Title: Probing the Grounds: developing a payment-by-results agri-environment scheme in Finland

Running title: Payment-by-results agri-environment scheme

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Supplementary material: Appendix A 1 and A 2. Indicator species guide (English common names) & information to farmers (translated from Finnish); Table A1. Indicator species; Table A2. Indicator species criteria for inclusion/exclusion; Appendix B. Farmer interview guide; Appendix C. Expert stakeholder interview guide.

Type of article: Original research article

Abstract

Results-oriented approaches are widely regarded as an effective means to improving cost-effectiveness of agri-climate-environment schemes. We designed a hypothetical payment-by-results scheme for biodiversity conservation on environmental grasslands in Finland. The scheme would pay farmers a premium if the site contains a set number of indicator species, which were selected based on vascular plant surveys of the target habitat type. We presented the hypothetical scheme to 20 farmers and six experts (researchers, officials and advisors) in agricultural policy for their opinions on the payment-by-result approach generally and the hypothetical scheme specifically. The indicator species list proved suitable for identifying sites with high total species richness of vascular plants and also appeared feasible in the eyes of the farmers. Farmers were mostly positive about the approach and, mainly, thought their peers and society at large would receive it positively. The main concerns were about implementation, especially verifying the biodiversity results. People working for the national control body were the most critical and could not see how the hypothetical scheme could fit into the current institutionalised programme. Experience in other countries may provide solutions for overcoming such obstacles. The results are highly relevant for a discourse on social experimentation and cost-efficient delivery of public goods for public money.

Keywords: biodiversity, farmer interviews, indicators, outcome-based instruments, public payments, results-based schemes

Highlights:

- Potential for results-based agri-environment schemes is identified in Finland
- Indicator species work well in identifying most species-rich grasslands.
- Farmers are supportive of the results-based approach.
- Officials working in administration are most critical of the results-based approach.
- Main concerns with the approach are the implementation and verification of results.

Introduction

The agri-climate-environment schemes (AES) are the single most important tool for securing and improving the environmental and ecological state of the agricultural environments across the EU (EEA 2004, Batáry et al. 2015), including in Finland (Kaljonen 2011). As with any multi-objective policy tool, AES require constant development to remedy shortcomings. Among the most critical problem areas are the

lack of incentives for achieving actual results, insufficient targeting, and difficulty in tailoring activities to diverse farm circumstances (e.g. Kleijn et al. 2011, Marggraf 2003, Whittingham et al. 2007, Arponen et al. 2013, McKenzie et al. 2013). The European Court of Auditors (2011) found that objectives of many AES were not specific enough for assessing whether or not they had been achieved. Furthermore, by paying participants a flat-rate remuneration for pre-specified management ("action" or "management" oriented approach), the current scheme design discourages participants from striving for innovative and site-specific approaches (Burton and Schwartz 2013, Kaljonen 2006 and 2008). The approach not only dis-incentivises farmers (Kaljonen 2006, Keenleyside et al. 2011), but makes their behaviour dependent on monetary stimuli at the expense of appreciation of results of their work (Herzon and Mikk 2007). Verification is entirely in the hands of officials, who are often perceived as a threat (Birge and Herzon 2014, Helenius and Seppänen 2004, Wilson and Hart 2001).

It is a widely held expert view that AES need to become more results-oriented (European Network for Rural Development and EC 2010). The European Court of Auditors (2011) recommendations to the European Commission for improving efficiency of AES include more precise targeting of measures and clearer objectives; tailoring more demanding measures to local circumstances; and creating clear indicators for measuring success. The report specifically recommends examining the usefulness of outcome-based, or payment-by-results (PBR), measures (*ibid, pp. 49*). Such results-based agri-environment payments are already in use in several member states, including Germany, France and The Netherlands (comprehensive list in Allen et al. 2014). These include paying landowners or other managing bodies for defined biodiversity or ecosystem results, either exclusively or as a bonus on top of a payment for management actions. The payment may be based, for example, on occurrence of a number of indicator species. The commonest approach is of a so-called 'hybrid' type (*ibid*), where active management by farmers and/or a list of prohibited actions are part of the scheme requirements, but the payment rate is dependent on the ecological results. Among the perceived benefits of the approach, results-based remuneration is said to i) increase farmer intrinsic interest in achieving environmental objectives, ii) provide greater opportunity for innovation and site-specific solutions, iii) increase cost-effectiveness both in AES payment and in land-use practices for environmental results and, iv) build "social capital" (Burton and Paragahawewa 2011, de Snoo et al.

2013, Klimek et al. 2008, Matzdorf et. al 2008, Swagemakers et al. 2009, Matzdorf and Lorenz 2010, Schroeder et. al. 2013). The latter refers to appreciation of farmer know-how in environmental management within the farming community and results in long-term change in farmers' behavior toward nature conservation.

In most cases, results-based agri-environment payments target botanically-rich grasslands (Allen et al. 2014). The results are easier to verify and monitor for biodiversity than for nutrient run-offs, for example (Berniger 2012, Allen et al. 2014, Table 7). Examples of result-based payments enhancing biodiversity include MEKA Baden-Württemberg Grassland Scheme in Germany (Matzdorf and Lorenz 2010, Matzdorf et al. 2010, EC 2015a), *Prairies fleuries* programme in France (De Sainte Marie 2014), Burren Life programme in Ireland (Burren Life 2015), and *Öko-Qualitätsverordnung* in Switzerland (Riedel et al. 2012). A similar approach to the Baden-Württemberg Scheme in Germany is under consideration in the UK (Schroeder et al. 2013). The payment level is linked to the occurrence of a progressively higher number of vascular plant species indicating extensive management and diverse plant communities. So far, there is no adaptation case of the approach to the northern agricultural environments, even if the potential benefits are large: In Finland, for example, production grasslands older than 5-years are rare (1.2 % of the utilized agricultural area; Natural Resources Institute Finland 2015), and semi-natural biotopes are fragmented remnants (Kemppainen and Lehtomaa 2009). However, uptake of AES is exceptionally high – 95% of agricultural land is under agri-environmental commitments (Niemi and Ahlstedt 2014) (cf. 25% in the EU-27, EC 2015b). Thus, AES have potentially very large impact on the ecological state of the agricultural environment.

Experience in developing and evaluating the indicators, as well as attitudes and skills of participating parties, are among the most important factors to consider in determining the feasibility of the result-based approach (Allen et al. 2014). In determining indicator species, preparatory research is needed because any indicator species list must be suitable for the target habitat and relevant to specific bio-geographical regions, but also broad enough that it is inclusive of the whole area covered by the scheme (*ibid*).

The objective of this study is to develop and test two key issues in developing the results-based payment approach for biodiversity in Finland. We i) develop and assess

the suitability of the biodiversity indicators, and ii) examine the range and commonality of opinions and perceptions of farmers, experts and policy officials in charge of the implementation of the agri-environmental schemes in Finland. We developed a prototype for a PBR element in an existing AES, Nature Management Grassland (NMG), based on experiences gained from other European regions with PBR measures for biodiversity conservation (e.g. Bertke et al. 2008, Groth 2009, De Sainte Marie 2014). We selected indicators based on data on vascular plants from two previous studies in NMG fields (Toivonen et al. 2013, 2015). We further evaluated suitability of the indicator list as, on the one hand, proxies for botanic diversity in NMG, and, on the other, as a tool for farmer participation in a potential PBR scheme. Using the prototype as an example, we explored farmers', experts' and public officials' opinions and perceptions about the proposed PBR measure. In our analysis we focus on the following questions:

A. How well does the set of indicator species perform as a biodiversity indicator and as a tool for communicating with farmers and facilitating self-guided assessment?
B. Is the idea of results-based payment for biodiversity conservation in NMG field accepted *in principle*?
C. What are the perceived advantages and disadvantages of the prototype scheme presented, as compared to the existing management-based scheme?
D. What type of capacity building is identified as necessary for the scheme?
E. What is the perceived impact of the proposed scheme on reputation and public perception?

Materials and methods

Developing the prototype

We built the prototype upon the existing NMG (or grassland type of Environmental Fallow as in Toivonen et al. 2013) under the Finnish agri-environmental schemes. NMG fields correspond to extensive grassland, for which results-based payments have been run in Germany (Matzdorf et al. 2008, Matzdorf and Lorenz 2010), France (De Sainte Marie 2013) and Switzerland (Riedel et al. 2012), and are under consideration in the UK (Schroeder et al. 2013). NMG fields in Finland are

established with grassland seed mixtures and are kept in place for at least two years. Farmers can also enrol old grasslands as NMG without sowing. Management restrictions include prohibition of fertilisers and pesticides. Mowing is required every second year in all parcels. NMG fields can be used for production purposes, both as source of fodder and as pasture. However, NMG fields are frequently managed as arable fallows in which mown material may be left on site to decompose. Currently, the NMG scheme occupies 4% of the Finnish agricultural area and is present on 46% of Finnish farms (Natural Resources Institute Finland, pers. comm.). With permanent grass, the NMG scheme promotes both biodiversity and water protection. As a policy instrument, the NMG scheme is, however, considered one of the most important tools in enhancing common biodiversity in the agricultural areas (Kuussaari et al. 2013, Herzon et al. 2012).

Previous research demonstrated a considerable variation in plant species diversity among NMG fields (from 5 to over 50 species per field on a sample area: Toivonen et al. 2013). Many long-term NMG have highly naturalised vegetation (Herzon et al. 2012) and provide valuable habitats for butterflies, bumblebees and birds in the agricultural landscape (Toivonen et al. 2015, 2016). However, the current scheme does not distinguish between diverse old grasslands and rotational grasslands – from 2015 onwards, support is 100 €/ha to all parcels. Previously, inspectors considered natural vegetation as “weeds”, and payment could be withdrawn on this basis (Finnish Agency for Rural Affairs, pers. comm.). Presently, the programming document explicitly states that naturalized vegetation is allowed. However, a requirement of obligatory mowing in cases of weeds remains vague since it is not specified which species constitute “weeds”. Vague management guidelines such as these are one factor hindering the scheme from realising its considerable biodiversity potential. At its worst, excessive mowing at the peak of the breeding season may turn the grasslands into ecological traps (Battin 2004). The prescription-based scheme also sends a contradictory message that farmers on the one hand should manage to support biodiversity and on the other simultaneously avoid open-to-interpretation weed infestation.

We designed the test scheme as a hybrid scheme in which the baseline conditions for retaining the NMG for the minimum of two years and not applying chemical inputs would remain as they are presently. However, the bonus payment would be paid if the

site were found to contain a set number of plant species indicating high nature value. Farmers would be responsible for self-monitoring twice during the agreement of five years. Results of the monitoring would be the basis for the normal subsidy application. The sites would be subject to normal agri-environmental inspection (*i.e.* a percentage of farmers are inspected annually and particular agreements verified). Extension services and materials for farmer and inspector capacity-building in species identification and best management would be available.

For developing the set of indicator plant species that correspond to Finnish conditions and type of vegetation under focus, we used botanical data from two previous studies (Toivonen et al. 2013, 2015). The studies ran on several types of environmental fallow fields but, for this work, we extracted the data only for the grassland option. In the first study, vegetation survey was performed in 104 NMG of various ages in three regions (Toivonen et al. 2013). Vascular plants were surveyed on one to four 12.5-m transects per field (Toivonen et al. 2013). A total of 185 vascular plant species or pseudospecies were registered. In the second study, vegetation data were collected from 20 NMG that were at least eight years old (Toivonen et al. 2015). There, vascular plants were surveyed on two 50-m long transects (Toivonen et al. 2015). The total number of registered species was 145. The second study gave us a better understanding of the species pool on sites that are most likely to reach the diversity level required for the bonus payment, that is, relatively long-term NMG fields. In both studies, transects were placed systematically by the criteria agreed in advance, and vegetation was always sampled both along field margins (on the field side) and in the middle of the field (Toivonen et al. 2013, 2015). Full species lists from both studies are available in the respective publications.

Several criteria were used in selecting potential indicator species (*cf.* Matzdorf et al. 2009, Magda et al. 2015): i) indication of species-rich communities and extensive management; ii) ease of recognition for a lay person with help of images; iii) species occurrence across the country and across a range of abiotic conditions typical for the field type; iv) frequency of occurrence in grassland communities of the focal field type; v) not a difficult agronomic weed. Details of inclusion and exclusion of specific species are presented in the Appendix Table A2.

The initial screening produced 42 species that correspond to the criteria above, of which we pooled several closely related species into species groups, as they can be

confused by non-specialists (farmers) (Table A.1). The final list of indicator species included 24 species and species groups. Including both common and infrequent species would give most potential participants a chance of detecting at least a few of the indicators on most of the NMG fields and might motivate them to "achieve" more through adaptive management.

We designed a leaflet for farmers that outlines the bonus scheme and provides a visual tool to aid discussion and to function as a guide to the 24 indicator species (Appendix A). The guide has names and photographs of the indicator species.

For the statistical analysis, we used the data from the vegetation survey of 104 NMG fields in three regions (Toivonen et al. 2013). We related the mean number of indicator species per field with total species number, and with field number and area using linear correlation in IBM SPSS Statistics 23 (IBM Corp 2015). We evaluated the potential coverage of the fields qualifying for the bonus payment and potential budgetary expenses under alternative threshold values of a minimum number of the indicator species.

Interviews and site visits

We used a mixed methods approach (Creswell et al. 2003, Yin 2014) for assessing the responses of farmers, public officials and experts to the prototype scheme. The empirical material is composed of two sets: 1) semi-structured interviews and site visits for ecological observation with farmers from the Uusimaa region in southern Finland, and 2) semi-structured interviews and questionnaires with public officials and experts at multiple administrative levels (Appendices B and C – both interview forms). We based farmer selection on diversity and expert selection on known expertise in AES policy development, implementation and research.

Farmer responses

We chose the Uusimaa region for gathering the farmer responses because it is an important farming region of more than 3000 farms, the majority of which specialise in cereal production (1804 cereal farms in total) (Natural Resources Institute Finland 2016). NMG scheme is particularly relevant for farms without animal production

because of its flexible management that does not require harvesting of biomass or grazing of the sites (as is the case with grassed buffer zones). The scheme is also especially important ecologically in cereal-dominated regions in which grassland parcels are otherwise infrequent.

We selected farmers from a sample of 92 farms with NMG in Uusimaa Province provided to us by the Information Centre of the Ministry of Agriculture and Forestry. We selected farms with multiple NMG sites because these farmers would have broad experience on various sites to draw on when assessing the prototype.

We sent letters to 47 farmers describing the research and inviting them to participate. Eight farmers contacted us and we included them in the study. We telephoned the remaining farmers for participation. To ensure variety between the farms, we grouped the farmers by municipality to ensure geographic distribution and aimed to include women, organic farms and livestock farms in our sample.

We reached a total of 33 farmers by telephone (a further 6 did not answer the calls), resulting in another 12 interviews. Of the 33 contacted by telephone, 12 declined to be interviewed, mainly due to time constraints, and 2 stated they would only be available for interview after the growing season. Table 1 summarises the farmers interviewed according to production type, farming "employment" status and number of NMG parcels under management. Of the farmers interviewed, 9 were 30-49 years old and 11 were aged 50-69 (mean age category: 45-50 years old). Primary production was cereals for all except two of the farms. However, the farms included present the range of farming contexts in the Uusimaa region, such as full vs. part-time farming, organic vs. conventional production and fields situated far from the farmstead vs clustered around the farm. Several of the cereals farms also had grazing animals.

Primary production type	**Full-time[1] farmers**	**Part-time[2] farmers**	**Number of NMG fields (incl. rented)**
Conventional, cereals	13	5 (incl. the only female farmer)	Median: 7 Range: 3-20
Conventional, specialty crops	1		6

Organic, cereals	1	3
Organic, dairy	1	6

Table 1 Summary of the farmers interviewed.

[1]Full-time includes in some cases farm-based machinery operation businesses (e.g. snow ploughing, digging) [2]Part-time – primary employment is off-farm; includes self-described hobby farmer

Farmer interview procedure

We interviewed the farmers using an interview guide and key themes. We audio recorded the interviews with permission of the interviewees. Interview themes included attitudinal (e.g. willingness to engage with bonus payments, perceived benefits and problems), institutional (e.g. challenges in terms of administration and delivery, incl. advisory), and financial aspects (adequate level(s) of payments (Appendix B). We asked background information on the farm and farmer before continuing to discussion of current and past nature management and other possible AES contracts. We presented the prototype scheme to the interviewees and asked about their interest in such a scheme. We asked targeted questions about e.g. possible participation, feasibility of the presented idea and what would be needed for such an idea to succeed. We also asked how the farmer felt others (society and peers) would perceive the scheme. The final part of the interview focused on the interviewee's conceptualisation of "good farmer" and whether the NMG scheme fit into such a conceptualisation (Appendix B). Interview time averaged over 1 hour. We conducted interviews in Finnish, and in seven of the interviews a spouse or someone else involved in the farming participated for at least part of the interview. The majority of interviews (17/20) were conducted by two authors, with the same researcher leading the interview in all cases. In most cases (17/20), interviews were followed by a visit to an NMG field of the farmers' choosing, where we continued discussion of the proposed prototype as we walked across the field with the farmers looking for the indicator species.

Public official and advisor interviews

303 We chose experts based on their known expertise in administration or advisory of
304 AES and, specifically, AES for biodiversity conservation. Hence, in choosing the
305 public officials and experts, we did not use geographical determinants. We
306 interviewed representatives of the key actors, such as the Ministry of Agriculture and
307 Forestry, Agency for Rural Affairs, regional administration, advisory services,
308 Farmers' Union and environmental NGOs (altogether six interviewees). These
309 interviews focused on evaluating the potentials and possibilities of PBR measures in
310 the Finnish policy context. We contacted potential interviewees by telephone or email
311 and then sent them the background information and a set of questions. Afterwards we
312 met with respondents face-to-face or via Skype video call and discussed the issues.
313 One respondent preferred to send the response in writing and declined a request for a
314 meeting. Interviews took place after the farmer interviews. After interview questions,
315 we presented preliminary results from work with the farmers to see if it brought in
316 new themes and reactions from the expert stakeholders.

317

318 *Analysis of the interviews*

319 Analysis of farmer interviews started with a summarising practice similar to that
320 described by Schroeder et al. (2013, citing Mayring 2008) and was followed by a
321 modified version of theoretical thematic analysis (Braun and Clarke 2006) according
322 to the topics presented in Introduction. Firstly, we recorded our initial impressions of
323 the interviews immediately post-interview. At this stage we noted key points, new or
324 repeated information, and attitude toward the topic. We assessed how well the
325 interviewee understood the prototype scheme and how trustworthy their responses
326 were (veracity, how well-considered or thought-out). Secondly, we produced a
327 summary of the interview experience and key findings. Thirdly, we listened to the
328 interviews, produced partial transcriptions, and made note of the emerging themes,
329 answers to the quantitative questions, and the major points of the key themes
330 discussed. The dataset from experts and officials is shorter in comparison to farmer
331 interviews. For analysis, we extracted the key themes and points from the interviews.

332 We classified the quality of the fields visited with farmers into three categories for
333 likelihood of achieving the hypothetical bonus-payment, based on the number of the
334 indicator species: i) "meets requirements" (seven or more indicator species), ii) "could

meet requirements with reasonable effort" (less than seven indicator species but a field is suitable in terms of its history and current vegetation type), and iii) "highly unlikely to meet requirements without considerable effort" (few, if any indicator species, high cover of species indicating nutrient-rich conditions or dominated by commercial seed plants).

Results

Indicator species evaluation

The mean number of the suggested indicator species per NMG field was 3.2 and maximum was 11 species. The number of indicator species strongly correlated with total number of vascular plant species per plot (Pearson r = 0.745, p< 0.000; one-tailed) (Fig. 1). The number of indicator species also positively correlated with field area (Pearson r = 0.318 p<0.001; one-tailed).

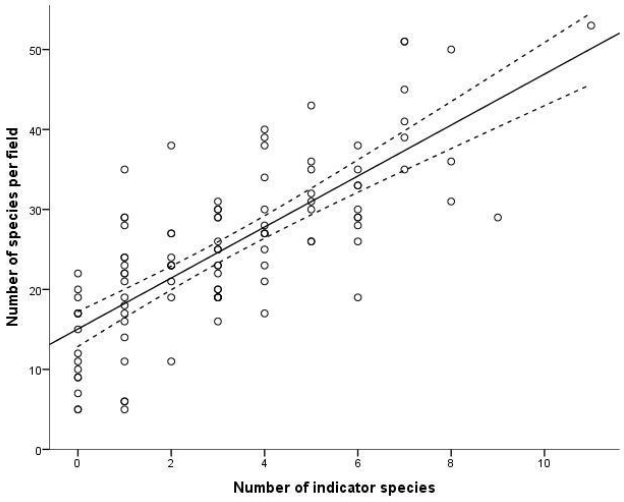

Fig. 1. Linear correlation between number of vascular plant species per field and number of indicator species in nature management grasslands in Finland. The vegetation data come from Toivonen et al. (2013) (n = 104).

The percentage of the number of fields that would qualify for the bonus payment and their combined area linearly declined with increasing threshold number of indicator species (Fig. 2). With six species as a threshold, the eligible number of fields would consist of about 20% of the total NMG parcels and 30% of the combined area. With

seven species as a threshold, about 10% of fields, covering 10% of NMG area, would have qualified.

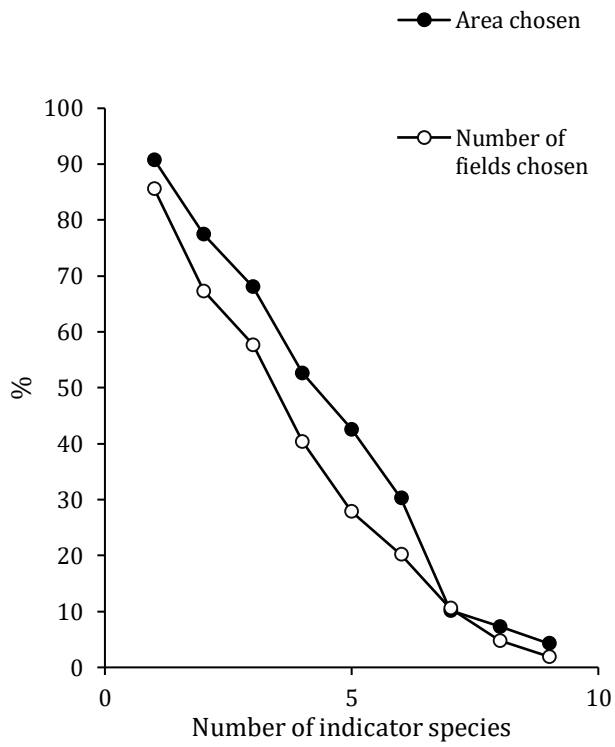

Fig. 2. Percentage of the a) number of nature management grassland fields and b) their area that would have qualified for the bonus payment based on a progressively increased threshold number of the indicator species. Vegetation data comes from Toivonen et al. (2013) (n = 104).

Mean number of plant species was 25 species for all fields. Fields which would have qualified for the bonus payment based on the threshold of seven indicator species had on average 42 species per field.

Modelling of the potential eligible area for the bonus payment and resulting budgetary expense demonstrated that the optimum of biodiversity gain (in terms of local species numbers) related to the expense is in the threshold of seven species (Fig. 3). If the bonus payment is set at, for example, 50 € per hectare, the NMG measure would draw an additional 0.5 million € from the agri-environmental programme. This would channel about 5% of the total current expenditure on the measure to retention and management of parcels with nearly double mean species richness per plot compared

to the scheme overall. The costs of paying the bonus can also be related to species as a unit of biodiversity. In this case, bonus for fields would target from 59 to 182 species accumulated over the whole fields potentially chosen (Fig. 3). The cost per unit in both cases drops at seven indicator species.

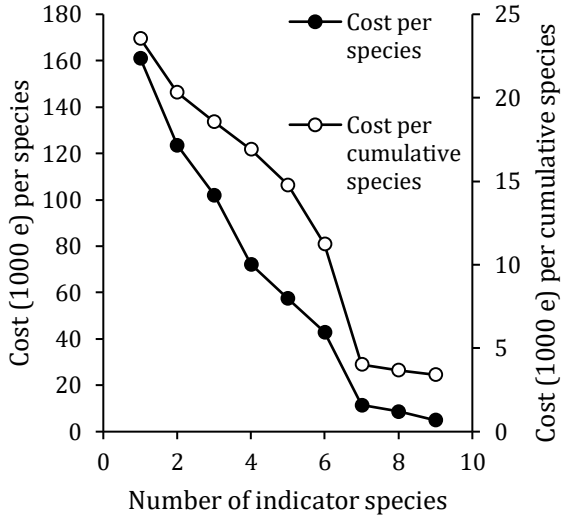

Fig. 3. Budgetary expense for the premium payment related to a) the mean number of species and b) the cumulative number of species in the potentially chosen fields, as a function of the threshold number of indicator species. The bonus payment is set to 50 € per hectare. Vegetation data comes from Toivonen et al. (2013) (n = 104).

Farmer participation in the NMG scheme

Farmers' reasons for participating in the NMG scheme were mainly related to convenience and low production value of the fields: NMG were often small, wet, oddly shaped, highly shadowed by forest, or far away from the farmstead (cf. Herzon et al. 2012). Most of the farmers had long-term NMG, and some also established NMG as part of their crop rotation. Farmers commonly adjusted to a greening requirement under the Common Agriculture Policy for the Ecological Focus Area by placing some of the former NMG into this obligatory field type. This practice was common amongst grain farms lacking other land use (e.g. pasture, leguminous crops) to fulfil the requirement.

Farmer acceptance of the potential payment-by-result option

Initial farmer responses to the PBR prototype scheme fell into three categories: immediate positive attitude (14), immediate negative attitude (2) and equivocal (4) (sample of responses in Table 2). Eight farmers used ‘smart’, ‘interesting/interested’ or ‘good’ in their response. Rather than giving a clearly positive or negative response, ‘equivocal’ farmers responded with questions, such as how to establish the indicator species and how inspection/documentation would work in practice. Negative responses were based on the scheme being perceived as ‘too bureaucratic’. There was no clear difference based on ages, farm size or education level.

The farmers, in general, approved of the idea of payments being linked to specific results. It was generally regarded as a fair approach. Farmers mainly were not able to propose their own measures to achieve the biodiversity goal proposed here. Some farmers (as well as experts) compared the approach to another scheme that targets semi-natural vegetation on so-called traditional rural biotopes and noted that the bonus measure for NMG has fewer management demands and, thus, a lower threshold for participation.

Table 2 Sample of the initial responses from farmers to the proposed bonus scheme, including description of the farmer and whether the nature management grassland visited was suitable for the bonus. Response classifications are positive (pos), negative (neg), and equivocal (equiv).

Farmer description: age, sex, field area, other work	**Field’s suitability for the bonus y/n***	**Response class**	**First impressions**
Over 35, 100 ha + another business	y	Pos	An interesting idea. It would bring more income but also more biodiversity… also more work. I would consider it.
Over 60, 42 ha	n	Pos	Why not? Farmers have done stranger things to get subsidies than count flowers.
Over 35, 150 ha	n	Pos	It sounds smart. Now when they’ve been mown it’s not necessarily so good for those plants.
Over 50, female, 35.5 ha + employed full time off-farm	y	Pos	It doesn’t sound like such a big job. We go out walking there sometimes anyway.
Over 30, 255 ha	y	Pos	Could be interesting. Clearly different than what has come before. For example, I've never been told about these [indicator] plants before.
Over 45, 150 ha + heavy	y	Equiv	The nature management fields are so different…some of them sure, there’s plenty of

machinery job off-farm			species, others–there's not much without sowing the seeds and then the cost has to be compensated.
Over 40, 260 ha	y	Neg	Payment is, of course interesting, but my first impression is that it sounds too bureaucratic. The whole AES scheme already has so many nuances and different directions.

*y= >7 indicator species found during site visit

Farmer concerns or reasons not to accept payment-by-result

Concerns focused on the proposed prototype, rather than payment-by-result approach generally, and mainly on implementation in practice (Table 3). The main concern was verifying the results in a consistent way for both farmers and inspectors. Farmers suggested several technical or management-based solutions, such as documenting indicator species by taking gps & time-stamped photos on smart phones and creating 'sections' within parcels to pinpoint species for special management for conservation (indicator species) or control (e.g. thistles). A farmer who was formerly an inspector for the state agency overseeing agriculture subsidy payments was initially highly critical of the approach for its lack of prescribed management actions, asserting that farmers need rules to follow and inspectors need actions to evaluate.

Table 3 main concerns about results-based approach brought up by the farmers. The most common concern is in bold.

Theme	**Concerns**
Cost	Where will the money come from for farmer training?
	Will the bonus cover the cost of purchasing seeds, extra management, loss of other crop/land use?
Farmer capacity: knowledge	Learning new management skills to propagate, identify, target species
Farmer capacity: time	Time commitment- more effort for management
Extension	Will the training be sufficient, what kind of support (contact information, materials) will there be?
Inspection & verification	**Farmer & inspector must have same criteria and result.**
Governance	Commitment to contract & options if it doesn't work out.
	Farm planning period, including subsidy applications, vs. knowing if site successfully meets the requirements;
Land use	If bonus is too attractive, good farmland could be taken out of production;
	Aesthetics, appropriate 'placement' for NMG;

	Long-term NMG becoming sources of noxious weeds;
Peer perceptions	Do not want to stand out as doing something different.

Implementation: prerequisites and capacity building

Though the approach would not stipulate management, most farmers were keen to receive advice for best management. Some voiced specific concerns about neighbours' disapproval of "weeds" or neglect of sites. Three farmers stressed the role of good marketing and packaging of the measure for farmer acceptance.

Among the farmers, being unsure about best management practices and associated work for improving the nature value of the NMG was more of a concern than carrying out self-monitoring of indicator species. Many farmers did not see species monitoring as a burden, with some pointing out that they walk in their fields regardless and others saying that it can be a pleasant break to go out in the field on a nice day to look for the indicator species and that it could even be done with their children or grandchildren.

Most farmers were able to correctly identify the fields potentially suitable for the bonus payment (Table A.1), even if they were not otherwise knowledgeable about the plant species chosen as indicators. According to their own assessment and based on reactions to the indicator species brochure, few (<5) farmers exhibited, or thought someone else in their household had, sufficient knowledge to carry out the self-monitoring of the indicator species at the time of the interviews. However, most interviewees stressed that their professional background provided them with enough know-how to successfully complete the task with supporting extension materials.

Though all farmers mentioned the need for extension services, most wanted the training to be 'light' (it '*comes out of the budget and then there's less to distribute*'). Most did not consider the indicator plant species brochure shown to them (Appendix A) sufficient on its own for getting started. Rather, the farmers suggested introductory hands-on training, contact information for expert support, online materials or even a smartphone app for species identification. Several farmers suggested the measure should be introduced in the obligatory continuing education meetings they attend.

Opinions about an appropriate sum for the bonus payment were influenced by individuals' perceptions of the proposed measure as either a low-cost maintenance of

462 possibly already suitable fields (low threshold) or establishment of new NMG (high
463 threshold). Fifty euros was most frequently suggested as a minimum: *'If you already*
464 *have the species and don't have to do anything, then small'*. Two farmers expressed
465 that the bonus *'shouldn't be too high'*, as it could then attract people who are willing
466 to cheat to get the subsidy. At the other end of the spectrum was consideration of costs
467 and forgone income: one suggestion was for the bonus to be equivalent to average
468 income for a field crop, and two farmers suggested that it should be equal to subsidy
469 for buffer zones (currently 400 €/ha).

470 The 17 fields visited during interviews fell into three groups according to the number
471 of present indicator species (Table A.1). There were 12 sites (71%) that would already
472 qualify for the bonus payment, four sites (24%) that might qualify under appropriate
473 management (e.g. mowing of overgrown patches or bringing in the hay mass from
474 another diverse field to seed), and one field (6%) that would require long-term
475 management investment (heavily overgrown on nutrient-rich soil).

476

477 *Reputation and public perception*

478 Perceived effects of the approach on reputation was mostly positive. Concerns were
479 formulated as 'growing weeds', 'unmanaged sites', and 'bad farming'. Aesthetics of
480 the overall farmland landscape and fields neighbouring others' properties elicited
481 particular concern. Farmers suggested that some peers would reject the idea of
482 farmers 'counting flowers'. Most farmers expressed that, though their peers' opinions
483 matter to them, they make their own decisions. Some farmers also explained that
484 attitudes change as new practices become normalised, and mentioned growing
485 acceptance of organic agriculture as an example of how farmers' attitudes toward
486 environmental practices may change over time. Farmers generally felt that this type of
487 environmental conservation activity would be received positively by the general
488 public, and may even improve reputation of farmers and farming by showing that
489 farming *'isn't just intensive production'*. A minority expressed the view that *'the*
490 *public is always blaming farmers'* and the measure may be perceived as *'more free*
491 *subsidies'* to farmers.

492

493 *Public officials' and advisors' reactions*

We identified seven main themes in the responses by experts and officials: cost, administrative capacity, verifying results, governance context, evidence of results, farmer capacity, and misuse and cheating (Table 4). Public officials working with administration and inspection of AES were most critical of the PBR approach. They could not see how the new approach could fit into the current AES, or even any reason for changing the existing system. One administrative expert noted that since subsidies are no longer coupled to production, a basic attitude is that *'nobody expects a result'*. The gravest concerns were about ability to verify the results at the right time and in a way compatible with EU requirements (Table 4). Also, the current capacity of already overstretched personnel to monitor new things and learn new skills was questioned.

Responses emphasised perceived administrative burden of the measure. Only one of the four interviewees representing administration and inspection considered the approach in terms of achieving agri-environment targets. None mentioned building of farmer capacity or other aspects of cultural capital in their responses. Responses to whether the proposed PBR scheme is better or worse than the existing management-based measure were mostly noncommittal to negative. However, one official stated that there may be contexts in which the results-based scheme is better but that *'the plant species component alone wouldn't make the NMG measure better'.* Two officials stated that adding more management requirements to the existing NMG scheme could achieve the biodiversity result aims of the proposed results-based prototype. Some of the experts viewed the proposed PBR as a 'continuous growth' model in which there was to be continuous increase in target species, which should be measured in some way.

Table 4 Concerns about results-based approach amongst the experts, officials and advisors interviewed. Number of interviewees commenting on each theme in (). The most strongly emphasised concerns (frequency + amount of discussion) within and across themes are in bold.

Theme	Concerns
Cost (5)	**Could result in more required inspections & more training**, outside trainers;
	Fields would be divided into good & bad, which would place demands for more funds;
	Lowering basic payment to support the bonus payment would be unfair to farmers.

Administrative capacity (4)	**High training threshold for inspectors to gain necessary skills/ indicator species knowledge.**
Verifying results (5)	**Planning & application in spring, species observation possible only in summer;**
	Farmer & inspector must have same criteria and result;
	Farmer self-reporting isn't reliable or accepted;
	No biodiversity baseline info on the sites.
Governance context (3)	**National programme must fit into EU framework/existing scheme structure;**
	Ministry has said no new 'norms'- aim is easing of existing burden.
Result? (3)	**Is it better? Must have evidence.**
Farmer capacity (3)	Farmers have to learn new skills;
	Farmers have to also learn a new scheme.
Misuse & Cheating (3)	'If it doesn't say what isn't allowed, then everything is allowed';
	EU could require higher rate of inspections if cheating is discovered to be higher;
	'Applicants want to maximise subsidies and will likely say they have the maximum-level of species needed'.

From the government side, the response from a Ministry of Agriculture representative was relatively optimistic and was based on experience with many dramatic changes in the working priorities and modes that the Ministry has seen in recent decades. The respondent stressed that the ever-pressing expectations of society for improvements in the state of the environment forces the administration to experiment with delivery of results in cost-efficient ways.

Agri-extension advisors were the most supportive of the approach, although they also acknowledged some risks similar to those raised by the administrators. The advisors saw the results-based thinking as providing genuinely new tools for enhancing biodiversity and landscape management in agricultural areas. Most respondents wished to see examples of successful piloting of the approach with solid evidence on performance and administrative costs.

Discussion

Suitability of the indicators for ecological targeting and as a guiding tool

The list of indicator species appeared to be suitable for identifying NMG with high total species richness of vascular plants. By using seven indicator species as a

threshold, the bonus payment could be channelled to the 10% of the NMG fields with nearly double mean species richness per plot compared to the scheme overall. As previous research has demonstrated, plant species richness and abundance of flowering plants in grassland habitats enhance, in turn, diversity and abundance of many other taxa, especially insects (Toivonen et al. 2016, Tscharntke et al. 2011, Siemann et al. 1998).

The process of developing the indicator species set for NMG was aided by availability of the nationwide species data for the vegetation type concerned. The data collection methods of the national survey differed from the proposed method in the prototype scheme, which means that the survey results are only indicative of possible occurrence of indicators under the PBR scheme. In the vegetation survey, the surveyed transect was of a fixed length and included field edges, which usually have more diverse vegetation than the middle parts of fields (Boatman et al. 2011). The initial monitoring format for the prototype scheme was occurrence of indicator species along a single transect across the field, which reduces the impacts of edges but, in most cases, increases the total monitored area. Site visits conducted with the interviewees showed that NMGs are sometimes heterogeneous, with patches of higher diversity or specific clusters of indicator plants. Thus, a monitoring approach accounting for such heterogeneity would likely increase the number of sites qualifying for the bonus. Practicality of such an approach is more complicated but could be addressed by, for example, GPS-coordinate marked 'hotspots'. Existing or trialled PBR schemes have taken various routes, with German *Lander* schemes requiring four reference species 'regularly present' in each third of the field and France's *Prairies fleuries* scheme using broad indicator genera in addition to individual species, and restricting the scheme to targeted priority areas only (Magda et. al. 2015).

Allen et al. (2014) stress that setting up an indicator threshold, such as number of indicator plant species, should not lead to a decline in ecological condition in the most biologically diverse sites. This can be prevented by having multiple indicator thresholds, or by ensuring that payments are dependent on the maintenance of baseline conditions. In our case, a management baseline of abstaining from chemical inputs serves the purpose.

572 Prevalence of indicator species on NMG suggested by the farmers shows that farmers'
573 know-how of their fields (their potential conservation values often coinciding with
574 poor production values) seems to be a sufficient baseline understanding among
575 potential participants. Participant knowledge base is expected to increase with
576 appropriate extension materials and advisory services and through hands-on
577 experience. This is particularly important considering that, even after decades of
578 payments for environmental conservation, farmers currently lack the knowledge and
579 skills for managing for optimal biodiversity conservation.

580

581 *Farmers' views on PBR approaches*

582 The number of participants represents a very small sample and farmers represent only
583 one region and, therefore, we had no intention of deriving a statistically representative
584 picture for the country. The results of the interviews gave us only an indication of the
585 range, strength and commonality of views across the interviewed groups. Importantly,
586 however, the farmers engaged with the scheme idea at a broad scale by generalizing it
587 to Finland's agriculture politics/policy as a whole and to other production and farming
588 styles and conditions, and regardless of perceived applicability of the scheme to their
589 own farm or context.

590 The idea of results-based payment for biodiversity results was overwhelmingly
591 accepted by the farmers in our study. This finding is in line with both anecdotal and
592 published evidence from Germany, France and Ireland (Oppermann and Gujer 2003,
593 de Sainte Marie 2010, Matzdorf and Lorenz 2010, Schwarz and Morkvenas 2012,
594 Osbeck et al. 2013, Schroeder et al. 2013). In particular, farmers favour the flexibility
595 offered by the PBR measures over the frustrations experienced by the detailed
596 management instructions and inspections of conventional management-based
597 approaches (Oppermann and Gujer 2003, de Sainte Marie 2010, Matzdorf and Lorenz
598 2010). Also, most of the farmers participating in an even more demanding auctioning
599 trial in Finland were supportive of the idea of linking payments to results
600 (Grammatikopoulou et al. 2013). The farmers' main concern with verification of
601 results (in this case meeting the indicator species qualification) is consistent with the
602 experiences in other countries (Oppermann and Gujer 2003, de Sainte Marie 2010,
603 Matzdorf and Lorenz 2010).

The two farmers whose initial responses to the proposed scheme were negative placed their criticism firmly in the context of perceived problems of AES overall. They attributed the bureaucracy problem to larger structural problems of the subsidy system itself, as well as to lack of trust in the bureau tasked with oversight in Finland. This criticism echoes previous findings that farmers are frustrated by detailed management instructions and inspections (Kaljonen 2006) and is only nominally related to the PBR approach and the proposed scheme.

Studies accompanying trials or implementation of PBR measures cite a more meaningful engagement of farmers in adaptive management for best fit for their situation and context as a key success factor for such measures (Klimek et al. 2008, Swagermakers et al. 2009, Zabel and Roe 2009, Osbeck et al. 2013). Concurrently, adaptive management and self-monitoring supports and builds 'cultural capital' in environmental stewardship (Burton & Swartz 2013, Lowe et al. 1997). In our study, such cultural capital potential was evident in e.g. farmers' express interest in best management practices and enthusiasm for the learning and sharing opportunities provided by the self-monitoring.

Differences and similarities in farmer and expert stakeholder views

Farmers, particularly those with 'equivocal' first impression of the proposed PBR bonus, and expert stakeholders brought up some similar concerns. Otherwise, they responded differently, with farmers mainly seeing opportunity and experts mainly seeing risk.

Each group considered how a novel approach might impact their own profession (e.g. skills, knowledge acquisition) and workload, but farmers also expressed values related to landscape, nature and agricultural production. Many of the farmers exhibited a high degree of knowledge regarding rules and structures governing AES and agriculture policy, and this was reflected in their concerns and questions on implementation of the bonus. We discovered during interviews that two of the farmers had formerly been employed in AES development or inspection. The former subsidy inspector's response was consistent with interviewed experts from the administrative sector. The farmer with several years experience in AES design-related tasks responded similarly to the extension advisory experts.

Rejection by most of the experts of the PBR approach as incompatible with EU Commission's framework is somewhat at odds with the fact that the approach is used in other EU countries, although some of those programmes are paid from regional, not EU funds (Allen et al. 2014). This reflects a currently low profile of the PBR approach at the EU level. Farmer self-monitoring was also criticised as unacceptable to the EU Commission, even though current action-based payments also rely on farmers' self-reporting with only a possibility of inspection. The learning curve and training needed for inspectors was also purported to be unreasonably high. However, experiences with the PBR approach so far show that people administering measures with PBR components believe that, on balance, measures focused on results are more cost-effective than management-based schemes (Allen et al. 2014, Butler et al. 2010, Matzdorf and Lorenz 2010, Groth 2009). Further, it could be argued that more training for farm-level visits (inspectors) is needed regardless of approach: a recurring criticism of the inspection process from farmers is that inspectors are critical but unable to give advice for improvement and problem solving (Birge and Herzon 2014, Seppänen and Helenius 2004). This study's finding that farmers wish now for more advice on good management practices for NMG is in line with others that adequate extension services are important to the success of programmes aiming for farmer engagement in conservation, regardless of the approach (Schroeder et al. 2015, Allen et al. 2014).

Farmers had more faith in their capacity to gain skills necessary for the self-monitoring than the expert stakeholders involved in administration and governance. The farmers' assessment of themselves in this respect is supported by studies confirming enhanced ecological knowledge in several PBR measures (for example, de Sainte Marie 2010).

Unlike many of the farmers, experts criticised but did not propose technical solutions to the monitoring issue. They were more concerned with cheating, whereas the majority of farmers who mentioned cheating mainly stated that people are not going to go to great lengths to cheat for a small bonus payment (*cf*. results in Klimek et al. 2008). Potential cheating was mentioned by experts in our study far more often than achieving environmental benefits. There was little indication that the subsidy administrators interviewed view farmers as partners in conservation or stakeholders whose conservation skills and attitudes can be developed. These results show a need

for orientation toward cultural capital thinking within the administrative structures if PBR measures are introduced.

Experimenting for policy learning

We cannot, based on this research, state that the PBR measure modification is per se better than the present management-based measure in terms of its effectiveness to deliver ecological quality. This would require a targeted study comparing the outcomes of two measure alternatives under comparable conditions. The degree to which agri-environment type measures perform for biodiversity benefits depends on a far greater range of factors than studied here (as reviewed in Allen et al. 2014). However, the approach explicitly encourages "innovation, self-help and mutual learning, and finding positive ways of harnessing the power of peer group pressure" (*ibid* pp. 115). Indeed, experiences from the French flowering meadows competitions indicate that the agro-ecological emphasis of combining agronomic and biodiversity aims result in a collective learning process for all participants (Magda et al. 2015).

Our results call for further experimentation aimed at policy learning. With specific recommendations from the EU for testing the result-based approaches as means for improving AES efficiency, the growing body of evidence that the PBR approach provides numerous benefits, and our findings showing farmer interest in the approach, the time might be ripe in Finland for piloting results-based payments for biodiversity management. The piloting should target different regions. Because agricultural policy is mandated on the national level, with only limited regional targeting, there is a general uniformity for policy implementation throughout the country. However, it is possible that new perspectives may be found in other regions and among other farming types due to factors that are not relevant to the cereal farmers in the Uusimaa region. Livestock farms have a larger range of options at their disposal for grasslands compared to non-livestock farms that may struggle with grazing or haying requirements of other schemes. Results may differ also in the regions with high levels of agricultural abandonment. Also other target biotopes, such as traditional or semi-natural biotopes, should be tested for a result-based approach to policy delivery. Indicator development for other environmental targets, such as reducing nutrient runoff, require independent trials.

Experimentation should incorporate systematic monitoring of the ecological and economic efficacy of the PBR approach as compared to the conventional management-based measures. Given the importance of farmer attitudes and management practices to scheme outcome, these should also be assessed and monitored. With respect to administrative officials, the experimentation, however, calls for an experimental mind and a licence to fail (cf. Primmer and Hildén 2015). According to our findings, such an experimental attitude might be the trickiest thing to achieve in the current practice and framework of agri-environmental schemes (cf. Kaljonen 2011).

Conclusions

The bonus scheme has the potential to target the most biologically diverse sites by possible channelling of just 5% of the total current expenditure on the measure to retention and management of parcels with nearly double mean species richness per plot compared to the current scheme. This can be regarded as a high efficiency in terms of environmental outcomes. The indicator species list also proved suitable for identifying NMG with high total species richness of vascular plants and appeared feasible in the eyes of the farmers.

Farmers were mainly positive about the PBR approach and the findings show a possibility for developing farmer capacity and cultural capital in managing for biodiversity conservation. Policy officials in charge of the implementation of the agri-environmental schemes were the most critical towards the monitoring of the results-based approach. Change from same-for-all management-based measures to payments tailored by results will require new thinking from AES officials.

Further experimentation and piloting, in different regions and for more production types, is needed before implementation of the results-based approach. According to our results, the experiments should focus on finding a balance between self-monitoring and inspection: verification should be able to take the heterogeneity of NMG sites into account but must not be overly cumbersome for either farmers or inspectors. Also, learning and capacity building for farmers and inspectors is needed. Close co-operation with policy officials, farmers and researchers in designing and monitoring the experiments is needed for overcoming obstacles. Lessons learned in

733 other countries may aid in finding solutions to issues brought up by the experts
734 interviewed, including verification and compatibility with national and EU
735 requirements.

736

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743

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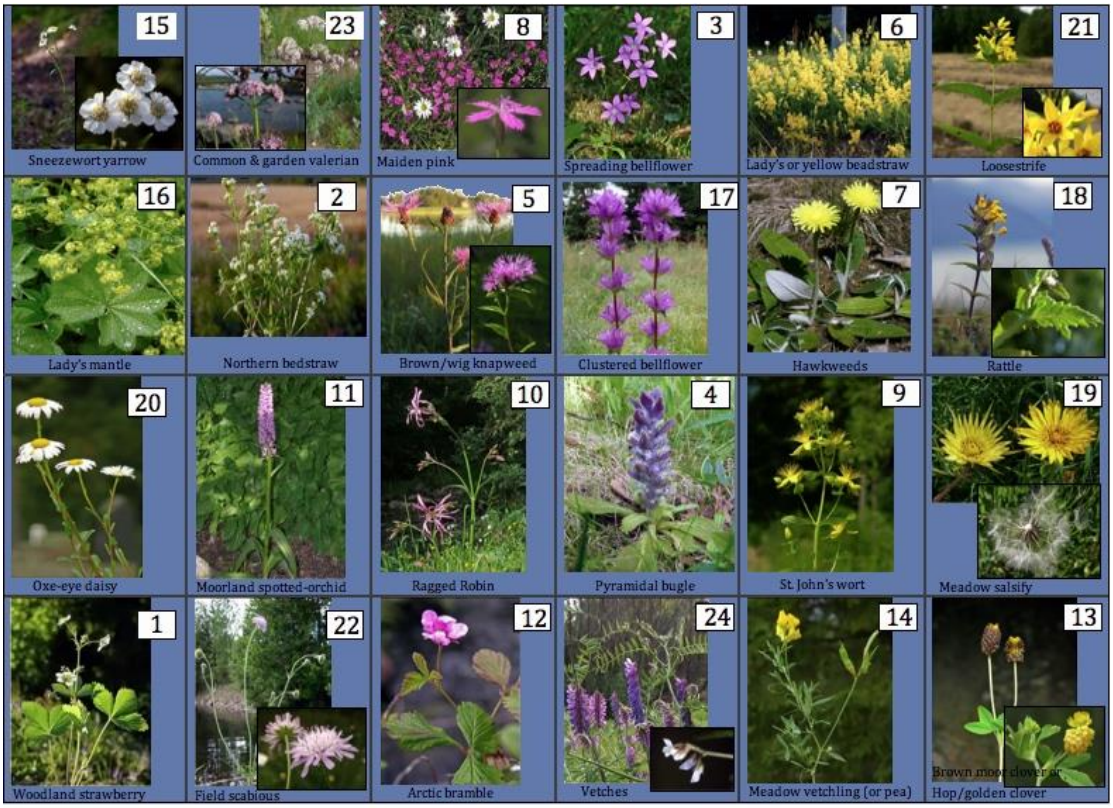
950

Appendices

Appendix A 1. Leaflet for farmers with the indicator plant species used in the farmer interviews about the hypothetical bonus payment for nature management fields. English common names added to leaflet for publication.



Appendix A 2 Leaflet text for farmers describing the prototype bonus scheme. Farmers were provided with common names for indicator species (left hand side). These correspond to the numbers on the photo guide (Appendix A 1). Space is provided for recording any indicator species found. Appendices A 1 and 2 are translations of the original Finnish language leaflet.

Hypothetical Nature Management Grassland (NMG) Bonus, With Indicator Species List

Mark observed species with an "x" in the appropriate column

Farm		
Parcel number		
Date		
Species/species family		
1. woodland strawberry		
2. northern bedstraw		
3. spreading bellflower		
4. pyramidal bugle		
5. brown/wig knapweed		
6. Lady's or yellow bedstraw		
7. hawkweeds		
8. maiden pink		
9. St. John's wort		
10. ragged Robin		
11. heath or moorland spotted-orchid		
12. Arctic bramble		
13. brown moor clover, hop/golden clover		
14. meadow vetchling, meadow pea		
15. sneezewort, sneezewort yarrow		
16. Lady's mantle (replacing white bedstraw)		
17. clustered bellflower or Dane's blood		
18. rattle		
19. Meadow Salsify, Showy Goat's-beard, Meadow Goat's-beard		
20. oxe-eye daisy		
21. loosestrife		
22. Field Scabious		
23. common & garden valerian		
24. vetches		

What: The goal of this proposed agri-environmental subsidy (AES) maintainencs and/or improvement of plai species diversity in Nature Management Fields (NMG). Improved plant species diversity would also support other species biodiversity. The hypothetical new payment model consists of a basic payment and a bonus payment dependent upon the presence of specific plant species on NMG. Bonus payment sum is X.

Why: NMG have been shown to be one of the most effective AES actions for maintaining regular natural biodiversity in the Finnish agricultural environment. Many NMG are old fallows and are located on low-production fields. Conversely, the flora of many NMG resemble production grassland and are used for fodde production. In the new measure presented, basic payment for NMG would remain 120€/ha. An additional bonus payment would be paid for species-rich parcels as an incentive for their maintenance.

In the proposed model, the landowner would have the freedom to choose how the NMG parcel is managed. This would include management actions for how to increase biodiversity including, for example, whether, hc and when to mow.

How: Bonus payment would be available for parcels with a minumum Y species from the 24 "indicator species" list. The list includes easy-to-identify species from NMG on with varied soil types and habitat conditions throughout Finland

Species observation would by conducted by walking the length the NMG parcel in a straight line at its longest transect and fillin in a form for all indicator species observed within a 1 meter distance of the transect. The best time for conducting the observation transects is July when the majority of the species ai in flower.

The compensation application would be submitted together wit the other AES tapplications. Indicator species observation woul be conducted twice during the 5-year agreement period.

Official inspection would take place during the same inspection visits as for other AES. Inspection would be done using the same observation method as that used by the farmers.

These 24 plant species on the left are indicative of diverse grassland flora and are the indicator species for th proposed bonus scheme.

Table A 1. List of 24 indicator species and their occurrence (in percent) on the nature management grasslands (n = 104) (Toivonen et al. 2013), and, in brackets, on old nature management grasslands (n=20) (Toivonen et al. 2015). Ease to recognise is assessed by the authors for a species or group of related species. Habitat after *Hämet-Ahti et al. (1998).* Status is according to the national Red list (Rassi et al. 2010) and positive indicator of diverse grassland vegetation after Pykälä et al. (2001). Percentage of registrations is during field visits with farmers in connections to interviews in this study (n = 17).

Name	Frequ-ency	Ease of recog-nition	Habitat	Region	Status	Regist-ered during field visits, %
Achillea ptarmica	36 (50)	1	Meadows, boundaries			41
Ajuga pyramidalis	0 (5)	3	Meadows, forest edges	South	Near threatened, positive indicator	0
Alchemilla spp.	14 (35)	2	Meadows, boundaries			65
Campanula glomerata	3 (5)	3	Meadows, forest edges	East	Positive indicator	12
Campanula patula[1] / *persicifolia*[2]	34 (70)	2	[1] Meadows, boundaries, fallows [2] Lush meadows	[2] South-West	[2] Positive indicator	82
Centaurea jacea[1] / *phrygia*[2]	7 (30)	2	[1] Dry meadows, boundaries [2] Meadows, boundaries	[1] South [2] East	Positive indicator	47
Dactylorhiza	0 (5)	3	Moist meadows, bogs		[1]Vulnerable	0

incarnate[1] / *maculata*						
Dianthus deltoides	2 (10)	3	Dry meadows, boundaries		Near threatened, positive indicator	18
Fragaria vesca	3 (30)	2	Meadows, boundaries		Positive indicator	24
Galium boreale	10 (0)	3	Meadows, forest edges		Positive indicator	41
Galium verum	0 (10)	2	Dry meadows, boundaries	South-West	Vulnerable, positive indicator	6
Hypericum maculatum[1] / *perforatum*[2]	25 (50)	2	[1] Meadows, forest edges [2] Rocky hills, juniper groves, boundaries	[2] South	[2] Positive indicator	53
Knautia arvensis[1]/ *Succisa pratensis*[2]	0	3	Meadows, boundaries, fallows	[1] East [2] South-West	Positive indicator	6
Lathyrus pratensis	49 (90)	1	Meadows, boundaries, hay fields		Positive indicator	94
Leucanthemum vulgare	18 (50)	1	Meadows, boundaries, forest edges		Positive indicator	65
Lychnis flos-cuculi	3 (5)	3	Damp meadows, shores, springs, ditches		Positive indicator	18
Lysimachia spp.	11 (15)	2	Shores, damp meadows, ditches, swamps			12
Pilosella/Hieracium group	17 (15)	3	Dry meadows, boundaries, forest margins, open forests, shores, rocky outcrops			18
Rhinanthus serotinus[1] / *minor*[2]	11 (10)	3	[1] Boundaries, fallows [2] Boundaries, meadows		Positive indicator	6
Rubus arcticus	4	1	Damp meadows, boundaries	Central	Positive indicator	0
Tragopogon pratensis	1 (20)	2	Railway embankments, roadsides, field margins	South		0
"Yellow clover" *Trifolium aureum*[1] / *spadiceum*[2]	2 (15)	3	[1] Dry meadows [2] Meadows	[1] East	Near threatened, positive indicator	29
Valeriana sambucifolia[1] / *officinalis*[2]	8 (5)	2	Shore meadows, stream banks, fallows, forest-edges	[1] West [2] South		29
Vicia spp.	74 (85)	1	Meadows, fields, boundaries, shores			100

971 Table A 2. Criteria for inclusion and exclusion for indicator species list

Included species:	**Examples**
Mainly ubiquitous by geographical coverage and growing conditions	*Leucanthemum vulgare, Achillea ptarmica*
Some specific to limited parts of the country and in specific abiotic conditions (incl. wet sites along coastal and inland waters, fields with numerous open ditches, and dry and nutrient-poor sandy soil sites).	*Valeriana sambucifolia/officinalis, Dactylorhiza incarnate/maculata, Rubus arcticus*
Some commonly occurring on NMG fields	*Lathyrus pratensis, Vicia spp.*
Some of high conservation value occurring only occasionally in old grassland vegetation.	*Ajuga pyramidalis, Dianthus deltoides*
Excluded species:	
Tolerant of high management intensity (either high soil fertility or mowing/grazing pressure)	*Urtica dioica*, *Trifolium repens*
Found almost at every focus field type	*Achillea millefolium*
Noxious weeds	*Cirsium arvense*, *Equisetum arvense*
Difficult to identify	All *Poaceae*, sedges and rushes, most *Apiaceae*

972

973 Appendix B. Farmer interview guide (abridged)

974 Prior to interview questions, interviewee read an introduction to the research text to interviewees, asked
975 if they had any questions before beginning, and secured permission to record the interview.

976 **I. Background**

977 **a. Personal:** sex, age, highest level of education, participation or membership in
978 hunting/agricultural/environmental orgs.

979 **b. Farm:** farm size (ha), organic or conventional, hunting on farm, honey production on farm,
980 on-farm income generation in addition to farming (e.g. tourism, direct sales, courses, etc).

981 **c. Existing or past voluntary environmental subsidies:** Nature management grassland
982 (research focus): general area and history, how far from main farm (visible or 'hidden'), main
983 reasons for scheme participation; other nature management fields & biodiversity fields (incl.
984 traditional rural biotopes, buffer zones, catch crops, game field, etc), any other 'special'
985 subsidies; possible impact of the 'greening' requirement on nature management grassland.

986 **II. Payment-by-results bonus prototype**

987 **a. Introduce prototype** (leaflet text & indicator species photos)
988 **b. First impressions:** interest in participating in scheme or not (reasons)
989 **c. Open questions:** perceived risks; requirements for success (e.g. extension services, self-
990 monitoring, inspection); necessary skills- do you have those skills?; affect on reputation- peer
991 and society; own ideas to achieve similar/better result; other views, including on fairness and
992 effectiveness of proposed scheme, impact on workload, etc.

993 **III Attitude**

994 a. **'Good Farmer':** What is a 'good farmer'/ 'good farming'? Is nature management grassland
995 suitable to 'good farmer/farming'?
996 b. **Nature stewardship:** non-production activities farmer/ farm family engages in for nature,
997 landscape management (e.g. nesting boxes for birds constructed wetland, hunting of invasive
998 species, etc.); 'extra' activities to reduce farming impact on nature (e.g. checking for birds'
999 nests before spring tractor work on the field).

c. **Farm natural history:** Changes over time, expected changes for future.
d. **Education:** continuing education courses, activities, professional competitions or awards.
e. **Social network:** Are opinions of peers important to you? How might peers view this scheme or your participation in it? Affect on your actions?

Agri-environmental subsidy effect on farm income: Agri-environmental subsidy as a percentage of farm's total income.

Any further comments or questions

Appendix C. Experts and officials ('expert stakeholders') interview guide

Introduction text

In Finland, the agri-environment scheme (AES) is entirely based on prescribed management actions, and the payment amount is compensation based on calculations of real costs and lost income. Thus, the system lacks any incentive mechanism for achieving better results or applying the most appropriate site-specific management. An alternative is results-based payment where payment is partially or fully tied to results. The European Commission and Parliament are interested in this option and funded a report on it: (*Biodiversity protection through results based remuneration of ecological achievement* http://ec.europa.eu/environment/nature/rbaps/index_en.htm).

The aim of this research is to clarify how Finland could employ the results-based payment approach for biodiversity conservation. In the study we develop a hypothetical results-based prototype and interview farmers and representatives of other expert stakeholder groups.

Nature management grassland (NMG) measure is used in the study as an example of how a possible results-based measure could be applied as an incentive for biodiversity management. Nature management grasslands have been shown to be one of the most effective AES measures for maintenance of biodiversity in the typical farmland environs in Finland. The measure is quite popular in Finland. Previous research shows that plant species richness varies on NMG parcels from between 5 and 50 species (in transect counts). Appropriate management for specific parcel contexts and farmer capacity would help in achieving results.

I General

1. Why, in your opinion, is results-based payment not used in Finland? Please provide any references you may have to support your opinion.
2. Does your professional group view the results-based payment approach positively or negatively in Finland? Other groups (farmers, governance, inspectors, advisors, etc). Is there evidence of this?
3. How broad (e.g. political) prerequisites would have to be realised for results-based approach to achieve support in Finland?

II Payment-by-results bonus prototype

Present prototype (leaflet of indicator species) and

III Specific opinions

1. From your perspective, what risks do you see with the results-based approach?
2. What prerequisites would you place on the approach, e.g extension services, self-monitoring, external inspection, etc.
3. In your opinion, are any specific skills needed in order to achieve the goals of the proposed measure? Do you have those skills?
4. In your opinion, does the approach strengthen or weaken AES reputation/ public perception in Finland?
5. Would the proposed results-based measure work better or worse than the existing management-based NMG measure in Finland? Please, explain your response.

IV Key results from farmer interviews.

Any further comments or questions