterns and strategies. It is a tool to facilitate the redevelopment of contaminated areas for natural or recreational use. The tool works by comparing risks associated with the present situation and possible alternative scenarios for use and management. It provides mapped information illustrating how risks are estimated to change across the landscape.

Following the analysis under INSPECT the model can now assess risk posed to small mammals (given their role as major prey species these are important for wider understanding), the little owl, large grazers (cows), the common blackbird and the common kestrel. In addition new illustrative case studies have been added, both testing the effectiveness of the BERISP approach and to demonstrate the application of the approach to inform future analysis. The pollutants covered within the decision support tool are Copper, Zinc, Lead and PCBs.

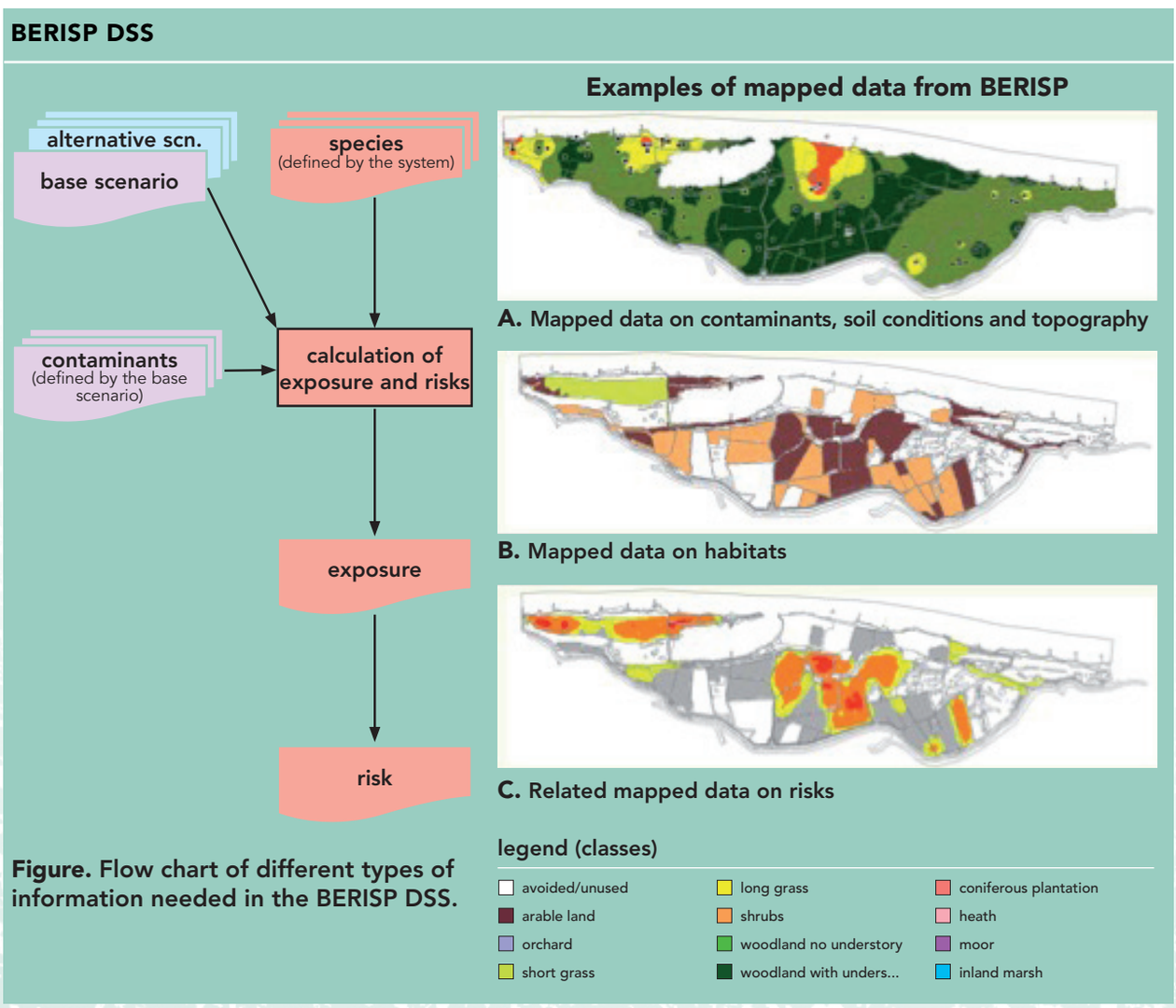


Figure. Flow chart of different types of information needed in the BERISP DSS.

Synthesis

The case studies and wider coverage of species within BERISP following the INSPECT work means that the decision support tool is more transferable to other situations. The final outcome of the work was to provide a step-by-step manual to BERISP[5], its application and use. This is available online and provides detailed instructions setting out how the tool might be used and developed for new sites of interest. This would be of use to local policy makers and local planning authorities, but also to those involved in the management of habitats or recreational areas where contamination is suspected. Given the industrial past of much of Europe this is of considerable value.

Conclusions

Improving decision support should improve the outcomes for society associated with the use of contaminated sites. As pressure on land increases there are obvious opportunities for using contaminated sites better and greater pressure to do so. Moreover, there are risks associated with inappropriately making use of contaminated land and it is important to understand the alternatives to existing management and the different economic avenues for products and materials.

Marginal land and brownfield sites, even when contaminated, should be seen as a potential resource rather than just a problem. A wide range of services can be offered by the land in question, which can contribute to the value proposition for redevelopment and regeneration. The tools presented here (Rejuvenate Decision Support Tool and BERISP) are intended to help support this transition.

About the SNOWMAN network

The SNOWMAN Network is a transnational group of research funding organizations and administrations in the field of sustainable management of soil in Europe. Acting as a Science-Policy-Practice interface, it aims to bridge the gap between knowledge demand and supply.

This policy brief is part of a series presenting the main results of the 17 European research project funded from 2006 to 2015 by the network.

More information on **www.snowmannetwork.com**.

REFERENCES :

1_ *http://www.ciwem.org/knowledge-networks/networks/contaminated-land.aspx*

2_ **Progress in the management of Contaminated Sites in Europe**, Marc van Liedekerke, Gundula Prokop, Sabine Rabl-Berger, Mark Kibblewhite, Geertrui Louwagie, 2014, Reference Report by the Joint Research Centre of the European Commission *http://eusoils.jrc.ec.europa.eu/ESDB_Archive/eusoils_docs/other/EUR26376EN.pdf*

3_ **Bardos et al. 2011**

4_ Details of the BERISP approach are no more available because of an ongoing software update

5_ *http://snowmannetwork.com/wp-content/uploads/BERISP-MANUAL-OCTOBER-2012.docx*

SNOWMAN Projects

INSPECT_
Materials relating to this project can be found at
http://snowmannetwork.com/?page_id=260

REJUVENATE_
Materials relating to this project can be found at
http://snowmannetwork.com/?page_id=264

Full reports available at **www.snowmannetwork.com**

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