Ireland

Report from Ireland pursuant to Article 19(2) of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

Introduction

Article 19(2) of Directive 19(2) requires Member States to submit to the Commission a list of those areas on their territory classified as level 2 in the nomenclature of territorial units for statistics (NUTS) or as a more disaggregated NUTS level in accordance with Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS) where the typical greenhouse gas emissions from cultivation of agricultural raw materials can be expected to be lower than or equal to the emissions reported under the heading 'Disaggregated default values for cultivation' in part D of Annex V to this Directive, accompanied by a description of the method and data used to establish that list. That method shall take into account soil characteristics, climate and expected raw material yields.

There are two NUTS2 regions in Ireland, the Border, Midlands and Western Region (IE01), and the Southern and Eastern Region (IE02). There are no data available to distinguish between the characteristics of agriculture in each regions. As such, the data presented here is national level data applied across both NUTS2 regions. Because of the limited arable production in the Border, Midlands and Western Region, and the constrained geographical range of the country as a whole, it is not expected that any significant differences would arise in any case.

The crops of relevance to Ireland are;

- Winter Wheat
- Spring Wheat
- Oilseed Rape
- Sugar Beet

Materials & Methods:

For each crop, a number of standard agricultural operations was defined according to standard practise in Ireland. Fuel usage from agricultural operations was obtained from Dalgaard (2001) and converted into greenhouse gas emissions according to Flessa (2002). Statistics for oilseed rape do not distinguish between winter and spring crops. Accordingly, the agricultural operations defined for oilseed rape represented an average between winter and spring sown crops.

Pesticides:

Pesticide usage was taken from the Department of Agriculture Pesticide Usage Survey- Arable Crops 2004 (http://www.pcs.agriculture.gov.ie/Docs/UsuageSurvey2.pdf) which gives the average weight of active substances used per hectare of crop grown to be as follows

Crops	Active ingredient kg/ha
Winter Wheat	5.6
Spring Wheat	3.4
Oilseed Rape	0.9
Sugar Beet	2.8

It was assumed that 1 kg/ha was used during each spraying operation. Greenhouse gas emissions from pesticide application were assumed to be 17305.9 g CO_2 eq/kg of active ingredient as per JRC (2010)

Fertilizer Rates

Rates of applied fertilizer on winter wheat and spring wheat were taken from Lalor et al., (2010). Sugar beet is no longer grown in Ireland since 2006. Fertilizer rates for sugar beet were taken from Coulter et al., (2002) who quantified fertilizer rates during a period when sugar beet was still being cultivated. There are no published applied fertilizer rates for oilseed rape. Instead, recommended rates of nitrogen for index 1 soils were used (Hackett et al., 2006) (150 kg N ha^{-1} for spring crops, 225 kg N ha^{-1}, average between winter and spring crops 185 kg N ha^{-1}).

In Ireland during 2008 and 2009, ammonium nitrate fertilizers are imported primarily from Great Britain (72.9%) and to a lesser extent from Sweden (21.8%). The production of ammonium nitrate fertilizers in modern plants equipped with N20 abatement technology has been calculated to have an ammonium nitrate emission factor of 2.9 kg CO2eq/kg N (Brentrup and Palliere, 2009). The Swedish manufacturing company YARA claims that this emission factor is relevant for the manufacture of ammonium nitrate fertilizers in its factories. It was assumed that nitrogenous fertilizer manufactured in the European Union is carried out with best available technology (BAT), that N_20 abatement technology is used and that am emission factor of 2.9 kg CO_2 eq/kgN is appropriate. These fertilizers were assumed to have a manufacturing emission factor of 2.9 kg CO_2/kg N. Compound fertilizers are obtained from a variety of countries both inside and outside the European Union, the default emission factor (6.099 kg CO_2 eq/kg N) was used for compound fertilizers. Figures on fertilizer imports were obtained from the Central Statistics Office (www.cso.ie). Aggregate emission factors for nitrogenous fertilizers currently used in Ireland were calculated as follows.

	Cereals and Oilseed Rape	**Sugar Beet**
% ammonium nitrate	61	35
% urea	3	
% compound fertilizers	35	65
Emission Factor ammonium nitrate kgCO2eq/kg N	2.9	2.9
Emission Factor urea kg CO2 eq/kg N	2.9	
Emission Factor compound fertilizers kg CO2eq/kg N	6.099	6.099
Aggregate Emission Factor kg CO2eq/kg N	**4.01**	**4.97**

Greenhouse gas emissions from the manufacture of nitrogenous fertilizers constitute a significant percentage of the greenhouse gas budget of crop cultivation. Emission factors are highly dependent on abatement technology used in fertilizer manufacture and consequently on the origin of the fertilizers. It is assumed that, with time, all operating plants will have abatement technology and that the efficiency of abatement technology will improve over time. Thus, emission factors associated with the manufacture of nitrogenous fertilizers will improve with progress. Consequently, the greenhouse gas budget for cultivation was calculated both with the current emission factors (given in the table above) but also using a greenhouse gas value for all nitrogenous fertilizers of 2.9 kg CO2eq/kg N. The latter figure represents a future scenario in which all nitrogenous fertilizers are manufactured in plants fitted with modern abatement technology.

Emission factors for the manufacture of Phosphorus and Potassium production were taken from LowCVP (2004) and were 0.71 kg CO_2eq/kg P and 0.46 kg CO_2 eq/kg K. There are no available figures on lime application in Ireland, lime application is highly dependent on soil type with fields in some areas getting regular applications and fields in other areas rarely getting any lime. Consequently, it was assumed that all crops would get an application of 3 tonnes lime per hectare every five years. The emission factor was taken from JRC (2010).

Emissions of N_20 were calculated according to EU guidelines on the calculation of direct and indirect soil emissions from the cultivation of biofuel crops in EU25. The model of Bouwman et al., (2002) was used to calculate direct emissions

E=exp(c+• ev)

Where c(constant) -1.516
The following factors were used
Fertilizer Input 0.0038* N application rate per hectare per year

Soil Organic Carbon Content	0.0526
Ph	-0.0693
Soil Texture	-0.1583
Climate	0.0226
Vegetation	0
Time Factor	1.9910

Indirect soil emissions were calculated using the default IPCC emission factors (0.00225 kg N20-N/kg N). N20 emissions from a reference land use (managed grassland fertilized with animal manure) were substracted from the emissions calculated from the crops featured in this study.

Yields

Fresh yields of winter wheat, spring wheat, sugar beet and oilseed rape were obtained from the Central Statistics Office (Area, Yield and Production of Crops). Average yields from three years were taken from each crop, 2006, 2007 and 2008 for wheat and oilseed rape., 2003, 2004 and 2005 for sugar beet.

Crop	Yield (t/ha)
Winter Wheat	9.4
Spring Wheat	7.4
Oilseed Rape	3.6
Sugar Beet	50.8

Calculation of Emissions per MJ biofuel

This procedure was carried out according to the procedure outlined in the JRC-Institute for Energy document “Information on calculating greenhouse gas emissions from the cultivation of arable crops:non-soil emissions”. Fresh yields were converted to energy content of dry matter per hectare using lower heating values and typical moisture contents specified in the above document before being multiplied by a ratio specific to the individual pathway to obtain emissions per MJ biofuel. The following results were obtained.

Crop	GHG emissions cultivation –current conditions (g CO_2 eq/MJ)	GHG emissions cultivation –Improved Fertilizer Manufacture (g CO_2 eq/MJ)
Spring wheat ethanol	20	18
Winter wheat ethanol	20	19
Oilseed Rape-Vegetable Oil	24	23
Oilseed Rape-Biodiesel	24	22
Sugar Beet Ethanol	12	11

Conclusions:

Greenhouse gas emissions associated with the cultivation of biofuel crops in Ireland are at or below the default values for cultivation given in Annex V of the directive. These greenhouse gas figures are likely to reduce further with future advances in abatement technology used in plants which manufacture nitrogenous fertilizers.

References:

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