Elm Farm Research Centre
For Organic Principles & Best Practice

THE ENVIRONMENTAL BENEFITS OF ORGANIC FARMING

A DEFRA Project. The full report can be viewed at
http://www.defra.gov.uk/science/project_data/DocumentLibrary/OF0405/OF0405_909_TRP.doc

This is the Executive Summary of the DEFRA-funded project, OF0405, by authors Mark Shepherd, Dr Bruce Pearce, Bill Cormack, Lois Philipps, Steve Cuttle, Anne Bhogal, Peter Costigan & Roger Unwin.

There is currently considerable interest in organic farming as a method to deliver environmental goods. This review was therefore undertaken to assess the likely benefits to the wider environment from organic practices. On the basis of the published scientific evidence, we have concluded the following:

Biodiversity: Comparative reviews of the evidence base have been conducted for MAFF, English Nature, The European Commission and the Soil Association. The general conclusion is that, on average, there is a positive benefit to wildlife conservation on organic farms. In most studies, organic agriculture provides a conservation benefit, whereas there are few studies where a disbenefit is shown. While some of the practices that favour biodiversity are used on some conventional farms, it is only generally on organic farms where most of the relevant management is routinely and systematically carried out. Both organic and conventional farms will perform better when under agri-environmental schemes.

Soil quality: There are few UK studies on the relative benefits of organic or conventional systems for soil quality. However, such studies as have been done, and those from other countries, tend to show benefits for organic systems. Organic farmers pay particular attention to their soils, and it is a fundamental tenet of organic farming to operate a sound rotational system to "feed the soil" to maintain organic matter content and to keep it in good condition. However, organic matter additions are also made in conventional agriculture and, in some situations, the return may be similar or greater than in organic systems. Soil structure can benefit from regular returns of organic matter, and the evidence is that soil structure is at least as good under organic practices. Earthworm numbers tend to be greater in organic systems and studies into the microbial response of soils to organic management indicate there are benefits in many but not all situations and not always in all the attributes measured. The low concentration of soluble nutrients, the absence of most pesticides and reduced use of veterinary medicines such as antibiotics and ivermectins can be also expected to benefit soil organisms.

Nitrate in water: Many organic systems operate at a lower level of nitrogen intensity than conventional systems, with nitrogen inputs from fixation by legumes, or from importation of animal feed onto the farm. Variation in leaching losses from individual fields is large both in organic and conventional agriculture. Organic farming adopts many of the practices that should decrease losses: maximising periods of green cover, use of straw-based manure, lower stocking densities. The body of evidence suggests that leaching losses are generally less from organic systems - though this is not always guaranteed. It might also be argued that this differential would decline as conventional fertiliser practices improve under the increasing regulatory pressure. Losses after ploughing the fertility building leys is one area of organic farming where losses can be especially large.

Phosphorus in water: The main loss pathway for phosphorus is by movement of soil particles. Leaching is a smaller and more site-limited effect. There are some additional "incidental" losses

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following the application of fertilisers or manure. There is no direct evidence of differences in phosphorus losses between organic and conventional agriculture.

Pesticide pollution to water (and air): Pesticide use in organic farming is very restricted. A small number of pesticides are approved for organic use (principally copper, sulphur, natural pyrethroids, and derris), and they are only used as a last resort. The pyrethroids, copper and derris are only permitted for use in protected cropping or for a restricted range of horticultural crops. With the exception of sulphur, on certain top fruit crops and pyrethroid sheep dip (which can be used in the same way on both organic and conventional farms), the use of the restricted range of pesticides is very limited by comparison with conventional agriculture. In particular, organic farmers do not use herbicides, some of which (such as isoproturon) have presented particular water pollution problems. Pesticide pollution from organic farming will be far less common than pesticide pollution from conventional agriculture. These differences are likely to hold whether assessed per area, or per unit of food produced.

Human Pathogens: Pathogenic organisms from livestock can contaminate surface waters used for drinking, bathing or irrigation. There is no reliable information on any differences in the incidence of zoonoses between organic and conventional farms that use manure, although there is on-going research. Studies have shown that composting manure and treating slurry, as encouraged under organic standards, decrease the survival of any pathogenic organisms but stacking or long-term storage can also be beneficial. The methods of handling manure between farming systems may not be sufficiently different to produce a consistent effect and, therefore, information on the incidence of organisms is needed before any conclusions can be drawn.

Ammonia: Ammonia is mainly lost from the surface of manure, either from animal buildings or hardstandings, which are soiled by manure, or during storage and handling. Manure produced in organic systems often has a lower concentration of nitrogen than does conventionally produced manure. Organic systems encourage the composting of manure, which leads to a relatively high loss of ammonia, although this will reduce the amount emitted when the compost is subsequently spread. Given the constraints on housing and stocking rate it is not possible to have organically certified intensive pig and poultry units, which are a major source of ammonia from conventional systems. Organic pigs and poultry are likely to have similar losses to conventional outdoor units at the same stocking densities. It seems likely that on balance there is little difference between organic and conventional systems in the amount of ammonia which is lost from the system per unit of yield, but it is likely that emissions are lower per unit area. Given that nitrogen is more valuable to organic systems than it is to conventional systems (which can purchase nitrogen fertiliser at about 30p per kg), there should be a greater incentive for organic farmers to control ammonia losses in the future.

Nitrous oxide: Nitrous oxide is emitted from manure and from soils. Emission tends to occur intermittently when there is a combination of the appropriate conditions. Within conventional agriculture, the main risks arise from manure and from the waterlogging of soils by heavy rainfall following fertiliser application. Within organic farming the risks are likely to come from manure and from waterlogging of soils where there is a legume crop. In the absence of direct measurement, it is not possible to assess whether there is any difference in risk from organic or conventional production.

Methane: About 75% of methane on farms is emitted directly from ruminant animals (chiefly cattle and sheep). There have been no direct comparisons of methane generation between organic and conventional production. Different types of fodder will generate different amounts of methane, with higher rates released from diets that are high in roughage relative to diets high in starch. This will tend to result in higher emissions from organic systems, as organic diets tend to be high in roughage and low in concentrates. Methane emission per unit of livestock product decreases as the intensity of animal production increases (two cows producing 5,000 litres of milk will generate more methane than one cow producing 10,000 litres). On average, production intensity is lower in organic than conventional

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systems, so methane generation from organic sheep and cattle farms is likely to be greater per unit of food produced. Because of the lower stocking densities, it may be similar or less on an area basis.

Carbon dioxide: Net emissions of carbon dioxide from agriculture depend upon use of fossil fuel and the amount of carbon sequestration in soil organic matter. Emission from fossil fuel use will be lower on a per unit area and a per unit of yield basis, reflecting the greater energy efficiency of organic agriculture noted below. There is insufficient evidence on whether there is a significant difference in the amounts of carbon sequestered in soils.

Energy efficiency: The literature supports the statement that organic methods generally use less energy per unit area and per unit of output, both for individual crops and livestock types, and overall on a whole-farm basis. However, the setting of system boundaries, methods of calculating the energy values of inputs and methods of calculating energy use efficiencies vary substantially between studies. The intensity of production in the conventional comparison, particularly in relation to the level of use of mineral nitrogen fertiliser, also had a large impact on the relative performance of organic methods in comparative studies. This makes comparisons across studies difficult; there is a need for an agreed standard methodology. Information is lacking for non-ruminant livestock.

Nutrient balance and use: Comparisons of nutrient budgets suggests that the balances can vary widely within a farming system. However, the general conclusion is that organic systems operate smaller nutrient surpluses. This is taken as an advantage, providing that nutrient reserves are not being depleted. Prohibition of various fertiliser additions is on the basis of encouraging self-sufficiency in a system and/or concern about damaging the soil ecosystem. However, evidence for the latter is largely anecdotal and there is a need to continually review the lists of allowed and disallowed products to ensure that choices are environmentally sound.

Controlled wastes: Waste is generally lower in organic farming since the system relies less on external inputs. Packaging materials for agrochemicals, veterinary medicine, animal feed, and fertilisers should all be lower on organic holdings. There is also little need for disposal of pesticide washings on organic systems.

The general conclusion from our review concurs with other reports that organic farming can deliver positive environmental benefits. However, some of the benefits, particularly of lower levels of gaseous emissions, decrease or are lost if comparisons are made on the basis of unit production rather than area. It should be noted that the differences depend on the farming system, with fewer benefits likely to accrue from converting extensive upland production, compared with converting intensive lowland systems.

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