Organic farming and the environment

This information sheet outlines how organic farming can deliver environmental benefits

1. Climate Change

Organic farming offers the potential to reduce the UK's emissions of agricultural greenhouse gases (carbon dioxide, nitrous oxide and methane) and their annual external costs, currently estimated at over £1 billion (Pretty *et al* , 2000). Organic farming additionally offers the highly significant potential to counter climate change through the development of the soil as a major carbon sink.

- **Carbon dioxide** - numerous studies have shown that CO2 emissions from organic farming are in general 15-30% lower per hectare than conventional systems. This is mainly because organic farmers do not use inorganic N fertilisers.
- **Soil carbon bank** – Soil contains about twice as much carbon as the atmosphere. The use of inorganic fertilisers and higher production levels in agriculture may have caused a large loss in organic matter from the UK's soils. Organic farming involves maintaining and increasing soil organic matter levels through various means. It has been estimated that if soils are developed as a CO2 bank, they could absorb 15 years worth of emissions from fossil fuels (Rattan Lal, Ohio State University).
- **Nitrous oxide** and **methane** – Agriculture produces half the UK's emissions of nitrous oxide. It is mainly emitted from manures and soils; methane is emitted by ruminant animals. There is little quantitative data on the production of these gases by organic farming. Organic farms may emit less per hectare because the livestock densities are lower (c.25% less) and inorganic N fertilisers are not used. However, methane emissions may be higher per unit of output, because more animals are needed for the same yield and emissions are thought to be increased by a forage-based diet (grass, silage or hay) rather than a grain based diet.
- **Energy use** – DEFRA and European research has shown that organic farming is more energy efficient per hectare and per unit of food produced. This is because of the non-use of N fertilisers, a major indirect use of energy in non-organic farming.

2. Air Quality

Air contamination from agriculture is mainly from pesticide sprays and ammonia volatisation (NH3). Organic farming should address both of these:

- **Pesticide sprays** - synthetic pesticides sprays are not used
- **Ammonia** - Agriculture accounts for about 80% of UK ammonia emissions, which causes nutrient enrichment and acidification of soils. Emissions should be lower because of the non-use of N fertilisers and because manure from organic farms often has a lower concentration of nitrogen. Composting can release relatively high levels depending on its composition, but it reduces the amount released when manures are spread. Straw bedding minimises odour. Organic farms do not involve high concentrations of animals in a small space and there must be sufficient land to spread manure (170kgN/ha is the maximum allowed). Local odours should therefore be much less of a problem.

3. Waste
British agriculture produces about 500,000t of waste annually. Waste is generally lower in organic farming since the system relies less on external inputs, is less intensive, and avoids the routine use of agro-chemicals and veterinary medicines. Agro-chemical, veterinary medicine and animal feed containers should all be reduced. The DEFRA manual, "Opportunities for saving money by reducing waste on your farm" encourages all farmers to consider organic farming.

4. Water Resources
The higher soil organic matter that results from organic farming increases water retention and reduces run-off, reducing the need for irrigation. Anecdotal evidence supports the significance of the effect (farmers report a reduced risk of drought).

5. Water Quality and Managing Fisheries
Water pollution is a major problem in agriculture. Nitrates in groundwater often exceed the standard for drinking water; 20% of groundwater sites sampled exceeded drinking water standards for pesticides in 1998, three quarters of lake SSSIs are affected by eutrophication; agriculture is a major source of bacterial contamination; 80% of the UK's ammonia emissions come from animal manures and urine which contributes to acidification and eutrophication; agriculture causes 17-28% of major pollution incidents (last three years); and sedimentation is a problem for fisheries. The total external costs of water contamination by agriculture are about £220 million annually. Organic farming offers the means to reduce all of these problems considerably and cost-effectively, for both diffuse and major pollution incidents. Wessex Water, for example, is providing financial incentives for conversion to organic farming, as it this works out cheaper than investing in cleaning equipment.

- **Nutrient leaching** - Inorganic N fertiliser, used for plant nutrition in conventional systems is the most mobile form of nitrogen: thus in conventional systems about 20% of the nitrogen applied is lost. In organic systems inorganic N and P fertiliser are prohibited and nutrient inputs are through organic matter, where two-thirds of the N is in an organic form which is chemically more stable. The biological life in the soil, bacteria and fungi, feed on the organic matter and fix nutrients from the air, and it is they which mainly provide the nutrients to the plants. Bacteria and fungi are the least leachable form of N. Leaching is also reduced by the fact that organic systems are more extensive (stocking densities for all livestock are restricted to 170kgN/ha, which means that densities are c.25% less in the UK), and all organic farmers must have adequate manure storage capacity. Many practices in organic systems increase the organic content of the soil, including humus levels, which means that water retention is increased and leaching and run-off reduced. This is supported by research: in all published calculations in Europe, the N,P,K surpluses of organic farms were significantly lower than conventional farms. ADAS research has shown that leaching from UK organic farms is equivalent to non-organic farms that meet the requirements of Nitrate Vulnerable Zones.
- **Pesticide contamination** – organic farming eliminates the risk of ground and surface water pollution from synthetic pesticides. This is of importance for drinking water and also fisheries (eg. for eliminating Persistent Organic Pollutants and endocrine disrupting chemicals), as well as for reducing the major cost of water clean up.
- **Sediment run-off** and **bacterial leaching–** as organic farming increases the level of soil organic matter, sediment run-off and bacterial leaching should both reduce.

6. Flood defence
Organic farming offers a major strategic opportunity for avoiding and reduce future flood damage in agricultural areas: very important for adapting to climate change:

Reducing the risk of flooding – the higher levels of organic matter in soils on organic farms, mean better water retention and drainage, and thus extremes of run-off and flooding are reduced. Anecdotal evidence indicates the effect is significant.

7. Conserving the land
DEFRA has calculated that up to 2.3 million tonnes of soil is lost every year in agriculture. With c. 6% of the soil in England and Wales now at high to very high risk of erosion, and much more land vulnerable to significant off-farm effects, organic farming is of immense importance to the UK's soil protection objectives.

Soil protection – Soil erosion is caused by the loss of organic matter and exposure. The mode of plant nutrition is highly pertinent here and is completely different in conventional and organic/natural agricultural systems. In intensive, arable systems, the possibilities for soil protection are inherently limited since soil organic matter does not play a major role and because the use of inorganic fertilisers and pesticides, which replaces the dependency on organic matter, actually inhibits soil life and thus the development of a healthy soil structure. In contrast, organic farming developed out of a realisation of the central role of the soil in natural plant nutrition and also an early concern over soil erosion. As in nature, organic farming is therefore based on the use of organic matter in the soil as the plant's nutrient source, with the nutrients supplied *by the soil life* , especially via fungal mycorrhiza, as opposed to via free mineral N/P/K. As a side effect of this, the soil life binds the particles, improving soil structure which means better water retention, better water drainage and also reduced compaction susceptibility. In other words, excellent soil protection is part and parcel of organic farming and the main objective of many of its practices, such as manure composting, crop rotation, as well as the non use of inorganic agro-chemicals. Additionally, because of its more extensive nature and the fact that organic farming encourages mixed sheep and cattle rearing, which is better for vegetation, organic farming avoids the damaging effects of over grazing. Research has confirmed the higher levels of soil life and organic matter and the reduced erosion potential of organic farms.

8. Conserving Biodiversity
Agriculture is the main land use on about 74% of the UK's land area. Although traditional farming methods created unique habitats and increased the UK's total biodiversity, recent developments have reversed this situation in a matter of decades and most farmland biodiversity is now in a state of crisis. Conservationists have identified the main agricultural practices that have caused these declines and, uniquely, organic farming addresses all of these:

- **Loss of mixed farming**: nearly all organic farms are mixed.
- **Specialisation**: organic farms use a much greater variety of crops and livestock because of their closed systems and use of crop rotation
- **Intensification**: organic systems are more extensive
- **Use of pesticides and herbicides**: these are avoided on organic systems, and replaced by ecological solutions such as the use of natural predators.
- **Loss of non cropped habitats**: organic farmers aim to maintain populations of natural predators at optimum levels and with good access to the crop, which means more non cropped areas such as hedgerows and smaller fields.
- **Autumn sowing**: organic farms retain a higher level of spring sowing
- **Nitrogen enrichment of the soil**: organic systems are reliant on nutrient supply from the organic matter in the soil, supplied via the soil life (eg. direct into plant roots via mycorrhiza), rather than on free nitrogen in the soil.

Organic farming addresses these concerns because it involves using natural processes including biodiversity for agronomic ends, rather than seeking to fight nature. Among its practices are many traditional approaches (for this reason alone, it is not surprisingly that it supports much higher levels of biodiversity). Many comparative studies have now proven that organic farms supports much higher wildlife levels than conventional farms, both of abundance and diversity. This includes those plant and animal groups that are known to have significantly declined in recent years:

- **Plants:** many once common arable flowering plants are now rare or dramatically declining, and

include some of Britain's most seriously endangered plants. A Danish study found five times as many wild plants and over 50% more species on the organic fields. A UK study found twice as many threatened wild arable species.

- **Invertebrates:** the number of insect and spider species associated with farmland has more than halved since the 1950s. A Danish study found that organic fields had about 60% more of those arthropods that comprise bird food. A UK study found up to five times as many spiders and up to twice as many spider species.
- **Butterflies:** almost half of the 44 species of butterfly breeding in lowland grassland are in decline. A UK study found that organic farms support twice as many butterflies as non organic farms.
- **Farmland birds:** these have declined by an average of 30% since 1970; skylarks have declined by 60%. A BTO study of 22 organic and 22 conventional farms found 40% more birds on the organic farms; another study found over twice as many skylarks.

It is sometimes suggested that integrated or other non organic farming methods could achieve similar results. However, these do not address many key practices such as mixed farming and the non use of herbicides, and, certain individual species apart, the research findings do not support this claim. The Government has now set ambitious targets for biodiversity, in particular to reverse the decline in farmland birds by 2020 and implement over 400 Biodiversity Action Plans. These individually designed plans have been costed at £1 billion. Organic farming, however, offers an integrated and cost effective certain means of reversing these declines, and should be the most long-term and certain solution.

1. Environmental and resources use impacts of organic farming in Europe, 1999, Stolze, Piorr, Haring and Dabbert. A review of European national literature on the effects of organic farming on different aspects of the environment.
2. The effect of organic farming systems on aspects of the environment, 1995, Unwon, Bell, Sheperd, Webb, Keatinge and Bailey. A study prepared by ADAS.
3. An assessment of the total external costs of UK agriculture, 2000, Pretty, Brett, Gee, Hine, Mason, Morison, Raven, Rayment and van der Bilj.
4. The Biodiversity Benefits of Organic Farming, 2000, Soil Association.
5. Agriculture and the Environment – An Impact Statement prepared by the Environment Agency (draft), 2000, The Environment Agency.

Further Reading

Please see the Soil Association website library, http://www.soilassociation.org/library, for more information

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Version082.4 Approved: