Building a greenhouse gas emissions reduction and sinks development programme into the CAP

The Carbon Cycles and Sinks Network was set up in early 2009 by Feasta, the Foundation for the Economics of Sustainability, an Irish NGO, under a three-year contract from the Irish Department of the Environment which felt that it needed advice on the policies that it might adopt to cut land-based greenhouse gas emissions. (Emissions which result from the way that Irish land is used make up a higher proportion of total emissions than in any other developed country apart from New Zealand.) The network structure was chosen to enable a wide range of organisations and individuals to feed into the policy-development process.

As the Network's work progressed, the Department asked that it work with the Department of Agriculture and the Irish agricultural research agency, Teagasc, to devise what became known as a Carbon REPS – in other words, a Rural Environmental Protection-type framework which rewarded farmers for practices that were likely to lead to their reducing their GHG emissions and also increasing the carbon content of their soils and the biomass growing on them.

The Network feels that the approach it is developing is highly relevant to the proposals on which you are working for reforming the CAP from 2013, particularly if the Integration and Refocus scenarios are followed. As stated in the briefing document, the public is likely to demand that it gets something tangible for the support that it is giving Europe's farmers and reduced emissions could be an acceptable part of the deal.

But the issue goes far beyond merely reducing land-based emissions. Many climate scientists now accept that the level of CO2 in the atmosphere is, at 389 ppmv, already too high for a temperature rise to be kept below 2 deg. C and that a 10-20% reduction in the amount of CO2 already in the air is required. Plants and soils are the only realistic tools available for extracting and sequestering carbon from the air and, as a result, we feel that the CAP needs to be restructured to enable it to happen in the EU. Moreover, farmers should be paid for this service, just as companies which sequester the CO2 from fossil fuel-fired power stations will expect to be paid for pumping it into, say, a disused gas well. The farms' sequestration service needs to be considered as a

new source of rural incomes provided by fossil fuel users rather than a burden on EU taxpayers.

So it is not enough for the reformed CAP to seek to reduce land-based GHG emissions – its aim should be to turn the land into an important emissions sink. The EU forestry sector is already such a sink. Whether forest landowners are getting sufficient reward for this benefit might be explored.

The essence of the Network's approach to developing a Carbon REPS is that best farming practice is re-assessed in the light of its climate effects and sequestration potential and re-defined if necessary. Farm payments would be made conditional on the adoption of these new best practice standards. No attempt would be made to pay farmers for the amount of carbon they lock away but the results would be monitored to ensure that, over the EU as a whole, the payments were achieving the desired results in an economically efficient way.

Of course, there will be no "one size fits all" pan-EU set of best practice standards. They will vary from farm to farm according to soil, rainfall, crop and other factors. We are therefore preparing web-based decision-trees for Irish crops and conditions. The farmer will be asked to answer a number of multiple choice questions and the programme will print out an advice sheet tailored for his or her circumstances based on the answers they gave. For example, the first question for a grassland farmer would be to determine the type of grassland for which the advice is required. The soil type, its current carbon content and how well it is drained make a big difference to the strategy to be followed. Other questions would be about the type of grass being grown, the use of nitrogenous fertiliser, the stocking rate and the method of grazing. Payments, we suggest, should be made conditional on following the advice on the sheet, which would be subject to modification by agreement.

We see pasture land increasing its importance as a sink if controlled grazing methods are encouraged. These allow the grass to develop strong root systems before being cut or grazed. After a short, intensive period of grazing, the animals are removed completely until the grass is tall again. This method, by encouraging the development of soil fungi, produces high levels of glomalin, a very persistent form of carbon, in the soil.

Methods to decrease greenhouse gases from Irish agriculture and increase carbon sequestration likely to be used in Ireland under a Carbon REPS.

1. Grassland

The management methods included in the table below can increase C uptake and reduce its loss but by how much cannot yet be quantified in most cases. It is however likely to be highly significant and should be further studied and the methods put to use.

Table 1: Summary of measures to increase C uptake and reduce its loss in grassland.

Management Practice	**C sink affect**	**Cost**	**Note**
Species Selection			
High yield perennials	**+**	low	Until more research is done the viability and affect of C4 forage grasses is not known.
C4 forage grasses	**+ +**	medium	
Native pasture	**+/-**	zero	
Drainage			
Peaty Soil	**- - -**	high	Should be avoided
Moderately wet sites	**+**	medium	Can give higher yields and increase C
Planting of Legumes	**+**	low	Reduces emissions of N_2O, increases yield and N uptake.
N Fertilisation	**+/-**	savings	Site assessment should occur
Grazing & Harvest intensity			
Increase grazing on low intensity sites	**+**	Increase profit	
Increase grazing on highly organic soil sites	**- -**	low	
Permanent grass vs Leys			
Short duration leys to permanent grassland	**++**	medium	
Increase ley length	**+**	medium	
Biochar addition	**+++**	high	Also increase yield and lowers fertiliser need

2. Nitrous oxide emissions

Irish agricultural N_2O emissions accounted for 9.9% of the country's total GHG emissions and 37% of agricultural emissions in 2007.
Significant reductions of around 20% could be made at a national level in Ireland via:

- Full adherence to the Teagasc, the Irish Agricultural Advisory Board Nutrient Advice.
- Replacing slatted sheds with out-wintering pads.
- Partial replacement of calcium ammonium nitrate with urea.
- Adopting white clover-grass swards.
- Using only low-emission slurry spreaders.
- Separating slurry into liquid and solid fractions, and storing the latter as "solid storage".

Cuts of a further 40-50% could be made if some or all of the following techniques were adopted:

- The urea spread on pasture and arable land could have nitrification and urease inhibitors added to it by the manufacturers.
- More slurry could be digested anaerobically. This would cut methane emissions also. Inhibitors could then be added to the liquid digestate before it was injected into the land or the nitrates and the phosphates it contains could be secured by being taken up by biochar which would then be spread on the land.
- Animal diets could be changed,
- More cover crops could be grown to take up the nutrients that might otherwise be lost if the land was bare between crops.
- Run-off water could be passed through a "bioreactor", of wood chips or sawdust which absorbs almost all the nitrates it contains.

3. Methane

Table 2 gives the best current estimates of what might be achieved in reducing enteric methane emissions from livestock in Ireland. If all the techniques could be applied in conjunction with each other, enteric emissions might be cut by about 5%. These estimates could still be highly inaccurate, and some depend on market conditions. The uncertainties due to a lack of whole life-cycle analyses could also be significant, notably the amount of nitrous oxide released when concentrates and additives such as dietary oils are grown. At the current stage of research, the only feasible methane-reduction techniques are simple management strategies such as sending a beef animal for slaughter as soon as the average rate at which it is putting on weight begins to decline. These strategies could be part of the proposed Carbon REPS programme.

Table 2: Summary of potential methane emissions reductions.

Practice	State of development	Financially viable without payment for emissions saved?	Abatement possible (% reduction in enteric methane)
Replacing roughage with concentrate for dairy cows	Being applied on farms	On a minority of farms	0.08
Replacing roughage with concentrate for beef cattle	Being applied on farms	Yes (with further research required)	0.79
Genetic improvement of the dairy herd	Being applied on farms	Yes	0.43
Improvement in milk yield additional to genetic progress	Being applied on farms	Yes	1.30
Genetic improvement of beef cattle	Being applied on farms	Yes	
Lifetime management of beef cattle: halve number of cattle slaughtered over 30 months	Being applied on farms	Depends on market conditions	0.88
Lifetime management of beef cattle: increase number of young bulls slaughtered to 100,000/ year	Being applied on farms	Depends on market conditions	1.0
Feeding dietary oils to beef cattle	Ready to apply on farms	Marginal	0.69
Feeding dietary oils to dairy cows	Establishing scope of measure (no programme currently in place to do this)		
Propionate precursors for beef and dairy cattle	Ready to apply on farms	Not currently	
Feeding maize silage to dairy cows	Establishing scope of measure (no programme currently in place to do this)		
Feeding maize silage to beef cattle	Establishing scope of measure		
Feeding other cereal silages instead of grass silage	Establishing scope of measure		
Improved grazing management	Establishing scope of measure		
Forage species and legume inclusion	Basic research stage/ Establishing scope of measure		
Probiotics	Basic research stage		
Halogenated compounds	Basic research stage		

4. Biochar

Biochar is a finely-grained charcoal with high organic-carbon content, produced by pyrolyizing plant and waste feedstocks, which can sequester carbon and increase nutrient retention when added to soil.

The benefits claimed for biochar are:

1. Plants will sequester much more carbon in the soil than will be added by the biochar itself.
2. The crops produced by land to which biochar is applied will be significantly larger than those grown on untreated soil.
3. Because biochar locks up nutrients, less fertiliser is required and this in itself cuts emissions.
4. Biochar reduces methane and nitrous oxide emissions from the soil to which it is applied.
5. Biochar improves the water-retention capacity of the soil
6. The production of biochar could lead to the development of a network of rural biorefineries which turn biomass into energy, foodstuffs and chemicals as well as producing char.

Research is needed to develop biochar as a potential tool for mitigating emissions from agriculture. The following area need to be examined:

- Identification and characterisation of potential feedstocks for biochar production from wastes, agricultural and forestry residues and energy crops.
- Development of a classification system for biochars produced from Irish feedstocks.
- Optimisation of pyrolysis technologies and operating conditions for Irish feedstocks.
- Examination of the stability of biochar in soils (lab-based trials, leading on to field trials) to determine the changes that occur when biochars are applied to different soils in order to determine the most important parameters that affect stability for carbon sequestration, plant growth and the health of the soil.
- Investigations in soil and plant growth improvement by biochar addition and the potential for fertiliser displacement.
- Investigations of the potential reductions in nitrous oxide emissions from fertiliser application using biochar.
- Investigations into the potential human health implications from biochar production and application.
- Development of a standard system for production of biochar from various feedstocks.

This information can be made available in the public domain.
For further information please contact CCSN project manager Richard Douthwaite richard@douthwaite.net or CCSN coordinator at corinnabyrne@gmail.com
www.carboncyclesandsinks.org