Appendix 5: Agriculture

A 5.1 Legislation / Regulation

Nitrates Directive

The Nitrates Directive (91/676/EEC) – Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources – was adopted in 1991 and has the objective of reducing water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution, with the primary emphasis being on the management of livestock manures and other fertilisers.

The Nitrates Directive generally requires Member States to -

- monitor waters and identify waters which are polluted or are liable to pollution by nitrates from agriculture
- establish a code of good agricultural practice to protect waters from such pollution
- promote the application by farmers of the code of good agricultural practice
- identify the area or areas to which an action programme should be applied to protect waters from pollution by nitrates from agricultural sources
- develop and implement action programmes to reduce and prevent such pollution in the identified area: action programmes are to be implemented and updated on a four-year cycle
- monitor the effectiveness of the action programmes, and
- report to the EU Commission on progress.

Judgments of the ECJ have clarified that the Directive requires Member States to establish a first action programme not later than 19 December 1995 and that Ireland is non-compliant with the Directive by virtue inter alia of not yet having established an action programme. It is incumbent on Ireland therefore to establish and implement an action programme at an early date in order to achieve compliance.

A National Nitrates Action Programme for Ireland was sent to the European Commission on 22 October 2004. In response, the EU Commission indicated by letter dated 22 December 2004 that the programme was inadequate and needed to be strengthened in specific respects. This current revised action programme responds to the concerns expressed by the Commission and incorporates appropriate revisions to the programme sent in October 2004.

Water quality in Ireland is generally good in a European context but has deteriorated from the position which prevailed when surveys commenced in 1971. The third report of the Environmental Protection Agency (EPA) on the state of the environment (Ireland's Environment 2004 - published in April 2004) indicated that agriculture is responsible for a significant proportion of Irish water pollution in rivers, lakes, estuaries and groundwaters.
A considerable strengthening of resolve and effort is required by all sectors to protect water quality and to reduce the prevailing levels of pollution to enable Ireland to achieve the WFD target of at least "good status" in all waters by 2015 or such higher status as is required in relation to protected areas.

Measures taken in the agricultural sector include obligatory, advisory and voluntary measures.

The obligatory / statutory measures include:-

- local authority bye-laws in relation to agricultural activities
- issue of "section 12 notices" and related farm inspections by local authorities under the Local Government (Water Pollution) Acts

- appropriate conditions applied by local authorities / An Bord Pleanala in the context of planning permissions
- integrated pollution control (IPPC) licensing by EPA of intensive pig-rearing and poultry-rearing units, and
- the rules for Good Farming Practice applicable to farmers claiming aid under direct payment and other national schemes operated by DAF.

The advisory measures include:

- national farm advisory service, Teagasc
- nutrient management advice.

The voluntary measures include:

- significant investment by farmers in waste storage capacity and other infrastructure for environmental protection supported by funding under the Farm Waste Management Scheme (previously the Control of Farmyard Pollution Scheme) operated by DAF
- a significant reduction in the use of chemical fertilisers
- the Rural Environment Protection Scheme (REPS operated by DAF). There are currently over 45,000 participants in REPS and all of these follow farm-specific nutrient management plans and already farm within the 170kg nitrogen, from livestock manure, limit. The number of REPS participants is projected to increase to approximately 59,000 by end 2006.

Document: National Action Programme under the Nitrates Directive (28 July 2005)

A 5.2 Energy Crops:

Short Rotation Coppice

Short Rotation Coppice to energy systems are generally accepted as being potentially beneficial if they are properly planned and managed. Under these conditions they can benefit the environment and the local community as they utilise an indigenous and renewable fuel and they can promote rural development and crop diversification.
The production of SRC may have impacts on landscape, water quality and biodiversity. That's why measures must be taken to minimise the detrimental environmental impacts and maximise the beneficial impacts.

The harvest volume of short rotation coppice is 60-70 green tonnes per hectare per rotation. Coppice for energy production produces energy equivalent of 6 tonnes of oil per hectare per year.

Example: Short Rotation Coppice fuelled combined heat and power gasification unit installed in spring of 1993 in the Agricultural College at Enniskillen, Co. Fermanagh. It supplies 100kW electrical which approximates to the maximum electrical demand of the College, in addition, 120kW thermal is produced for space heating and a further 60-80 kW thermal for fuel drying.

Document: Irish Best Practice Guidelines for Short Rotation Coppice
Link: http://www.eeci.net/archive/biobase/B10193.html

Miscanthus

Miscanthus is a tall perennial grass that has been evaluated in Europe during the past 5-10 years as a new bioenergy crop. It is sometimes confused with elephant grass (Pennisetum purpureum) and has been called both "elephant grass" and "E-grass". Most of the miscanthus cultivars proposed as a commercial crop in Europe are sterile hybrids (Miscanthus x giganteus) which originated in Japan. A number of ornamental varieties of miscanthus are also known to exist under various common names.

Miscanthus can be harvested every year with a sugar cane harvester and can be grown in a cool climate like that of northern Europe. Like other bioenergy crops, the harvested stems of miscanthus may be used as:

- fuel for production of heat and electric power
- biofuel after conversion to bioethanol.

Miscanthus has

- relatively high yields — 8-15 t/ha (3-6 t/acre) dry weight,
- low moisture content (as little as 15-20% if harvested in late winter or spring),
- annual harvests, providing a regular yearly income for the grower,
- good energy balance and output/input ratio compared with some other biomass options,
- low mineral content, especially with late winter or spring harvest, which improves fuel quality.

Forestry

Thinnings

Thinnings are wood fuels which can be used to heat farms, big buildings, or to provide district heating. They can be burned into special boilers called wood chip boilers. Wood chip boilers can provide a high level of automation and convenience for wood fuelled space heating. Wood chip systems generally have an output of greater than 20 kW (suitable for a large farmhouse or larger) and are not cost effective or appropriate for typical domestic scale applications. Extensive fuel handling systems and fuel storage facilities are required for automated operation. It is important to be able to source a steady supply of woodchip with a consistent size and moisture content suitable for burning in a boiler, as not all chips are suitable for burning.

Traditional assortments such as boxwood, stakes and pulp utilise only part of the felled tree. Wood fuel utilises the entire tree or the parts remaining after the more valuable assortments are removed. This additional production should provide a greater return to the grower and help to offset the cost of first thinning.

Thinning assortment quality and price are largely determined by straightness, branchiness and size. Wood fuel quality is related to moisture content (the lower the better), chip size and uniformity, and absence of fines such as a needle or leaf material. Freshly harvested Sitka spruce has a moisture content of 50 - 65%. Seasoning the wood over the summer and then chipping the wood in the autumn should reduce the moisture content and therefore increase the combustibility of the wood and its energy performance. A key point is that it is possible to air dry whole logs outdoors, whereas woodchips can only be dried at great cost in ventilated, heated driers.

Supplying wood energy from forest thinnings successfully will require adapting present methods and operating new approaches to thinning. Different supply systems will be appropriate for softwood first thinnings, broadleaves and mixed plantations.

Residues

Forest residues consist of the tree tops and branches remaining after timber is harvested. Some forest residues need to be left on the forest floor to decompose and return nutrients to the soil. These can act as brash mats, which allow machinery to travel across soft ground. However, much of this material could be harvested with suitable machinery and used as a renewable fuel for energy production.

COFORD (National Council for Forest Research and Development) has estimated that the residues from forestry and saw-milling will exceed the demand from the panel board industry by increasing amounts over the coming decade.

The alternative markets that can be envisaged for this material are other energy uses e.g. pellet production, CHP plant and co-firing in peat or coal burning power station.

Sustainable Forest Management (SFM) certification

The concept of sustainable forest management (SFM) is not a new one, but has become a much-used term in recent years. The United Nations Conference on Human Environment held in Stockholm in 1972 was the first international forum that recognised environmental issues, and introduced the idea of sustainable development as a way of dealing with the environmental dilemmas that faced the world.

SFM is defined in resolution H1 as the "stewardship and use of lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems."

Example: Coillte has adopted the six Helsinki criteria and have developed 35 associated indicators for SFM. Our indicators can be found in our Sustainable Forest Management Framework Document Coillte's Forests: A Vital Resource. Although the Helsinki C&I is a very useful tool for demonstrating progress towards SFM, it is not associated with any independent processes that verify that timber is being produced from sustainably managed forests.
www.coillte.ie

In order for forestry to become truly sustainable it is hoped that new standards will lead to significant changes in policy and practice. Recommended changes include a planting target of 1:1 ratio of broadleaved to conifer species, an increased mix of species in forest plantations, greater structural and spatial diversity, greater use of local Irish seed, active management to protect relict broadleaf woodlands, more education to develop broadleaved tree management skills and encouragement of local involvement at all levels of operation. In addressing these vital changes we can look forward to a better and brighter future for Irish forests.

A 5.3 Liquid Bio fuels

Some products of agriculture can be used as biofuels. The products concerned are:

Rape Seed

The cold pressed rape seed oil presents the energetically and environmentally best alternative to fossil diesel with a strongly positive energy and CO_2 balance. The use of rape seed oil for transport can substitute the agricultural industry's own fuel consumption. Rape seed can be used pure, or refined into biodiesel.

Rape-seed production has always been small in Ireland. In the early 90s it was about 6000 ha, and it has now fallen to little than 2000 ha. Until recently, all oil-seed rape was exported to the UK for oil extraction.

Beet, Wheat, Potatoes

Plants as beet and wheat can be used to produce bioethanol, which is a substitute to petrol.
In Ireland, the beet area has been falling slowly, under the influence of a static sugar quota and increasing sugar yields. The potato area has been falling more rapidly, due to a static ware market, a reduction of losses. But some of the land currently used as grassland has the potential to be converted to arable use.

Report: Liquid biofuels strategy study for Ireland, 2004, SEI
Link: www.sei.ie

A 5.4 Anaerobic Digestion

Anaerobic digestion (AD) is the bacterial fermentation of organic material. This produces biogas which is typically made up of 65% methane and 35% carbon dioxide with traces of nitrogen, sulphur compounds, volatile organic compounds and ammonia. This biogas can be combusted directly in modified gas boilers or can be used to run an internal combustion engine. The calorific value of this biogas is typically 17 to 25 MJ/m^3. Typically, between 40% and 60% of the organic matter present is converted to biogas. The remainder consists of an odour free residue with appearance similar to peat which has some value as a soil conditioner and also, with some systems, a liquid residue which has potential as a fertiliser.

Technologies for anaerobic digestion of sewage sludge, industrial sludges and waste water are fully commercialised, they need no further RTD support and are not covered in this information. Anaerobic digestion of animal manure and organic wastes are still under development and are treated in detail here. The EU energy potential of sludges is given as 20,000 GWh/year (EU7) which is equivalent to 2500 MW/y. In comparison to the figures for agricultural and MSW feedstocks this is about 20% of the total potential. However, the treatment of sewage sludge by AD is likely to see a greater immediate increase in EU countries compared to other feedstocks due to the banning of sea dumping of this waste.

All anaerobic digesters consist of the following basic components: feedstock storage and handling system, digestion tank, gas and residue recovery systems. The digestion tank requires a mixing system which can either be mechanical or achieved by bubbling the biogas through the organic slurry. The digester can be either above or below ground level and should be insulated. In Northern Europe the digester would be fitted with internal heat exchangers to maintain temperatures close to the optimum for the bacteria which produce the methane. For a farm digester of the mesophilic type this is 30C to 35C. Centralised anaerobic digestion plants (CAD plants) can be mesophilic or thermophilic (about 55C). Thermophilic systems offer several advantages, including higher methane production, faster throughput, better pathogen and virus 'kill' and the prospect of compost production to a consistent standard. However, thermophilic systems are more expensive and require greater levels of control.

The digesters operate mainly as plug flow systems with fresh material being fed into the mixed batch which is allowed to spill out into the overflow. A recent development has been to adapt digesters for higher dry matter wastes such as farmyard manure with substantial quantities of straw. These produce a high yield of fibre in the digested material which can be processed further by composting to produce a high grade soil conditioner for horticulture and for local authority landscaping in towns and cities. Compost sales can improve the profitability of the enterprise.

The technology of anaerobic digestion is now well developed and a range of digesters from 70m^3 capacity to 5,000m^3 are commercially available. The size and type depends on the manufacturer and the quantity and type of the material to be digested. Smaller digesters tend to use the biogas for heat production whereas larger units can generate up to about 2 MW of electricity.

AD technology has been developed by industry and government. In most EU countries some form of government assistance has been necessary to enable the construction of demonstration plant.

Example: small scale centralised anaerobic digestion plant in Ballytobin

A 5.5 Energy consumption on Farms

Energy efficiency can be applied to farms, whatever the type of farm. The following points factors can reduce energy consumption on farms.

Low or no-cost ways of improving energy efficiency in farms:

- Good Housekeeping

- Electricity

Tips for domestic electricity saving can be applied to farms : use natural light wherever possible; replace the light bulbs in your most frequently used lights with energy-efficient compact fluorescent bulbs; use ‘Energy Star’ computers and equipment with shut-down times and sleep modes.
And other tips are more specific to farms: when replacing a motor, choose the most energy efficient model, not the cheapest; use electric motors that are the right size for the application.

- Dairy Farming

Water heating uses the most electricity in a dairy shed. To reduce the energy consumption due to water heating, it is possible to:

  - Insulate the hot water cylinder with a wrap and insulate pipes near the cylinder.
  - Use correctly sized hot water cylinders.
  - Turn off the water heater by installing a timer.
  - Use cold water for wash-downs once per day. The other washes need to be at 80oC to achieve adequate sanitation.
  - Use plate coolers to pre-cool milk before it enters the vat.

- Heat Recovery Unit

Retrofitting a heat exchanger into the refrigeration unit is a good investment in a farm and the pay back period is really short. The heat recovery unit can take water from the farm supply and use it to heat both the plant hot water cylinder and CIP vat wash tank. With the heat recovery unit installed the daily average electricity usage reduces consequently.

- Irrigation

Energy can be saved if gravity supply is used where possible. When it is not possible, it is important to correctly match the pump to the system requirements, rather than throttling a system with a gate valve; monitor and track water use and demand with a meter, use a soil moisture sensor or a professional service to schedule the irrigation applications.
Other tips:

  - Irrigate little and often – do not irrigate below the active root zone.
  - Where appropriate, use mulching and/or shelter belts to conserve applied water.
  - Ensure pumps are regularly maintained and any leaks repaired promptly.

- Greenhouses

The majority of energy use in a greenhouse is for heating.
Make the most of ‘free’ solar heating by keeping glass clean. Dirty glass reduces daylight getting into the greenhouse, reducing the amount of light reaching the plants and the amount of ‘free’ solar heating. Regular cleaning will ensure that both plant growth and energy efficiency are optimised.
Double skin plastic construction is more energy efficient than traditional glass.
Sealing greenhouses properly can reduce heating costs by up to 25%.

- Diesel

Different actions can be done, like: Regularly service and tune all farm vehicles and machinery; Correctly ballast the tractor to optimise wheel slip; Use minimum tillage techniques; Select most appropriate gear for the job by "gear up – throttle back".