Water and wildlife on a commercial farm: multifunctional management of set-aside and other natural resources in lowland England

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Abstract

Natural resource management on farmland can often be multifunctional. At Loddington, the Allerton Project's research and demonstration farm in Leicestershire, England, the set-aside area necessary to qualify for Arable Area Payments is used to achieve environmental benefits. These include planting of crops for wildlife, and the creation of a riparian buffer strip that protects watercourses from pollutants from arable land while also providing a wetland habitat. These habitats are exploited by wild gamebirds, as well as other wildlife. At Loddington, a management system integrating commercial farming, set-aside obligations, game management and other environmental objectives has also resulted in increases in numbers of nationally declining songbird species. This principle could be applied more widely in Europe. Objectives and implementation vary from field to farm and landscape/catchment scale, requiring varying levels of collaboration between farmers, according to farm size in different regions. However, this project demonstrates that a range of environmental objectives can be integrated into a farm business, satisfying current Rural Development objectives for multifunctional management and use of natural resources.

Introduction

There is an increasing recognition of the need to integrate the various aspects of natural resource management on farmland in order to meet the economic, environmental and social objectives of rural development. This is reflected in the EU Rural Development Regulation (1257/99) and in the legislation and funding frameworks in individual EU countries, such as England's Rural Development Programme. The latter "identifies those activities which will contribute to more than one objective, for example, agri-environment schemes not only lead to environmental protection and enhancement but can also generate new employment opportunities directly - through land management activities - or indirectly - by providing an attractive environment as the foundation for other activity e.g. tourism" (DEFRA, 2001).

"Given the innovative nature of a number of measures in the Programme, and the importance of encouraging use of measures which will improve the competitiveness and sustainability of farm and forestry businesses, pilot or demonstration projects will be needed" (DEFRA, 2001). There is currently little research and demonstration at this level of integration at the farm scale in Europe. This paper describes a research and demonstration project in lowland England. The project is thought to be unique in Europe in terms of the combination of a farm business with environmental management, applied scientific research, and farmer involvement at the same site.

Management practices and objectives vary from field, to farm and landscape scales. Because farm size varies considerably across Europe, the potential benefits of management at the farm scale also vary and there is a need for collaboration between farmers where farm size is small and where management objectives are at the landscape scale (e.g. water quality within a catchment).

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The study area

The research has been carried out since 1992 at The Allerton Research and Educational Trust's 333 ha mixed arable and livestock farm at Loddington in Leicestershire, England. A flock of 284 sheep grazes permanent pasture. The soils are mainly clay and the altitude is 105 - 185m. The arable crops (248ha) are almost all autumn-sown and comprise wheat, oats, oilseed rape and beans. Set-aside comprises 10% of the arable area, in compliance with the Arable Area Payments Scheme. Small woods (19ha) are distributed across the farm and there are small field ponds and watercourses, including a stream along the southern boundary which feeds into a reservoir 6 km to the south east of the farm. The area is rural, with only one major road and no major settlements. Table 1 shows percentage cover of the three main land uses at Loddington and in four adjacent zones in the surrounding landscape up to 6 km from the centre of the farm.

Table 1. Percentage land use cover at Loddington and four adjacent zones in the wider landscape (from Stoate, 2002a)

Site	Arable	Grass	Wood
A	25	64	11
B	67	32	1
C	61	36	3
D	58	33	9
Loddington	78	13	9

The farm is managed primarily as a commercial farm business, employing two full time staff and occasional seasonal help (e.g. at lambing and harvest). 1992 was a baseline year in which cropping was not changed and monitoring of some wildlife groups was carried out. From 1993, the management of the farm was adapted to accommodate habitats for wildlife. Songbirds and gamebirds have been the main wildlife groups to be monitored. More recently, other environmental objectives have received a higher profile, especially soil management and the maintenance, and where possible, the improvement of water quality.

Three examples of integration

1. Set-aside compliance and wildlife habitat

Payment of Arable Area Payments is conditional on putting 10% of each farm's arable area into set-aside (5% in 2004). In England, set-aside is generally allocated to whole fields or blocks of fields. These may be permanently sited, in which case they tend to be on less productive land, or incorporated into the arable rotation, in which case they are used to control grass weeds by the application of broad-spectrum herbicide in summer. At Loddington, set-aside is permanently sited in the form of 20m wide strips distributed across the farm. This makes the habitat associated with set-aside more readily available to territorial birds during the breeding season.

The set-aside is further enhanced by planting crops specifically designed for wildlife.

Crops grown on set-aside as 'Wild Bird Cover' include kale (*Brassica napus*) and quinoa (*Chenopodium quinoa*), grown in combination, and cereals such as triticale (*Triticum x Secale*) and wheat (*Triticum aestivum*). These crops can produce a high seed yield that is used as a source of food by farmland birds in autumn and winter. Birds make significantly greater use of these seed-bearing crops, relative to their availability) than they do commercial crops (Figure 1) (Boatman et al., 1999).

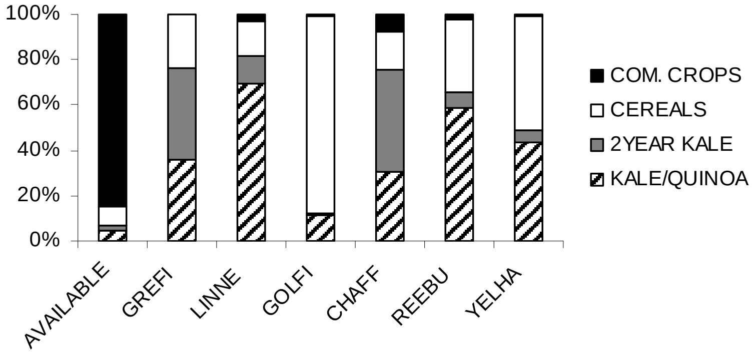

Figure 1. Percentage occurrence of six passerine species (Greenfinch (*Carduelis chloris*)- GREFI; Linnet (*Acanthis cannabina*) - LINNE; Goldfinch (*Carduelis carduelis*) - GOLFI; Chaffinch (*Fringilla coelebs*) - CHAFF; Reed Bunting (*Emberiza schoeniclus*) - REEBU; and Yellowhammer (*Emberiza cirinella*) - YELHA) in commercial crops and three seed-bearing crop types (cereals, first year kale with quinoa, and second year kale), relative to their availability on farmland

2. Water quality and wetland creation

The clay soils and autumn cultivation at Loddington result in soil erosion and transport of sediment and nutrients, especially nitrate and phosphorus to watercourses. Phosphorus, in particular, can cause eutrophication of inland waters, including streams and ponds within the farm at Loddington, and in the Eyebrook Reservoir downstream of the farmed area. One measure to mitigate the problem of nutrient and sediment transport to watercourses at the field or farm scale is the implementation of riparian buffer strips (Haycock et al., 1997).

At Loddington, riparian buffer strips take the form of sown grass or naturally regenerated vegetation along the streamside. At the base of the longest arable slope, a 80 m wide buffer strip has been created. Water from adjacent arable land has been diverted into the buffer strip from a ditch and from field drains. Water is therefore held in a series of shallow pools and does not enter the stream directly.

Water from field drains and pools has been sampled at monthly intervals and analysed for phosphorus, nitrate, nitrite and total N. Levels of both P and N are lower in the buffer strip pools than in the water entering from ditch and field drains, as illustrated for P in Figure 2. The shallow pools are used by mallard (*Anas platyrhynchos*), teal (*Anas crecca*), common snipe (*Gallinago gallinago*) and jack snipe (*Lymnocryptes minimus*) in winter, and the pools and rank vegetation around them are used by moorhen (*Gallinula chloropus*), whitethroat (*Sylvia communis*) and reed bunting during the summer. Commonly occurring invertebrates include *Laccophilus minutus, Sigaria nigrolinecta, Hesperocorixa sahlbergi, Corixa punctata*, *Notonecta glauca*, and *Sigaria* spp.. A number of plants have also colonised the buffer strip from seed delivered during winter flooding (e.g. *Juncus* spp., *Myriophyllum spicatum, Scrophularia auriculata, Scutellaria galericulata*). As well as protecting the stream from nutrient pollution from arable land, the buffer strip therefore also provides a habitat for wildlife.

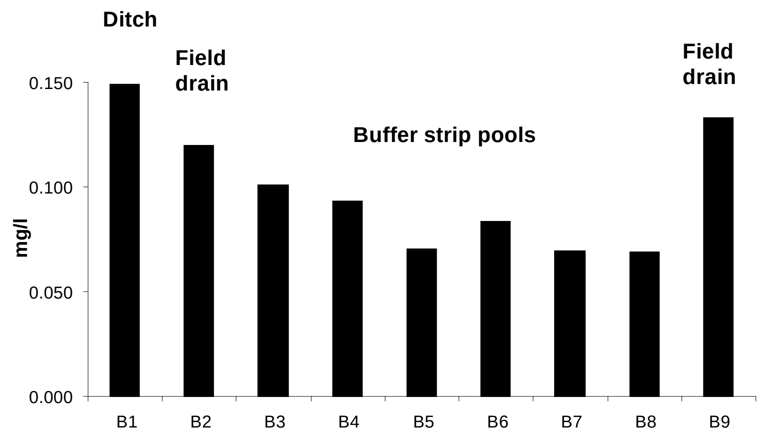

Figure 2. Phosphorus levels (mg/l) in ditch and field drains as they enter a buffer strip, and in shallow pools within the buffer strip. Values are means derived from monthly sampling. Some monthly values are maxima because of constraints imposed by methods of nutrient analysis, and standard errors are therefore not given

3. Bird conservation and game management

Shooting of gamebirds is a major social, and in some cases economic activity in lowland England. In most cases, gamebirds are artificially reared and released into woods and other cover in late summer for shooting in winter. However, wild gamebird populations can also be managed by providing suitable habitats that might also benefit other wildlife species. Particular attention has been given to the numbers of songbird species that have been declining nationally since the 1970s (Siriwardena et al., 1998) and are targeted for conservation by the UK government. This has been the policy at Loddington since 1993.

Habitats created for wild gamebirds include Wild Bird Cover (described above), conservation headlands (Sotherton 1991), beetle banks (Thomas et al., 1991), and grass field margin strips. Of these, Wild Bird Cover and beetle banks are within the set-aside area. Woodland has also been managed to improve the internal structure for wild pheasants (*Phasianus colchicus*). In addition, nest predators such as fox (*Vulpes vulpes*), brown rat (*Rattus norvegicus*) and magpie (*Pica pica*) have been controlled during the nesting season (April – July), and grain is provided as food during the winter. Together, these form a system that is designed to meet the ecological requirements of wild pheasants at all times of year. Pheasant shoots were held each year. Very few female pheasants were shot, so as to leave adequate breeding numbers for subsequent years. Wild pheasant numbers were monitored each autumn and spring by counting from a vehicle in the first three hours of the day. Songbird numbers were monitored by walking a 11.5 km transect four times in May and early June.

Both wild pheasants and nationally declining songbirds increased in numbers during the early part of the project, with numbers stabilising at a higher level in the second half of the project (Figure 3). Nationally declining songbirds were twice as abundant at Loddington as on surrounding farmland by 1997.

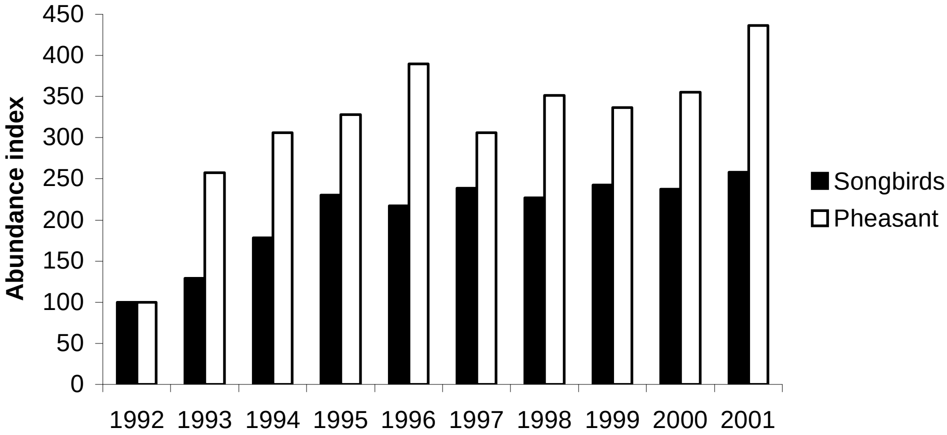

Figure 2. Relative abundance of pheasants in autumn and nationally declining songbirds in spring at Loddington, Leicestershire. A different abundance index is used for the two groups

Wider implications

Spatial considerations

The work at Loddington demonstrates that multiple objectives can be integrated in the same area at field and farm scales. Allocation of a set-aside area is a prerequisite for Arable Area Payments, but fields, or parts of fields in set-aside can also be managed positively to benefit wildlife. Wild Bird Cover provides an example of this. The riparian buffer strip described here was also set-aside land that was developed to perform the environmental functions of providing a wetland habitat and mitigating nutrient pollution of watercourses. Benton et al. (2003) argue that landscape heterogeneity at a range of scales is 'key to restoring and sustaining biodiversity in temperate agricultural systems'. Both Wild Bird Cover and riparian buffer strips contribute to such heterogeneity at landscape scale and can be managed to create similar structural and ecological diversity at much finer scales if conservation objectives are defined.

Adoption of a game management system, designed primarily to perform a social function within the rural community, can also benefit wildlife species that are targeted nationally for conservation action. This *systemic* approach must be adopted at the farm scale in order to be successful, and is most likely to succeed if adopted at the landscape scale. Where farm size is smaller than that at Loddington, collaboration will be necessary if the objectives of game and songbird conservation are to be achieved. This principle applies to an even greater extent where water management within a catchment is concerned. Here, soil management, creation of riparian buffer strips, and other steps to mitigate the impact of agriculture on watercourses, need to be adopted at the catchment scale. Such an approach is adopted in southwest England where a commercial company, 'Wessex Water', provides financial incentives to farmers to manage their land in a way that ensures that water treatment costs are minimised. However, willingness to adopt measures to mitigate impacts of farming on watercourses can vary considerably between farmers, as illustrated in the French Garonne catchment by Amigues et al. (2002), and in Upper Normandy by Mathieu and Joannon (2003).

In terms of wildlife conservation, Loddington is an exceptional demonstration of how a systemic management approach can benefit game and wildlife species at the farm scale. In the Netherlands, where farm sizes are generally smaller and drainage has a greater environmental influence, government incentives directed at the conservation of wading and other birds have encouraged farmers to collaborate in meeting conservation targets. In Devon (southwest England), farmers managing land occupied by cirl buntings (*Emberiza cirlus*), a nationally endangered species, have been encouraged to adopt an agri-environment scheme targeted at the conservation of this species (Peach et al., 2001). In this case, the landscape approach to conservation was successful. Application of an agri-environment scheme across farms in the Netherlands has been claimed to be unsuccessful (Kleijn et al., 2001), while in Portugal there is some indication that such an approach has been successful (Borralho et al., 1999). Such a systemic landscape approach is likely to be very dependent on the interests and cultural, and socio-economic background of participating farmers (Stoate, 2002b).

Economic implications

There are other examples of integration at Loddington. For example, pesticide use is restricted on wheat and oats (*Avena sativa*) fields in order to increase abundance of arable invertebrates. This practice currently attracts a 16% premium on crop sales as these cereals can be sold as 'conservation grade'. Minimum tillage has recently been adopted at Loddington in order to reduce crop establishment costs, but this is likely also to result in improvements in aquatic and terrestrial ecosystems. Low-grade timber, produced during woodland thinning operations can be sold for fuel, thereby paying for the cost of this habitat management for wildlife.

In these latter cases, habitat management is combined with income generation. However, wildlife conservation is more usually a net cost to the farm business. In the case of a game management system, this cost can be substantial, and only applicable where farmers are interested in shooting and where their incomes are relatively high. Management of wild gamebirds is considerably higher than that of artificially reared and released gamebirds, but there is currently no established premium for the sale of wild gamebird shooting.

In the case of Wild Bird Cover management, habitat creation can be carried out on set-aside land so that there is no crop yield penalty, but the costs of seed, cultivation, drilling and subsequent costs must be borne by the farmer. Where these crops are grown on the same land for more than one or two years, inputs in the form of fertiliser and herbicide are required in order to achieve the objective of high seed production (Stoate et al., 2003). These costs are increasingly difficult to bear as farm incomes fall. For example, Figure 4 shows farm profits for the business at Loddington, reflecting the regional trend. Current legislation specifically states that income generation from management of set-aside land is prohibited, so that no opportunities exist for funding such work within the farm business.

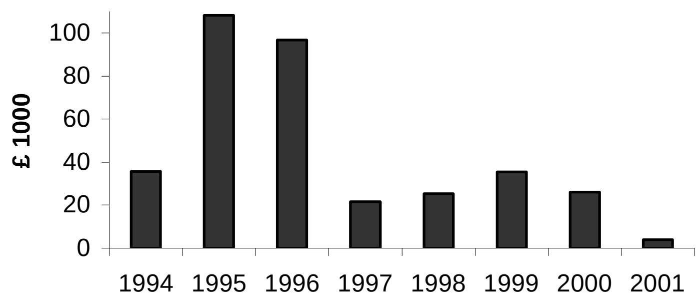

Figure 4. Loddington farm profits (1994 – 2001)

An opportunity exists to fund such environmental work under agri-environment schemes that are currently being reviewed within the UK. Agri-environment schemes such as England's Countryside Stewardship Scheme provide income for management of such habitats on farmland. However, these very rarely completely cover the costs of habitat management, so that there is still a net cost to the farmer. Because CSS agreements are for ten years, many farmers who entered the scheme when farm profits were high are now struggling to pay for the commitments within their agreements.

Current agri-environment policy is generally against rewarding farmers for conservation work that has already been carried out. However, this policy penalises farmers who have been managing land in an environmentally sensitive way, while rewarding those who carry out new conservation management. Recognition of this is resulting in a relaxation of this policy so that existing landscape features can be entered into CSS agreements. This has been the case with the riparian buffer strip at Loddington. However, this newly emerging policy diverts payments from creation of new habitats. Future policy should encourage farmers to explore potential for market led environmental management, while also adequately supporting the maintenance and creation of habitats for which there is no potential for income generation.

The set-aside area on farms could have a role to play here. State-funded environmental management could also be developed on set-aside land as the opportunity costs, and therefore necessary payments to farmers, would be lower. Many of the environmental problems associated with agriculture in lowland Britain are also experienced in other parts of Europe (Stoate et al., 2001). The results presented in this paper could therefore have considerable relevance to agricultural areas and policy elsewhere in Europe.

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