Biofuel on contaminated land – A sustainable contribution to reach carbon goals?

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Abstract
There is an increasing request of biomass for biofuel production. However, the use of land to produce such biomass has raised a range of concerns including worries about the sacrifice of food production land and habitat land conservation issues. In parallel, brownfield land exists for which there is no economic case for restoration to conventional functional re-use and/or no realistic prospect for "hard" re-use. The combination of biomass cultivation and soil rehabilitation could provide leverage to bring such economical marginal land back into use. This paper overviews the findings of the results from a Snowman funded project investigating the sustainability of using this marginal land for non-food crops. The Snowman network is a transnational group of research funding organizations and administrations in the field of Soil and Groundwater in Europe.

Introduction

The production of non-food crops for biofuel and energy can contribute to sustainable development policy goals related to renewable energy and carbon management. However, the use of land to produce such biomass has raised a range of concerns about the sacrifice of food growing land, food security, food poverty and habitat land conservation issues. It has been questioned whether some biofuels even have a positive carbon balance at all based on impacts from transportation, change in land use and the emissions from biomass cultivation, soil and water usage and environmental costs of artificial fertilisers and pesticides.

In parallel brownfield land exists for which there is no economic case for restoration to conventional functional re-use and/or no realistic prospect for "hard" re-use. In Europe there are areas of land which have been degraded by past use that are not easy candidates for conventional regeneration, or for which conventional regeneration may not be the most sustainable approach (e.g. areas affected by mining, fallout from industrial processes, activities related to forestry and the pulp and paper industry, areas elevated with contaminated dredged sediments and former landfill sites) and many other areas where the decline of industrial activity has left a legacy of degraded land and communities. The extent of contamination may not be sufficient to trigger remediation under current regulatory and economic conditions, and there may be little economic incentive to regenerate the areas affected.

The combination of biomass cultivation and soil rehabilitation could provide leverage to bring such degraded land back into use. Benefits from this kind of land use might include providing: a self-funding land management regime, economic activity to deprived areas, a long term improvement in land values and environmental benefits such as carbon sequestration (substitution of fossil carbon resources, and temporary sequestration in managed soils). The Snowman funded project Rejuvenate (1) has developed a decision support tool (DST) consisting of a set of model procedures (Bardos et al., 2009). The procedure starts with an objective setting for the marginal site being considered, including identifying any constraints on land use. Decision-making then proceeds through four sequential stages considering the biomass crop, the site, the project value and the project risks to identify viable project opportunities. It uses a simple traffic light concept to describe the outcomes for project options at each stage. This work included partners from UK, Sweden, Germany and the Netherlands.

Materials and Methods

A second project, Rejuvenate (2) has now begun. Rejuvenate (2) encompasses a review of the legal framework at a European scale, environmental and risk assessments including a Triad analysis of a site and final results from demonstration sites in Sweden and Romania. The DST will be updated and enhanced based upon the findings of this work. In this second phase the project group has been expanded to include Belgium and Romania.

The demonstration scale case studies in Romania and Sweden are:

- Copsa Mica – Micasasa (Central Romania, spontaneous vegetation and agricultural land 0.5 + 0.5 ha, heavy metals) – Rape, Sunflower, Maize, various wild grasses
- Vivsta varv (NW Sweden, previous shipyard with timber storage, 2 ha, dioxins,

heavy metals, with and without sewage sludge) - Salix Klara

- Utansjöbruk(NW Sweden, previous ash and wood sludge storage, present use has been timber storage, 0.5 ha, heavy metals, with and without wood sludge). Salix Klara

- Kallinge bruk (South Sweden, landfill at previous multi industrial site, heavy metals, 0.2 ha, Triad analysis (Triad is a combination of chemical analyses, bioassays and ecological field surveys), no sludge). Salix Inger

Results

The preliminary results of the SWOT analysis indicate that the DST is a useful process structure to evaluate risks, environmental, legal and economical impacts from a specific site perspective.
From a generic perspective the results, including a life cycle analysis, indicate that biomass on marginal contaminated land can have significant sustainability benefits, depending on approach (Andersson-Sköld et al., 2009, Suer ete al., 2009) From a specific site perspective there are, however, several aspects that need to be considered to fulfil the requirements of sustainability. The preliminary results of the SWOT analysis indicate that the DST can be a useful and sound base for a sustainability analysis. At each phase of the DST legal aspects are considered. Rules on biodiversity, the use of fertilisers and pesticides, etc are considered. Solutions for bottlenecks and prohibitions in law enable a successful implementation of the phytoremediation project. Since phytoremediation projects will only attract investments when these are economically viable, an economic analysis is also part of the methodology.

Discussion

In principle biomass on marginal contaminated land has a number of sustainable development benefits, such as:

- reducing the carbon intensity of land remediation,
- generating renewable energy,
- broader community benefits such as landscape management,
- potential wider environmental benefits, for example on soil functionality and biodiversity
- economic benefits such as revenue generation or at least offsetting remediation costs.

The DST is a useful process structure to evaluate risks, environmental, legal and economical impacts from a specific site perspective. Marginally contaminated land can be used for bio energy production leading to a positive contribution in reaching our carbon goals.

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