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

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A QUANTITATIVE SURVEY OF SEMI-NATURAL HABITATS ON DUTCH ARABLE FARMS

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Summary

To enhance biodiversity, guidelines for farm-based nature management recommend that farmers manage at least five per cent of their land as semi-natural habitat, in tandem with other measures. Semi-natural habitats are defined here as those areas of a farm that are non-productive, i.e. areas with no intentional inputs of pesticides or manure and remaining effectively undisturbed. Reliable information on the actual amount of semi-natural habitat on arable farms was lacking, however. To address this lacuna the absolute and relative area of such habitats was assessed on 105 arable farms in seven regions of the Netherlands.

The results on the national level, showed that on conventional Dutch arable farms 2.1% of the holding was managed as semi-natural habitat, a disappointing figure. No marked interregional differences were found, reflecting the high intensity of land use throughout the country. On average, 1.7% of farm holdings were taken up by farmyards, buildings and farm roads and 96.2% by cropped land. Ditch banks were the most common semi-natural habitat on the farms, followed by ditches, hedgerows and dry ditches. Farms participating in field margin projects maintained $5.3 \pm 2.7\%$ as semi-natural habitat, twice the average figure compared to $2.4 \pm 0.8\%$ without the field margins. Comparing conventional with integrated and organic farms revealed no essential difference in the relative amount of semi-natural habitat on each type of farm. In addition to quantitative criteria, targets should also be set for the intended quality of semi-natural habitat implementing both in environmental certification schemes for farms and farm produce.

3.1 Introduction

Throughout Europe there has been a major decline in the biodiversity in agricultural landscapes, a result of the growing industrialisation and intensification of agriculture (e.g. Baldock, 1990; Fuller *et al.*, 1995; Andreassen *et al.*, 1996; Delbeare *et al.*, 1998). European governments have therefore introduced several amendments to improve biodiversity and environmental quality in the current agricultural practices, as set out in CAP and Agenda 2000 documents (European Commission, 1992; 1997). Several countries have also introduced national environmental schemes, as the United Kingdom (MAFF, 1994), the Netherlands (LNV, 1997; LASER, 2000) and Sweden (Swedish Board of Agriculture, 2001).

Within the agro-production chain itself, incentives to encourage more sustainable agriculture have been introduced by retailers (EUREP, 2001a; 2001b), the food industry (SAI, 2002) and farmers, either through certification of agricultural holdings (Udo de Haes and de Snoo, 1996) or through labelling of agricultural crops (de Snoo and van de Ven, 1999; Manhoudt *et al.*, 2002). Most of the criteria used in current product labels relate to pesticide and nutrient use, whereas criteria relating to on-farm biodiversity are generally lacking (Manhoudt *et al.*, 2002).

To promote on-farm biodiversity, targets can be set at either the species or habitat level. In the first approach, species diversity is defined in terms of target or indicator species (Vanpeene Bruhier *et al.*, 1998; Holland and Fahrig, 2000; Jobin *et al.*, 2001). In the second, targets are set for semi-natural habitats, accompanied by quantitative and qualitative criteria e.g. acreage, spatial layout and management of specific habitats. This study examines the situation in the Netherlands based the habitat-oriented approach and is concerned specifically with quantitative aspects.

To enhance biodiversity, most studies recommend for integrated and organic farms that a minimum of 5% of total farm area be reserved for semi-natural habitats (Boatman *et al.*, 1999; van Mansvelt and van der Lubbe, 1999; Smeding and Joenje, 1999; Vereijken, 1999; Visser, 2000). For olive groves in the Mediterranean region, targets of 4 - 8% have been recommended (Kabourakis, 1996) and a figure of 5% have been recommended for arable farms in Europe (Vereijken, 1999; Smeding and Joenje, 1999; Boatman *et al.*, 1999). Only in Switzerland legislation has been introduced, whereby organic and integrated farms must maintain 7% of their holding as semi-natural habitat to be entitled to the so-called ecological compensation (Bundesamt für Landwirtschaft, 2001). However, there has been little actual surveying of the area of semi-natural habitat found on arable farms. Although there are some quantitative data on the situation on organic and integrated farms (Smeding *et al.*, 2001; Vereijken, 1995 and 1999), similar data on conventional farms are lacking.

The present study aims at estimating the amount of semi-natural habitat on conventionally managed arable farms in the Netherlands. Semi-natural habitats were surveyed on 105 farms in seven regions of the Netherlands characterised by different types of landscape. The results obtained were regionally averaged, weighted and extrapolated to yield an estimate for the country as a whole. Options for increasing the area of semi-natural habitat on arable farms were discussed and our results were compared with data from other European countries.

3.2 Methods

Semi-natural habitats were defined as those areas of a farm that are non-productive, i.e. areas with no intentional inputs of pesticides or nutrients and remaining undisturbed (e.g. aquatic, herbaceous and woody habitats).

Seven regions differing in soil type and land reclamation history were selected as representatives of arable farming in the Netherlands: Haarlemmermeer Polder (marine clay; reclamation 1855), Wieringermeer Polder (marine clay; reclamation 1930), Zeeland (clay; reclamation pre-1600), Veenkoloniën (reclaimed peat, reclamation 1800-1950), Overbetuwe (river clay), Drenthe (sand) and Noord-Brabant (sand). In each region, 15 farms were randomly selected with at least 15 hectares of land under crop. This total of 105 farms represents about 1% of Dutch arable farms (CBS, 2000a). Included in the sample were 18 farmers who participated in field margin projects in which field margins were sown with herbs and grasses (only in the Haarlemmermeer Polder and Zeeland).

The acreage of semi-natural habitat on each farm was measured in the field. A field was defined as a unit of land use (one user, one set of agricultural practices) bounded by a semi-natural habitat or road (adapted from LeCoeur *et al.*, 2002). The width of all habitats, including ditch banks, was measured horizontally. In the case of woody habitats, horizontal tree crown projection was determined. The cropped area and the area occupied by farmyards, buildings and roads were also established and all figures expressed as a percentage of total farm acreage averaged for each region. On farms participating in field margin projects, the area of field margins sown was recorded separately, as well as the percentage of semi-natural habitat maintained before and after joining the project. In addition, the average field margin width required to increase the area of semi-natural habitat to five per cent on all farms was calculated.

Since ditches in Zeeland and hedgerows in Drenthe and Noord-Brabant were neither the property nor the responsibility of farmers, two average percentages were calculated in every region: 1) semi-natural habitat on land owned or managed by the farmer himself (henceforth, 'under farm management') and 2) total semi-natural habitat under farm management, including the semi-natural habitat bordering on the farm holding on land formerly part of the farm holding and now managed by others (henceforth, 'under extended management').

To estimate the average percentage of semi-natural habitat on arable farms in the Netherlands, the sample data were weighted according to the number of arable farms in the region concerned (CBS, 2000a). Each region was assigned a calculated average percentage according to the type of landscape, based on the sample. To investigate interregional differences, one-way ANOVA Least Significant Difference (LSD) analysis was applied (Manly, 2001; Oude Voshaar, 1995). For the relative data a logistic transformation was used and for the absolute data a logarithmic transformation ($Y+1$) (Sokal and Rohlf, 1981). Only significant differences between regional results and distinctive, non-overlapping groups were reported. When only one region differed significantly from the others, the statistical test was repeated with this region excluded, to assess whether a further subdivision of non-overlapping groups was possible.

3.3 Results

On the 105 farms visited, an average of 2.1% of the land was managed as semi-natural habitat (Table 1). Zeeland scored significantly lower than the other six regions investigated. When this region was excluded, three separate clusters of regions could be distinguished of which: 1) Veenkoloniën had a high, 2) Drenthe and Noord-Brabant a low, and 3) Haarlemmermeer Polder, Wieringermeer Polder and Overbetuwe an intermediate percentage of semi-natural habitat per farm.

Table 1. Average semi-natural habitats, farmyard, buildings and roads and crop area under regular and extended management (percentages \pm s.d.) and the holding area (hectare) in seven Dutch regions as for the complete sample (logistic transformation, One-way ANOVA LSD; same letter = no significant difference between averages; * = $P < 0.05$; ** = $P < 0.01$).

Regions considered	Total holding area (ha)	Crop area	Farmyard, buildings and roads	Semi-natural habitat – regular	Semi-natural habitat – extended
Haarlemmermeer	54.6 \pm 21.9	95.1 \pm 1.6	2.5 \pm 1.3	2.4 \pm 0.6 ^a	ditto
Wieringermeer	60.1 \pm 14.7	95.7 \pm 1.8	1.6 \pm 0.6	2.7 \pm 1.4 ^a	ditto
Zeeland	57.8 \pm 23.5	97.5 \pm 1.2	1.7 \pm 1.1	0.7 \pm 0.9 ^{**}	2.2 \pm 0.7
Overbetuwe	66.1 \pm 34.4	96.1 \pm 2.6	1.7 \pm 1.5	2.2 \pm 1.5 ^a	ditto
Veenkoloniën	64.0 \pm 37.8	94.6 \pm 2.1	1.4 \pm 0.8	4.0 \pm 1.8 ^b	ditto [*]
Drenthe	90.4 \pm 39.6	97.5 \pm 1.3	0.9 \pm 0.4 [*]	1.6 \pm 1.1 ^c	2.3 \pm 1.0
Noord-Brabant	40.3 \pm 22.5	96.9 \pm 1.5	2.2 \pm 1.2	0.9 \pm 0.4 ^c	1.9 \pm 0.9
Average	60.0 \pm 29.4	96.2 \pm 2.0	1.7 \pm 1.1	2.1 \pm 1.6	2.5 \pm 1.3

When land under extended management was included, farms in the Veenkoloniën again had significantly more such habitats than in other regions and no other differences were found. An average of 2.5% semi-natural habitat per farm was obtained for the Netherlands as a whole. On average, 1.7% of farm holdings were taken up by farmyards, buildings and farm roads; except in Drenthe with a significantly lower percentage. Extrapolation of the sample data to the whole of the Netherlands yielded lower overall percentages of semi-natural habitat of respectively $1.6 \pm 0.4\%$ and $1.7 \pm 0.4\%$ for farm and extended management, due

Table 2. Area of each semi-natural habitat per farm and total area (median, 25th and 75th quartile in hectare) in seven Dutch regions as for the complete sample (logarithmic transformation, One-way ANOVA LSD; same letter = no significant difference between averages; * = $P < 0.05$; ** = $P < 0.01$).

Regions considered	Hedgerow	Ditch bank	Dry ditch	Ditch	Others	Total area
Haarlemmermeer	0.1 (0-0.1)	0.6 (0.6-0.9) ^a	< 0.1	0.4 (0.3-0.5)	< 0.1	1.1 (0.9-1.5)
Wieringermeer	0.4 (0.2-0.6) [*]	0.8 (0.6-0.9) ^a	< 0.1	0.2 (0.1-0.3)	< 0.1	1.6 (1.2-1.8)
Zeeland	0.1 (0-0.1)	< 0.1 ^{**}	< 0.1	< 0.1 ^{**}	0.1 (0-0.3)	0.2 (0.1-0.4) ^a
Overbetuwe	< 0.1	0.4 (0.3-0.7) ^a	< 0.1	0.3 (0.3-0.5)	< 0.1	1.0 (0.6-1.4)
Veenkoloniën	< 0.1	1.0 (0.5-2.2) ^a	< 0.1	0.4 (0.2-2.1)	< 0.1	1.5 (0.9-4.4)
Drenthe	< 0.1	0.1 (0-0.3) ^b	0.3 (0.2-0.5) ^b	< 0.1 ^a	< 0.1	0.8 (0.6-1.5)
Noord-Brabant	< 0.1	< 0.1 ^b	0.1 (0.1-0.2) ^b	< 0.1 ^a	< 0.1	0.3 (0.2-0.3) ^a
Average	< 0.1	0.4 (0.1-0.8)	< 0.1	0.1 (0-0.4)	< 0.1	0.9 (0.4-1.5)

to the high number of farms in Drenthe, Noord-Brabant and Zeeland with comparatively little semi-natural habitat.

In absolute terms, farms in Zeeland and Noord-Brabant were found to have significantly less semi-natural habitat than other regions (Table 2). The average acreage of ditch banks and ditches on farms in Zeeland was significantly lower than on farms elsewhere. In Drenthe and Noord-Brabant, there was a significantly lower acreage of ditches and ditch banks, with dry ditches accounting for a greater amount of semi-natural habitat, as for hedgerows in the Wieringermeer Polder.

With respect to linear semi-natural habitats (Table 3), the average arable farm in the Netherlands had about 4 km of both ditch bank and ditch. In Zeeland, the length of ditch banks and ditches is significantly lower than elsewhere, with the two sandy regions as an intermediate group. With respect to dry ditches, only Noord-Brabant scored significantly higher.

Table 3: Length (median, 25th and 75th quartile in kilometres) of the most frequent linear semi-natural habitats per farm in seven Dutch regions as for the complete sample (logarithmic transformation, One-way ANOVA LSD; same letter = no significant difference between averages; ** = $P < 0.01$; *** = $P < 0.001$).

Regions considered	Hedgerow	Ditch bank	Dry ditch	Ditch
Haarlemmermeer	0.1 (0-0.2)	3.8 (2.9-4.5) ^a	< 0.1	3.8 (2.9-4.5) ^a
Wieringermeer	0.2 (0.2-0.3) ^b	3.9 (3.2-5.0) ^a	< 0.1	2.9 (1.9-3.9) ^a
Zeeland	< 0.1 ^b	< 0.1 ^{***}	< 0.1	< 0.1 ^{**}
Overbetuwe	< 0.1	6.5 (3.6-8.3) ^a	< 0.1	5.6 (4.0-8.6) ^a
Veenkoloniën	< 0.1	7.3 (4.2-10) ^a	< 0.1	7.3 (4.2-10) ^a
Drenthe	< 0.1	0.8 (0.3-1.6) ^b	0.6 (0-2.9)	0.8 (0.3-1.6) ^b
Noord-Brabant	< 0.1	0.3 (0-0.5) ^b	1.0 (0.6-2.1) ^{**}	0.3 (0-0.5) ^b
Average	0.1 (0-0.2)	3.6 (1.7-5.7)	< 0.1	3.5 (1-5.1)

On farms participating in field margin projects the average percentage of the holding maintained as semi-natural habitat was twice the average figure: $5.3 \pm 2.7\%$ compared with $2.4 \pm 0.8\%$. To reach a figure of 5% of semi-natural habitat on Dutch farms, field margins with an average width of 2.1 metres (s.d. = 1.8) would be required.

3.4 Discussion and conclusions

The present survey indicated that conventional farms in the Netherlands had an average of 2.1% of the land as semi-natural habitat, only a small proportion of the farm. In Zeeland, where ditch banks and ditches are owned and managed by local authorities, semi-natural habitats on farms were significantly lower than in other regions. Including adjacent semi-natural habitat on land formerly managed by farmers depressed interregional differences with only the Veenkoloniën deviating significantly, due to the wider ditches, as reclamation was undertaken here for the extraction of peat and an extensive network of waterways constructed for transportation (Lambert, 1985).

Although the farms investigated were located in a wide variety of Dutch landscapes with various soil types and reclamation histories, no clear interregional difference was found in the amount of non-productive land per farm. Apparently land use in the Netherlands is highly intensive, due to the relatively high price of real estate compared with other European countries (CBS, 2000b).

Dutch organic farms on clay soils had similarly low areas of non-productive land, according to Smeding *et al.* (2001) (1.5% for 8 farms) and Vereijken *et al.* (1995; 1999) (2.3% without ditches, for which about 0.8% may be added). On integrated farms, the area of non-productive land per holding ranged from 1 to 2% (Vereijken, 1995). These data are basically similar to those obtained here for conventional farms. There seems to be no difference between conventional, integrated and organic management, in terms of the area of non-productive land maintained on Dutch farms.

Precise data about the amount of non-productive land in other European countries are only available for Switzerland, where both organic and integrated farms have an average 8% (Bundesamt für Landwirtschaft, 1999). (Vereijken, 1995). For integrated arable farms ranges of 2 - 12% for France, 1 - 4% for Poland and 3 - 6% for Baden-Württemberg and 1 - 7% for Nordrhein Westfalen (Germany) were found, whereas for organic farms the amount of non-productive land ranged from 2 - 4% in Belgium and 3 - 9% in Ireland. So the amount of non-productive land in other European countries is probably comparable to Dutch arable farms, but more research is required.

The average figure of 2.1% for the area of semi-natural habitat obtained on Dutch farms shows that the five per cent criterion set for the Netherlands (Smeding and Joenje, 1999) is far from being achieved. On conventional farms participating in field margin projects, the average area of semi-natural habitat (5.3%) was more than twice as high. On organic farms where similar regimes were introduced, the average area of semi-natural habitat has doubled, from 3.1% to 6.3% (Vereijken, 1999). To achieve the goal of the five per cent criterion on conventional farms in the Netherlands, field margins with a width of at least 2.1 metres will have to be established throughout.

Within the framework of sustainable farming, it seems feasible to increase the area of semi-natural habitats to five percent of the total farm acreage, as the field margin projects have demonstrated, although this implies a doubling of the area of semi-natural habitat per farm.

The mere area of semi-natural habitat on a farm holding provides no guarantee that these habitats are of an ecological quality contributing to biodiversity on the farm. Targets should therefore also be set for the intended quality of specific semi-natural habitats, implementing these as part of an environmental labelling scheme for farms and their produce (de Snoo and Van de Ven, 1999; Manhoudt *et al.*, 2002; Vereijken, 1999; Van Mansvelt and Van der Lubbe, 1999). To this end, guidelines should be issued on the management and spatial layout of each type of semi-natural habitat (Udo de Haes *et al.*, 1997; Van Mansvelt and Van der Lubbe, 1999; Opdam, 2002).

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