Enhancing biodiversity on arable farms in the context of environmental certification schemes

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DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS

We first recapitulate the methodologies developed in this thesis and the results obtained, based on the four applied indicators. This will be followed by an overview of all conclusions. Finally a proposal for a set of habitat management criteria for inclusion in an environmental certification scheme and possible approaches to practical implementation of these habitat management criteria will be given.

8.1 Discussion

Environmental certification schemes and on-farm biodiversity

In Chapter 2, four Dutch environmental certification schemes for arable farming were compared in relation to their effects on environmental quality and on-farm biodiversity. The methodology of these schemes and the completeness of the certification criteria were analysed with reference to five key aspects of arable farming practice: pesticide use, nutrient use, energy and materials consumption, water management and biodiversity. The certification schemes for both conventional and organic farming focused primarily on only two of these aspects: pesticide use and nutrient use. Compulsory criteria for biodiversity were lacking. In addition, the certification criteria employed were most often specified with reference to individual crops. An environmental certification scheme geared to the farm holding as a whole, rather than to crops, as is realised in organic farming, will have greater potential to improve both biodiversity and environmental quality. In this way, the continuity of habitat management regimes aiming at the improvement of the on-farm biodiversity can be guaranteed.

Another serious drawback of current certification schemes for parties further in the agro-production chain (auctioneers, retailers and consumers) is that there is no way of assessing the actual environmental gains, since most criteria are merely qualitative. Quantitative criteria should therefore be developed for all cited aspects of farming.

When this research on Dutch environmental certification schemes was carried out (Chapter 2), the EUREP Good Agricultural Practice (GAP) guidelines were relatively new and the certification agencies were only just starting to implement these proposed guidelines for food safety and sustainable agriculture. Today (2005), quite a number of European retailers subscribe to the EurepGAP guidelines (Source: www.eurep.org) or the

Sustainable Agriculture Initiative (SAI; Source: www.saiplatform.org). Despite these developments, the EurepGAP scheme still only includes on-farm biodiversity on a voluntary basis with qualitative criteria, although it does comprise the whole farm, since the label is subscribed to the farmer or even a group of farmers (EUREP, 2004). The Dutch environmental certificate 'Milieukeur' also includes the whole farm, although farmers do not have to include all crops cultivated on the farm. On-farm biodiversity in the 'Milieukeur' is, nowadays, part of a system of credits and contains criteria based on management regimes and the area of specific semi-natural habitats. This seems like an improvement. However, the credits can be easily achieved, since gardens, kitchen garden, nesting boxes and participation in Agri-environmental schemes can be included. Also, the subscribed areas of semi-natural habitats are relatively small.

After this comparative study of the current environmental certification schemes, this thesis focused on biodiversity at the level of the whole farm. Research regarding the other aspects of farming has been excluded from this thesis. In relation to the on-farm biodiversity, two important questions remain to be answered:

- What kind of biodiversity criteria can be included in environmental certification schemes for arable farming?
- Can these biodiversity criteria be practically implemented?

Criteria for on-farm biodiversity

If enhancement of on-farm biodiversity is to be included in environmental certification schemes, in principle, criteria can be based on the presence of specific species (species approach), or on the farm layout and management (habitat approach). As was discussed in the introduction and Chapter 4, the aim of this thesis was to develop biodiversity criteria applicable on all kind of farms. The species approach is then a rather difficult and time-consuming concept. Therefore, a habitat approach has been used to develop biodiversity criteria. This will offer a more robust system that is assumed to be easy to implement.

The first developed indicator for biodiversity (Chapter 3) was based on the total area of semi-natural habitat per farm, i.e. those areas with no intentional inputs of pesticides or nutrients and remaining undisturbed (e.g. aquatic, herbaceous and woody habitats). This indicator, which is also relevant for the landscape quality, was shown to be methodologically well measurable and was capable of differentiating between regions, farm management regimes and the presence of Agri-Environmental Schemes. It was therefore concluded that this indicator is feasible for inclusion in an environmental certification scheme.

The practical implementation of this indicator on Dutch arable farms showed that on average the area of semi-natural habitat per farm was overall quite low (2.1 ± 1.6). However, it was remarkable that farms in the traditional small-scaled landscapes, e.g. the sandy regions in Drenthe and Noord-Brabant, had a smaller amount of semi-natural habitat per farm compared with farms in modern landscapes such as the Veenkoloniën, the Wieringermeer Polder and the Haarlemmermeer Polder. The highest average percentage of semi-natural habitat per farm was found in the Veenkoloniën, a very open reclaimed-peat landscape. These differences are due to the outsourcing of ownership and management of

these semi-natural habitats to other parties concerned. In some Dutch regions, and particularly in the small-scale landscapes, most semi-natural habitat is owned by local authorities rather than by farmers (Chapter 3). Of course, in addition to farmers, other actors, e.g. municipalities, water boards and other local authorities, also should retain their own responsibility for maintaining and enhancing the biodiversity and landscape quality of agricultural landscapes. This would enable a linking of environmental certification schemes for individual farms to region-oriented initiatives that aim to improve the on-farm biodiversity within targets for sustainable development, spatial quality and multiple land-use (Graaf and Musters, 1998; Jansen *et al.*, 2005).

However, the minimum required acreage of semi-natural habitat per farms for inclusion in an environmental certification schemes has still to be defined. To enhance biodiversity, present guidelines for farm-based habitat management recommend that farmers manage at least 5% of their farmland as semi-natural habitat, in tandem with other measures (van Mansvelt and van der Lubbe, 1999; Smeding and Joenje, 1999; Vereijken, 1999; Visser, 2000). The results of this thesis showed that the 5% goal is rarely achieved, irrespective of farming practice, as evidenced on farms participating in field margin projects (Chapter 3 and 5). It became clear that the 5% criterion is only achieved in combination with Agri-Environmental Schemes. Thus, without additional payment, 5% semi-natural habitat area per farm is currently not achieved on most Dutch arable farms. Reaching 5% habitat area per farm would imply a doubling of the current farm area reserved for semi-natural habitats, for instance implying that on average field margin strips of at least 2 m wide have to be created on all fields per arable farm (Chapter 3). Nevertheless, in our opinion, the 5% criterion is a feasible starting point for improving biodiversity and can be included in an environmental certification scheme for farms. A further guideline is that the newly created habitat types should fit in the cultural history of the specific region as well as in the specific landscape type (Zonneveld, 1993; Dirkmaat, 2005) and increase landscape coherence (e.g. Opdam *et al.*, 1993 and Verboom *et al.*, 2001).

The enhancement of the area of semi-natural habitats on the farm is in principle a good starting point for improving biodiversity on farms. However, the area of semi-natural habitat gives no direct information about the ecological quality, such as species richness of habitats or the shelter site availability for birds and small mammals. To improve the relevance of the area indicator for on-farm biodiversity, in a second step the management of semi-natural habitats was taken into account for both plant and animal species.

For plant species (Chapters 4 and 6), the aim was to investigate the effectiveness of different management regimes on semi-natural habitats and crops, in order to include them in the environmental certification scheme. Therefore the relationship between management regimes, farming practices and the plant species richness was established for ditch banks.

For these habitats an optimum sampling area for plant species richness has been determined independent of the total farm area. Given that most semi-natural habitats in agricultural landscapes are linear, adopting a fixed sampling area created problems in terms of both practical application and analysis. For these linear habitats, consecutive plots of fixed length were taken so that the full ecological gradient of the habitat was included.

However, different sampling areas may have been found if a random sampling method had been used on the farm instead of a transect inventory. Random sampling can result in an higher overall species number (Higgs and Usher, 1980; Margules *et al.*, 1982). Therefore, to properly determine differences between the ditch bank plant species richness on the experimental farms and the other farms which differed in sampling method, also the plant species composition ad the nutrient requirements of the vegetation were taken into account.

The total plant species richness per habitat type was determined as a suitable response variable for comparing different farming practices, management regimes and regions (Chapter 4 and 6). Application of this response variable showed that ditch banks on organic farms had a significantly higher number of plant species than those on conventional farms (Chapter 6). This enhanced plant species richness on organic compared with conventional farms was also found in research elsewhere along hedgerows (Stopes *et al.*, 1995; Aude *et al.*, 2003 and 2004), in arable fields (Hald, 1999; Norton, 2002; Albrecht and Mattheis, 1998; Hyvönen *et al.*, 2003) and also holds for other species groups in arable fields such as insects and birds (Feber *et al.*, 1997; Wilson *et al.*, 1997; Azeez, 2000; Shepherd *et al.*, 2003; Hole *et al.*, 2005).

Also, an active ecological ditch bank management on experimental farms aiming at a reduction of nutrient input and vegetation biomass in combination with a buffer zone was investigated. The results showed that the plant species richness significantly increased within six years. It also led to a shift in plant species composition from very common to more less common or fairly rare species. This trend was also observed on the organic farms, but to a smaller extent. Under ecological management, a change in the vegetation composition was also seen from plant species indicative for nitrogen rich vegetation types to more plant species indicative of the intermediate and nitrogen poor vegetation types. Similar results were also found in hayfields and meadows (Olff and Bakker, 1991; Marrs, 1993; Bakker and Olff, 1995). The combination of the increase in plant species richness and the change in plant species composition (based on the rarity index and the Ellenberg nitrogen values) which was most marked in ecologically managed ditch banks on the experimental farms indicates that ecological ditch bank management might enhance plant species richness more than organic farming alone.

The results showed that the species diversity does differentiate in relation to management regimes, farming practices and regional or environmental variation, irrespective of farm size. So, it can be concluded that, for the environmental certification schemes for farms, a combination of the area indicator together with requirements on their management offers good possibilities to improve plant species richness on arable farms.

For animal species (Chapter 5), the research was also focused on the habitat requirements rather than on the presence of species themselves. The habitat requirements of the following farmland species were investigated: skylark (*Alauda arvensis*), partridge (*Perdix perdix*), harvest mouse (*Micromys minutus*) and hare (*Lepus europaeus*) for wintering or nesting. Until now the so-called shelter site availability has received little attention in international research. To assess on-farm shelter site availability for birds and small mammals, a model was developed based on the vegetation height and cover of semi-natural habitats and crops on farms through the year.

The model developed has proved useful for establishing key differences associated with management regimes, farming practices and implementation of Agri-Environmental Schemes at different times through the farming year. Potentially the model can contribute to further development of farming methods geared to improving biodiversity, although further ecological validation in the field is required. It can be used for overall assessment of farm holdings for the purpose of environmental labelling schemes.

Finally, it can be concluded that the indicators developed offer challenging possibilities to improve biodiversity within an environmental certification scheme for arable farms, which will be further discussed in section 8.3.

Implementation of environmental certification schemes including biodiversity

The comparison of the existing environmental certification schemes (Chapter 2) showed that biodiversity has not yet been included as a compulsory requirement in the organic label nor the other labels. This contrasts with pesticide use and nutrient use, which in fact have been included in all labels. The question remains why this is the case: is the interest from the agro-production chain lacking or is it not really important to the consumers, as opposed to what they say?

It seems logical that the difficulties to construct meaningful biodiversity indicators and habitat management requirements will surely be a reason for not including biodiversity criteria in environmental certificates. The present research aimed to solve this problem. But the results of this thesis also indicate that pesticide and nutrient use criteria were regarded as more important for farmers than criteria related to biodiversity. The question then is how to stimulate farmers to take a more proactive stance here.

To stimulate farmers, it will be necessary to stress the importance of reversing the decline of biodiversity as a result of the ongoing intensification of agriculture. This can then be coupled to the improvement of functional biodiversity, the preservation of the Dutch agricultural landscapes as well as the improvement of environmental quality. However, this is not only the responsibility of the farmer himself. Therefore, a starting point can be found in the relationship with other actors in the agro-production chain, since the two main reasons mentioned by farmers for participating in a certification scheme were ‘to improve the image of farming’ (society/people) and ‘requests by retailers/supermarkets’ (market/profit). From this, it can be concluded that other actors in the agro-production chain such as supermarkets, retailers and auctioneers have to act as important pull factors to enhance the inclusion of on-farm biodiversity in environmental certification schemes.

The growing number of retailers, food processing companies, food suppliers and distributors who participate in the SAI or EurepGAP shows that these initiatives are of importance in the agro-production chain. However, this is opposed to the slow-growing participation of farmers in organic or integrated farming labels as well as the lagging sale of organic food products in for instance the Netherlands. Several causes with a social, economic or other background may be found to explain this, however, these were beyond the scope of this research.

A possible approach to stimulate participation in such initiatives at all levels of the agro-production chain may be to show the perceived benefits for the consumers, processing

industries and farmers. Some examples of possible benefits for these actors are improved food quality and safety, a sound environment and maintenance of renewable resources (cf. Information Pack SAI; Unilever, 2002 and 2005; www.eurep.org). If we can increase consumers' awareness as well as participation of farmers, retailers, food processing industries and other actors in the agro-production chain, this will promote sustainable agriculture in environmentally and ecologically-sound surroundings.

8.2 Conclusions

Environmental certification schemes:

- Present certification schemes for both conventional and organic farming focused primarily on only two aspects of farming: pesticide use and nutrient use: compulsory criteria for on-farm biodiversity were lacking.
- For conventional farming, the criteria employed were most often specified referring to individual crops instead of the whole farm. This limits their usefulness, since the continuity of habitat management regimes aiming at the improvement of the on-farm biodiversity is not guaranteed.
- In most cases the criteria had a pass/fail character with mostly qualitative thresholds. To be able to assess the actual environmental gains after implementation of an environmental certification scheme, quantitative criteria should be developed for all cited aspects of farming.

Farm acreage of semi-natural habitat:

- The first indicator for biodiversity which has been developed in this research, was based on the total area of semi-natural habitat per farm, i.e. the aquatic, herbaceous and woody habitats which do not receive intentional inputs of pesticides or nutrients and which remain undisturbed. This indicator appeared to be easily measurable and was capable of differentiating between regions, farm practices and the presence of Agri-Environment Schemes.
- On Dutch arable farms 2.1% of the farm area was semi-natural habitat. Interestingly enough, the smallest average percentages of semi-natural habitat were found in Zeeland (0.7 ± 0.9) and the traditional small-scaled landscapes Drenthe (1.6 ± 1.1) and Noord-Brabant (0.9 ± 0.4). The highest average percentage of semi-natural habitat was found in the Veenkoloniën (4.0 ± 1.8), a region with large-scale agriculture.
- On farms participating in field margin projects, the average percentage of semi-natural habitat was higher, ranging from 5.3% up to even 7.3% in some cases.
- Ditch banks were the most common kind of semi-natural habitat on farms, followed by ditches, hedgerows and dry ditches.

Plant species richness

- To be able to propose effective additional requirements for the management of semi-natural habitats aiming at an increase of on-farm biodiversity, next to the area indicator, differences related to management regimes, farming practices and regional or environmental variation were investigated. Therefore, the total plant species richness per semi-natural habitat was used as a response variable. This parameter appeared to be able to determine differences in species richness related to regional variation and farming practices:
- Regional variation: the plant species richness of ditch banks on conventional farms was significantly higher on sandy soils than on clay soils.
- Farming practices: ditch banks on organic farms had a significantly higher number of plant species than those on conventional farms. On farms that had converted to organic farming more than 5 years ago, even more plant species were found, although this trend was not statistically significant.
- However, using the plant species as a response variable, no conclusive differences could be established between ditch banks on organic farms and ditch banks under an active ecological management and, therefore, the plant species composition and the nutrient requirements were taken also into account to establish the following conclusion:
    - the combination of the increase in plant species richness and the change in plant species composition (based on the rarity index and the Ellenberg nitrogen values) which was most marked in ecologically managed ditch banks on the experimental farms indicated that ecological ditch bank management might enhance plant species richness more than organic farming alone.

Shelter site availability for birds and small mammals

- For animal species additional habitat requirements were also proposed. These were focused on the availability of shelter sites for birds and small mammals on farms and were based on the vegetation height and cover of semi-natural habitats and crops in winter and summer.
- This indicator proved to be able to establish differences in shelter site availability associated with management regimes, farming practices and the implementation of Agri-Environmental Schemes or on-farm nature conservation schemes.
- Significant differences in shelter site availability appeared to exist between farms, but these were not clearly related to the different types of farms. Although the effectiveness of this indicator has yet to be validated ecologically, it was suggested that there is significant potential for its use and it should be included in an environmental certification scheme.
- A combination of the area indicator together with the above mentioned management requirements aiming at both flora and fauna is a challenging approach to improve biodiversity within an environmental certification scheme for arable farms.

Farmers' perception of environmental certification

- The main reasons cited by farmers for participating in a certification scheme were 'to improve the image of farming' and 'requests by retailers/supermarkets'. Therefore, the agro-production chain can play a key role in implementing an environmental certification scheme for sustainable farming on conventionally managed farms.
- Pesticide and nutrient use criteria were regarded as more important for farmers than criteria related to biodiversity.
- Farmers expressed a preference for a farmers' union or independent organisation to develop certification criteria and monitor on-farm implementation.
- Having semi-natural habitat on the farm was seen as equally important by all farmers, regardless of the percentage area of such habitat on their own farm.
- For creating new or extending the area of existing habitats on the farm, most farmers expressed a preference for field margin strips over hedgerows or other types of semi-natural habitat.
- Since the two main reasons mentioned by farmers for participating in a certification scheme were 'to improve the image of farming' (society/people) and 'requests by retailers/supermarkets' (market/profit), other actors in the agro-production chain have to act as important pull factors to enhance the inclusion of on-farm biodiversity in environmental certification schemes.

8.3 Recommendations

In this section criteria to enhance biodiversity are proposed for inclusion in an environmental certification scheme for arable farms as well as possible future applications.

To improve the acreage of semi-natural habitat on farms, the 5% goal is recommended for certification schemes (Table 1). Field margin strips are the most suitable habitats for filling in the 5% goal and these can also be linked to the shelter site availability for birds and small mammals. The selection of other habitat types, such as hedgerows or tree rows, should be related to the cultural history and landscape type of the region. Also, it is advised to improve the connectivity of existing on-farm habitats with habitats on the neighbouring farms and in the surrounding landscape where possible.

Additional criteria should aim to improve the on-farm biodiversity quality (Table 1). To increase plant species richness, two management criteria are proposed. Firstly, all semi-natural habitats on the farm should be protected against the negative impact of everyday farm management. To prevent nutrient misplacement and pesticide drift to adjacent semi-natural habitats, buffer zones are to be required depending on the method of application (e.g. Orleans *et al.*, 1994; de Snoo and de Wit, 1998; STOWA, 1998) following current legislation (V & W *et al.*, 2000). Secondly, an active ecological ditch bank management aimed at reducing nutrient input and vegetation biomass (mowing with removal of the cut grass) should be implemented on ditch banks buffered by field margin strips. In this case, field margins of 3 metre width are required to buffer nutrient leaching from the cropland.

Implementation of this management regime is to be continued for a minimum of five years to guarantee results.

Table 1: Habitat management criteria for inclusion in an environmental certification scheme based on the research performed in this thesis (Chapter 2 to 6).

Objective	Habitat type	Criteria for farm layout and management
Quantity:		
Habitat acreage		5% of semi-natural habitat per farm
Quality:		
Plant species richness	Ditch banks	Ecological management in ditch banks buffered with field margin strip
	Other habitats	Buffer zone according to legislation
Shelter site availability	Field margins and ditch banks	Creation of field margin strips
		Late mowing of several stretches of ditch bank in spring or no mowing in autumn

To improve shelter site availability for birds and small mammals, field margin strips can be created on farms spread out over the total farm area. A mixture of grasses and herbs might be used to create enough variation in vegetation height and cover in these field margin strips. Also, the ditch bank management can be adjusted to increase shelter site availability. Next to the ecological management, several stretches of ditch bank should not be mown in spring to create nesting sites and in late summer and autumn to create shelter and wintering sites.

These recommendations concerning the environmental certification of arable farms can be seen as a bridge between the agro-production and biodiversity. Other actors in the agro-production chain, such as supermarkets and retailers, can use the implementation of such a scheme to improve the image of agriculture and agricultural food products towards consumers by focusing on sustainable agriculture (cf. Unilever, 2002).

The proposed criteria for inclusion in an environmental certification scheme can also be used in other applications for improving on-farm biodiversity (de Snoo, 2004). Other options are the inclusion of these habitat management criteria in the EU cross-compliance (EEC Regulation 1259/1999), Agri-Environment Schemes (EEC Regulation 2078/92), green-blue services or socially responsible management (Maatschapelijk Verantwoord Ondernemen/Erfdienstbaarheden) (Stortelder *et al.*, 2001; de Snoo, 2004).

Beside positive effects on agriculture, we will also see other effects of the implementation of such a scheme. The agricultural landscape will become more attractive for everyone and recreation can become more important in these enriched agricultural landscapes. This will result in a more vital and dynamic countryside that will be of interest for farmers, citizens and other people that live in the countryside (Montijn, 2002; Dirkmaat, 2005). The on-farm implementation of such habitat management criteria may well be coupled to a contract period per farm to guarantee continuation of the proposed management regimes. The response variables and indicators for on-farm biodiversity

developed in this thesis can then be used to monitor the resultant impacts on biodiversity as well as farmer compliance with the set criteria.

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