Final Draft

The Relationship between Biodiversity and Organic Agriculture

Defining Appropriate Policies and Approaches for Sustainable Agriculture

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Executive summary

The 2000 IUCN *Red List* of threatened species highlights habitat loss as the main threat to biodiversity, with agricultural activities affecting 70 per cent of all threatened bird species and 49 per cent of all plant species (Hilton-Taylor, 2000). However, despite agriculture being responsible for such well-documented losses in biodiversity, it can conversely also provide a major tool for biodiversity conservation if appropriate policies and approaches, which combine agricultural production and biodiversity conservation, can be defined and implemented.

More than half of the EU's total land area is used for agricultural production, which over the centuries has produced an impressive diversity of landscapes. The importance of maintaining the biodiversity associated with these agricultural areas is a high priority for the conservation of nature in Europe as a whole. However, these traditional farming methods are now increasingly being superseded by more intensive agricultural systems. The challenge, therefore, is to develop a system of agriculture that will produce food in a sustainable and economically viable manner in a way that enhances biodiversity rather than depletes it.

Within Europe there has recently been a realignment of agricultural policy towards more environmentally sustainable systems – notably through the agri-environment programmes of the EC. Within this policy framework, organic agriculture has played a central role in many countries' national agri-environment policies, alongside other components such as systems of management agreements for biodiversity conservation. The main reason for this policy support has been the perceived positive environmental effects of organic agriculture.

This paper explores the scientific evidence for these benefits to biological and landscape diversity and examines a series of examples of projects and policies that are encouraging the dual aims of biodiversity conservation and organic agriculture within Europe. Whilst the case studies and research overviews highlight the positive effects of organic farming on diversity, it also becomes clear that organic farming systems are not always automatically sympathetic to biodiversity conservation. The paper thus concludes with a series of recommendations outlining how the right policy and economic environment, along with the most suitable production systems, can maximise the biodiversity benefits of organic agriculture.

Recommendations

Ensuring that the joint aims of organic agricultural and biodiversity conservation are met and expanded will require changes at many levels, from policy to education and training; actions that could bring about this change include:

1. Increased research into organic management regimes that influence (in both positive and negative ways) biodiversity.

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2. Increased monitoring of biodiversity to develop understanding about the interactions between biodiversity and organic farming and subsequent development of policies that maximise benefits to biodiversity.

3. Provision of compensatory mechanisms for loss of production caused by changes in farming practice to optimise biodiversity (i.e. combinations of organic farming with management agreements under agri-environmental schemes, grants and development of value-added marketing, loans).

4. Increased provision and funding for agricultural education, training and advisory services that provide information on developing organic farming systems to meet biodiversity conservation goals.

5. Continued and intensified dialogue between nature conservation organisations and institutions and the organic movement, to enhance understanding of the goals of biodiversity conservation and organic agricultural systems.

6. Development of specific guidelines within the IFOAM basic standards that emphasise biodiversity conservation and landscape preservation, and promotion of these to standard setting bodies in Europe and beyond. (Such standards should be developed in close co-operation with standard setting bodies in Europe that have already developed conservation standards or requirements and also with a wide range of conservation organisations). (Appendix 2 summarises some of the key contributions organic farming make to biodiversity that have been highlighted in research.)

7. Following from point 6, the development and introduction of biodiversity conservation standards into the production guidelines for organic farming legislated by the EC.

8. Targeted policies developed to encourage the uptake of organic agriculture in areas of high conservation priority (i.e. areas with species-rich meadows, areas associated with high numbers of threatened species, protected areas and buffer zones).

9. Integration of organic farming methods that are beneficial to biodiversity (see Appendix 2) into regional landscape planning tools and projects.

Table of contents

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Section 1:
The relationship between biodiversity and organic agriculture

1.1 The changing relationship between biodiversity and agriculture

Natural vegetation in Europe has been greatly modified as a result of agricultural activities (EEA, 1995). Today Europe has a mosaic landscape made up of various cultural uses and, particularly in countries with high populations, few large areas of 'wilderness'. Much of the biodiversity in these 'cultural landscapes' has been influenced, and to some extent maintained, by traditional forms of agriculture (Baldock *et al*, 1993). However, over the last century agriculture has moved from being an integral part of the cultural landscape to being a less benign influence from a biodiversity perspective, typically imposing a single agricultural model onto a wide range of ecosystems. Increases in productivity have been gained at the price of many ecosystem values. From creating or maintaining a system that encourages a proportion of the natural biodiversity, agriculture has, at its most extreme, become a system that aims to produce one or two species, a monoculture, whilst managing (i.e. trying to eliminate) everything else. Economic demands have also led to agricultural abandonment in areas where production is considered less economically viable.

As a result, agriculture and the landscape within which it operates have, in many cases, become alienated – to the detriment of biodiversity and the agricultural landscape. In the UK, for example, agricultural changes since 1945 have resulted in the loss of 95 per cent of flower-rich meadows, 30-50 per cent of ancient lowland woods, 50-60 per cent of lowland heathlands, 192,000 kilometres of hedgerows and over 50 per cent of lowland fens, valley, and basin mires (Ratcliff, 1984). As agricultural production has intensified there has also been a decline in those species traditionally associated with agricultural land. For example, a survey by BirdLife International found that farmland habitats account for nearly 60 per cent of bird species of European Conservation Concern (Tucker and Heath, 1994). In Germany, an analysis of the Red List of extinct, missing and endangered wild plants showed that agriculture was responsible for the decline of 513 out of 711 the species that were evaluated (Korneck and Sukopp, 1988). Agriculture has also been identified second only to felling as most frequently recorded threat to globally threatened tree species (Oldfield *et al*, 1998). Thus, the intensification of farming systems in many areas has both modified traditional cultural landscapes and reduced species diversity.

Biodiversity is also disappearing *within* agriculture. For example, the imported US apple variety Golden Delicious accounts for 71 per cent of France's apple production (Vellve, 1993), effectively eliminating many traditional varieties in the process. Within the EC, this erosion of diversity in crops has become 'legally obligatory' with the introduction of a *'EC Common Catalogue'* (EC, 1982).

Until recently, attempts to address this decline in agricultural biodiversity have focused on reducing land under agriculture and indeed agricultural intensification has been seen as one way of *reducing* impacts by allowing more space for protected areas. It is now acknowledged that this strategy has been unsuccessful. An alternative strategy, which involves a move towards enhancing biodiversity in agriculture through organic (sustainable) farming methods and the conservation of semi-natural habitats, has however begun.

1.2 Why the organic agriculture systems needs diversity

Organic farming is a system of agriculture that relies largely on locally available resources and is dependent upon maintaining ecological balances and developing biological processes to their optimum. These systems take local soil fertility as a key to successful production. Wild species perform a variety of ecological services within organic agriculture: for example pollinators, natural enemies of pests and soil micro-organisms are all key components in agro-ecosystems. Thus, higher levels of biodiversity can strengthen some farming systems and practices. Organic systems dramatically reduce external inputs by refraining from the use of synthetic chemical fertilisers, pesticides and pharmaceuticals. Instead, systems are designed to manage nature in order to determine agricultural yields and disease resistance. By respecting the natural capacity of plants, animals and the landscape, organic agriculture aims to optimise quality in all aspects of agriculture and the environment.

Organic agriculture is thus committed to the conservation of biodiversity within agricultural systems, both from a philosophical perspective and from the practical viewpoint of maintaining productivity. Biological pest control on organic farms, for example, relies on maintaining healthy populations of pest predators. By using a system of crop rotation, in time (over several years rotations) or in space (through intercropping or growing several crops in the same season in different fields), the build up of harmful pests and diseases can be reduced and biodiversity increased, although with respect to grassland ecosystems it must be stressed that periodic ploughing is harmful to grassland vegetation, a reason grassland areas should, if possible, be kept as permanent grassland. One of the most important elements in conversion to organic systems has proved to be the time needed to restore a natural ecological balance with respect to pest-predator populations (Lampkin, 1990).

Organic agriculture also encourages variety. Reduced reliance on agrochemicals to control changes in soil conditions means that the plants must themselves be better adapted to local conditions. Organic systems thus encourage the expansion of varieties grown, and the preservation of older, locally bred varieties and breeds.

The importance of biodiversity as part of a well-balanced organic system is enshrined within the operating standards that have been developed worldwide for organic farming (see Appendix 1). Further to the basic standards for organic agriculture developed by IFOAM and the individual standards developed regionally and nationally, some organic farming organisations have identified further specific conservation aims which organic producers have to meet. For example, in Sweden, organic farmers producing to the standards developed by KRAV must have a biodiversity management plan for their farm (Mattsson and Kvarnbäch, 2000).

Section 2:
The diversity of agro-ecosystems and the positive impact that organic agriculture can have on biodiversity and the rural landscape

2.1 Protecting and enhancing biodiversity

- **The diversity of agro-ecosystems**

Biological diversity (or biodiversity) can be measured on three levels: genetic diversity, species diversity and ecosystem diversity. Agricultural biodiversity, or agro-biodiversity, is a vital sub-set of biodiversity. According to the Conference of the Parties to the Convention on Biological Diversity:

> Agricultural biodiversity is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agro-ecosystem: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes. Components of agricultural biodiversity that provide ecological services …. include a diverse range of organisms in agricultural production systems that contribute, at various scales to, *inter alia*:
> (i) Nutrient cycling, decomposition of organic matter and maintenance of soil fertility;
> (ii) Pest and disease regulation;
> (iii) Pollination;
> (iv) Maintenance and enhancement of local wildlife and habitats in their landscape;
> (v) Maintenance of the hydrological cycle;
> (vi) Erosion control; and
> (vii) Climate regulation and carbon sequestration (CBD/COP, 2000).

The interactions between farming and biodiversity are complex. At the regional level, the type of agriculture (i.e. intensive arable crops, dairy farming) and the area which is cultivated (i.e. mountain pastures, grasslands) are the main determinants. At a landscape level, patterns of field-size, land cover and types of field boundaries all effect biodiversity. At the farm level, land use management (e.g. crop succession and rotations) is a key factor. At the field level, different farming practices determine habitat quality and associated biodiversity. At each level, different ecological processes affect species distribution.

In the following sections the relationship between organic agriculture and biodiversity and the rural landscape, are discussed broadly at each of the three levels at which agro-biodiversity can be assessed.

- Genetic diversity: The variety and variability of animals, plants and micro-organisms that are used or related to food production and agriculture.
- Species diversity: The diversity of species that support production (soil biota, pollinators, predators, etc.) and the species diversity in non-productive but associated landscapes.
- Ecosystem diversity: The diversity of the agro-ecosystems and its role in the landscape (Hoffmann, 2000).

- **Genetic Diversity**

Whereas agriculture was once at the centre of preserving and encouraging genetic diversity, today the adoption of high-yielding, uniform cultivars and, in the EU, regulation of approved varieties has led to a considerable reduction in the number of genetically viable species used in agriculture. Internationally, concern for this rapid loss of genetic resources led to the establishment of the International Board for Plant Genetic Resources (IBPGR), which co-ordinates a global network of gene banks (Altieri and Merrick, 1988). Within the EU funds provided under the Agri-environment programme are being made available for the cultivation of threatened species. For the first time in decades, agricultural diversity is receiving, albeit limited, encouragement. However, a new threat to genetic diversity, and biodiversity in general, is the possible effects of the release of genetically engineered organisms into the environment (Soil Association, 1999).

Plant breeding has been concentrated in recent years on producing varieties that grow well in farming systems reliant on chemical inputs. Organic producers, on the other hand, are looking for varieties that are suited to their local climatic and soil conditions and are not susceptible to disease and pest attack. Research has shown that in general these characteristics are more likely to be found in the older native cultivars. For example, conventional wheat grown in an organic system will have reduced protein content, whereas the selection of a variety suitable for the particular growing conditions will provide higher protein, and thus higher baking quality wheat to be grown (Woese *et al*, 1997). Research has also indicated that yields and disease resistance are better in native cultivars as opposed to modern varieties for vegetables (tomato, cucumber and melon) grown in an organic system (Jani and Hallidri, 2000). Similar experiences have been found with native animal breeds, many of which are now considered endangered. As with native plant varieties, rare animal breeds are particularly appropriate for organic systems in part due to their suitability to local conditions (see, for example, Wanke, 2000).

Box 1: An Italian Case Study – the 'Zolfino' Bean

Zolfino, a bean variety grown in the Pratomagno area of Tuscany, has benefited from EU agri-environment funds aimed at increasing cultivation of threatened species. The bean, which has a thin peel and dense pulp, is ideal for some typical regional recipes and is grown on marginal hilly and mountainous land, where it is cultivated in terraces, often alongside other crops such as olives.

A low yield (from 1,000 to 2,500 kg/Ha), limited storage capacity and poor response to technical inputs resulted in the bean being on the verge of extinction in the 1970s. However, initiatives aimed at encouraging organic agriculture and adding value to local gastronomic production, have raised both the demand and the price of the crop and its processed products, thus raising farmers' interest. Over a twenty year period production has increased from 2,000 to 20,000 kg/ha, and the price from 1,500 to 15,000 ITL/kg. The majority of the production is distributed to local markets, with only about 10 per cent of the crop being sold to restaurants in Rome.

The conservation project for the *zolfino* bean aims is being carried out by the *Associazione Fagiolo Zolfino del Pratomagno* (*Association for the Zolfino Bean of Pratomagno*), which aims to:
- improve organic production techniques in order to increase productivity;
- develop the use of machinery in some stages of production;
- characterise the genetic diversity of the product; and
- improve conservation techniques.

(adapted from Marino and Catarci, 2000)

- **Species diversity**

Long-term research projects have accumulated substantial evidence that organic systems are beneficial to biodiversity. Many studies of both botanical composition and animal species present on farms confirm these findings (see box 3 and Stolze *et al,* 2000 and ADAS, 1998). These benefits have been recognised by organisations concerned with the conservation of individual species or habitats, which are increasingly turning to organic management regimes on farmed areas. In the UK, for example, the Royal Society for the Protection of Birds is introducing organic systems to the farmed area of its reserves as is the National Trust (Everett, 1999 and National Trust, 2000).

Organic farms are also more likely to have higher agro-biodiversity with greater crop rotation diversity, number of cultivated crops and grassland composition (Stolze *et al*, 2000). For example, a study of 110 farms in Switzerland determined that organic and integrated farms grew an average of 10.2 crops as opposed to 7.4 in conventional farms (Hausheer *et al*, 1998). Organic systems can also play a role in the ecological restoration of landscapes, such as the species rich meadows of central Europe. In Switzerland, for example, two currently endangered plant communities, *Arrhenateretum* and *Mesobrometum*, have been re-established by researchers on formerly intensively used farmlands (Bosshard, 2000).

Box 2: Biodiversity on lowland organic farms

An overview of research findings from 23 European research projects concluded that organically farmed areas had a much higher level of biodiversity than conventionally farmed areas. A summary of the results found that organic farms had:

	Abundance	Diversity
Plants	Five times as much biomass of wild plants in arable fields, including more rare and declining arable plants	On arable fields, 57 per cent more wild plant species, two times as many rare or declining wild plant species and several rare species found only on organic farms
Invertebrates	1.6 times as many of the arthropods that comprise bird food; about three times as many non pest butterflies and one to five times as many spiders in the crop area	One to two times as many spider species in cereal fields
Birds	25 per cent more birds at the field edge, 44 per cent more in-field in autumn/winter, 2.2 times as many breeding skylarks and on average more breeding yellowhammers.	

The study also concluded that:

– Distribution of the biodiversity benefits: though the field boundaries had the highest levels of wildlife, the highest increases were found in the cropped areas of the fields.
– Quality of the habitats: both the field boundary and crop habitats were more favourable on the organic farms. The field boundaries had more trees, larger hedges and no spray drift; the crops were sparser, with no herbicides, allowing more weeds; there was also more grassland and a greater variety of crop types.
– Organic farming was identified as having many beneficial practices, reversing the trends in conventional farming that have caused the decline in biodiversity: crop rotations with grass leys, mixed spring and autumn sowing, more permanent pasture, no use of herbicides or synthetic pesticides and use of green manuring.

(Azeez, 2000).

- **Ecosystem diversity**

An ecosystem is made up of the organisms of a particular habitat, such as a farm or forest, together with the physical landscape in which they live (WRI, 1992). Although little research has been carried out comparing agro-ecosystem diversity in different farming regimes, many of the principals of organic farming are likely to have a positive impact on ecosystem diversity (Stolze *et al*, 2000). For example, field edges, hedges, lakes and ponds are protected from chemical nutrients and pesticide drift and are thus likely to, and in many cases are encouraged to, provide suitable habitats for biodiversity. Indeed, many of the research projects which have studied the abundance and diversity of individual or groups of species in organic systems attribute higher levels of biodiversity to the more favourable habitats provided by organic farms (Azeez, 2000).

By studying the whole farm, or even the whole landscape within which the farm operates, researchers are trying to find ways to characterise the ecosystems benefits of organic farming. Criteria and indicators for evaluating sustainable rural landscapes have been defined in the EU-concerted action project: '*The nature and landscape production capacity of sustainable/organic types of agriculture*', co-ordinated by the Department of Ecological Agriculture of the Wageningen Agricultural University (Van Mansvelt and Van der Lubbe, 1999). At a farm scale, attempts have been made by several organic and conservation bodies to improve the range of habitats and thus diversity of organic farms (see section 3.4). Whilst, in some areas conservationists have worked with organic farmers to re-introduction grazing animals, generally native traditional breeds, to maintain threatened landscapes, such as grasslands, heathlands, moorland and mixed pasture/woodland habitats (Read, 1999).

The introduction of organic agriculture in the management of areas that have been specifically set aside for the protection of biodiversity provides one of the clearest examples of the relationship between organic systems and agro-ecosystem diversity.

Protected areas as defined by the World Commission on Protected Areas are areas *especially dedicated to the protection and maintenance of biological diversity*. However, protected areas are not always strict nature reserves. Instead, they can fulfil many functions *alongside* biodiversity conservation. As a result, people living in and around protected areas are being encouraged to, and in some cases rewarded for, maintaining lifestyles that minimise environmental damage and help to enhance natural biodiversity. IUCN The World Conservation Union has identified a globally recognised system of categories that defines the management activities of the various forms of protected areas worldwide (IUCN, 1994). Organic agriculture has the potential to offer an important agricultural management option in several of these protected area categories, although an increased emphasis on ecological and landscape preservation may necessitate modifications to organic systems.

The structure of many protected areas and regional parks in Europe clearly shows the centuries old relationship between agriculture and the natural environment. In particular, this relationship is characterised by the large number of protected landscapes at higher elevations that have for centuries been grazed, but are now slowly being abandoned to the detriment of the species-rich pastures/meadows that have developed. The conversion to organic agriculture in much of Europe has been dominated by the conversion of upland farms, a trend that is also being applied by protected area managers who are increasingly turning to organic agriculture systems to preserve mountain areas (Ulãák *et al,* 2000, Spampinato, 2000 and Leibl, 2000).

A secondary and closely connected link between ecosystem diversity, protected area management and organic farming is in the buffer zones (the region near the border of a protected area). Buffer zones are by their nature areas where land management aims to help maintain the integrity of the ecosystem of the core protected area. Where agriculture is a dominant land-use in buffer zones, the detrimental effects of farming systems can be reduced by conversion to organic systems. In Bulgaria, for example, studies of earthworm (Lumbricidae), insect (i.e. Coccinellidae and Chrysopidae) and bird species on organic and conventional farms in the buffer zones of protected areas found a higher diversity and abundance of species in the organic farms. Some species of Lumbricidae were, for example, found in the organic fields and in the protected areas but not in the fields farmed conventionally (Paraskevov *et al*, 2000).

The use of organic farming in protected buffer zones has been explored most thoroughly in the MesoAmerican Biological Corridor, a projected complex of protected areas and sustainable management stretching over seven countries and involving over a hundred NGOs and over a thousand communities. The initiative envisages a range of sustainable land uses within the buffer zones and linking areas, including certified forest management and organic agriculture, perhaps with an additional label to show that the products come from the biological corridor (Salas, 2000).

Section 3:
Overview of existing research data and case studies

3.1 Making the case: Research into the links between biodiversity and organic farming

- **Floral diversity**

Due to the great diversity of flora, comprehensive research into the extent and range of threats being faced by plants is still in it infancy. However, research carried out to date indicates that as with other major groups floral diversity is under threat. In the USA, for example, research by The Nature Conservancy found that one third of the country's 15,300 native flowering species are threatened with extinction (Hilton-Taylor, 2000).

The increasing use of herbicides in agricultural production has had an inevitable effect on the diversity of arable flora in Europe. It would therefore stand to reason that floral diversity would benefit from a system that does not allow the use of chemical herbicides.

Grassland fungi are particularly good indicator species for determining levels of biodiversity. Factors that inhibit grassland fungi include plant growth unchecked by grazing, the application of synthetic fertiliser, slurry, solid manure and synthetic pesticides and soil disturbances, i.e. through ploughing or cultivating. From these factors it might be expected that there would be a greater variety of grassland fungi on organic than on conventional farms. The Norwegian Centre for Ecological Agriculture (Norsøk) carried out research on organic farms in Norway on the occurrence of grassland fungi species such as waxcaps (for example, *Hygrocybe* spp.) and earth tongues (for example, *Geoglossum* spp.). Field-work was carried out on 16 organic farms, recording the quantity and quality (the degree of threat) of species. On half of the organic farms researchers found grassland fungi that are on at least one European red list (list of threatened species), with seven of those having at least one species on the Norwegian or Scandinavian red lists. The grassland fungi were found in areas with the positive conditions noted above and no grassland fungi were found in grasslands ploughed up less than 28 years ago (Jordal and Gaarder, 1995 reported by Wynen, 1996).

In Greece, floral species diversity and biomass were found to be higher in organic vineyards and olive-groves when compared with conventional systems (Kalburtji *et al*, 2000). A two-year study comparing the diversity and abundance of plant species on neighbouring organic and conventional farms in England, found that the organic farms supported a substantially greater number of rare and declining arable plant species. Out of 21 'target' species present, eleven were found only on the organic farm and eight were found on both but were more common on the organic farm. The species found only on the organic farm included four included on the UK Biodiversity Action Plan: red hemp-nettle (*Galeopsis angustifolia*), corn buttercup (*Ranunculus arvensis*), corn gromwell (*Lithospermum arvense*) and narrow fruited cornsalad (*Valerianella coronata*). At the field and crop margins of the organic farm, the diversity of threatened species was twice that of the conventional fields (Azeez, 2000).

Although studies such as these provide evidence that organic production can increase floral diversity, the effects of different management and production techniques can have as much influence as production method. For example, German research on about 100 organic grassland sites showed that floral diversity decreased significantly as productivity increased, due to higher proportions of white clover (Wachendorf and Taube, 1996). Similarly, applying organic fertilisers can reduce the number of herbs and incorrect organic fertilising strategies can have further negative effects on biodiversity (Svensson and Ingelög, 1990). Thus some of the observed benefits of organic farming may be more influenced by the fact that the farms involved are traditional and have undergone less of the changes associated with other farms than on the organic production systems itself. More research regarding the tolerance of grassland ecosystems towards different management practices like manuring, is desirable.

- **Faunal diversity**

Invertebrate diversity

The physical, chemical and biological characteristics of the soil are greatly influenced by soil fauna (Coleman and Crossley, 1995). There have been several research projects on the effects of organic and conventional farming on the abundance and diversity of the most important soil faunal taxa (Pfiffner, 2000). Comparative research has concentrated on two invertebrate groups, arthropods and earthworms – both of which are widely distributed and often play a key role in agro-ecosystems.

In arable crops, beneficial arthropods play an important role in the regulation of various pests (Luff, 1983; Nyffeler and Benz, 1987). In addition, certain arthropods, especially carabids, are considered indicators of habitat quality (Matthey *et al.*, 1990; Steinborn and Heydemann, 1990). Investigations of on-farm sites as well as in trial plots have found a higher faunal diversity and abundance in organic systems compared with conventional farming systems. This is most pronounced for arthropods that are known to be beneficial in agro-ecosystems (e.g. carabids, staphylinids, coccinellids, bugs, spiders and chilopods), whilst only a few taxa have been found to be more abundant in conventional sites (staphylinids and nematocera). The arthropod populations in organically cultivated fields are characterised not only by a higher diversity and abundance, but also generally by a more even species distribution (Pfiffner and Niggli, 1996).

Box 3: Effect of different farming practices on beneficial arthropods

Treatment	Effects
Tillage	– spring tillage is more favourable than autumn (overwintering) – minimal tillage is more favourable than traditional – heavy machinery can lead to soil compaction (reduction of larvae) – reduced abundance of hunting spiders, carabids and staphylinids
Fertiliser	– high input enhances disease and certain pests species – organic manures favourable for microarthropods as food resource of macroarthropods – less dense stands enhance xero-/thermophilous species – high doses of inorganic fertilisers seem to be harmful
Crop rotation	– multi-cropping is more favourable than monocroping – grass-clover leys allow ‘regeneration’ of soil animals
Pesticides	– effectiveness and susceptibility of pesticides are species specific – the effects of insecticides depend on application time and reproduction cycle. Spiders and carabids are particularly vulnerable during mating and reproduction – reduction of prey and/or their contamination can lead to lower fecundity of predators – biocontrol has the lowest impact on non-target organisms, herbicides are mostly less harmful (but there are indirect effects on flora diversity with a decrease of ‘prey items’)
(Adapted from Pfiffner, 2000)	

The reasons for higher arthropod diversity and abundance in the organic fields are mainly related to organic plant protection management, low input organic fertilisation, more diversified crop rotations and more structured landscapes with semi-natural habitats and field margins (Pfiffner, 2000). The quality and amount of food is also a key factor in the survival of arthropod populations, thus higher weed diversity and abundance in organic fields provides a more suitable habitat (Frieben and Köpke, 1994). Indeed, research carried out in tomato plots on the effects of weed control on surface-dwelling arthropod species (ground beetles, ants and spiders) found the abundance of species clearly influenced by weed biomass. Species numbers were lowest where mulching with rye straw was controlling the weeds. However, removing weeds within 20 cm of each plant reduced weed biomass but retained higher arthropod populations than in the plots treated with herbicide or mulch (Yardim and Edwards, 2000).

Earthworms are good bio-indicators of soil fertility. Due to their biology, earthworm populations can indicate the structural, microclimatic, nutritive and toxic situation in soils (Christensen, 1988). Populations of earthworms are also strongly influenced by different cultural practices, such as soil tillage, use of pesticides, fertilisation and crop rotations (crop residues). Studies on the effects of organic and conventional farming systems on earthworms are numerous. Generally, organically managed soils exhibit a higher biomass, abundance and number of earthworm species compared to conventionally managed plots or farms (Pfiffner, 2000).

Researchers have found greater diversity and abundance of many other invertebrate species in organic farming systems (Stoltze *et al*, 2000). For example, an English study comparing spider communities in organic and conventional winter wheat fields found the abundance and diversity of spiders greater on the organic fields. Researchers concluded that the abundance and diversity of the spiders was directly effected by the increased levels of understorey vegetation (i.e. broad-leaved and grass species) in the organic fields (Feber *et al,* 1998, reported in Azeez, 2000). The same researchers also studied the levels of pest and non-pest butterflies in southern England (Feber *et al*, 1997). Significantly more non-pest butterflies were recorded on organic farms than conventional farms, there was however no significant difference in the abundance of pest species. The difference in non-pest species was around three times greater in the organic cropped areas. Cropping patterns effected species diversity. Pest species were particularly attracted to oilseed rape and linseed crops, cereal crops attracted similar numbers of pest and non-pest species and grass leys attracted more non-pest species. No oilseed rape or linseed was recorded on organic farms, but grass leys six times higher than on the conventional farms.

Avifauna diversity

A review of the conservation status of all European birds carried out by BirdLife International identified 195 (38 per cent of European avifauna) Species of European Conservation Concern (SPECs). Most declines in populations were linked to changes in land-use, with agricultural intensification being the commonest threat, affecting some 42 per cent of SPECs (Tucker and Heath, 1994).

The greater abundance and frequency of invertebrate species on organic farms has a direct relation with the number and diversity of bird species – as does the availability of plant food sources. A two-year comparative research project in Denmark studied the availability of invertebrate and plant food sources for birds on arable land (Hald and Reddersen, 1990). The biomass of wild plants was found to be five times higher in organic as opposed to the herbicide treated cereal fields and arthropod species were also more numerous. The organic fields had 57 per cent more plant species (130 compared with 83 species) and also contained several rare species (reported in Azeez, 2000).

The skylark *(Alauda arvensis)* has been the subject of several research projects as it is a ground-breeding bird whose breeding success depends on the management of legume-grass crops and has thus been badly effected by changes in farming systems and is declining over much of its range. In the UK, the British Trust for Ornithology studied the breeding and over-wintering patterns of birds on 22 paired organic and conventional farms. The breeding densities of skylark were significantly higher on organic farms (BTO, 1995). Bird densities of all species studied were also higher on organic farms, as were invertebrate and food sources (Chamberlain *et al*, 1996). In Germany, researchers found higher percentages of skylarks and other ground-breeding birds on legume-grass crops in the Schorfheide-Chorin biosphere reserve in the state of Brandenburg (Saacke and Fuchs, 1998). Further research on a biodynamic farm within the reserve showed that *set-aside strips* in the fields appeared to have a number of positive effects on ground-breeding birds in general. For species such as the Whinchat (*Saxicola rubetra)* and Yellow Wagtail (*Motacilla flava*) they provided potential nest and food habitats as well as song and rest sites; for ground-breeding birds they provided shelter from agricultural operations and predators and for arthropods important retreat areas where present after cutting (Stein-Bachinger *et al*, 2000).

A three-year study in Denmark concentrated on the non-crop habitats, such as hedgerows, of conventional and organic farms and their effects on bird populations (Brae *et al*, 1988). The abundance of birds was 2 – 2.7 times greater on the organic farms. In total, 24 species where more prevalent on organic as opposed to conventional farms, of these 11 species had declined in number in Denmark since 1976 (reported in Azeez, 2000).

3.2 Providing support: Policy incentives and mechanisms for the conservation of biodiversity in organic farming

In the last twenty years there has been a gradual move towards the creation of policies and mechanisms aimed at encouraging and exploiting the links between organic agriculture and biodiversity conservation, both at a governmental and non-governmental level.

The objectives defined for the Common Agricultural Policy (CAP) in the Treaty of Rome (Article 39) make no reference to the environment. Since the mid-1980s, however, environmental concerns have become more prominent within the policy. In 1993, the European Union (EU) approved the Fifth Environmental Action Programme, 'Towards Sustainability', which later led to the adoption of the EC-Biodiversity Strategy in 1998 by the European Commission. The Strategy considers the conservation and sustainable use of biodiversity and defines a two step approach to implementation through policy development and implementation of action plans in six sectors – one of which is agriculture. The *Biodiversity Action Plan for Agriculture* published in spring 2001, makes consistent mention of organic agriculture as a means of promoting farming methods which enhance biodiversity and calls for an increase in the share of farmers practising organic farming (EC, 2001).

The impetus for these initiatives comes from the Convention on Biological Diversity (CBD), the international agreement stemming from the Earth Summit held in Rio de Janeiro in June 1992 (Chapter 15 of Agenda 21). The European Union ratified the CBD in December 1993, thus becoming a contracting party to the CBD. The EC-Agricultural Action Plan on Biodiversity, for example, is part of the European Community's activities to fulfil its commitments under the CBD, through the European Community Biodiversity Strategy (Hoffmann, 2000).

Probably the most notable realignment of the CAP towards more environmentally sustainable systems has been through the introduction of the agri-environment programmes. The implementation of targeted agri-environmental measures over the whole of the EU constituting the core of the Community's environmental strategy. To date, agri-environment measures are being applied to 20 per cent of the agricultural land in the EU. Agri-environment programmes allow for agricultural land to be used in ways that are compatible with the protection and improvement of the environment. The scheme offers payments to farmers who, on a voluntary and contractual basis, undertake an environmental service for a 5 year period. Payments, which are based on the costs incurred and income lost, are made for measures that go beyond the application of usual good agricultural practices (EC, 2001). So far, organic agriculture has played a central role in many countries national agri-environment policy. The main reason for this policy support has been the perceived positive environmental effects of organic agriculture (Stolze *et al*, 2000). In 1997, for instance, EU expenditure on organic farming through agri-environment programmes was 261 million ECU, just over 10 per cent of the total EU agri-environment budget (Lampkin *et al,* 1999). In Belgium, Denmark, Greece and Italy, over 20 per cent of the total expenditure of their agri-environment budget is on organic farming (Stolze *et al,* 2000). One drawback of the scheme is that it lacks precise objectives, targets or indicators of performance. Production that conforms to organic standards, particularly if these standards where developed to meet more stringent biodiversity strategies, could provide the basis for filling this lack of outcome monitoring, whilst the agri-environment payments could provide the mechanism for increased attention to biodiversity conservation on organic farms.

Political support for organic farming also exists in Central and Eastern European countries, who when consulted by the Institute for European Environmental Policy in 1999 on their priorities for rural policy, nominated the following objectives (Petersen, 1999):

- support for the farming population in marginal areas;
- ensuring the management of semi-natural grassland habitats;
- introducing sustainable land use practices, in particular organic farming; and
- providing environmental education and training for farmers.

'Agenda 2000', adopted in 1999, includes a proposal for the reform of the CAP and a framework for the CAP until 2006, which provides the structure for the better integration of environmental and agricultural policy (Hoffmann, 2000). The further development of the Agri-Environment Programme and the Biodiversity Action Plan for Agriculture, are key instruments in this reform, which could further develop the links between the CAP and biodiversity conservation in Europe.

Box 4: International NGO's support of organic farming

Policies encouraging the further development of biodiversity considerations into organic farming practices have also been developed by National and International NGOs. Conservation organisations, such as BirdLife International and Greenpeace are supportive of organic initiatives.

In 1999, a joint workshop in Vignola, Italy (organised by IUCN **–** The World Conservation Union and IFOAM with the World Wide Fund for Nature (WWF) European Policy Office and AIAB, the Italian organic organisation) was held to exchange ideas and information and draw up a joint action plan for both the conservation and organic movements. The resulting Vignola Declaration begins by stating that: '*IUCN should inform its members about the value of organic agriculture for biodiversity, encourage all conservationists to consume organically grown products, and expand its project activities linking organic agriculture with biodiversity – working in partnership with IFOAM members wherever possible – and include these issues into policy considerations within IUCN'* (Stolton *et al*, 2000). A series of follow-up collaborations is also being undertaken.

3.3 Taking action: Examples of organic agriculture in Europe's protected areas

One area where the interactions between organic agriculture and biodiversity conservation have been most thoroughly explored is within some of Europe's protected areas. The case studies presented below provide a brief look into several initiatives that are providing working examples of how organic farming and biodiversity conservation can work together to achieve a variety of biodiversity and landscape preservation goals.

- **Promoting organic farming in the regional parks of Emilia Romagna, Italy**

The Associazione Italiana Agricoltura Biologica (AIAB) project 'Organic Agriculture and Agroecology in Regional Parks' has been working with the regional park authorities in the Emilia Romagna region to promote organic agriculture in relation to the regional agri-environment programme. The project has been successful in:

- modifying local farmers' attitudes towards organic farming – by showing them that their extensive traditional practices are close to organic methods and thus gaining their participation in agri-environment programmes;
- contributing to easing conflicts between local farmers and regional parks – where instead of the protected area being seen as an imposed set of extra obligations, the park is seen as a vehicle for providing better access to opportunities offered by the regional agri-environment programme;
- growing awareness and competence in regional parks authorities towards the possibilities of organic agriculture and agro-ecology;
- functioning as an initiator of actions and projects in different regional parks linked to organic agriculture and agro-ecology, such as training courses and extension services for local farmers, seminars, workshops, farm demonstrations, inclusion of organic farming in environmental education programmes, certification programmes for wild products and financial support mechanisms developed by regional parks for farmers and processors; and
- providing for co-operation between 'old' and 'new' organic farmers.

During the first two years of activity funds of 45,000 Euro contributed significantly to an increase in the rate of adoption of the regional agri-environment programme, particularly of organic agriculture, by farmers in the park and the buffer zone. Between 1996 and 1997, 113 farms in the area applied for organic certification, compared with only 73 between 1994 and 1996.

(Adapted from Compagnoni, 2000)

- **Strategies for managing a new network of protected areas in Brandenburg, Germany**

A rapid development programme has seen the establishment of 15 protected areas, 1 national park, 3 biosphere reserves and 11 nature parks in Brandenburg in Northeast Germany since 1990. The main reason for the programme was the relatively intact, rich biodiversity of the area, which still harboured many endangered species, in particular those dependent on low-input, diversified landuse. As part of this development, the parks administration has developed a number of projects with respect to organic agriculture, including:

- stabilising and increasing the number and area of organic farms in protected areas;
- improving the market for organically grown products; and
- developing and testing adaptive management methods for buffer zone agriculture that conserve both the natural wildlife and ecology.

Currently more than 15 per cent of the three biosphere reserves are managed organically. Nationwide under two per cent of the agricultural landscape is farmed organically, in Brandenburg this level is double, with about 50 per cent of the organic farms being situated within the parks. Other activities in the parks concern rural development, agro-tourism and marketing of local products. These activities are helping improve the employment situation and stabilise rural networks in an area experiencing difficult industrial and social change. For example, there are on average 2.5 times more workers on the organic farms than on conventional farms.

(Adapted from Voegel, 2000)

- **Re-introducing grazing to the meadows of the White Carpathian Mountains, Czech Republic**

The Carpathian mountains are valued for their species rich habitats, which have been created over centuries by extensive farming systems which use meadows for hay-making in June and July and provide grazing in the Autumn. However, in recent years the number of farm animals has decreased dramatically and grazing has ceased. Although grass cutting has been carried out by volunteers for nature conservation purposes, this provides only basic maintenance as the absence of grazing, natural seeding of trees and bushes and a slow increase in nitrogen in the soil is resulting in changes in species composition.

In 1997, The Czech Union of Nature Conservationists launched the project 'Sheep grazing as a tool for nature and landscape conservation in Southern Walachia'. A herd of Romney sheep was introduced to permanently graze the pastures. The herd is kept by two organic farmers and the funds to purchase the sheep were raised locally as part of a community supported agriculture scheme (the participants receive three lambs and one sheep over a six year period). Local benefits from the project have included temporary employment opportunities as shepherds and closer farmer-consumer relationships. All production is sold locally and a local carpet factory uses the wool.

The project has been monitoring the species composition of the grazed meadows since 1999. The results show that carefully managed organic grazing systems can contribute to the survival of the typical species-rich meadow agro-ecosystems of the region.

(Adapted from Ulãák *et al,* 2000)

- **Pilot project for developing organic agriculture in the Regional Parks of Tuscany, Italy**

The main goal of this project is to provide extension services to farmers in organic agriculture in the parks and buffer zones of Parco delle Alpi Apuane, Parco della Maremma, Parco di Migliarino and San Rossore Massaciuccoli in Tuscany. The objective is the development of organic agriculture and livestock, resulting in the conversion to organic agriculture of 30 per cent of the farms within the park administration and of 20 per cent of the farms in the total area. The project has a three-year budget of 340,861.5 Euro.

The promotion of organic agriculture is seen as a way of maintaining the agro-ecosystems of the parks. The type of agriculture in these areas is often characterised by extensive methods, an ageing farming population and in some cases the abandonment of agricultural activity. The initial focus for the project was the farms in the buffer zones of the park. In order to encourage conversion, extension services have been developed, which include:

– visits to organic farms and interviews with organic farmers;
– completion of questionnaires concerning technical and legislative aspects;
– the organisation of workshops and meetings for local entrepreneurs interested in activities within the park;
– provision of specific technical support by homeopathic veterinary services for livestock farming; and
– the development of demonstration plots.

Technical support is concentrated on the conservation and maintenance of soil fertility, selection of species and varieties for crop rotation, animal husbandry and techniques for organic livestock production. Finally assistance is provided for the identification of marketing channels, creation of direct points of sale within the parks and the development of systems to manage the income from sales, to promote the marketing of organic products from the park and the identification of a quality label.

During the first 20 months of activity 27 per cent of farms in Parco della Maremma and 27 per cent of farms in the wider area of Maremma converted to organic production, as well as, 4 per cent of the farms in Parco di Migliarino and 8.5 per cent of the farms in the wider area of Migliarino.

(Adapted from Migliorini, 2000)

3.4: <u>Planning for change</u>: Conservation planning in organic agriculture

Several organic organisations in Europe are already taking positive steps to incorporate biodiversity conservation planning into their standards and organic certification schemes. The case studies below show the willingness of organic farmers and their standard setting organisations to undertake stewardship of their land, for production, biodiversity conservation and landscape preservation.

- **Organic Conservation Guidelines in the UK**

Organic farmers in Britain have been shown to have a highly positive attitude toward conservation management (Stopes *et al*, 2000a). The Soil Association (the largest certifying body in Britain) pioneered the development of specific conservation and environmental protection standards in the 1980's (Soil Association, 1990). This was welcomed by the conservation agencies. However, it was recognised that:

- the full potential value of these standards might not always be realised in practice;
- some aspects of organic production might conflict with conservation and environmental objectives; and
- the understanding of farmland ecology has progressed, providing new insights into the relationship between farming practices and protection of the environment.

In view of this, a comprehensive review of the Soil Association Organic Conservation Standards was initiated in 1998. The review involved the active participation of the major UK environmental and conservation organisations. Final recommendations included five key action points:

- further research and development of organic whole farm conservation planning and the application of organic systems for the maintenance and restoration of lowland and upland grasslands;
- training and information for producers on the interpretation, implementation and potential costs of conservation standards;
- the development of advisory services on conservation and environmental protection for organic producers;
- the integration of organic farming standards and other agri-environment incentive schemes; and
- the harmonisation of agricultural conservation standards between all organic sector and government bodies.

(Adapted from Stopes *et al*, 2000)

- **Planning for biodivesity in Sweden**

In Sweden, a working group made up of organic farmers groups, nature conservationists, government agencies and universities have been working together since 1997 to strengthen the links between organic agriculture and biodiversity conservation. The main objectives have been:

- to help organic agriculture develop in such a way that it enhances biodiversity;
- to start co-operation and dialogue between the nature conservation and organic agricultural movements; and
- to spread knowledge about biodiversity in organic agriculture.

Initially the group concentrated on information exchange on the different parties main areas of concerns, i.e. nature conservation and organic agriculture, and to discuss different standpoints. From there, the discussions developed into a planning exercise leading to proposals for changes to the country's main organic standard (KRAV), to require all organic farmers to have a plan for the management of biodiversity on their farms from 2001. The group has clearly identified that it is crucial not to force the farmer to work with biodiversity, instead they should be made more aware and interested in the subject with increased information and advice. The group is now working on producing educational material on biodiversity in organic agriculture and is arranging courses for agricultural advisors and consultants on the subject.

(Adapted from Mattsson and Kvarnbäch, 2000)

- **Evaluating the ecological benefit of farms in Germany**

In 1997, the Naturschutzbund Deutschland (NABU) – Germany's largest nature conservation NGO, began a campaign for more sustainable agriculture. A working group was established of farmers and nature specialists in Baden-Württemberg to discuss proposals for agriculture and agro-policy. It became clear that one of the central tasks in relation to nature conservation was to find a means to measure the biodiversity and ecological benefit of a farm, as it was often not known which measures were the most suitable to develop on the farm. The idea thus evolved to develop a *Nature Balance Scheme* from which it would be possible to obtain an overview and survey of agro-biodiversity.

The scheme that was subsequently developed aims to:

- produce a general view/survey of the biodiversity and ecological suitability of the farm;
- develop awareness and training for ecological values/biodiversity;
- provide a positive presentation of biodiversity;
- improve direct marketing of organic produce; and
- undertake of ecological improvements.

The Nature Balance Scheme is divided into four main sectors. There are two sections concerning biodiversity – one is related to structural richness and the other to species richness of the farm. The two further sections are concerned with the management of the farm. All the data is collated on to a one sheet ecological profile. Each of the four sections contributes to a percentage of the overall evaluation, which is measured on a scale of 100 points.

(Adapted from Oppermann, 2000).

Section 4:
Conclusions and recommendations: How organic agriculture can further its contribution to biodiversity

4.1 Conclusions

The sections above show that there is considerable research and a wide range of initiatives that confirm the contribution organic agriculture can make to biodiversity conservation. The accumulated evidence is now strong enough to encourage organic farmers and organisations to ensure biodiversity conservation is at the heart of the organic system. These findings are corroborated by desk studies and modelling exercises (see Box 5). It is also, however, clear that these positive contributions to conservation do not necessarily guarantee the protection of individual threatened or endangered species, particularly where the agricultural policy climate stresses the economic necessity of land use intensity.

Conversion to organic farming can thus be seen as a first step towards a modern system of agriculture that not only produces crops but also increases biodiversity. However, to emphasise the benefits to biodiversity conservation, organic agriculture itself needs to develop policies and approaches that maximise the diversity and suitability of farm habitats. Standards and directives (e.g. to have at least five per cent natural habitats for wildlife on each farm) can be one vehicle in this direction. Another can be to identify and act upon a number changes to farming practice, support and policy areas to ensure that these interactions between farming and conservation are achieved.

As discussed above the term biodiversity comprises ecosystem diversity, as well as the diversity of species. As ecosystem diversity is a pre-condition for species diversity, organic farms systems should first and foremost develop habitats – within farms and as part of the wider landscape – which realise their potential for biodiversity conservation. Thus organic farming *in combination* with management strategies aimed at biodiversity conservation can play an important role in a sustainable enhancement of biodiversity. Organic farming could become a regional tool for landscape protection and improvement, contributing to agro-ecosystem conservation and to the maintenance, enhancement and management of the landscape (Mansvelt and Lubbe, 1999).

Box 5: Modelling change

Scientists in Denmark have modelled the consequences of a large-scale conversion to organic agriculture on biodiversity and the landscape. Four scenarios (in which farms covering 25 per cent of the area are assumed to convert to organic agriculture) were created to describe and evaluate the effects of changes in crop pattern, crop management and farm characteristics following conversion, on nitrogen loss, farmland birds and living conditions for other fauna groups. The area covered was 2000ha of agricultural land on sandy/loamy soils and farming systems included dairy, stockless, pig and mixed farms. The main findings were:

- nitrogen leaching decreased in all four conversions;
- acreage with no tillage, undersown crops and organic manure increased, improving conditions for soil fauna;
- above ground fauna was favoured by an increase in spring sown crops, due to the potential of increased weed diversity;
- crop diversity was unchanged; and
- skylark species responded to both changes in crop combinations and agricultural operations.

(Langer *et al*, 2000)

4.2 Recommendations

Ensuring that the joint aims of organic agricultural and biodiversity conservation are met and expanded will require changes at many levels, from policy to education and training; actions that could bring about this change include:

1. Increased research into organic management regimes that influence (in both positive and negative ways) biodiversity.

2. Increased monitoring of biodiversity to develop understanding about the interactions between biodiversity and organic farming and subsequent development of policies that maximise benefits to biodiversity.

3. Provision of compensatory mechanisms for loss of production caused by changes in farming practice to optimise biodiversity (i.e. combinations of organic farming with management agreements under agri-environmental schemes, grants and development of value-added marketing, loans).

4. Increased provision and funding for agricultural education, training and advisory services that provide information on developing organic farming systems to meet biodiversity conservation goals.

5. Continued and intensified dialogue between nature conservation organisations and institutions and the organic movement, to enhance understanding of the goals of biodiversity conservation and organic agricultural systems.

6. Development of specific guidelines within the IFOAM basic standards that emphasise biodiversity conservation and landscape preservation, and promotion of these to standard setting bodies in Europe and beyond. (Such standards should be developed in close co-operation with standard setting bodies in Europe that have already developed conservation standards or requirements and also with a wide range of conservation organisations). (Appendix 2 summarises some of the key contributions organic farming make to biodiversity that have been highlighted in research.)

7. Following from point 6, the development and introduction of biodiversity conservation standards into the production guidelines for organic farming legislated by the EC.

8. Targeted policies developed to encourage the uptake of organic agriculture in areas of high conservation priority (i.e. areas with species-rich meadows, areas associated with high numbers of threatened species, protected areas and buffer zones).

9. Integration of organic farming methods that are beneficial to biodiversity (see Appendix 2) into regional landscape planning tools and projects.

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Appendix 1
Principals of Organic Farming

The International Federation of Organic Agriculture Movements (IFOAM) has developed *Basic Standards* for organic agriculture that have provided a framework for almost all the national regulations and for the international WHO/FAO *Codex Alimentarius* on organic agriculture (IFOAM, 1996).

The principal aims of organic agriculture, which are summarised in the *IFOAM Basic Standards for Organic Agriculture and Food Processing,* are:

- to produce food of high nutritional quality in sufficient quantity;
- to interact in a constructive and life enhancing way with all natural systems and cycles;
- to encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals;
- to maintain and increase long-term fertility of soils;
- to use, as far as possible, renewable resources in locally organised agricultural systems;
- to work, as far as possible, within a closed system with regard to organic matter and nutrient elements;
- to work, as far as possible, with materials and substances which can be reused or recycled, either on the farm or elsewhere;
- to give all livestock life conditions which allow them to perform the basic aspects of their innate behaviour;
- to minimise all forms of pollution that may result from agricultural practice;
- to maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats;
- to allow agricultural producers a life according to the UN human rights, to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment; and
- to consider the wider social and ecological impact of the farming system.

Reflecting increased interest in an internationally agreed definition, the FAO/*WHO Codex Alimentarius* Commission adopted 'Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods' in June 1999.

The definitions states that organic agriculture refers to: a holistic production management system which promote and enhance agroecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, cultural, biological and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system.

The Codex Guidelines further specify that an organic production system is designed to:
- enhance biological diversity within the whole system;
- increase soil biological activity;
- maintain long-term soil fertility;
- recycle wastes of plant and animal origin in order to return nutrients to the land, thus minimising the use of non-renewable resources;
- rely on renewable resources in locally organised agricultural systems;
- promote the healthy use of soil, water and air as well as minimise all forms of pollution thereto that may result from agricultural practices;
- handle agricultural products with emphasis on careful processing methods in order to maintain the organic integrity and vital qualities of the product at all stages; and
- become established on any existing farm through a period of conversion, the appropriate length of which is determined by site-specific factors such as the history of the land, and type of crops and livestock to be produced.

European Union Council Regulation 2092/91 sets standards and regulations for the production and labelling of organic products within the EU. The Regulation defines principles of organic production at the farm level, materials that are authorised for use, inspection requirements, and requirements for processed food. Under the Regulation, each EU member country has established a national system for inspection and certification, conducted by public or private bodies, or both.

Appendix 2 **Positive contributions organic agriculture can make to contribute to biodiversity conservation**	
Organic agriculture's contribution	**Biodiversity benefits**
Farming systems	
Emphasis in organic standards on the need to preserve biological relationships and natural processes	Acknowledges value of biodiversity
Certified farming method	The aim of biodiversity conservation can be regularly monitored by outside assessors
Inclusion in standards of requirement to have farm conservation/biodiversity protection plans, which for instance maps a farms biodiversity habitats and cultural features and evaluates there effectiveness (and hopefully areas for improvement)	Ensures maintenance and improvement of biodiversity and biodiversity habitats, and provides records of biodiversity sensitive farming actions
Whole farm planning	More diverse habitats and ability to plan for biodiversity conservation as well as agricultural production
No chemical pesticides, herbicides or fertilisers	Greater diversity and species abundance
Emphasis on soil health, i.e. higher soil biomass	Greater diversity and species abundance
Closed nutrient cycle	Soil conservation and increased biodiversity
Mixed/diversified farming systems	Increased food sources, higher agro-biodiversity and diverse habitats
Fertilisation methods which benefit biodiversity, i.e. use of nitrogen fixing crops	Greater agro-biodiversity and food sources
Organic fertiliser storage (i.e. ensuring minimal leaching) and use (i.e. timing of application and use near watercourses) strategies that are sympathetic to biodiversity conservation	Greater diversity and species abundance
Weed control methods that encourage maximum biodiversity, such as more weeds between crop plants and more under-storey vegetation	Greater diversity and species abundance due to habitat creation
Use of crop rotations (including grass/clover leys) to maintain soil fertility and minimise pest and disease and weeds	Greater habitat biodiversity, agro-biodiversity and possibly genetic biodiversity
Pest control, through providing habitats for predators, species that repel pests and alternative host plants for pests	Greater diversity and abundance of species through habitat creation
Choice of plant varieties grown (i.e. avoidance of species linked to low levels of diversity, such as oilseed rape and linseed)	Greater agro-diversity and genetic diversity, including opportunities to farm rare species
Management of cropped land to encourage biodiversity: strategies which can provide biodiversity benefits include lower levels of crop density; stubble left over-winter and spring sown crops; undersowing (sowing a grass or clover ley under cereal crops); Intercropping (growing two or more crops within the same row or in alternate rows), minimising tractor-based operations impacts on ground-nesting birds and limiting negative effects of mechanisation in general	Habitats for biodiversity: greater diversity and abundance of species, greater agro-diversity, better food sources over winter and habitat diversity (i.e. for ground nesting birds)
Meadows and grasslands should be managed to increase biodiversity and maintain cultural landscapes. These areas include permanent pasture, species-rich meadows, unimproved grasslands etc. Suitable management includes attention to species composition (i.e. using local varieties), timing cutting/mowing (i.e. to allow species to set seed and not disturb ground-nesting bids), limiting applications of fertilisers	Increased biodiversity due to suitability of habitat. Greater floral diversity

Farm structure and buildings should be managed (retained, restored or created) in a way that ensures the maintenance of biodiversity benefits (i.e. nest sites for bats and owls) and local cultural customs and landscapes	Maintains and creates habitats for conservation and preserves cultural diversity
More labour-intensive	Can contribute to preserving cultural heritage
Animal production systems	
Concentration on on-farm produced feed	Diversified agricultural production, increasing habitat diversity
Grazing management : Management for biodiversity should include more extensive grazing and higher levels of grassland, careful management of semi-natural habitats (i.e. moorland, heathlands, wetlands etc) to maximise conservation priorities (i.e. avoidance of over-grazing), careful management of stocking levels	Maintenance of species-rich pastures through low livestock densities, and more habitats for biodiversity
Breed choice and breeding	Opportunities to farm rare species and higher genetic variation in stock
Nature conservation	
Provision of farmer training and thus contributing to creating positive farmer attitudes and understanding of biodiversity conservation	Creation of suitable habitats for biodiversity
Encouraging farmers to work with conservation agencies on surveying, recording and managing wildlife	Biodiversity monitoring, planning and maintenance
Farmer advisory services dedicated to on-farm biodiversity conservation	Creation of suitable habitats for biodiversity
Regional landscape planning with integrated farming and biodiversity	Increased landscape diversity
Creating wildlife corridors of linked semi-natural habitats (i.e. linking hedgerows, field margins, verges, woodland areas)	Habitats for biodiversity: refuge and migration areas for species
Management of boundaries to provide wildlife corridors and habitats, including creating set-aside areas and uncultivated strips, less intensive use of boundary areas, careful management of ditch clearance, sensitive hedge management and trimming	Habitats for biodiversity: refuge and migration areas for species
Restoring, maintaining and/or creating woodlands and hedgerows (i.e. as stock boundaries) and ponds and wetland area in a way which is sympathetic to biodiversity conservation. Ensuring management of these areas is in accordance with local customs, ensuring use of native species in restoration and creation	Habitats for biodiversity: refuge and migration areas for species
Identification of areas of high biodiversity and of habitats of species of conservation concern (i.e. Red List species) for special management regimes if necessary	Increased biodiversity and targeted conservation of species of conservation concern
Sources: Bellegem *et al*, 1997; Azeez, 2000; Soil Association, 2000, National Trust, 2000	