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Self-initiated nature conservation by farmers: an analysis of Dutch farming

Hens Runhaar [a,b], Nico Polman[c] and Marijke Dijkshoorn-Dekker[c]

[a]Forest and Nature Conservation Policy Group, Wageningen University and Research, Wageningen, Netherlands; [b]Environmental Governance Group, Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, Netherlands; [c]Wageningen Economic Research, Wageningen University and Research, The Hague, Netherlands

ABSTRACT

In Europe, the active contribution of farmers to nature conservation is mainly voluntary. Whereas participation in agri-environmental schemes (AES) has been studied in detail, less is known about self-initiated nature conservation. Given the alarming decline in species diversity and abundance in agricultural landscapes, it is important to explore this form of conservation in more detail. In this paper we report on the results of a survey of Dutch dairy and arable farmers. We conclude that a large majority of farmers conduct self-initiated conservation activities on their farmyards and fields with varying ecological impacts and impacts on farming system. Helping birds was the most often mentioned activity. Farm size, on-farm side activities (in dairy farming), organic farming, the quality of the surrounding area and the absence of external constraints have a positive effect on the number of activities. Intensity has a negative effect on both the number of activities and on the probability that farmers conduct activities with substantial ecological impacts. There is no unambiguous evidence of a 'crowding-out effect' due to participation in AES. More research in this area can help contributing to a maximal exploitation of the conservation potential by farmers and to creating synergies with agri-environmental policies.

KEYWORDS

Agriculture; agrobiodiversity; self-governance; voluntary conservation; the Netherlands

1. Introduction

Trends in species abundance and diversity in European agricultural landscapes (hereafter: agrobiodiversity) are worrisome, as a consequence of agricultural intensification as well as land abandonment (EEA, 2015a, 2015b; Ollerton, Erenler, Edwards, & Crockett, 2014; Sanderson, Kucharz, Jobda, & Donald, 2013; Stoate et al., 2001). Agri-environment schemes (AES) and other forms of public and private governance of agrobiodiversity have not been able to reverse these trends (e.g. Gamero et al., 2016; Runhaar et al., 2017). One of the most often mentioned reason is the *voluntary* element in nature conservation by farmers (Runhaar et al., 2017). European Union and Member State agricultural policies do prescribe limits to environmental pressures from agriculture, which indirectly affect agrobiodiversity. Yet, few and not very strict regulations apply to habitat conservation, whereas an active contribution to nature conservation (e.g. in the form of participation in AES) is up to farmers themselves (Pe'er, Dicks, Visconti, Wulf, & Scott, 2014; Runhaar et al., 2017).

The voluntary character of nature conservation by farmers has attracted much research on the motivations of farmers to engage in nature conservation activities and on the barriers that farmers face. Various studies have addressed these themes in the context of farmers' participation in AES (e.g. Lokhorst,

CONTACT Hens Runhaar hens.runhaar@wur.nl
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Staats, van Dijk, & de Snoo, 2011; Murphy, Hynes, Murphy, & O'Donoghue, 2014; Peerlings & Polman, 2004, 2009; Polman & Slangen, 2008; Riley, 2011; Smits, Driessen, & Glasbergen, 2008; Westerink, Melman, & Schrijver, 2015). AES is not fully self-initiated because the measures themselves are predetermined by government (Runhaar et al., 2017), however: participation in AES is voluntary. Literature suggests conservation measures in AES that have the highest ecological potential are also the hardest to integrate into modern farming systems (Westerink et al., 2015). Self-initiated nature conservation activities could be easier to integrate in farming systems than AES measures because farmers develop these activities themselves. As a consequence, self-initiated conservation might be implemented at a larger scale than AES (also in view of the limited budgets for AES). It could be even a more heterogonous form of conservation because there is no formal coordination on design. However not that many studies have been conducted on voluntary self-initiated nature conservation by farmers outside AES and the available studies often are case-study based (e.g. Buizer, Arts, & Westerink, 2015; Runhaar & Polman, 2018; Triste et al., 2018; Westerink et al., 2015) or based on choice experiments (e.g. Greiner, 2015).[1]

This paper aims to complement the above studies by surveying a larger set of farmers in order to identify their activities related to self-initiated nature conservation by addressing the following research questions:

1. What self-initiated conservation activities are conducted by farmers, next to AES?
2. What factors explain which and how many self-initiated nature conservation activities are conducted?

We will focus on the Netherlands. In this country, agrobiodiversity continues to be threatened and species abundance has dropped at even higher rates than elsewhere in Europe (e.g. CBS, 2015; CBS et al., 2012; EEA, 2015a, 2015b) despite a long history of AES and self-initiated nature conservation, both on an individual level and in the context of environmental cooperatives (Renting & van der Ploeg, 2001; Runhaar et al., 2017). This is not only problematic in itself but also because some specific species such as meadow birds are particularly dependent on Dutch grasslands (Kentie et al., 2016). The Dutch agricultural sector is characterized by relative intensive way of farming in the Netherlands (Polman & Michels, 2017. This makes the Netherlands not necessarily representative in terms of self-initiated nature conservation; however, we do think that particularly *barriers* to self-initiated nature conservation will be clearly identifiable because of the intensive character of Dutch farming.

The remainder of this paper is structured as follows. In Section 2 we describe our analytical framework, which is organized according to the two research questions. In Section 3 the methods and data are discussed. In Section 4 we present our results. In Section 5 we wrap up our main conclusions and reflect on the findings as well as the approach taken in our research.

2. Analytical framework

2.1. Self-initiated nature conservation

We define self-initiated nature conservation by farmers as the implementation of conservation activities without being obliged to do so by legislation, public policy or by requirements within the value chain. This does not mean that self-initiated implementation of conservation activities is always a 100% free choice without any social or economic incentives. For instance, some farmers may feel that other farmers, neighbours, customers or other stakeholders expect farmers to contribute to nature conservation in one way or the other and thus feel to some extent 'obliged' (Runhaar et al., 2017; Schroeder, Chaplin, & Isselstein, 2015; Van Dijk, Lokhorst, Berendse, & de Snoo, 2016). In this paper, we only look at individual conservation activities, while recognizing that also collective forms of conservation exist (e.g. Ostrom, 2010). Often farmers are intrinsically motivated to manage nature on their farms (Polman & Slangen, 2008). We conceptualize self-initiated nature conservation also as distinct from participation in AES or other forms of payments in terms of degrees of freedom in initiating what *types* of conservation measures (in AES farmers can choose among predefined measures but cannot develop conservation activities themselves; Runhaar et al., 2017, Supplementary online material). Figure 1 positions self-initiated nature conservation by farmers vis-à-vis other forms of conservation.

It is impossible to provide an exhaustive list of conservation activities farmers can conduct, because ecological challenges and opportunities for restoration are area- and agricultural sub-sector-specific. In general terms, conservation activities can be

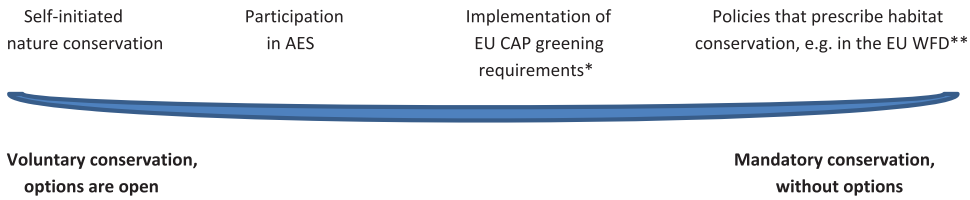

Figure 1. Self-initiated nature conservation versus other forms of conservation by farmers. Note: *: EU CAP: EU Common Agricultural Policy; **: EU WFD: EU Water Framework Directive.

characterized and classified by means of (partly overlapping) categories such as:

- *Land sparing versus land sharing activities:* e.g. flower-rich field margin strips versus the protection of nests of farmland birds (Santangeli, Arroyo, Millon, & Bretagnolle, 2015; Van Rijn & Wäckers, 2016).
- *Structural/long-term versus temporal activities:* see above.
- '*Add-on' activities versus fundamental transformation of farming systems:* e.g. nest protection of meadow birds versus creating a more open grassland structure by higher groundwater levels and no or lower use of fertilizer. These categories also overlap with the categories low ecological performance versus high ecological performance (Westerink et al., 2015).
- *Intensity of conservation efforts:* sowing and maintaining flower-rich field margin strips is usually less labour-intensive than the active protection of meadow birds, encompassing conservation activities during the breeding season (see e.g. Kentie, Hooijmeijer, Trimbos, Groen, & Piersma, 2013).

These examples show that, at least in intensively farmed fields, often a trade-off exists between nature conservation and agricultural productivity (but see Clough et al., 2011).

2.2. Factors affecting self-initiated nature conservation

As we stated in the Introduction, much research has been conducted on farmers' motivations for and perceived barriers to self-initiated nature conservation, as well as on more structural factors such as farm and farmer characteristics (e.g. Riley, 2011). Whereas the lists of factors that have been produced over the years are insightful, it also seems their relative importance is context-dependent, i.e. vary along temporal zones, soil types, agricultural sub-sector and farming systems as well as along socio-political situations (see e.g. Page & Bellotti, 2015; Wilson & Hart, 2000 and Schoonhoven & Runhaar, 2018).

In this paper, we focus on structural factors, including agricultural sub-sector and farm and farming style characteristics. These factors can be measured in a more neutral and objective way than perceived motivations and barriers, which complicates their comparison. We also included as a factor whether or not farmers are engaged in AES. This factor was not only deemed relevant because if farmers participate in AES there may literally be less room for other conservation activities, but also because previous studies have shown how self-initiated conservation can be negatively influenced by AES (Russel & Omer, 2015, p. 137). Examples of such factors in the context of the uptake AES are: trust in the government, perceived institutional design of contracts, and social capital. These factors show the importance of non-monetary (dis)benefits of being involved in AESs.

More specifically we included the following factors in our study:

- *Intensity:* this factor is negatively related to agri-environmental management (Uthes & Matzdorf, 2013) and we hypothesize the same applies to self-initiated nature conservation.
- *Size:* previous research has shown that farm size is correlated with participation in AES (e.g. Schroeder, Isselstein, Chaplin, & Peel, 2013), although also mixed evidence is presented (see Lasta-Bravo et al., 2015). We hypothesize that also for self-initiated conservation generally the larger the farmland, the more space is available for conservation activities (e.g. on marginal pieces of land).
- *Organic or mainstream:* we hypothesize that organic farmers will be more inclined to conduct self-initiated conservation activities than

mainstream farmers because other studies have shown organic farmers have a higher intrinsic motivation to engage in nature conservation (Stobbelaar, Groot, Bishop, Hall, & Pretty, 2009).

- *Side-activities:* farmland biodiversity benefits side-activities such as tourism (Sutherland, 2004) but probably also on-farm sales; we, therefore, hypothesize that farmers who diversified their activities will be more inclined to engage in self-initiated nature conservation than 'specialised' farmers. This is in line with Lasta-Bravo et al. (2015), who, in a meta-analysis of studies on farmers' participation in AES (which is not the same as self-initiated nature conservation but to some extent comparable; see Figure 1) observe that 'Farmers with little or no off-farm income were less likely to join an AES, perhaps because the scheme involves the extensification of farm activities and this brings with it a risk of income reduction (Lasta-Bravo et al., 2015, p. 4)'. Side-activities outside the farm, however, seem to influence voluntary conservation negatively because these farmers have less time available to conduct extra activities when they are on their farm (compare: Wilson & Hart, 2000).
- *Participation in AES:* we hypothesize that self-initiated nature conservation is negatively related to AES (see above).
- *Landscape and natural values:* we hypothesize that farmers located in high nature value landscapes will more often conduct self-initiated nature conservation activities than farmers in low value nature areas where conservation probably will not yield much in terms of biodiversity (Jongeneel, Polman, & Slangen, 2008; Lasta-Bravo et al., 2015; but see McGinlay, Gowing, & Budds, 2017).
- *External constraints:* we hypothesize that farmers face different degrees of freedom in engaging in (self-initiated) nature conservation in terms of e.g. financial freedom (do they own the land or do they have mortgages and if yes, under what conditions; Lasta-Bravo et al., 2015), practical freedom (weeds; Schroeder et al., 2015) and social freedom (is there pressure from peers to (not) conduct conservation activities? Runhaar & Polman, 2018) etc. (see also Jongeneel et al., 2008). Without external constraints, based on the above we expect that extensive, large-sized, organic, diversified farmers located in high-value nature areas without AES contracts will conduct more conservation activities than other farmers will do.

3. Methods and data

3.1. Research strategy: a survey

We conducted an explorative survey in order to obtain an overall impression of self-initiated nature conservation by Dutch farmers and the relative importance of the structural factors affecting self-initiated nature conservation as discussed above. An online survey was chosen because this was expected to be most convenient for respondents. Invitations for a short internet survey were sent via a publisher of agricultural journals and magazines with national coverage in November 2017. A reminder was sent to non-responding farmers a few weeks afterwards. The average time to complete the survey was about 9 minutes. We targeted dairy farmers and arable farmers separately in order to account for sub-sector-specific conservation activities and the factors affecting self-initiated nature conservation. The questionnaires for dairy farming and arable farming differ regarding the options for self-initiated conservation activities because those depend on the type of land-use.

The response was about 9.5% in terms of farmers who were approached (about 50% of all Dutch farmers). The response rate is relatively low, but higher than in a comparable study by Giomi, Runhaar, and Runhaar (2018) and high enough to do statistical analyses. We have 5.1% of all Dutch dairy farms in our sample (812 farms) and 3.1% of all arable farmers (335 farms). Table 1 shows how the farmers in our sample compare to other dairy farms in the Netherlands, including some general characteristics that encompass some of the explanatory factors from Section 2.2. The farms in our sample are comparable in terms of intensity but not completely in terms of size, organic or not and side-activities.

3.2. Measuring self-initiated nature conservation

Because of the explorative nature of our methodology, we did not confront our respondents with an exhaustive list of conservation activities, but included some common, exemplary activities whilst having some variance in terms of ecological impacts and impact on farming systems. The conservation activities were taken from lists of measures in AES schemes for dairy as well as from studies that identified other forms of nature conservation associated with both

Table 1. Self-initiated conservation activities in the survey.

	Dairy		Arable	
	Our sample	Average in the Netherlands	Our sample	Average in the Netherlands
Size (ha.)	48.7	53.5*	72.4	61.2*****
Intensity (number of livestock units per ha.)	2.4	2.5**		
Organic (%)	6	2.9***	6	5.4******
Side-activities (%)	26	28****	29	24****

Notes: *: Figures 2017 Agricultural Census Data; **: one dairy cow counts for 1 livestock unit, a calf younger than 1 year for 0.25 dairy cow and a heifer (between 1 and 2 years) counts for 0.5 dairy cow. Figures 2017; Agricultural Census Data; ***: based on SKAL annual report.; ****: Figures 2016; source CBS Statline; *****: Agro & food portal, Wageningen Economic Research; *******: based on SKAL annual report.

forms of farming (e.g. Erisman et al., 2017; Sanders & Westerink, 2015; Van Dijk et al., 2016). Table 2 summarizes the activities included in the survey; the assessment of their impact (relative to other activities) was made on a three-point scale in a tentative way by the authors. We allowed respondents to add conservation activities. This did not result in clear new categories of activities because often very (location) specific activities were mentioned (e.g. nature management on areas of others, rare species protection (e.g. bats) and traditional orchards). Some activities resembled activities from Table 2.

Table 2. Self-initiated conservation activities for dairy and arable farms in the survey.

	Potential ecological impact	Potential impact on mainstream farming system
Help birds on farmyard and buildings (e.g. hives in stables for barn owls or swallows)	Modest	Limited
Herb-rich grasslands (instead of monocultures; wild plants, insects and meadow birds), dairy farming	Substantial	Substantial
Extensive grazing (less disturbance for meadow birds and vertebrates such as hares), dairy farming	Modest	Modest-substantial*
Leave pieces of land unutilized for wild plants and flowers and field margins arable farming	Modest-substantial	Modest-substantial**
Nature friendly banks along ditches	Substantial	Modest-substantial**
Waterhole (for amphibians and foraging meadow birds), dairy farms	Substantial	Substantial
Search for calves of roe deer, young hares etc. before mowing	Modest-substantial	Modest-substantial

Notes: *: depending on size of land, number of cows and size of stables; **: depending on cost of land.

The potential ecological impact and impact on mainstream farming systems of activities are diverse, ranging from limited to substantial. We purposely included this range to include the opportunity cost of activities as an additional factor. If opportunity cost are substantial this means that major changes on the farm are needed to initiate and implement such an activity. The potential impact depends on the farming system and the context in which the farmer operates. We are also interested in the potential ecological impact of the activities farmers initiate. Whereas we follow the line of reasoning of Westerink et al. (2015) we also realize these impacts are very rough estimates, hence the label 'potential'.

3.3. Factors affecting self-initiated nature conservation

In Section 2.2 we introduced explanatory factors for self-initiated nature conservation. We measured these as follows:

- *Intensity:* average number of cows per hectare for dairy farming (see also Table 1)/rotational crops for arable farming (potatoes, sugar beet, onions, vegetables and cereals).
- *Size:* hectares of land in use.
- *Organic or mainstream:* whether or not the farmer is organic (or in transition).
- *Side-activities:*
  - *On farm side-activities*: yes/no.
  - *Job outside farm: yes/no*.
- *Participation in AES:* yes/no.
- *Landscape and natural values:* because this was difficult to assess without direct observations (which is not self-evident, either), we took the presence of landscape elements on farms as a proxy (i.e. (solitary) trees and wooded banks that provide shelter for all kinds of animals and breeding place for birds).

- *External constraints:* we asked farmers whether or not they envisaged to initiate new conservation activities in the next five years (answer categories: probably yes, probably no, I don't know yet) in two scenarios: one in which (EU) agricultural policies and legislation would largely remain the same ('business-as-usual' scenario) and one in which the respondent would have the freedom to do what s/he wants and in which there would be no hindering rules, high expenditures or practical problems related to more space for nature or different forms of nature on their farm ('no barrier' scenario). Respondents could choose of a list of 9 pre-coded activities for dairy farming and 11 for arable farming. Next to the activities from Table 2 we included a few that are currently not allowed or under strict conditions or hardly applied.

In Table 3a and b we show the scores of our sample of farmers on all of the above factors except for participation in AES and the external constraints, because these factors were measured in a specific way (see below). On average, about 2.7 activities are self-initiated per dairy farm (with a maximum of 8 activities in the survey). For arable farming, this number if 1.2 with a maximum of 4. In the next Section, we will go into more detail into what activities are conducted. As mentioned before, dairy farms in our sample are a little bit smaller and less intensive that the Dutch average. About a quarter of both dairy and arable farmers have side activities (selected from the following list tourism, accommodation or leisure, on-farm sales or day care). The percentage of organic farmers in both samples is about the same for dairy and arable farming.

Participation in AES could not be determined at sample-level, because AES only applies to certain 'core areas' in the Netherlands (Runhaar et al., 2017). Therefore we had to calculate participation rates in AES for farmers located in such areas. Among dairy farmers located in core areas in our sample ($n = 233$), 83% participated in AES; for arable farmers this percentage was 70% ($n = 83$).

We tried to assess the importance of *external constraints* by comparing the difference in numbers of extra (or fewer) activities in the 'business as usual' and the 'no barrier' scenario. For this purpose, we calculated a variable based on the difference between the individual answers to these questions (see Supplementary material S1 for the average responses and Figure 2 for their distribution). Both dairy farmers and arable farmers state that they would perform on average about one activity more under the no barrier scenario. A positive number means farmers generally will increase the number of activities under the 'no barrier' scenario as compared to the 'business as usual' scenario whereas a negative answer means the opposite. Figure 2 shows that about one-third of our respondents show no difference in number of activities between both scenarios (the '0' bar). A relatively larger group of farmers states to perform more activities in the 'no barrier' scenario than in the 'business as usual' scenario.

Table 3. (a) Data for dairy farms ($n = 812$) and (b) arable farms ($n = 335$).

Variable	Mean	Standard deviation	Maximum	Minimum
Self-initiated activities (dairy farming)	2.68	1.66	8	0
Intensity (GVE/ha) (dairy farming)	2.45	1.04	6.5	0.5
Area (ha) (dairy farming)	48.65	27.12	150	12.5
Organic (yes/no) (dairy farming)	0.06	0.23	1	0
On-farm side activities (yes/no) (dairy farming)	0.15	0.36	1	0
Job outside farm (yes/no) (dairy farming)	0.13	0.34		
Landscape and natural values: presence of landscape elements on farm (yes/no) (dairy farming)	0.51	0.50	1	0
Self-initiated activities (arable farming)	1.20	1.09	4	0
Intensity (share rotational crops) (arable farming)	0.55	0.25	1	0
Area (ha) (arable farming)	72.45	82.50	850	3
Organic (yes/no) (arable farming)	0.06	0.24	1	0
On-farm side activities (yes/no) (arable farming)	0.29	0.46	1	0
Job outside farm (yes/no) (arable farming)	0.23	0.42	1	0
Landscape and natural values: presence of landscape elements on farm (yes/no) (arable farming)	0.47	0.49	1	0

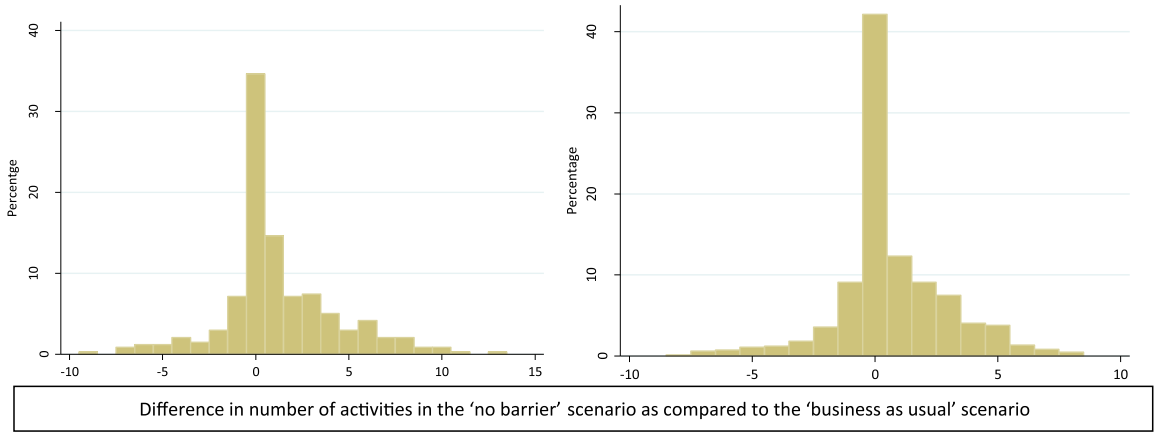

Figure 2. Percentage of farmers changing the number activities in the 'no barrier scenario' as opposed to the 'business as usual' in arable farming (left) and dairy farming (right). Note: positive values on the x-axis refer to the percentage of farmers having more activities under the no barrier scenario. The bars show the percentage of famers having more activities.

Some farmers indicated that they would reduce the number of conservation activities. One example is higher water tables; some farmers prefer lower water tables but apparently currently are forced to accept relatively high ones (e.g. because they rent land from nature reserve area managers who keep water tables high for ecological reasons; Runhaar et al., 2017.

3.4. Analysis techniques

We were interested in factors affecting both the *types* of self-initiated conservation activities and the *number* of activities per farm. Firstly, we applied the Poison regression model to the activity data. The dependent variable was the number of self-initiated conservation activities a farmer reports. A Poisson regression model is appropriate for this purpose (Wooldridge, 2015). Secondly, a binomial logit regression was estimated in order to explain the participation in activities with modest ecological impact and limited impact on the farming system as a function of the variables as explained in the previous paragraph.

4. Results

4.1. Self-initiated nature conservation

Table 4 shows the distribution of self-initiated conservation activities by our respondents. Helping birds on farmyards and buildings was the most often mentioned activity. This form of voluntary conservation also has the lowest impact on farming systems. A bit over half of all farmers states to conduct other conservation activities, including leaving pieces of land unutilized or unmanaged. These activities have a modest-to-substantial impact on both ecological values and farming systems; however, a limitation of our survey is that we do not know how much land is left for wild plants and for wildlife.

Table 4. Self-initiated conservation activities in the survey, arable farming and dairy farming.

	% of farmers who implements the activity	
	Arable farming (n= 335)	Dairy farming (n = 812)
Meadow birds protection		61%
Help birds on farmyard and buildings (e.g. hives in stables for barn owls or swallows)	65%	77%
Herb-rich grasslands (instead of monocultures; wild plants, insects and meadow birds)		26%
Extensive grazing (less disturbance for meadow birds and vertebrates such as hares)		23%
Leave pieces of land unutilized for wild plants and flowers including field margins arable farming	32%	13%
Nature friendly banks along ditches	29%	16%
Waterhole (for amphibians and foraging meadow birds)		13%
Search for calves of roe deer, young hares etc. before mowing	17%	37%
Other activities	22%	26%

Note: the percentage of arable farmers searching for calves of roe deer and young hares etc. before mowing is relatively low. Initially this question was only meant to be asked to grassland farmers (i.e. dairy farmers), but it was also asked in the arable farming survey. Arable farmers who indicated to perform this activity probably have some grassland.

Of all respondents in dairy farming and arable farming, only 10% reported no self-initiated conservation activities. About 80% combines 1 to 4 conservation activities. The remaining farmers reported 5 or more activities. 17% of all dairy farmers who responded to the survey stated to conduct conservation activities other than the ones from Table 3. Other activities that were relatively often mentioned included activities to protect meadow and farmland birds.

How should these findings be interpreted? Compared to AES, with a participation rate of some 10–20% of all Dutch farmers, self-initiated conservation activities are commonly conducted by a larger share of both arable and dairy farmers. On the other hand, the self-initiated activities do not outweigh the reduction in habitat (both in quantity and in quality) in agricultural landscapes due to amongst other things agricultural intensification and scale enlargement (see e.g. Schippers, 2016, for the reduction in surface of herb-rich grasslands in the Netherlands).

4.2. Factors affecting self-initiated nature conservation

4.2.1. Explaining the number of self-initiated conservation activities

Supplementary material S2 presents the results of the equations on the number of self-initiated activities on dairy farms and arable farms respectively. We computed the model's deviance: a measure of how well the model fits the data. We conclude both for dairy and arable farming that the Poisson model is appropriate for this model because the goodness-of-fit chi-squared test is not statistically significant. (with for dairy farming a deviance of 740.174 on 803 d.f. and a corresponding *P*-value of 0.947 and for arable farming a deviance of goodness of fit of 287.956 on 327 d.f and a corresponding *P*-value of 0.942). Most of the factors that we hypothesized to be of important for the number of self-initiated conservation activities appear to be important. Only side-activities were not relevant or only for one sector. More intensive farmers have fewer nature-related activities. Most of the other factors positively contribute to the number of conservation activities. External constraints also have a significant impact (see also Figure 2)[2]. Follow-up research is required to identify the specific constraints (regulation, requirements from processors and banks, practical problems such as weeds etc.).

The assessment of the importance of participation in AES for the number of self-initiated conservation activities did not show significant effects for arable farming. For dairy farming, a simple one-sided *t*-test on the difference in number of activities between farmers with AES and without AES shows that dairy farmers with AES even have more self-initiated activities in areas where they can conclude AES (Supplementary material S3). This unexpected finding might, however, be due to the relatively low sample sizes.

In order to explore the relative importance of the above factors, we calculated the incidence-rate ratios for respectively dairy farming and arable farming (see Supplementary material S4)[3]. Organic dairy farmers and organic arable farmers respectively are expected to have 46% and 44% more activities than other farmers, all other variables equal. If a dairy farmer were to increase his intensity by one point, his rate ratio for activities would be expected to decrease by a factor of 0.89, while keeping all other variables in the model constant. The effect of farm size is significant. The coefficient, however, is small – if farm size increases by 1 ha the number of nature-related activities is expected to increase by 0.4%.

4.2.2. Explaining the type of self-initiated conservation activities

Regarding factors affecting the *type* of self-initiated conservation activities we compared farmers who only contributed to the conservation of birds on farmyards and buildings (a 'light' measure) with farmers who also conducted activities with a higher ecological impact (ranging from modest to substantial; see Table 3). Table 5 presents the results based on final

Table 5. Estimation results of activities with substantial impact versus those with limited impact, following a Logit regression.

Variable	Dairy farming	Arable farming
Area (ha)	0.01**	0.00
Intensity (GVE/ha or intensity of cropping)	−0.25***	−1.08*
External constraints (difference in number of activities in the 'no barrier' scenario relative to the 'business as usual' scenario)	0.05	0.09**
On-farm side activities (yes/no)	1.35***	−0.09
Job outside farm (yes/no)	0.02	0.10
Organic (yes/no)	0.99	0.09*
Landscape and natural values	−0.04	0.33
Constant	1.55***	0.86*
χ^2	38.28	18.31
Count R^2	82.3%	65.9%
Pseudo R^2 (McFadden)	0.05	0.05

Notes: ***significant at 1% level, **significant at 5% level, *significant at 10% level. Dairy farmers: $n = 729$ and arable farming: $n = 270$. Excluding farmers who do not conduct any activity at all.

estimates for the binomial ordered logit models. The low pseudo-R^2 in the model might be due to the fact that we tried to explain with a rather general model. The goodness of fit is fair for the dairy model but weak for arable farming. Both models have significant χ^2, indicating that all variables are jointly significantly different from zero.

Our results indicate that it is less likely that intensive farmers have activities with a substantial ecological impact as compared to activities with a low impact. Fewer external constraints a large farm size make it more likely that arable farmers have activities with a substantial ecological impact. On-farm side activities make it more likely for dairy farmers to have activities with substantial impact on their farm. Surprisingly, the presence of high landscape and natural values have no impact on the type of activities (but we observed an impact of this factor on the number of conservation activities; see above).

5. Discussion and conclusions

The active involvement in conservation activities by farmers in Europe is mainly voluntary. Yet relatively little research has been conducted on nature conservation by farmers, other than participation in agri-environmental schemes (AES). Given the alarming decline in species diversity and abundance in agricultural landscapes, more insight is needed into what forms of conservation farmers implement and what factors account for this.

In this paper, we focus on self-initiated conservation by Dutch farmers. In the Netherlands, agrobiodiversity has declined substantially and relatively more than elsewhere, among other things due to highly intensive farming styles and ongoing scale enlargement. Yet our survey shows that many farmers perform conservation activities ranging from measures with a limited ecological contribution and impact on farm management to more substantial impacts. Although these forms of conservation clearly are insufficient to stop the ongoing decline in species richness and diversity, it must be acknowledged that it is voluntary and paid for farmers themselves.

We analysed the importance of so-called structural factors on both the number of conservation activities and their nature ('light' versus having an expected modest to substantial ecological impact). We derived these factors in part from literature about AES and in another part from logical reasoning. The factors included in our study were farm size, intensity of farming style, organic or conventional farming, side-activities (on- and off-farm), participation in AES, location (high or low landscape and natural values) and external constraints.

In an exploratory survey among dairy and arable farmers, we conclude that a majority of dairy and arable farmers in the Netherlands conduct self-initiated conservation activities. A mix of activities is reported, ranging from activities with a low to a substantial ecological impact and impact on farming styles. The types of activities conducted in dairy and arable farming differ to some extent, which is logical because both sectors offer different habitats and possibilities for conservation.

Farm size, on-farm side activities (only in dairy farming), organic farming, landscape and natural values of the area where farmers are located and the extent to which farmers perceive no external constraints have a positive effect on the number of activities. Intensity has a negative effect. Intensity has a negative effect on the probability of conservation activities with substantial ecological impacts; fewer other factors are relevant factors affecting the number of self-initiated activities conducted and the factors that play a role are much more sector-specific. A 'crowding-out effect' due to participation in AES could not be detected. However, more research is needed given the limited sample.

The results presented in this paper provide a first impression of self-initiated conservation by farmers. The results should be interpreted with some caution because of the following reasons. One, they are based on self-reported activities and we could not check against revealed activities. Two, not all possible structural factors were included. Market value of land for instance will most probably have an impact on intensification and on the willingness (and ability) of farmers to implement voluntary conservation measures. International comparative research could be interesting in this respect, as land prices in the Netherlands (including those of agricultural land) are relatively high. Three, not all contextual characteristics of farmers are included in the survey because of the explorative character of the survey and to avoid non-response and drop-out. In future work, farm-related variables like soil types, tenure, age, farmer attitudes, off-farm employment, social networks, educational levels etc. need to be included in order to have a more complete picture. The same applies for other factors such as availability of technical information about conservation, proximity to protected areas but

also to urban areas, participation in farmer organizations concerned with nature conservation or in other landscape initiatives and incentives from companies in agri-food chains to engage in conservation (see e.g. García-Martín, Bieling, Hart, & Plieninger, 2016 and Runhaar et al., 2017). Four, despite our efforts to keep the questionnaire as short as possible, the response rate is relatively low but reasonable for the type of questionnaire. Five, very rough proxies were employed to assess the effects of landscape and natural values of the area where farmers were located, to measure agro-biodiversity (e.g. soil biodiversity was not included) and for measuring external constraints. The same applies to how we tentatively assessed the impact of conservation measures on ecology and on farming practices. It would be very interesting to explore how farmers perceive these impacts, particularly whether there are farmers who derive benefits from conservation (other than enjoying nature).

In view of the relatively large number of self-initiated conservation measures and our finding that if farmers could decide themselves, they would implement even more measures, we propose that follow-up research is conducted that combines quantitative research (including more factors, including motivation and other personal characteristics; see e.g. Wilson & Hart, 2000 and Edwards-Jones, 2006) with qualitative research (i.e. in-depth interviews or case studies), not only in the Netherlands but also elsewhere. The effectiveness of European AES could benefit from potential synergies with self-initiated farmer activities. What is also interesting is to make an assessment of the ecological impacts of self-initiated conservation. Thus far our knowledge about these impacts is merely anecdotal[4]. Finally, more insight is needed into what external constraints limit the number of self-initiated conservation activities farmers take and what public or private interventions can remove these constraints. Various studies have shown that motivation is an important factor affecting farmers' participation in AES and we expect the same for self-initiated conservation. More research in this area can help contributing to a maximal exploitation of the conservation potential by farmers.

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Notes

1. An exception is Van Dijk et al. (2016) who also employed a survey-based approach; however under a specific group of farmers, namely those who were member of an Environmental Cooperative.
2. Note that farmers who would include more activities under a scenario where barriers are removed are already performing more activities in the current situation.
3. These relations are by exponentiation the Poisson regression coefficient in Table 1.
4. E.g. Runhaar et al. (2017) report on the successful restoration of barn owls in agricultural landscapes due to voluntary work by farmers and citizens.

ORCID

Hens Runhaar http://orcid.org/0000-0001-7790-097X

References

Buizer, M., Arts, B., & Westerink, J. (2015). Landscape governance as policy integration 'from below': A case of displaced and contained political conflict in the Netherlands. *Environment and Planning C: Government and Poliy*, *34*(3), 448–462.

CBS. (2015). *Persbericht: weidevogels in duikvlucht* [press release: Meadow birds in a nose dive; in Dutch]. The Hague: Statistics Netherlands. Retrieved from www.cbs.nl/nl-NL/menu/themas/natuur-milieu/publicaties/artikelen/archief/2015/weidevogels-in-duikvlht1.htm?RefererType=RSSItem

CBS, PBL and Wageningen UR. (2012). *Ontwikkeling soorten in natuurgebieden en agrarisch gebied 1975–2005* [Developments in species in nature reserves and agricultural areas 1975–2005; in Dutch]. The Hague /Bilthoven/ Wageningen: Statistics Netherlands/Netherlands Environmental Assessment Agency/Wageningen UR. Retrieved from www.compendiumvoordeleefomgeving.nl

Clough, Y., Barkmann, J., Juhrbandt, J., Kessler, M., Wanger, T. C., Anshary, A., … Tscharntke, T. (2011). Combining high biodiversity with high yields in tropical agroforests. *PNAS*, *108* (20), 8311–8316.

Edwards-Jones, G. (2006). Modelling farmer decision-making: Concepts, progress and challenges. *Animal Science*, *82*(6), 783–790.

EEA. (2015a). *Soer 2015 — The European environment — state and outlook 2015. A comprehensive assessment of the European environment's state, trends and prospects, in a global context*. Copenhagen: European Environmental Agency.

EEA. (2015b). State of nature in EU. Results from reporting under the nature directives 2007–2012. EEA technical report no2/2015. Luxembourg: European Environment Agency.

Erisman, J. W., van Eekeren, N., de Wit, J., Koopmans, C., Cuijpers, W., Oerlemans, N., & Koks, B. J. (2017). Agriculture and

biodiversity: A better balance benefits both. *AIMS Agriculture and Food*, *1*(2), 157–174.

Gamero, A., Brotons, L., Brunner, A., Foppen, R., Fornasari, L., Gregory, R. D., … Voříšek, P. (2016). Tracking progress towards EU biodiversity strategy targets: EU policy effects in preserving its common farmland birds. *Conservation Letters*, *10*(4), 395–402.

García-Martín, M., Bieling, C., Hart, A., & Plieninger, T. (2016). Integrated landscape initiatives in Europe: Multi-sector collaboration in multi-functional landscapes. *Land Use Policy*, *58*, 43–53.

Giomi, T., Runhaar, P., & Runhaar, H. (2018). Reducing agrochemical use for nature conservation by Italian olive farmers: An evaluation of public and private governance strategies. *International Journal of Agricultural Sustainability*, *16*(1), 94–105.

Greiner, R. (2015). Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts. *Agricultural Systems*, *137*, 154–165.

Jongeneel, R. A., Polman, N. B. P., & Slangen, L. H. G. (2008). Why are Dutch farmers going multifunctional? *Land Use Policy*, *25*, 81–94.

Kentie, R., Hooijmeijer, J. C. E. W., Trimbos, K. B., Groen, N. M., & Piersma, T. (2013). Intensified agricultural use of grasslands reduces growth and survival of precocial shorebird chicks. *Journal of Applied Ecology*, *50*(1), 243–251.

Kentie, R., Senner, N. R., Hooijmeijer, J. C. E. W., Márquez-Ferrando, R., Figuerola, J., Masero, J. A., … Piersma, T. (2016). Estimating the size of the Dutch breeding population of Continental Black-tailed Godwits from 2007–2015 using resighting data from spring staging sites. *Ardea*, *114*, 213–225. doi:10.5253/arde.v104i3.a7

Lastra-Bravo, X. B., Hubbard, C., Garrod, G., & Tolo´n-Becerra, A. (2015). What drives farmers' participation in EU agri-environmental schemes? Results from a qualitative meta-analysis. *Environmental Science & Policy*, *54*, 1–9.

Lokhorst, A. M., Staats, H., van Dijk, J., & de Snoo, G. (2011). What's in it for me? Motivational differences between farmers' subsidised and non-subsidised conservation practices. *Applied Psychology*, *60*(3), 337–353.

McGinlay, J., Gowing, D. J. G., & Budds, J. (2017). The threat of abandonment in socio-ecological landscapes: Farmers' motivations and perspectives on high nature value grassland conservation. *Environmental Science and Policy*, *69*, 39–49.

Murphy, G., Hynes, S., Murphy, E., & O'Donoghue, C. (2014). An investigation into the type of farmer who chose to participate in Rural Environment Protection Scheme (REPS) and the role of institutional change in influencing scheme effectiveness. *Land Use Policy*, *39*, 199–210.

Ollerton, J., Erenler, H., Edwards, M., & Crockett, R. (2014). Extinctions of aculeate pollinators in Britain and the role of large-scale agricultural changes. *Science*, *346*(6215), 1360–1362.

Ostrom, E. (2010). The challenge of self-governance in complex contemporary environments. *The Journal of Speculative Philosophy*, *24*(4), 316–332.

Page, G., & Bellotti, B. (2015). Farmers value on-farm ecosystem services as important, but what are the impediments to participation in PES schemes? *Science of the Total Environment*, *515–516*, 12–19.

Pe'er, G., Dicks, L.V., Visconti, P., Arlettaz, R., Báldi, A., Benton T.G., … Scott, A. V. (2014). Eu agricultural reform fails on biodiversity. *Science*, *344*(6188), 1090–1092.

Peerlings, J., & Polman, N. (2004). Wildlife and landscape services production in Dutch dairy farming; jointness and transaction costs. *European Review of Agricultural Economics*, *31*(4), 427–449.

Peerlings, J., & Polman, N. (2009). Farm choice between agri-environmental contracts in the European Union. *Journal of Environmental Planning and Management*, *52*(5), 593–612.

Polman, N., & Michels, R. (2017). Agricultural policy objectives on productivity, climate change adaptation and mitigation. Policy assessment for the Netherlands, Wageningen, Wageningen Economic Research.

Polman, N. B. P., & Slangen, L. H. G. (2008). Institutional design of agri-environmental contracts in the European Union: The role of trust and social capital. *NJAS – Wageningen Journal of Life Sciences*, *55*(4), 413–430.

Renting, H., & van der Ploeg, J. D. (2001). Reconnecting nature, farming and society: Environmental cooperatives in the Netherlands as institutional arrangements for creating coherence. *Journal of Environmental Policy and Planning*, *3*(2), 85–101.

Riley, M. (2011). Turning farmers into conservationists? Progress and prospects. *Geography Compass*, *5*(6), 369–389.

Runhaar, H. A. C., Melman, T. C. P., Boonstra, F. G., Erisman, J. W., Horlings, L. G., de Snoo, G. R., … Arts, B. J. M. (2017). , promoting nature conservation by Dutch farmers: A governance perspective. *International Journal of Agricultural Sustainability*, *15*(3), 264–281.

Runhaar, H., & Polman, N. (2018). Partnering for nature conservation: NGO-farmer collaboration for meadow bird protection in the Netherlands. *Land Use Policy*, *73C*, 11–19.

Russel, N., & Omer, A. (2015). Meeting the challenge of food security through sustainable intensification. In G. M. Robinson & D. A. Carson (Eds.), *Handbook of the globalisation of agriculture* (pp. 125–142). Cheltenham: Edward Elgar.

Sanders, M., & Westerink, J. (2015). *Op weg naar een natuurinclusieve duurzame landbouw*. Wageningen: Alterra Wageningen UR.

Sanderson, F. J., Kucharz, M., Jobda, M., & Donald, P. F. (2013). Impacts of agricultural intensification and abandonment on farmland birds in Poland following EU accession. *Agriculture, Ecosystems and Environment*, *168*, 16–24.

Santangeli, A., Arroyo, B., Millon, A., & Bretagnolle, V. (2015). Identifying effective actions to guide volunteer-based and nationwide conservation efforts for a ground-nesting farmland bird. *Journal of Applied Ecology*, *52*(4), 1082–1091.

Schippers, W. (2016). Boeren met ontzag – over groei, grenzen en perspectieven, self-publication.

Schoonhoven, Y., & Runhaar, H. (2018). Conditions for the adoption of agro-ecological farming practices: A holistic framework illustrated with the case of almond farming in Andalusia. *International Journal of Agricultural Sustainability*.

Schroeder, L. A., Chaplin, S., & Isselstein, L. (2015). What influences farmers' acceptance of agrienvironmental schemes? An ex post application of the theory of planned behaviour. *Landbauforschung*, *65*(1), 1528.

Schroeder, L. A., Isselstein, L., Chaplin, S., & Peel, S. (2013). Agri-environment schemes: Farmers' acceptance and perception

of potential 'payment by results' in grassland-A case study in England. *Land Use Policy*, *32*, 134–144.

Smits, M. J., Driessen, P., & Glasbergen, P. (2008). Governing agri-environmental schemes: Lessons to be learned from the New Institutional Economics approach. *Environment and Planning C: Government and Policy*, *26*(3), 627–643.

Stoate, C., Boatman, N. D., Borralho, R. J., Carvalho, C. R., De Snoo, G. R., & Eden, P. (2001). Ecological impacts of arable intensification in Europe. *Journal of Environmental Management*, *63*(4), 337–365.

Stobbelaar, D. J., Groot, J. C. J., Bishop, C., Hall, J., & Pretty, J. (2009). Internalization of agri-environmental policies and the role of institutions. *Journal of Environmental Management*, *90*(SUPPL. 2), S175–S184.

Sutherland, W. J. (2004). A blueprint for the countryside. *Ibis*, *146* (SUPPL. 2), 230–238.

Triste, L., Vandenabeele, J., van Winsen, F., Debruyne, L., Lauwers, L., & Marchanda, F. (2018). Exploring participation in a sustainable farming initiative with self-determination theory. *International Journal of Agricultural Sustainability*, *16*(1), 106–123.

Uthes, S., & Matzdorf, B. (2013). Studies on agri-environmental measures: A survey of the literature. *Environmental Management*, *51*, 251–266.

Van Dijk, W. F. A., Lokhorst, A. M., Berendse, F., & de Snoo, G. R. (2016). Factors underlying farmers' intentions to perform unsubsidised agri-environmental measures. *Land Use Policy*, *59*, 207–216.

Van Rijn, P. C. J., & Wäckers, F. L. (2016). Nectar accessibility determines fitness, flower choice and abundance of hoverflies that provide natural pest control. *Journal of Applied Ecology*, *53*(3), 925–933.

Westerink, J., Melman, D. C. P., & Schrijver, R. A. M. (2015). Scale and self-governance in agri-environment schemes: Experiences with two alternative approaches in the Netherlands. *Journal of Environmental Planning and Management*, *58*(8), 1490–1508.

Wilson, G. A., & Hart, K. (2000). Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environment and Planning A*, *32*(12), 2161–2185.

Wooldridge, J. (2015). *Introductory econometrics* (6th ed.). Boston: Cengage Learning Inc.