# Chapter 3. Sustainability of contemporary agriculture in England

It should be emphasised that, traditionally, agriculture has tended to be more of a creator than a destroyer of environmental wealth and diversity. For example, a large proportion of the most valued habitats and their associated species in England has arisen from agricultural management of the natural environment over a period of hundreds or thousands of years. Much of the biodiversity, landscape and wider environmental resource of soil and water depend for their wellbeing upon the continuation, or resumption of, traditional, low intensity or mixed farming practices. Farming practices of this type have not only been compatible with the conservation of biodiversity and other environmental resources, they have actively moulded their very character.

- **Key components of agricultural environments (agro-ecosystems) in England are:**

  - ❑ Semi-natural 'infield' habitats. These habitats are the product of grazing and, less commonly, of mowing. They include chalk and limestone grassland, neutral grassland, lowland heathland, fen meadows and heather moorland. These habitats are species-rich and this richness depends upon the maintenance of low soil nutrient status. The application even of very low levels of artificial fertiliser leads to loss of species diversity.

  - ❑ Interstitial habitats, including hedgerows, field margins and ponds. Hedgerows and their associated hedge bottom flora represent valuable 'woodland edge' habitats which, in conjunction with appropriate infield habitats, support a wide range of invertebrate, bird and mammal species. Such diversity depends upon appropriate hedgerow and hedge-bottom management (eg cyclical coppicing or layering) in combination with appropriate infield practices (eg retention of wider stubbles). Ponds, ditches and streams support a wide variety of aquatic and emergent flora together with invertebrate, amphibians and mammals. Such diversity depends upon appropriate management, high water quality and appropriate water quality.

  - ❑ Artificial 'infield' habitats, that is cropped habitats, including grass leys. Under traditional management these habitats are valuable for biodiversity in their own right. Traditional ley farming, whereby pasture is established by undersowing spring cereals with a grass/legume mix followed after one to three years by a return to cereals, represents the favoured habitat management for a suite of now declining farmland birds such as corn bunting, skylark and grey partridge.

  - ❑ Species dependent upon mosaic of habitats including the above and small traditionally managed broad-leaved woodland (eg greater horseshoe bat).

  - ❑ Non-agricultural habitats such as open water bodies and river systems whose biodiversity is dependent upon the sustainable use of land in the river catchment and of groundwater resources.

  - ❑ Soils that retain structure, fertility and unpolluted status.

- ❑ Unpolluted atmosphere that does not compromise biodiversity through, eg acidification or nitrification.

- ❑ Social communities that retain the population, skills and knowledge and economic and political wherewithal to sustain the above environment components.

- **The breakdown of the traditional relationship of agriculture and biodiversity**

  The period since the Second World War (and particularly since Britain's accession to the EEC) has witnessed steep declines in the area of semi-natural habitat and in the number and range of characteristic farmland species. Far from sustaining biodiversity and productive resources as it used to do, agriculture has now become a central factor in their destruction and degradation. For example, in England and Wales since 1940, unimproved neutral grassland has decreased in area by an estimated 97% whilst lowland calcareous grassland has decreased in area by an estimated 80% (NCC 1984). In the last 25 years a whole suite of characteristic 'common' farmland species has suffered declines in population and range.

| | |
|---|---|
| Corn bunting has declined by | 76% |
| Tree sparrow has declined by | 80% |
| Grey partridge | 73% |
| Turtle dove | 72% |
| Skylark | 54% |
| Linnet | 56% |
| Lapwing | 50% |

  Such biodiversity loss and decline, together with the degradation of landscape and productive resources, can be attributed in general to processes of agricultural intensification and specialisation stimulated and supported initially by domestic post-war policy and subsequently by the Common Agricultural Policy. These effects can be enumerated as key environmental indicators or generic impacts (see Annex 1).

  As a general rule biodiversity has been pushed to the margins of modern, agro-chemical agriculture (except where physical constraints prohibit this, as in the uplands) where it now subsists as a residual resource peripheral to most farming systems. Over much of the lowlands, for example, semi-natural habitats survive typically as fragments, often abandoned or undermanaged, within an otherwise intensively farmed landscape. Freshwater habitats continue to suffer loss and decline through nutrient pollution, sedimentation and water abstraction from intensive agriculture. In the uplands, habitat deterioration rather than outright loss has been the norm, the result most frequently of ecological overgrazing by livestock. The net effect of the processes of agricultural intensification and specialisation has been to replace ecological and landscape diversity with uniformity.

## The current status of the dimensions of environmental sustainability in agriculture

The framework outlined in Chapter 1 will be employed to assess in detail the current state of agriculture in England. The four dimensions identified there can be further disaggregated into a number of objectives which require to be fulfilled if environmental sustainability in agriculture is to be realised. These objectives are as follows:

- protect the quantity and quality of the natural resources of soil, air and water together the genetic base of domestic breeds and species

- ensure that food is safe and produced in an environmentally sustainable way

- sustain biodiversity by protecting and enhancing wildlife habitats and species

- ensure that landscape character and local distinctiveness are conserved

- retain historic and cultural buildings and features

- provide for public enjoyment of the countryside

- help build vibrant and viable rural communities through the sustainable use of their distinct natural and cultural resources and the creative use of appropriate technologies

- provide for the full participation of local populations and ownership of their own future development

The following discussion will focus on the current status of agriculture in respect of the first, second, third, seventh and eighth objectives above. The analysis will conclude with an examination of the current agricultural and rural development policy context and will identify the need for objectives and policy premised on the notion of 'strong sustainability'. Before proceeding further, however, we need to provide a definition of environmentally sustainable agriculture. This is as follows:

> "Environmentally sustainable agriculture is one which seeks to maintain and enhance the natural qualities and characteristics of the farmed environment and its capacity to fulfil its full range of functions, including the maintenance of biodiversity."

**Objectives 1 and 2**

- Soil

  Unacceptable levels of soil erosion (ie rate of loss exceeds the natural formation of new soils). Whilst it is recognised that soil erosion has increased in the last 40 years there is no comprehensive survey in the UK to monitor soil erosion from farmland and its effect on agricultural productivity. It has been estimated that up to 15% of arable land in England and Wales is at risk of soil erosion in some years (Soil Survey and Land Research Centre *et al* 1994). Much of this erosion, real and potential, may be attributable to intensive agricultural practices, such as conversion of grassland to arable production in vulnerable areas, continuous cropping, the production of fine tilth etc and is exacerbated by exceptionally heavy rainfall. Whilst essentially a localised problem, soil erosion has the potential to become a larger scale concern in the longer term, especially if intensification and specialisation continue.

  Declining soil function. The appropriate levels of organic matter in the soil is an important but very complex issue. Whilst high levels of organic matter often are associated with high fertility, structural stability and sustainability, many factors influence their balance (including crop or vegetation cover, rainfall, drainage conditions, acidity of the soil and management of the land). Nonetheless, the continuous removal of crop biomass, drainage and cultivation of grassland are contributing to the gradual reduction of the organic matter content of many lowland soils and may cause long-term damage to the soil structure. Loss of structure decreases the ability of soils to retain inorganic fertiliser, thereby enhancing rates of nutrient run-off with adverse consequences for surface and groundwaters. The problem is particularly acute on arable land in low rainfall areas, notably East Anglia, where the combination of wind erosion and oxidation of organic matter resulting from cultivation has caused huge loss of formerly productive peat soils. Another concern is the increasing volume of sewage sludge disposed of on farmland; in principle, this is a sensible means of recycling nutrients but there are dangers that some soils could be contaminated over time with heavy metals.

Evidence submitted to the RCEP (1996) points out that Government policy neglects the need for the protection of the land and soil resource (MLURI 1994; SSLRC *et al* 1994; IACR, 1994). RCEP makes a number of recommendations including the development and implementation of a national soil protection policy for the UK and modifications to regional planning guidance to give greater weight to appropriate use of soil resources. A strong presumption against converting green-field land to other uses is advised.

The existing Code for Good Agricultural Practice for the Protection of Soil provides recommendations for soil conservation techniques. These are only voluntary guidelines, however and are not linked to any impelling incentives. The UK's SD Strategy fails to identify any specific policy targets regarding the land resource. In order to ensure adequate agricultural productivity in the longer term, a target for soils first needs to be defined in terms of both quantity and quality. This is difficult without precise government statistics concerning land use changes or nationwide monitoring of soil erosion rates, for example. There are no existing data in Britain which can be used effectively as the basis of a soil monitoring programme.

Work carried out by the Soil Survey and Land Research Centre has identified a critical soil organic matter content level of 2%, below which soil becomes unstable. Similarly, a maximum acceptable level of soil erosion should be set for different soils. Inappropriate arable farming methods should be prevented and those areas vulnerable to severe soil erosion should be protected from cultivation. There needs to be research into appropriate methods for restoring damaged soils.

The quantity and quality of the land resource is intimately linked to the sustainability of agriculture. Although soil erosion does not appear to pose a short-term threat to agriculture other than in a few localised areas, there is potential for significant, large-scale erosion problems to develop in the future unless action is taken. In order to develop a national soil strategy, the minimum requirements for soil quantity and quality need to be defined. Research programmes are also needed to work towards identifying the critical thresholds at which the sustainability of agriculture becomes compromised by soil degradation.

- **Water**

*Water quantity*

In England and Wales, agriculture currently accounts for only 1% of total demand for water (DoE 1996). However, a decline in the amount of water abstracted for general agricultural use over the last ten years has been accompanied by an increase in demand for abstractions for spray irrigation. Between 1984 and 1990, the area of irrigated farmland in England and Wales rose by 23,860 ha to 164,460 (MAFF 1991). Irrigation rates have also doubled from c.1300 litres/day/ha in 1982 to 2500 litres/day/ha in 1992 (DoE 1996). Both the area irrigated and the amount of water used per/ha therefore have increased. While abstraction for agricultural use represent only a small proportion of total annual abstractions, they can be significant because the demand occurs during periods of drought or low rainfall when resources are most depleted. Furthermore, they are immediately consumptive as little water is returned to the system due to plant retention and evapotranspiration. There is an underlying trend towards irrigation of a larger area of agricultural land in drier years.

To compound the problem, highest demand occurs in the drier parts of the country. In certain regions, notably East Anglia, the peak drought demand for spray irrigation exceeds the amount of water available. In conjunction with other demands, this may lead increasingly to the utilisation of groundwater aquifers with implications for the sustainability of this resource, as natural replenishment generally is slow and may not sustain current rates of abstraction. Such abstraction has profound implication for biodiversity of surface water and that dependent upon groundwater sources eg fens and mires.

The NRA (1994) has stated that 'agricultural demand for water, especially for spray irrigation, presents particular problems for the provision of future supplies.' The forecasts suggest that agricultural demand will increase by about 30% in the next 30 years, concentrated in the south east, principally in East Anglia and the Severn Trent, where the most water-intensive production is undertaken.

Over abstraction can cause unacceptable changes in hydrology including the lowering of groundwater levels, low-flow rivers and dry river levels. Such changes may have numerous adverse impacts on water dependent wildlife. Although further expansion of supply to meet demand is a physical possibility, the question must be whether such an approach is sustainable in environmental terms. The principles of sustainable water management suggest that sufficient water levels must be maintained in order to conserve and enhance current biodiversity, allow pollutants to be diluted, biodegraded and removed. This implies less emphasis on new supply and more on demand management or local initiatives which prevent the further exploitation of water resources, particularly groundwater aquifers. Constraints on water availability could limit the further development of certain production practices in areas with water deficit, which may in turn encourage the use of more appropriate or drought resistant crops.

*Water quality*

There are essentially two main sources of water pollution from agriculture in England:

- 'Diffuse' sources ie leaching and run-off of pollutants from areas of agricultural land to ground and surface waters. In practice, diffuse sources comprise mainly small point sources dispersed over many locations.

- 'Point' sources ie discrete and easily identified locations such as slurry stores, farm buildings and silage clamps.

Although point sources of pollution often receive the most attention because of their obvious and dramatic effects, diffuse sources are probably of greatest concern since their control is inherently difficult and are more likely to require significant changes in agricultural practice and land use.

Agriculture is a major source of surface and groundwater pollution. The intensification of agriculture has been associated with increased waste disposal problems and the heavy use of fertilisers and pesticides, which in turn have led to the contamination of both surface and groundwater. In some catchments as much as 55% of the phosphate entering surface waters is from agricultural sources (WWF-UK, 1993). There is growing concern about the levels of nitrate in groundwater and some surface waters. Much of this is attributable to agricultural practice, including the continued application of nitrogenous based fertilisers and the disposal of slurry from intensive livestock units.

Eutrophication is a complex process and sources and pathways are still poorly understood. It is unclear, for example, the length of time required, once a nutrient source has been removed, for the natural ecological balance to be restored or indeed whether this is ever likely to occur. This suggests that a precautionary approach is required in order to prevent further damage to fresh and marine waters particularly in the vicinity of sensitive sites. This implies possible further restrictions on agriculture (as well as sewage works which are the other main source of phosphate pollution and are due to be controlled by the EC urban waste water treatment Directive 91/271).

The precautionary approach also needs to be adopted to prevent further contamination of groundwater aquifers, which have generally long regeneration times. There are currently considerable clean-up costs associated with removing nutrients from drinking water taken from both surface and groundwaters. Despite the fact that the government has recognised that 'prevention is better and cheaper than cure' (HMG 1990) efforts to prevent nutrients from entering water bodies in the first place have focused mainly on advice from the Code of Practice, research and for improved storage and disposal of slurry. Water protection zones have not been used as a method of reducing leaching at sensitive sites and progress in establishing Nitrate Vulnerable Zones, as required by EU legislation, has been slow. Only relatively small zones have been designated as NSAs, where farmers receive incentives for changes in practice designed to reduce leaching. The most effective change in many areas is to convert arable land to grass, but few farmers have taken up this option in the NSAs. There is a clear anomaly between NVZs and NSAs, with the availability of incentives in the latter violating the Polluter Pays Principle.

Although the quantity of pesticides used in Britain by farmers has fallen since the mid-1980s (in terms of tonnes of active ingredient) this had been due, in part, to a gradual shift towards the use of more potent pesticides (Ward *et al* 1993). In terms of amount applied per square km the use of pesticides in the UK (including herbicides, fungicides and insecticides) is higher than in most other OECD countries and double the OECD average (Rae 1991). The pollution of water by pesticides only began to emerge as an issue during the 1980s and this was largely due to the impact of the EC drinking water quality Directive 80/778 which set a maximum admissible concentration of 0.1 mg/l for any individual pesticide and 0.5 mg/l for total pesticides in sources of drinking water.

Little is known of the full cumulative impact of current releases from agricultural use on the wider environment. Pesticides can enter surface and groundwaters either from direct discharges, as a result of spillage or leaking stores or from diffuse releases from normal agricultural applications. Pesticides are currently found in higher concentrations in surface waters than groundwaters. (This could be explained partially by pesticides [as with nitrates] being 'trapped' in the unsaturated zones above aquifers.) This means that it is not yet possible to quantify the level of environmental contamination caused by past and current usage. Once contaminated, however, groundwater may recover only after a lengthy period during which time measures to treat water abstracted for drinking may be required - at considerable cost.

Monitoring of pesticide concentration in water bodies has occurred only on a limited scale and has been confined mainly to drinking water sources, where pesticides are becoming more frequently detected and at higher levels (Ward *et al* 1993). This lack of information, together with the time delay in detecting pesticide residues in groundwater, suggest that a precautionary approach should be adopted. Those pesticides which are particularly mobile in the environment or which are persistent and bioaccumulate need to be phased out and replaced with new techniques or products which are less toxic and more targeted. Were a precautionary approach to be adopted, pesticide use would need to be reduced and made subject to tighter management, for example by improved crop rotation, uses of biological pest control and integrated crop management, greater application of organic farming techniques, utilisation of disease-resistant cultivars, more selective use of pesticides, etc.

As with nitrates, water companies currently spend considerable sums removing pesticides from drinking water taken from contaminated sources (one estimate suggested £500 million was being invested to comply with EU drinking water quality standards (ENDS Report March 1995)). Recent research by DoE in Warwickshire and Hertfordshire concludes that water protection zones may offer the most cost-effective means of maintaining pesticide levels in water below EU standards, in comparison to water treatment or application restrictions. The predicted minimum size of protection zones in the catchments investigated ranged from 10 m strip along both sides of major water courses to designation of up to 90% of the catchment area, depending on factors such as the pesticide concerned, soils, topography, rainfall etc.

Since neither the agricultural sector nor the agro-chemical industry is meeting the costs due to farm pesticide use, the polluter pays principle is not being applied at the moment. This cost is currently borne by the consumer (in respect of drinking water) and the environment. A stricter application of the principle could provide the necessary incentive for reduced use of pesticides and would be a tangible step towards a more sustainable agriculture.

Unfortunately, the heavy reliance of conventional agriculture upon pesticides as an attempt to address the ecological contradictions of specialisation and intensification (monocropping and loss of rotations) looks set to be reinforced with new pressure from the agro-chemical industry for the introduction of pesticide resistant genetically modified organisms (GMOs). Concerns with GMOs centre on three main areas:

- the likelihood of genetically modified farm crops inter-breeding with wild relatives to produce aggressive, herbicide-resistant super-weeds;

- if genetically modified seed passes on insect resistance to wild cousins, insects which depend on affected wild plants could be denied their only food source. The effects could then knock on to creatures higher up the food chain;

- with crops guaranteed to be herbicide- and insect-resistant, farmers could spray more broad-spectrum weedkillers like Roundup, with the consequent eradication of all non-crop infield and field-edge flora. The result is likely to be a further drastic reduction in the variety of farmland wildlife: few wild plants and serious reductions in farmland insects and birds.

However, the probable development of herbicide-resistant weeds, either through genetic transferral or natural selection, is likely to negate any short-term benefits perceived to arise from such GMOs. GMOs are likely further to reinforce agricultural specialisation and further encourage the dependence of farmers upon external inputs (and upon agro-chemical companies as providers of the 'complete package' of both GMOs and pesticide) and, with this, the further divorce of agriculture from local environmental character and local economies.

- **Dependence upon non-renewable resources, especially fossil fuels**

Agriculture's principal use of non-renewable resources is in the form of fossil fuel-based energy inputs. Although agriculture accounts for only about 2-3% of national energy consumption, a large proportion of this derives from fossil fuels. This figure also hides the fact that UK agriculture is energy intensive, especially in comparison with low input systems in the developing world (post-war policy has of course systematically encouraged directly and indirectly the substitution of capital for labour). The long-term energy consumption implications of the contemporary European agri-food system remain a cause for concern.

Agriculture's consumption of fossil fuels is both direct, such as the use of diesel to power machinery, and indirect, through the use of fossil-based fertilisers and pesticides, for example. The direct use of fossil fuel energy has increased in the post-war years as labour has been replaced by more mechanised forms of production, although there have been improvements in efficiency since the 1970s. Potentially more significant, in environmental terms, is agriculture's indirect use of fossil fuel energy. Over two million tonnes of fertiliser are used annually in the UK. While consumption has declined recently, the production of these fertilisers is a significant source of energy demand and adds to the environmental burden of fertiliser use.

Agriculture in the UK, as in most other industrialised countries, is intensive in its energy requirements and savings could be made by adopting lower input systems, such as zero cultivation techniques, where these are appropriate. Total direct consumption of energy in agriculture was declining until 1989 but then began to increase again.

Given that the supply of fossil fuels is finite, the heavy reliance on such inputs is unsustainable in the long term. Alternative sources will be required, some of which could be produced within the farming sector, while overall energy efficiency needs to be improved.

- **Air pollution**

On a global scale, agriculture is a significant source of greenhouse gases. In the UK agriculture was responsible for 2% of carbon dioxide emissions (by end user); 32% of methane emissions (by sector); and 17% of nitrous oxide emissions (by source) in 1990 (HMG 1994). Increased emissions of methane, nitrous oxides and carbon dioxide are associated with the intensification of agriculture and these gases are amongst those contributing to potential climate change. If agriculture is to play a part in the national programme to reduce emissions of greenhouse gases, steps to regulate methane and nitrous oxide emissions are the priority. The picture is complex, however: for example, the projected fall in the number of dairy cattle could reduce methane emissions, while increased areas under forestry and energy-coppicing could provide a larger sink for carbon dioxide.

Agriculture, particularly livestock farming, is also the main source of ammonia emissions in Britain, accounting for around 60-90 per cent of the total. These contribute to acid rain and result in cumulative acidification of freshwater and soils and adverse ecological changes.

- **Narrowing genetic base of crops and livestock**

  The drive to increase productivity has led breeders progressively to narrow down the gene pool to a number of high yielding varieties and breeds. (Since 1892, 26 breeds of farm animal have become extinct; pig farming is now dominated by just two breeds; and three varieties account for 86% of all areas sown with spring wheat (UNED UK 1994). Often varieties of breeds which are well adapted to local conditions are displaced by those which may be higher yielding but more demanding in their input requirements. Beef cattle in the UK are one example. This narrowing of the genetic base restricts consumer choice and could render crops and livestock more susceptible to significant pest damage and disease - and thus, in turn, requiring the greater use of chemicals in the farm environment. Whilst these trends do not impair the continuation of agriculture under current conditions, they create longer term risks which could threaten sustainability. The threatened introduction of GMOs into conventional farming would be likely to reinforce such trends still further (see discussion above under 'Water Quality'). Traditional breeds and varieties are much better adapted than high yielding breeds and varieties to low input and organic systems of agriculture. Traditional breeds of sheep and cattle are important for the appropriate management of low input on species rich pasture land.

**Objective 3**

Even today, claims are made that farmers are the stewards of the countryside, with an implied connection between successful farming and the maintenance of an attractive, diverse and biologically rich countryside. This perception, however, bears little relationship to reality. All the evidence suggests that modern farming has greatly reduced the landscape, wildlife and heritage value of the countryside. While this may not be an impediment to the continuation of food production, at least in the immediate sense, it is clearly not environmentally sustainable according to definition cited above. It was noted earlier that, historically, the relationship between farming and many of the species now established in Britain was relatively symbiotic. A sustainable agriculture might be expected to be one which maintains this relationship. Since the Second World War agriculture has become probably the single most destructive force as far as biodiversity is concerned. Post-war policy intentionally encouraged agricultural intensification and specialisation, key elements of which have been greater mechanisation, labour shedding, greater use of agro-chemicals, increase in farm and field size. The results of intensification and specialisation for biodiversity can be gauged by examining their impacts upon the key components of agro-ecosystems identified above.

- **Semi-natural 'infield' habitats.**

  In the lowlands such habitats have suffered catastrophic losses since the Second World War largely as a result of conversion to arable or through application of inorganic fertilisers/reseeding with higher yielding species (improvement). Drainage has also led to the loss of wet meadows, mires and grazing marsh. The result is that such habitats are now highly fragmentary and improvement in their current resource status is constrained by a number of generic ecological/management factors *viz*:

- ❑ lack of or inappropriate management of habitat (generally undergrazing);
- ❑ fragmentation of sites causing outright loss, vulnerability to edge effects and to species extinction and difficulty of management;
- ❑ loss of management skills (eg due to arable specialisation);
- ❑ lack of livestock and livestock infrastructure necessary for habitat management due to production specialisation.

This situation may be described as the 'peripheral' scenario where intensification and specialisation of agricultural activity have pushed semi-natural habitats to the periphery of farm systems, both spatially and functionally. Within the 'peripheral' scenario remaining semi-natural 'infield' habitats are now rarely managed, if managed at all, as part of normal farming operations. They survive because they occupy land which is economically marginal or irrelevant to the farming enterprise.

Upland semi-natural 'infield' habitats by contrast, have tended to suffer degradation, mainly as a result of ecological overgrazing, rather than outright loss. Heather moorland, for example, has tended to be replaced by grassland that is less valuable, both in terms of species and structure. Such semi-natural 'infield' habitats tend to be 'integral' to the management of the farm systems of which they are a part (largely because, physically, such areas are not amenable to agricultural improvement). As a consequence the generic ecological and management factors underlying current resource status are, in principle, much more easily addressed than is the case in the lowlands - in essence the only problem is that of securing ecologically sustainable grazing levels.

- **Interstitial habitats**

*Hedgerows*

Between 1947 and 1987, 175,000 km of hedgerows in England and Wales were removed (CoCo 1986), representing a loss of 22% of all hedgerows. Later research indicates that the rate of loss may have increased during the remainder of the 1980s, due to neglect and removal (an estimated 150,000 km of hedgerows were lost between 1984 and 1990 in Great Britain [DoE 1996]). Although new schemes have been introduced to promote the management of existing hedgerows and planting of new ones 'evidence from the latest survey for England and Wales suggests that hedgerows are still in decline, with many becoming derelict, through neglect although more hedges are now being planted than uprooted' (DoE 1996).

Such decline and loss is the product of a number of generic management/ecological impacts:

- ❑ Mismanagement of hedgerows through flailing and annual cutting causing 'lollypop and gappy hedgerows' with no agricultural function and little wildlife or landscape value.

- ❑ Outright hedge removal.

- ❑ Hedgerow neglect leading to gappiness and overmaturity (mainly in pastoral areas) and loss of function, wildlife and landscape value. Hedgerow usually replaced by fenceline.

- ❑ Grazing of hedge bottoms by livestock leading to gappiness and loss of boundary function and wildlife/landscape interest.

- ❑ Spreading of artificial fertiliser and herbicides into hedgerow bottoms leading to replacement of diverse flora (and associated fauna) with impoverished nitrophilous flora. Often the latter are annual pest species (eg *Bromus sterilis*) which the farmer then has to spray out, perpetuating floristic impoverishment and giving rise to the myth that hedgerows intrinsically harbour arable weed species.

- ❑ cultivation right up to the field margin, directly removing diverse flora and facilitating the above process.

- ❑ Close and unseasonal cutting of field margin vegetation (misplaced tidiness) leading to loss of cover and food sources for wildlife and change in floristic composition.

All the above factors have underlain the recent declines in populations of characteristic hedgerow bird species such as song thrush, bull finch, turtle dove, whitethroat and lesser whitethroat and, in combination with adverse 'infield' changes, to the declines in species such as tree sparrow, corn bunting, cirl bunting, yellow hammer, linnet and grey partridge. Similarly, a wide range of other vertebrate and invertebrate species, including non-pest species of butterfly, has been affected adversely.

- **Broadleaved woodlands**

Between 1978 and 1984, 24,700 ha of broadleaved woodland were cleared in Britain, with over 60% converted to agricultural use (Barr *et al* 1986). There has been a loss also of hedgerow and other farmland trees due to disease (eg Dutch Elm), the requirements of larger farm machinery, the lowering of water tables and deep ploughing near tree roots. The introduction of new grant schemes (eg the Farm Woodland and Farm Woodland Premium Scheme) has helped somewhat to arrest this decline.

- **Pond, ditches and streams**

Between 1945 and 1990 the number of ponds and lakes in Great Britain decreased from 470,000 to 330,000 (DoE 1996). The primary generic ecological/management factors in this loss and decline are as follows:

- ❑ Neglect through redundancy as watering holes resulting in siltation and overgrowth (result of arable specialisation).

- ❑ Intentional drainage/infilling or inadvertent drying out as a result of lowered water table (through wider drainage/water abstraction).

- ☐ Eutrophication through careless application of nitrogen fertiliser and through nutrient run-off.

- ☐ Pollution through pesticide spray drift.

- ☐ Overdeepening and canalisation of streams and ditches and removal of characteristic bankside vegetation, usually to improve drainage and raise productivity of surrounding fields.

These factors have meant that formerly diverse bankside and emergent floras have been destroyed or replaced by nitrophilous species (nettles, willow-herb, creeping thistle) whilst open waters are subject to algal blooms in warm weather, leading in turn to deoxygenation. These trends have been accompanied by severe reductions in the population and ranges of invertebrates (eg dragonflies and damselflies), amphibians and mammals (eg otter).

- **Artificial 'infield' habitats (including improved pasture)**

The more productive land on the farm, occupied by arable cultivation or improved pasture, are important breeding, feeding and wintering areas for a suite of characteristic farmland species, such as skylark, lapwing, corn bunting, a variety of finches and buntings, stone curlew and brown hare. All these species have suffered serious or catastrophic declines in population/range, particularly during the last 25 years. A number of generic factors can be identified as underlying such decline in status:

- ☐ Universal use of pesticides on arable land reduces the number and quantity of insect species while herbicides eliminate arable weed species and with them invertebrate species, a crucial source of food for bird species and bats.

- ☐ The recent trend towards autumn sown crops has caused stubble fields to disappear from most arable areas; those that remain are often treated with herbicide and are therefore of reduced value. Autumn sowing also reduces suitable nesting breeding habitat for species which require open ground/good visibility such as corn bunting, stone curlew and brown hare.

- ☐ Agricultural specialisation and industrialisation based on agro-chemical inputs has largely eliminated the mosaic of arable and grassland required by species such as skylark, stone curlew and brown hare.

- **Habitat Mosaics**

Many species utilise a number of the above habitats in conjunction with one another, and therefore require the juxtaposition for example of small woods, hedgerows, pasture and arable. Such juxtaposition also makes up the quality of the countryside - a particular spatial relationship between habitats can generate total environmental value greater than the sum of its individual parts. Diversity at the landscape scale is vitally important therefore; the combined effect of all the above process, however, has been to substitute uniformity for diversity.

**Objectives 7 and 8**

As noted earlier, state support and technological advances have resulted in a rise in agricultural productivity per hectare and per animal, with increases of about 2-3% per annum since the Second World War. Over the same period the number of farms has fallen and the average size of holdings has increased as farmers have attempted to reduce fixed costs in order to improve efficiency and maintain or increase farm income in the face of a cost-price squeeze. Between 1945 and 1992 the number of farms in England and Wales fell from 363,000 to 184,000. This trend has been witnessed across all agricultural sectors. (Office of Science and Technology, 1995.)

Mechanisation and the consolidation of land holdings have resulted in dramatic reductions in the agricultural work force. In 1970, 787,000 people were employed in agriculture. By 1993 this figure had fallen to 547,000 (a 30% reduction) and by the year 2003 the total agricultural labour force is expected to be 480,000 (MAFF CAP Review Group 1995). The relative importance of seasonal or casual workers has increased. This reflects not only a drive to reduce fixed costs but also agriculture's transformation to a capital intensive industry with pronounced seasonal workloads which part-time, casual and seasonal labour can be deployed to meet. As agriculture has moved from labour to capital intensive forms of production, so the financial pressures on farm businesses have increased. Farm incomes in the UK halved in real terms between the late 1970s and early 1980s and then almost halved again by the early 1990s. Capital formation had virtually ceased until recently and farm product prices have fallen relative to the prices of factor inputs (Harrison and Tranter 1994). Increased financial pressures and declining farm incomes have forced many farm families to look for additional income sources and led to the development of pluriactivity which is now seen as an important means of maintaining the farming population.

In the past, farms and farming related enterprises provided the foundation of the rural economy and through their continuity, a certain social stability. This relationship has changed dramatically in the post-war period, however. While the productivity of UK agriculture has increased annually since the Second World War, agriculture's contribution to GDP has been falling steadily and was estimated to be 1.4%, compared to just over 2% in 1984. Agriculture now makes a relatively small direct contribution to rural employment. By 1989, agricultural employees accounted for only 6.3% of total employees in remote rural areas, compared with 4.1% in accessible areas and 1.9% for England as a whole. A further 15% reduction in the total agricultural labour force is forecast by the year 2000 (Office of Science and Technology 1995). This is not to underestimate agriculture's wider economic importance - the number of people currently employed in agriculture-related industries is approximately 14% of the population, but these jobs are not always located in rural areas. Paradoxically, the economic well-being of farm families now depends increasingly on the vibrancy of the rural economy rather than *vice versa* (Lowe *et al* 1993). Productivist agricultural support is not an effective means of maintaining rural employment either directly or indirectly. Although agriculture benefits from approximately £5.6 billion of public sector support (MAFF CAP Review Group 1995) these payments do not greatly benefit the wider rural economy. For example, Whitby & Dowe (1995) found that the indirect effects of agricultural support on rural employment are limited because farmers tend to be linked to non-local supplies and processors. Research for the MAFF CAP Review Group estimated that the removal of agricultural support would only result in a slightly faster rate of agricultural employment decline than over the last decade. Nonetheless, it would result in a rapid reduction in the total number of holdings within a few years.

Specialisation, concentration of land holdings, and the dramatic decrease in agricultural employment, coupled with wider social change in rural Britain, have weakened the links between farmers and rural communities. A sustainable form of agriculture must be one that combines respect for environmental capacities with long-term economic viability, that is a reasonable standard of living. Agriculture should be seen as one amongst a number of sectors that con contribute to the maintenance of a vibrant rural economy able to sustain a wide range of services, including those of an environmental kind. Sustainability thus depends on prosperity for producers who are efficient in an environmental as well as an economic sense. This is likely to require state subsidy and regulatory intervention, the latter as measures to incorporate environmental and social costs into production prices.

## Sustainability of the current policy context

Agriculture, despite recent reforms, is still overwhelmingly 'productivist' in orientation and its generally adverse impacts upon the environment and rural economy derive from this fundamental characteristic. Sustainability concerns, whether embodied in regulation or in incentives for land management, impinge only weakly upon this productivist thrust and are very largely mitigatory in character. The rights to state subsidy and to virtual freedom from planning and environmental regulation that have been accorded to agriculture in the post-war period are still regarded as almost sacrosanct. Farmers expect to be compensated for any erosion of such rights. Environmental gains since the 1980s have quite literally been purchased - the farming lobby has successfully asserted new property rights over the provision of environmental goods, demanding payment for these, and for any uncompensated controls, to be based, as far as possible, on the voluntary principle and self-regulation. What the current framework of productivist support achieves, in effect, is the conferral of rights to agriculture to pollute and degrade/destroy the environment in direct contravention of the polluter pays principle (embodied in the 1987 Single European Act). The Nitrate Sensitive Areas (NSA) scheme, for example, in effect pays farmers (negative) compensation for the adoption of agricultural practices required to conform to the European Drinking Water and Nitrate Directives. European and domestic policy is characterised in short by a gross disparity between formal commitments to environmental sustainability (embodied for example in the Single European Act and the 5th Environment Action Plan) and substantive action. This disparity reflects an incompatibility between objectives of productivism (and indeed of free market policies), on the one hand, and those of environmental sustainability, on the other. In agriculture, this policy dichotomy is reflected in the way in which 'productivism' determines the essentially 'exclusionary' and/or 'exceptionalistic' character of environmental policy. Environmental sustainability on this model is either to be confined to discrete sites or areas or, if it is to have 'wider countryside' applicability, must be purchased through market competitive incentives. In other words, environmental incentives are obliged to compete against either CAP commodity support, or against unsupported crops, the competitiveness of which may well be secured, particularly in the case of the latter, through the externalisation of environmental (and social) costs.

Current agri-environmental policy is thus characterised by a weak and inconsistent structure of regulation; by the existence of only voluntary Codes of Good Agricultural Practice; and by the payment of incentives to prevent negative activities, often in breach of the polluter pays principle and the Codes of Good Agricultural Practice. In EU policy, we thus currently encounter, for example, the absurd situation in which DGV1 of the European Commission resists the payment of incentives (under Regulation 2078/92) for <u>positive</u> management measures needed to secure Natura 2000 objectives because the latter constitute a regulatory requirement, whilst at the same time making such monies available (e.g. NSAs) for the prevention of activities which are clearly in breach of the polluter pays principle.

By contrast, a more environmentally sustainable and socially equitable policy framework would be founded on a rather different relationship between regulation and incentive (this policy framework will be presented more fully in the final chapter). Agri-environmental policy should be underpinned by a strong and consistent regulatory baseline. Regulatory control offers the opportunity to secure environmental benefits more permanently than voluntary incentive schemes, which usually apply for only a limited period of time. Regulation is a means of internalising some of the external environmental costs attributable to farming and of complying with the polluter pays principle. Perhaps most importantly, regulation is required, and is best adapted, to achieve the control of environmentally damaging (i.e. negative) activities; it is not well suited, however, for the encouragement of positive conservation initiatives, such as those required to secure appropriate management on Natura 2000 sites. On this model, therefore, incentives are required only where appropriate management cannot be secured by more widely applied policies which do not involve payment. Incentives should be restricted to positive management activities. Incentives should thus be built on a baseline of minimum environmental standards.

The current status of domestic and EU policy in relation to agri-environment ( biodiversity and water resources) and rural economic issues is examined further below.

- **Biodiversity**

  Recognition of the rate and scale of biodiversity loss and decline has stimulated the introduction, over the last decade and a half, of a number of remedial/mitigatory measures. Some are (quasi-)regulatory in character, for example, the notification of SSSIs under the Wildlife and Countryside Act 1981, the attachment of conditions to receipt of livestock subsidy and the introduction of management rules to enhance the environmental benefits of set-aside. The majority, however, take the form of incentives and the most important of these fall within the agri-environment programme (implemented under EC Regulation 2078/92).

  Currently the focus of the present suite of agri-environment schemes is upon habitats and landscapes identified as being of greatest conservation priority, that is the semi-natural infield element of agro-ecosystems. The two main schemes, ESAs and Countryside Stewardship, target respectively large areas of land if particular environmental value and identified habitats, landscapes and features in the wider countryside.

  The primary rationale underlying ESAs has been to prevent the further deterioration of the natural heritage within such areas whilst simultaneously contributing to a reduction in surplus commodity production and maintaining farm incomes. Significantly, they reflect the view that designations of special sites cannot alone prompt the whole-farm/whole countryside management required to preserve environmentally beneficial styles of farming. ESAs are particularly well adapted therefore to secure and sustain the broader fabric of countryside character over large areas. They are also significant in recognising that environmental protection on a whole farm/whole countryside basis can be secured only through an appropriate framework of income support for the farmer - thus ESAs mean that farm support monies are being used for the first time to maintain what might justifiably be called 'environmentally sensitive farmers'. The 'downside' of this ESA framework is that it is structured in the style of post-war 'permissive corporatism', whereby the partnership between state and farmers is based on markets and incentives rather than on controls and regulations. The result of such voluntarism is that the objectives of ESAs have been relatively loosely defined in terms of environmental outcomes (particularly **positive** outcomes) and have been compromised to a greater or lesser degree of the need for incentives to be market competitive. The result is that questions have been raised concerning the 'value for money' of ESA payments, in particular regarding the enhancement and re-creation, rather than the mere maintenance, of the biodiversity and landscape resource. ESAs now need to demonstrate greater responsiveness to biodiversity (and other) needs - this can be secured through adding an element of flexibility to the basic ESA approach of common prescriptions and through the addition of new tiers. Given an incentive based approach and a relatively static budget, the danger here is that the need to demonstrate 'additionality' will lead to a concentration on special sites within ESAs at the expense of the broader fabric of the countryside.

A basic problem with ESAs is that they apply only to a relatively few discrete areas (ie they are exclusive) large areas of semi-natural habitat, for example, lie outside ESAs. Large areas of moorland, for example, suffer from significant overgrazing with a resulting reduction in biodiversity. Since such areas remain inadequately covered by other agri-environmental schemes (eg the modest Moorland Scheme) they remain under threat from continuing mainstream productivism in the form of support for high sheep numbers. Overgrazing conditions now attached to livestock headage payments are invoked only in rare cases and do little to address underlying problems, solutions to which must lie with reform of CAP livestock commodity regimes themselves.

The remaining agri-environment schemes, principally Countryside Stewardship, now have the theoretical potential to address the conservation of all priority semi-natural habitats. They are particularly well adapted to the targeting of such habitats on sites peripheral to the functioning of farm systems and the low opportunity cost of land in such situations has ensured the relative success of Countryside Stewardship. Along with the Habitat Scheme, Countryside Stewardship is able in theory to secure habitat enhancement and expansion through conversion of arable or improved pasture to conservation management. Less success has been achieved here because of the higher opportunity cost of such land. However, such objectives will need to be more fully realised in the longer term if fragmentation of semi-natural habitats is to be reversed or if freshwater wildlife dependent on vulnerable water catchments is to be protected. Given the constraints of a limited budget and the relative expense of reverting productive land to conservation use, such efforts in the short-term will tend to be confined to buffering and linking existing semi-natural sites in areas where they occupy a high percentage of the land surface.

The main focus of the agri-environment schemes is currently upon semi-natural grazed land (semi-natural infield habitats) therefore, reflecting both the priority attached to the conservation of these habitats and, given their economic marginality, the ease of purchasing appropriate management. However, the majority of the biodiversity resource in the wider countryside (the other main components of agro-ecosystems) remains without adequate safeguard and most wildlife and characteristic species continue to decline in extent, quality and numbers as a direct or indirect result of productivist agricultural policy (see eg Andrews and Rebane 1994). The Biodiversity Action Plan begins to address these issues and indicates where agricultural practice can change with most benefit to wildlife. This programme of action, however, will be built upon the existing framework of incentive-led conservation, albeit through a possibly expanded agri-environment programme. As we have seen, however, agri-environment incentive schemes serve to mitigate rather than to resolve the underlying causes of biodiversity loss. They exist in a relation of marginality, competition and contradiction with the main thrust of productivist CAP policy. The latter, despite the 1992 reform agreement, continues, through the major commodity regimes, to sustain farming practices generative of biodiversity loss and decline in the wider countryside. Despite being heralded by some as a central element in the 1992 reform package, in practice the agri-environment programme has amounted to little more than a continuation and extension of existing programmes. In financial terms the programme takes up a fraction of the total CAP budget. In 1993/94 total CAP funding in the UK amounted to £2,380 million, of which £840 million was devoted to arable area payments but just £43 million to the agri-environment package.

- **Water quality/quantity (and flood defence)**

  Problems of water quality, water quantity and flood defence have increased in tandem with agricultural intensification and specialisation and are manifested in pollution by fertiliser/pesticide run-off and drift and silage/slurry, irrigation, drainage, disruption of natural river catchment processes and coastal squeeze.

  Under the 1995 Act the Environment Agency (EA) took over from the NRA the latter's powers under the 1989 Water Act. As such, the EA has the ability to regulate quality of water (regulation of pesticides resides with MAFF) and to prosecute polluters. Before 1989, agriculture was exempt from pollution legislation if it could be shown that activities accorded with the Code of Good Practice. This was revoked by 1989 Act. Water quality is determined by human consumption requirements, not by environmental criteria, the former being given formal expression in the EU Drinking Water Directive and Nitrates Directive. The achievement of requisite quality, however, still very much reliant on the voluntary approach or the use of incentives (e.g. NSAs, again voluntary) with mandatory powers held in reserve. The only regulatory powers employed for controlling diffuse pollution seem to be Nitrate Vulnerable Zones (NVZs) designated under the Nitrates Directive, which will be only minimally applied, however. (NVZs will cover only about 650,000 ha of agricultural land, representing a small fraction of the total and affecting only 1,800 farmers).

  The NRA/EA had/have considerable powers to prosecute and fine over pollution incidents eg from silage and slurry effluent. MAFF's approach to the problem is still to focus upon measures that do not adversely affect the economy of the industry - trying to discover 'technical fixes' to solve particular problems rather than tackling underlying problems of production concentration.

  MAFF have begun to take the first tentative steps to control pesticide use in order to improve compliance with the EC Drinking Water Directive (Directive 80/778). In 1995 MAFF placed restrictions on the use of Isoproturon. The NRA, however, stated at that time that it does not believe that these restrictions will be sufficient to reduce pesticide contamination of water. In the UK Strategy for Sustainable Development it is a stated aim to 'minimise the use of pesticides'. So far, however, there have been no specific measures to achieve this aim, except for voluntary schemes inside ESAs. This is a voluntary, almost 'do nothing' approach. A number of non-government initiatives have started, for example, Integrated Farming Systems and Integrated Crop Management but they are entirely voluntary and changes are incremental. There is no encouragement or inducement (other than indirectly through the pitifully small Organic Aid Scheme) to stop the vast majority of farmers from carrying on with 'business as usual'.