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Bioenergy as a biodiversity management tool and the potential of a mixed species feedstock for bioenergy production in Wales

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HIGHLIGHTS

- The 'biomass productivity potential' of Welsh 'Less Favoured Areas' is estimated.
- The theoretical Fischer Tropsch fuel production potential is calculated.
- The Symons and Buswell equation is adjusted to reflect empirical data.
- Biogas production using biomass from Welsh 'Less Favoured Areas' is estimated.
- The potential impacts upon Welsh GHG reduction targets are calculated.

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ABSTRACT

A cutting management regime maintains high levels of biodiversity in semi-natural habitats across Europe. We utilise three years of annual yield data from Welsh semi-natural areas to calculate the mean feedstock production from cutting management to be 1.05×10^6 t DM annum^{-1}. Using formulae based upon Fischer Tropsch (FT) fuel process models, we predict that 2.12×10^5 t of FT fuel annum^{-1} could be produced. That represents 38% of the Welsh transport sector's green house gas (GHG) reduction target for 2020. Alternatively, predictive formulae reveal that methane yields from anaerobic digestion of the feedstock could reduce GHG emissions by 11% of the domestic sector's reduction target for 2020. Electricity generation from methane is also explored. The results presented encourage further investigation into the contribution of this resource to sustainable domestic energy supply. Furthermore, the proposed system would potentially protect a broad range of ecosystem services and maintain biodiversity.

1. Introduction

The growing of cultivated biofuels raises a number of issues. Dedicated biofuel crops such as rape seed oil and cereals compete with food and feed crops for land cover and large scale carbon dioxide emissions are associated with clearing land for first and second generation biofuel crop production. Depending upon the species of cultivated crop and the location, there can be a risk of inadvertently introducing competitive invasive biofuel species, and under some circumstances these crops may have a negative impact upon biodiversity. Some first generation biofuel crops require substantial fertiliser input and the resulting nitrous oxide emissions can carry a higher greenhouse gas (GHG) impact than the carbon emission reductions achieved by replacing fossil fuels. High level fertiliser input also results in high nitrogen runoff into waterways.

Promising potential for bioenergy production using feedstock from low input high diversity (LIHD) areas is emerging. By using the waste created from LIHD habitat management as a feedstock for bioenergy generation, the negative side effects associated with bioenergy production are potentially avoided whilst managing biodiversity, reducing CO_2 emissions by replacing fossil fuels, conserving broader ecosystem services and sequestered carbon.

LIHD harvests have been explored as a potential feedstock for Fischer Tropsch (FT) fuel production in the USA. (Kreutz et al., 2008; Tilman et al., 2006; Williams et al., 2009). However, in Europe LIHD derived feedstocks have tended to be examined for their potential use in biogas production (Heinsoo et al., 2010); in Germany mixed species harvests from semi-natural grasslands have been successfully converted into biogas and solid fuel. Many of these approaches encompass the concept of on-farm biorefining and the Integrated Generation of Solid Fuel and Biogas from Bio-

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