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

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7

FARMERS´ PERCEPTIONS OF ON-FARM BIODIVERSITY IN THE CONTEXT OF ENVIRONMENTAL CERTIFICATION SCHEMES

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Accepted with revision in Journal of Environmental Management

Summary

This study evaluates farmers' perceptions of environmental certification schemes for sustainable arable farming. To this end, in seven regions of the Netherlands, 105 farmers were interviewed about their attitudes towards participating, or not participating, in an environmental certification scheme, about the inclusion of biodiversity criteria in such a certificate, and about their knowledge on enhancing on-farm biodiversity.

The two main reasons cited by farmers for participating in a certification scheme were 'to improve the image of farming' and 'requests by retailers/supermarkets'. It can be concluded that the agro-production chain can play a key role in implementing an environmental certificate for sustainable farming on conventionally managed farms. Most farmers were open to the idea of a certificate based on criteria for crop protection and nutrient use. One third of the farmers saw the importance of including criteria for habitat management. Asked what agency or agencies are best placed to develop certification criteria and monitor on-farm implementation, farmers expressed a preference for a farmers' union or independent organisation on both counts, with no role seen for government agencies.

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. However, ditch banks, the principal semi-natural habitat throughout much of the Netherlands, were considered 'less natural' than hedgerows. Asked if they would be prepared to create new or larger semi-natural habitat, most farmers expressed a clear preference for field margin strips, these being less permanent than hedgerows or ecologically remodelled ditch banks and easy to create and remove.

However, more education or guidance is necessary to improve farmers' awareness of the importance of properly managed ditch banks within an ecological network and to inform them about management

options for increasing plant species richness on ditch banks as well as enhancing species richness and habitat quality generally.

7.1 Introduction

To reduce the impact of intensive agriculture on environmental quality and biodiversity, several countries have introduced environmental certification schemes. The first of these was legalised in Europe in 1991 for organic farming (European Council, 1997). Later, a number of other environmental certification schemes were introduced for use in conventional agriculture (van Ravenswaay and Blend, 1997; EHI, 1998; ICA Handlarna, 1999; Albert Heijn, 1999). Most of the latter focused on crop protection and nutrient use per crop, with criteria for on-farm biodiversity lacking or implemented only on a voluntary basis (de Snoo and van de Ven, 1999, Manhoudt *et al.*, 2002).

In 1999 the so-called EurepGAP system of Good Agricultural Practice (EurepGAP) was introduced in Europe by supermarkets and retailers. This scheme, with guidelines on food safety and sustainable agriculture, provides a framework for certification of Good Agricultural Practices (Eurep, 1999; www.eurep.org). Some environmental certification schemes have incorporated the EurepGAP guidelines in their own certificate (Manhoudt *et al.*, 2002).

In the Netherlands, environmental certificates have been implemented by only a few farmers. No more than 1800 hectares of the Dutch farmland (less than 0.1% of total acreage) is certified under the agro-environmental certificate Agro-Milieukeur (Stichting Milieukeur, 2004). The crops most commonly produced under this certificate are ware potatoes and barley. At the moment only 2.1% of Dutch agriculture is organically certified, this figure has not risen significantly the last few years (Biologica, 2004), despite government efforts. There are several possible reasons, including anticipated paperwork, economic losses or uncertainties and impacts on everyday farm management.

In contrast to developments in the Netherlands, in Europe as a whole there has been a 9% increase in the amount of land organically managed due to a strong growth in France, Spain and the UK in 2003. In some countries, including Switzerland and Italy, over 5% of farmland is now organically managed and in Austria the figure is over 10%. In Europe, on average 3.5% of the agricultural area was managed organically in 2004 (Willer and Yussefi, 2004).

Besides the perceived economic impact of adopting an innovation like an environmental certification scheme, behavioural and information issues are also important (Hooks *et al.*, 1983; van der Meulen *et al.*, 1996). However, there is still little understanding of farmers' attitudes and motives vis-à-vis more sustainable forms of agriculture. The same holds for perceptions of environmental certification schemes in general, as reflected in farmers' ideas on development of certification criteria and monitoring of on-farm implementation.

The goal of this study is to evaluate farmers' attitude towards participation or non-participation in an environmental certification scheme for sustainable arable agriculture and towards inclusion of criteria to enhance on-farm biodiversity in such a certification scheme. More specifically, an answer was sought to the following research questions:

- What socio-psychological factors motivate farmers to participate, or not participate, in environmental certification schemes?
- What agencies do farmers think should be involved in developing such a certificate and monitoring on-farm implementation?
- What is the farmers' opinion about their own on-farm biodiversity, the importance of well-developed semi-natural habitats and the creation of new semi-natural habitats?
- Should such a certificate include criteria for on-farm biodiversity and other aspects of farming, according to farmers?
- Do farmers have the requisite knowledge for enhancing on-farm biodiversity?

7.2 Methods

General information

Farmers were visited in seven regions of the Netherlands differing in soil type, reclamation history and landscape type: Haarlemmermeer Polder, Wieringermeer Polder, Zeeland, Over-Betuwe, Veenkoloniën, Drenthe and Noord-Brabant. Landscapes ranged from open and strictly agricultural, as in the case of the Haarlemmermeer and Wieringermeer polders, to more varied with hedgerows and forests in the two sandy regions, Noord-Brabant and Drenthe (Zonneveld, 1993). In each region 15 farmers (with farms > 15 ha) were interviewed by means of a questionnaire about the semi-natural habitats on their farm and their views on implementation of an environmental certification scheme for arable farming. The survey was conducted between July and December 2000.

Questionnaire

The questionnaire was structured around questions on the following topics: farmer participation, or non-participation in a certification scheme and organisational aspects of such a certificate: inclusion of on-farm biodiversity criteria in the scheme and farmers' knowledge about enhancing biodiversity.

To evaluate farmers' attitudes towards (non)-participation in a certification scheme, a quantitative approach was adopted, with farmers being asked to rank options on a five-point Likert scale from 'important' to 'not important'. The options for participation were: 'to improve the image of farming', 'requests by retailers/supermarkets', 'consumer demand', 'to enhance biodiversity' and 'environmental benefits' and for non-participation: 'stricter regulations', excessive paperwork', high yield losses', 'too time-consuming' and no improvement of image'. A Kruskal-Wallis test was used (SPSS 11.0) to test for inter-regional differences.

Each farmer was also asked what aspects of farming should be included in such a certificate, e.g. crop protection, nutrient use, habitat management, water use or energy and materials use. They were also asked what agency or agencies should be responsible for developing certification criteria and monitoring on-farm implementation: government, supermarket/retailer, environmental/nature conservation organisation, farmers' union, consumer organisation or independent organisation.

With respect to on-farm biodiversity, farmers were asked to give the semi-natural habitats on their own farm a 'school' mark on a ten-point scale. A Chi-square test was used to test for any relationship between this score and the physical extent of such habitats on their own farm. Farmers were also asked to rate the importance they attach to well-developed semi-natural habitats on their farm, on a four-point scale, as well as the current biodiversity status of hedgerows and ditch banks on their farm, again on a four-point scale, now ranging from 'real nature' (4) to 'no nature at all' (1). A paired-sample t-test was used (SPSS 11.0) to determine which semi-natural habitat, i.e. ditch bank or hedgerows, was deemed more 'natural'.

In open questions the farmers were asked what they considered to be the best management options for enhancing plant species richness of ditch banks, whether they would be prepared to create new semi-natural habitats on their farm or extend existing habitats and what type of habitat they would prefer.

7.3 Results

Participation in an environmental certification scheme

Farmers cited two main reasons for participating in an environmental certification scheme: 'to improve the image of farming' and 'requests by retailers/supermarkets' (Table 1). There was no significant inter-regional difference, although farmers on sandy soils in Drenthe and Noord-Brabant were slightly less motivated to participate because of anticipated 'environmental benefits' (nearly significant, $P = 0.057$).

The main reasons for not participating in a certification scheme were 'stricter regulations' and 'excessive paperwork' and in six of the seven regions the first was cited as being most important. 'High yield losses', 'too time-consuming' and 'no improvement of image' were less important reasons for non-participation. No significant inter-regional difference was found for any of the five reasons.

When asked which of the cited aspects of farming should be included in an environmental certificate, 13 of the 105 respondents (12.4%) answered 'none'. The aspects most frequently cited by the others were crop protection and nutrient use (65.4% and 72.1%, respectively; Table 2). The aspect least frequently cited was habitat management (31.6% of farmers). Only minor regional differences were observed ($P < 0.05$), although in Drenthe there was a more negative response overall.

The agency most frequently cited as being favoured for developing criteria for an environmental certificate was the farmers' union (95% of farmers). It was generally cited by the farmers together with a second organisation, in particular a consumer's organisation (10.5% of farmers), environmental organisation (8.6%) or independent organisation (10.5%). To monitor on-farm implementation, 59% of the farmers favoured an independent agency, with 11.4% citing the farmers' union together with a second organisation. The majority of farmers (62%) also stated that on-farm audits should be announced in advance so they can prepare for the visit.

Table 1: Farmers' motives for (non-)participation in an environmental certification scheme (n = 100), ranked from 1 = important to 5 = least important (Likert scale).

	Haarlemmermeer Polder	Wieringermeer Polder	Zeeland	Over-Betuwe	Veenkoloniën	Drenthe	Noord-Brabant	The Netherlands
Participation:								
to improve image of farming	2.5 ± 1.4	2.5 ± 1.5	2.7 ± 1.2	2.4 ± 1.4	2.2 ± 1.7	1.9 ± 0.8	1.9 ± 1.0	2.3 ± 1.3
requests by retailers/supermarkets	2.5 ± 1.2	2.9 ± 1.6	3.1 ± 1.3	1.9 ± 1.3	2.3 ± 1.7	2.0 ± 1.2	2.1 ± 1.3	2.4 ± 1.4
consumer demand	3.0 ± 1.8	3.2 ± 1.4	2.5 ± 1.5	2.6 ± 1.6	2.9 ± 2.1	2.5 ± 1.5	2.7 ± 1.3	2.8 ± 1.6
to enhance biodiversity	3.0 ± 1.5	2.9 ± 1.2	3.1 ± 1.4	2.8 ± 1.6	1.9 ± 1.4	3.1 ± 1.0	3.4 ± 1.1	2.9 ± 1.3
environmental benefits	3.1 ± 1.1	2.8 ± 1.3	2.5 ± 1.2	2.7 ± 1.4	2.8 ± 1.4	3.6 ± 1.0 [a]	3.6 ± 0.9 [a]	3.0 ± 1.2
Non-participation:								
stricter regulations	2.2 ± 1.6	3.0 ± 1.0	1.8 ± 0.9	1.9 ± 1.5	2.2 ± 1.4	2.1 ± 1.4	2.0 ± 1.0	2.2 ± 1.3
excessive paperwork	2.3 ± 1.2	2.1 ± 1.5	2.5 ± 1.2	2.8 ± 1.2	2.4 ± 1.4	2.5 ± 1.5	2.3 ± 1.3	2.4 ± 1.3
high yield losses	2.6 ± 1.5	3.2 ± 1.6	3.7 ± 1.1	2.7 ± 1.5	3.5 ± 1.3	3.3 ± 1.4	2.5 ± 1.3	3.1 ± 1.4
too time-consuming	3.1 ± 1.3	2.7 ± 1.3	3.1 ± 1.5	3.5 ± 1.2	3.5 ± 1.6	3.2 ± 0.9	3.5 ± 1.2	3.2 ± 1.3
no improvement of image	3.7 ± 1.8	3.7 ± 1.3	3.6 ± 1.3	3.8 ± 1.4	3.4 ± 1.0	3.4 ± 1.2	4.1± 1.1	3.7 ± 1.3

[a] P = 0.057

Table 2: Percentages of farmers citing five aspects of farming for inclusion in an environmental certification scheme (n = 15 per region; total: 105 farmers).

	crop protection	nutrient use	habitat management	water use	energy and materials use
Haarlemmermeer Polder	86.7%	73.3%	40.0%	66.7%	40.0%
Wieringermeer Polder	86.7%	80.0%	53.3%	46.7%	33.3%
Zeeland	85.7%	92.9%	71.4%	78.6%	50.0%
Over-Betuwe	60.0%	66.7%	20.0%	14.3%	14.3%
Veenkoloniën	60.0%	53.3%	53.3%	40.0%	33.3%
Drenthe	40.0%	26.7%	14.3%	25.0%	18.2%
Noord-Brabant	86.7%	66.7%	53.3%	35.7%	28.6%
The Netherlands	65.4%	72.1%	31.6%	43.7%	44.4%

Biodiversity criteria

Most farmers considered it important to have semi-natural habitats on their farm, giving this an average score of 7.0 ± 1.3 on a ten-point scale. No relationship was found between the percentage area of semi-natural habitat on a farm (Manhoudt and de Snoo, 2003) and farmers' valuation of such habitat ($P = 0.93$; Figure 1).

In all regions most farmers described the current status of hedgerows and ditch banks on their farm as 'barely natural' (Figure 2). In four of the seven regions, however, hedgerows were ranked with a significantly higher quality than ditch banks ($P < 0.05$). This was also the case for the seven regions as a whole ($P < 0.001$), with hedgerows scoring an average 2.3 ± 0.7 compared with 1.9 ± 0.9 for ditch banks.

When farmers were asked whether they would be prepared to create new or larger areas of semi-natural habitat on their farm for the purpose of an environmental certificate, 17.1% responded negative. The majority (82.9%) expressed a preference for field margin strips in this respect (Table 3: 55.3%). Only a few farmers (9.8%) said they would be willing to remodel their ditch banks on more ecological lines, with a less pronounced gradient and wet or swampy areas. Other options mentioned by the farmers were pools, fallow land and the creation of corners with herbaceous vegetation on the fields.

When asked how the plant species richness of ditch banks might be improved, farmers cited a wide range of management options. These varied from doing nothing at all (21.9% of farmers) to changing the mowing regime, e.g. mowing more or less frequently, or later in the season (17.2% of farmers). About one-third of respondents (35.2%) said they had no wish to alter management patterns, nor to devise ways of enhancing plant species richness. Some farmers also feared greater weed pressure on adjacent fields and deterioration of ditch drainage capacity. Only 12.4% of the farmers cited mowing of ditch bank vegetation combined with removal of cuttings to reduce nutrient inputs and vegetation biomass as a means of enhancing plant species richness.

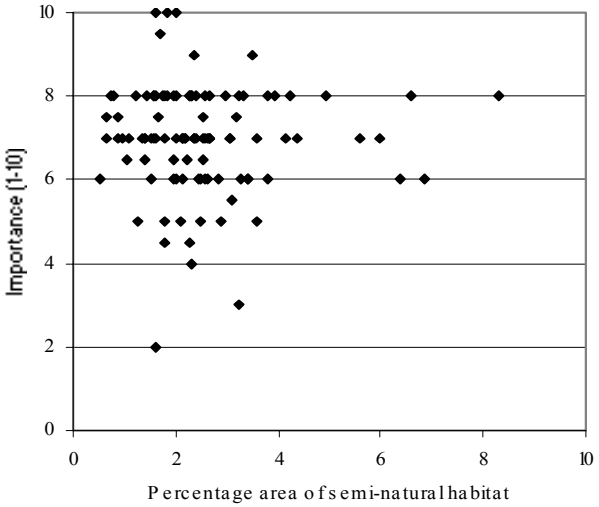

Figure 1: Importance attached by farmers to semi-natural habitats on their farm (10-point scale) vs. percentage area of such habitats on their farm (n = 105). Per-farm percentages of semi-natural habitat from Manhoudt and de Snoo (2003).

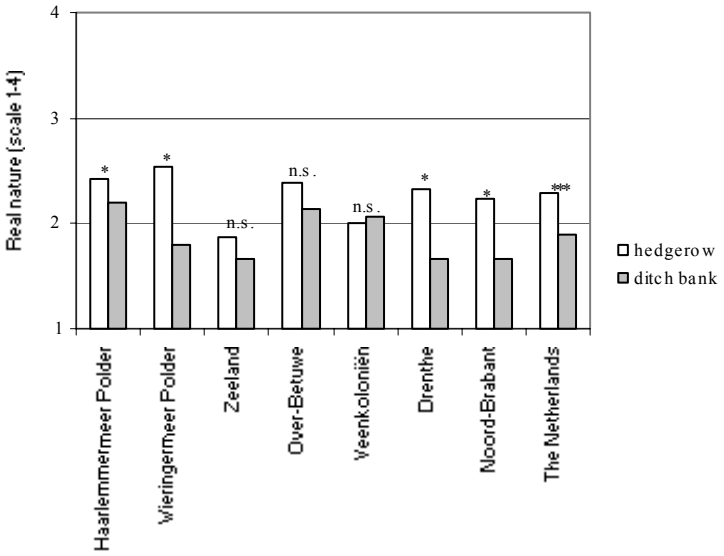

Figure 2: Average valuation of hedgerows and ditch banks on the following scale: 'real nature' (4), 'fairly natural' (3) 'barely natural' (2) and 'no nature at all' (1) with tested differences (n.s. = not significant; * = $P < 0.05$ and *** = $P < 0.001$).

Table 3: Farmers' preferences for new or lager areas of semi-natural habitat (percentage of farmers; n = 15; total: 105 farmers).

	field margin	hedgerow	remodelled ditch bank	others
Haarlemmermeer Polder	61.1%	22.2%	16.7%	0
Wieringermeer Polder	58.3%	8.3%	33.3%	0
Zeeland	40.7%	7.4%	14.8%	37.0%
Over-Betuwe	50.0%	37.5%	0	12.5%
Veenkoloniën	81.8%	9.1%	9.1%	0
Drenthe	45.8%	12.5%	0	41.6%
Noord-Brabant	73.3%	13.3%	0	13.3%
The Netherlands	55.3%	15.4%	9.8%	19.5%

7.4 Discussion

Participation in environmental certification schemes

Given farmers' attitudes towards participation in an environmental certification scheme, as described above, several actors in the agro-production chain, e.g. supermarkets or retailers, would seem to be very important for motivating farmers to participate (Udo de Haes and de Snoo, 1996 and 1997; de Snoo and van de Ven, 1999; Manhoudt *et al.*, 2002). In the agro-production chain, environmental certification schemes can be implemented as a delivery condition for farmers.

The most important reasons for not participating in such certification schemes were similar to those cited in other studies for farmers' non-participation in agri-environmental schemes. These included unwanted changes in farm management and additional restrictions on certain practices (Wilson, 1997). Criteria that directly affect or intensify farm management are therefore a bottleneck for participation. However, the amount of paperwork can be limited if a single system is adopted that can provide all relevant information to retailers, governments and other parties (Kragten and de Snoo, 2003).

Asked which aspect of farming should be included in an environmental certificate, farmers responded very positively on two issues: crop protection and nutrient use. This was probably because farmers must already meet standards on both accounts, under Dutch as well as European legislation. The respondents were less keen about inclusion of other aspects, which were given low scores. One-third of farmers were of the opinion that on-farm nature conservation should be included within a certification scheme, this still opens up scope for integrating habitat management criteria within such a scheme. The generally low response in Drenthe was probably due to farmers' poor experience with a local re-allotment geared to nature conservation and landscape development.

The government was not geared as the most suitable agency for developing certification criteria and monitoring on-farm implementation. These results showed that, to avoid conflicts, farmers wished to be involved in the setting of criteria via the farmers' union or otherwise an independent organisation.

Biodiversity criteria

No relation was found between the percentage area of semi-natural habitat on-farm (Manhoudt and de Snoo, 2003) and the farmers' valuation of such habitats. It can therefore be said that on-farm biodiversity is equally important to the majority of the farmers, regardless of the area of semi-natural habitat on their particular farm, although there are some positive and negative exceptions. It should be borne in mind, though, that farmers with plenty of semi-natural habitat on their own farm would be unlikely to give those habitats a low rating.

It was also striking that the most common semi-natural habitat, ditch banks, was deemed 'less natural' than hedgerows, which account only for a minor share of total farm area (Manhoudt and de Snoo, 2003). Functional as well as aesthetic aspects were probably important in this assessment. In connection to the aesthetic aspects Burel and Baudry (1995) have demonstrated that hedgerows are seen solely in terms of visual properties rather than their ecological importance. In line with this, it is to be queried whether farmers are aware of the importance of an ecologically managed infrastructure of ditch banks or hedgerows on their farm, although there is certainly potential for improvement (Marrs, 1993; Schippers and Joenje, 2002; Manhoudt et al, submitted). It is therefore important that farmers be properly informed about the importance of ecologically managed ditch banks and other semi-natural habitats for enhancing species richness and on-farm shelter site availability, as well as taking other measure to increase the potential for species dispersal in relation to the surrounding landscape (e.g. Opdam *et al.*, 1993; Burel and Baudry, 1995; Smallidge and Leopold, 1997; Verboom *et al.*, 2001; Geertsema, 2002; Manhoudt and de Snoo, submitted).

When asked about their preferences regarding the creation of on-farm habitats, most farmers cited field margin strips, a less permanent habitat that is readily implemented, as well as removed.

In other studies, it was proven that an active ecological management of ditch bank aiming at a reduction of nutrient input and vegetation biomass did increase plant species richness of ditch banks (Marrs, 1993; Schippers and Joenje, 2002; Manhoudt *et al.*, submitted). However, only 12.4% of the farmers knew this. Informing and guiding farmers on these issues would therefore seem to be a key element in any strategy to improve habitat management regimes, as well as render farming practices more sustainable (Wossink *et al.*, 1997; Koeijer *et al.*, 2002).

7.5 Conclusions

The two most important reasons cited by farmers for participating in an environmental certification scheme were, 'to improve the image of farming' and 'requests by retailers/supermarkets'. This means that the agro-production chain can play a key role in implementing an environmental certificate for sustainable farming on conventionally managed farms.

Most farmers were open to the idea of a certificate with criteria for crop protection and nutrient use. Also, one-third of farmers were of the opinion that on-farm nature

conservation could be included within a certification scheme. For developing certification criteria and monitoring on-farm implementation, the government was not seen as the actor of choice, with most farmers expressing a preference for the farmers' union or an independent organisation.

The presence of semi-natural habitats on the farm was equally important for all farmers, regardless of the percentage area of such habitats on their particular farm. However, ditch banks, the most common semi-natural habitat in almost every region of the Netherlands, were considered 'less natural' than hedgerows. When farmers were asked whether they would be prepared to create new or larger areas of semi-natural habitat, most expressed a preference for field margin strips above any other type of habitat. Such margins are less permanent than ecologically remodelled ditch banks and more readily created and removed.

However, more education or guidance seems necessary to increase farmer awareness of the importance of ecologically managed ditch banks within an ecological infrastructure, and inform them about management options for increasing plant species richness on ditch banks, as well as enhancing on-farm biodiversity and habitat quality generally.

Acknowledgements

We would like to thank all the farmers who cooperated in this research programme, Paul Vos for his statistical advice, Joke van der Peet for importing all interview data to Excel and Nigel Harle for editing the English manuscript.

References

Albert Heijn, 1999. Milieunormen voor aardappelen, groenten en fruit. Zaandam.

Biologica, 2004. EKO-Monitor nr. 17 De biologisch landbouw in cijfers. Biologica The Netherlands.

Burel, F., Baudry, J., 1995. Social, aesthetic and ecological aspects of hedgerows in rural landscapes as a framework for greenways. Landscape and Urban Planning 33, 327-340.

EHI (EuroHandelsinstituts e. V.), 1998. Fruit and Vegetables from Flanders Integrated Crop Management Fruit and Vegetable. DHI Germany.

EUREP (Euro-Retailer Produce Working Group), 1999. GB-GAP Protocol 2000, Eurohandels-institute e.V., Cologne.

European Council, 1997. Council Regulation (EEC) No. 2092/91 on organic production of agricultural products and indications referring hereto on agricultural products and foodstuffs (OJ L 198, 22.7.1991; Bull. 6-1991), as last amended by Regulation (EEC) No 1488/97: OJ L 202, 30.7.1997.

Geertsema, W., 2002. Plant survival in dynamic habitat networks in agricultural landscapes. PhD-thesis, Wageningen University.

Hooks, G.M.. Napier, T.L., Carter, M.V., 1983. Correlates for adoption behaviours: The case of farm technologies. Rural Sociology 48, 308-323.

ICA Handlarna, 1999. ICA Handlarnas AB Annual Report 1999. Source: www.ica.se.

Kragten, S., Snoo, G.R. de, 2003. Benchmarking environmental impacts of pesticide use. In: Ghent University, 2003. 55th International Symposium on Crop Protection, Universiteit Gent, Belgium.

Koeijer, T.J. de, Wossink, G.A.A., Struik, P.C., Renkema, J.A., 2002. Measuring agricultural sustainability in terms of efficiency: the case of Dutch sugar beet growers. Journal of Environmental Management 66, 9-17.

Manhoudt, A.G.E., Ven, G.W.J. van de, Udo de Haes, H.A., Snoo, G.R. de, 2002. Environmental labelling in the Netherlands; a framework for integrated farming. Journal of Environmental Management 65, 269-283.

Manhoudt, A.G.E., Snoo, G.R. de, 2003. A quantitative survey of semi-natural habitats on Dutch arable farms. Agriculture, Ecosystem and Environment 97, 235-240.

Manhoudt, A.G.E., Udo de Haes, H.A., Snoo, G.R. de, 2005. An indicator of plant species richness of semi-natural habitats and crops on arable farms. Agriculture, Ecosystem and Environment 109, 166-174.

Manhoudt, A.G.E., Snoo, G.R. de, submitted. Availability of shelter sites for small mammals and birds on Dutch organic and conventional farms. Submitted.

Marrs, J.H., 1993. Soil fertility and nature conservation in Europe: theoretical considerations and practical solutions. Advances in Ecological Research 24, 241-300.

Meulen, H.A.B. van der, Snoo, G.R. de, Wossink, G.A.A., 1996. Farmers' perception of unsprayed crop edges in the Netherlands. Journal of Environmental Management 47, 241-255.

Opdam, P., Apeldoorn, R. van, Schotman, A., Kalkhoven, J., 1993. Population responses to landscape fragmentation. In: Vos, C.C., Opdam, P. (eds.), 1993. Landscape Ecology of a Stressed Environment. Chapman and Hall, London, pp. 147-171.

Ravenswaay, E.O. van, Blend, J., 1997. Using ecolabelling to encourage adoption of innovative environmental technologies in agriculture. Staffpaper No. 97-19 Michigan state University Michigan US.

Schippers, P., Joenje, W., 2002. Modelling the effect of fertiliser, mowing, disturbance and width on the biodiversity of plant communities of field boundaries. Agriculture, Ecosystem and Environment 93, 351-365.

Smallidge, P.J., Leopold, D.J., 1997. Vegetation management for the maintenance and conservation of butterfly habitats in temperate human-dominated landscapes. Landscape and Urban Planning 38, 259-280.

Snoo, G.R. de, Ven, G.W.J. van de, 1999. Environmental themes in ecolabels. Landscape and Urban Planning 46, 179-184.

Stichting Milieukeur, 2004. Jaarverslag 2003. Den Haag The Netherlands.

Udo de Haes, H.A., Snoo, G.R. de, 1996. Companies and Products: Two Vehicles for a Life Cycle Approach? International Journal of Life Cycle Assessment 1, 168-170.

Udo de Haes, H.A., Snoo, G.R. de, 1997. The agro-production chain: environmental management in the agricultural production-consumption chain. International Journal of Life Cycle Assessment 2, 33-38.

Verboom, J., Foppen, R., Chardon, P., Opdam, P., Luttikhuizen, P., 2001. Introducing key patch approach for habitat networks with persistent populations: an example for marshland birds. Biological Conservation 100, 89-101.

Willer, H., Yussefi, M. (eds.), 2004. The World of Organic Agriculture-Statistics and Emerging Trends-2004. IFOAM Germany.

Wilson, G.A., 1997. Factors influencing farmer participation in the Environmentally Sensitive Areas Scheme. Journal of Environmental Management 50, 67-93.

Wossink, G.A.A., Buck, A.J. de, Niejenhuis, J.H. van, Haverkamp, H.C.M., 1999. Farmer perceptions of weed control techniques in sugar beet. Agricultural Systems 55, 409-423.

Zonneveld, J.I.S., 1993. Levend Land. De Geografie van het Nederlandse Landschap. Bohn Stafleu Van Loghum Nederland.