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# The evaluation of a participatory extension programme focused on climate friendly farming

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1 **The evaluation of a participatory extension programme focused on climate friendly**  
2 **farming**

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18

19

20 **Abstract**

21 Agriculture is a major source of global greenhouse gas emissions and therefore effective policy  
22 interventions are required in order to mitigate these emissions. One form of intervention used  
23 within the agricultural sector is participatory extension programmes (PEPs). PEPs are advisory  
24 programmes based on voluntary participation where farmers, researchers, and rural experts  
25 collectively learn by sharing information and experiences. To evaluate the contribution of these  
26 programmes towards more climate friendly farming, this paper conducts an *ex-post* evaluation  
27 of a PEP focused on the voluntary uptake of on-farm emissions mitigation practices in the UK.  
28 We use a mixed-methods approach to understand both the adoption of new practices and a  
29 range of human-social outcomes such as social learning, resilience and improved decision-  
30 making. We find that participants in the PEP show a higher level of practice adoption compared  
31 to non-participants. However, the evaluation of the human-social indicators shows that the  
32 change cannot always be attributed to PEP participation. The paper contributes to the current  
33 literature by conducting the first evaluation on a climate change PEP in a developed country  
34 and by developing and applying an effective evaluation framework for climate change PEPs,  
35 in order to achieve an understanding of the change achieved by PEPs.

36 Key words: climate change, agriculture, extension programme, evaluation, mixed-methods

37

## 38        **1. Introduction**

39    Agriculture is directly and indirectly responsible for approximately 25% of global greenhouse  
40    gas (GHG) emissions (IPCC 2014; Le Quéré et al. 2016), and there is an increasing interest in  
41    ways to manage emissions caused by farm level practices (Olander et al. 2014). Although a  
42    range of interventions and practices have been developed (Black 2000), implementing these is  
43    complex due to the biophysical, economic and behavioural heterogeneity of farms. To date,  
44    attempts to stimulate the uptake of climate friendly practices in Scotland have mainly been  
45    delivered through voluntary programmes seeking to reduce emissions while maintaining farm  
46    profits. One approach to promoting these mitigation practices is via participatory extension  
47    programmes (PEPs), a type of advisory service, in which farmers, researchers and rural experts  
48    collectively learn by sharing information and experiences (Black 2000).

49    Given the public investment in PEPs, and their uncertainty around the potential contribution to  
50    achieving environmental targets, it is important that these programmes are reliably evaluated  
51    (Klerkx, Landini and Santoyo-Cortés 2016; Faure, Desjeux and Gasselin 2012). EU member  
52    states have set up evaluation guidelines for their Rural Development Programmes, including  
53    recommendations on mixed-methods (European Commission 2010; European Commission  
54    2015). However, while a lot of these evaluations have probably been conducted within the EU,  
55    limited work has been reviewed and discussed in scientific literature. The evaluations that have  
56    been published in peer-reviewed literature have mainly been conducted in developing  
57    countries; predominantly financial and productivity indicators have been used to identify the  
58    monetary return on investment (Läpple and Hennessy 2015; e.g. Läpple, Hennessy and  
59    Newman 2013); only a limited set of studies have applied qualitative or mixed methods to  
60    evaluate the effectiveness of programmes (Jones, Glenna and Weltzien 2014; Prager and  
61    Creaney 2017); and no study has evaluated agri-environmental PEPs to identify the  
62    contribution towards climate friendly farming.

63    To address this knowledge gap, this paper applies a mixed-methods approach to evaluate the  
64    effectiveness of an agri-environmental PEP in Scotland, focusing on environmental indicators  
65    and human-social aspects, i.e. social learning, resilience, and management skills. The paper  
66    adds to the current literature by conducting an evaluation on a climate change PEP in a  
67    developed country context by developing and applying an evaluation framework to gain  
68    understanding in the potential change achieved by such PEPs. In the following subsections we  
69    introduce PEPs and current literature regarding their evaluation.

## 70 1.1 Participatory extension programmes

71 PEPs first emerged as an alternative to the linear top-down ‘transfer of technology’ model in  
72 the 1960s in Australia and New Zealand (Braun and Duveskog 2011; Millar 2011; Parminter  
73 2011). In this model researchers developed and validated new technology, extension agents  
74 communicated this to farmers, who then adopted these new technologies (Black 2000).  
75 However, in the 1980s the approach received various critiques, such as: failing to account for  
76 local complexity; lacking a farmers’ perspective (Pretty 1995); failing to account for  
77 knowledge in the development and dissemination of practices (Pretty and Chambers 1993);  
78 and not providing sufficient return on investment (Feder, Willett and Zijp 1999). Participatory  
79 extension in the agricultural sector has so far shown to be a success due to its association with:  
80 high rates of practice adoption; a positive impact on productivity and income; an increase in  
81 knowledge and skills; and good availability of peer support (Davis et al. 2012). After Australia  
82 and New Zealand, participatory extension also became widely applied in developing countries  
83 as ‘farmer field schools’ (Braun and Duveskog 2011), and in European countries as farmer led  
84 discussion groups and innovation platforms (Knook et al. 2018).

85 PEPs aim to create an egalitarian environment in which farmers interact with peers and experts,  
86 with experts fulfilling a facilitating role, and farmers actively participating in goal and agenda  
87 setting. Meetings take place over a period of time, typically 1-3 years, and create knowledge  
88 by participatory learning methods, such as group or one-on-one meetings, training sessions and  
89 (experimental) demonstrations (Black 2000). The intended outcomes from PEPs include  
90 practice adoption, enhanced social learning, increased resilience to challenges and  
91 uncertainties, and improved farmer management skills and decision-making abilities  
92 (Cristóvão, Koutsouris and Kügler 2012). Overall, PEPs aim for cultural embeddedness of the  
93 key learnings via building cultural capital, i.e. the ideas stimulated in the PEP become  
94 embedded within the culture of farming and thus when the programme ends, farmers will  
95 continue incorporating the learnings into their farm management (Burton and Paragahawewa  
96 2011). The identified aims will be discussed further in the Methods section, in which the  
97 evaluation framework is explained.

## 98 1.2 PEP evaluation

99 The majority of PEP evaluations have been conducted in developing countries (Knook et al.  
100 2018; Van den Berg 2004), which might be due to the fact that the majority of PEPs are  
101 implemented in the developing world (Anderson and Feder 2004). The majority of the

102 evaluation literature to date is dominated by quantitative evaluations in which economic  
103 performance indicators are used to measure value for money, using indicators such as ‘financial  
104 performance’ and ‘productivity’ (Knook et al., 2018). Most studies show a positive return to  
105 programme participation in terms of an increase in financial performance or productivity,  
106 however, on closer inspection the calculation of returns is often questionable. Approximately  
107 50 percent of peer reviewed evaluations do not properly account for self-selection bias, which  
108 occurs when participants have the opportunity to decide whether to participate in a study or  
109 not, and results in a sample bias (Knook et al., 2018). Randomised controlled trials are the  
110 favoured approach to address this bias, but these are limited due to contextual complexity, such  
111 as overcoming ethical restrictions when non-participants are disadvantaged because of  
112 exclusion from the treatment group (Duflo et al. 2007). Therefore, quasi-experimental  
113 approaches are often applied, such as propensity score matching (e.g. Läpple and Hennessy  
114 2015). This method accounts for sample bias by matching participants from the control and  
115 treatment group on social, economic and biophysical characteristics (Läpple and Hennessy  
116 2015; Stuart 2010).

117 Although PEPs are mostly evaluated using quantitative approaches, these may actually limit  
118 the questions studied (Munro 2014; Cartwright 2009). Using only quantitative evaluation  
119 approaches is criticised for overlooking other intended outcomes, such as enhanced social  
120 learning (Munro 2014; Cartwright 2009), and thus falling short of a holistic evaluation of a  
121 PEP (Knook et al., 2018; Murray, 2000). Prager & Creaney (2017) and Sewell et al. (2017) are  
122 two of few studies that go beyond adoption rates, by including a qualitative evaluation of levels  
123 of learning, knowledge and practice change, which are important indicators to provide insight  
124 into long-term behavioural change (Muro and Jeffrey 2008). There are few studies that apply  
125 both qualitative and quantitative methods. A recent example of Hill et al. (2017) applied a  
126 quasi-experimental and a ‘naïve’ approach, in which participants were asked to list their own  
127 sense of progress in the adoption of new practices. However, these studies do not include other  
128 aspects of PEPs, such as whether programme participation improves management skills, which  
129 are addressed by Kraaijvanger et al. (2016). Overall, these studies show that holistic  
130 evaluations are likely to require a mix of qualitative and quantitative methods, as well as a set  
131 of indicators in addition to practice adoption, to provide greater depth of understanding  
132 (Davies, Nutley and Smith 2000; Montuschi 2014).

133 **2. Methods**  
134 2.1 Case study

135 To evaluate the potential contribution of a PEP to climate friendly farming we selected a PEP  
136 in Scotland focused on enhancing the uptake of GHG emission mitigation practices: Farming  
137 for a Better Climate (Scotland’s Rural College 2020). This PEP was initiated in 2010 by the  
138 Scottish Government with the aim of contributing to the development of a ‘low carbon society’  
139 (The Scottish Government 2010). The selected PEP targeted farm practices in five topic areas:  
140 using electricity and fuel efficiently, developing renewable energy (RE), locking carbon into  
141 the soil, making the best use of nutrients, and optimising livestock management. The practices  
142 were promoted as ‘no-cost’, suggesting that they could reduce emissions while maintaining  
143 (and in some circumstances increasing) farm profits. The programme was not part of the  
144 Scottish Rural Development Plan under the European Union’s (EU) Common Agricultural  
145 Policy (CAP), but was a national policy outlined in the first Report on Proposals and Policies  
146 in 2010 (The Scottish Government 2010). The PEP was expected to increase the uptake of  
147 voluntary emission reduction measures by 50% amongst farmers (The Scottish Government  
148 2013). At the time of evaluation, the PEP was the main Scottish policy tool to achieve on-farm  
149 GHG emissions reductions (The Scottish Government 2017). Although the PEP was not funded  
150 under the CAP, Scotland has similar market systems to other EU countries, which makes  
151 potential findings relevant for other EU and strictly regulated countries facing the  
152 implementation of agricultural climate change policy.

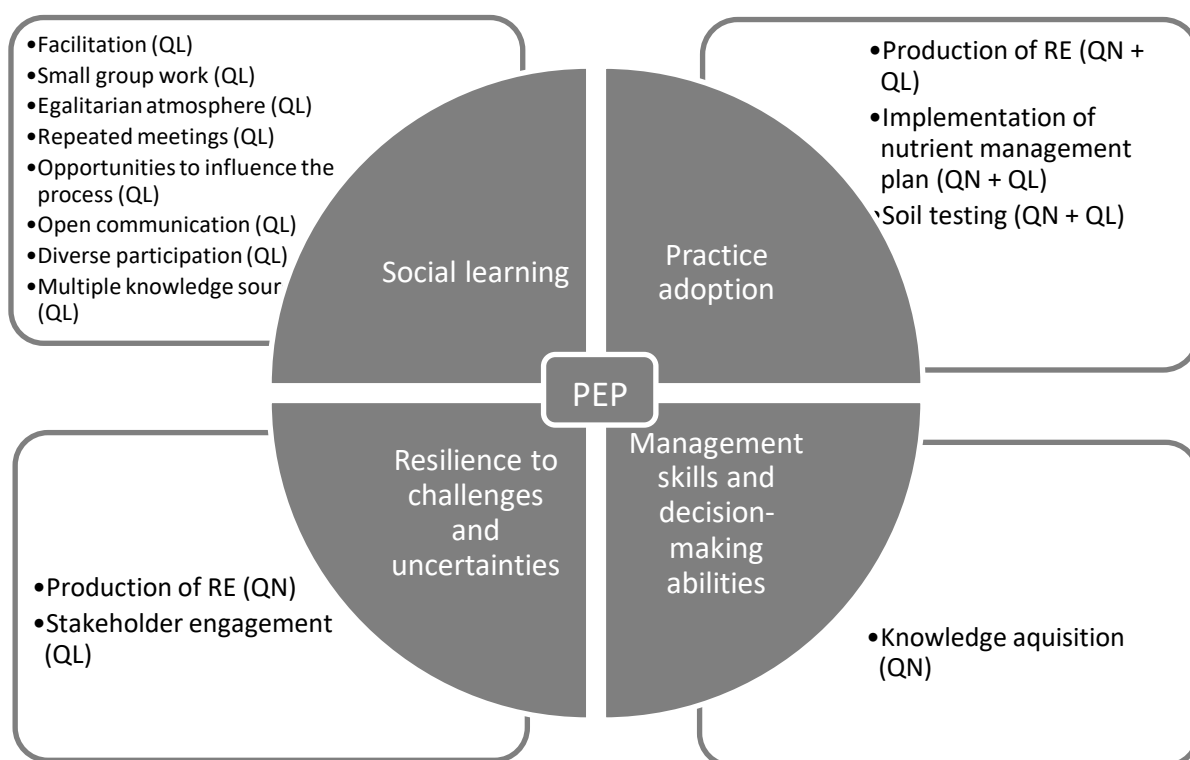
153 Focus farms were part of the PEP in order to provide knowledge exchange between researchers,  
154 extension agents and farmers. These farms shared and implemented new practices while  
155 functioning as a platform for discussion group meetings with peers, researchers and experts.  
156 Discussion group meetings were organised on the focus farms: four focus farms hosted  
157 discussion groups from 2010 to 2013, and nine focus farms operated from 2014 to 2017. Wider  
158 data collection relating to the potential contribution to emission reduction of the discussion  
159 group meetings was not a requirement of the programme. To identify the potential contribution  
160 to emission reductions of discussion group members, our evaluation focused on the farmers  
161 participating in the discussion group meetings. Participation in the discussion group meetings  
162 was on a voluntary basis and as a consequence the group composition changed through time,  
163 depending on the schedule and interest of the farmers. This meant some of the farmers only  
164 attended a few meetings, which was taken into account as a limitation of the evaluation. The  
165 topic, content, timing and location of the meetings were planned based on discussions between  
166 the focus farm, the farm advisor and farmers who were part of the discussion group.

167 Over the course of the programme at least 800 farmers attended the discussion group meetings.  
168 To provide some context for the scale of the PEP, in total there are 37,735 farmers in Scotland  
169 (Scottish Government 2018), including full-time and part-time farmers, of which  
170 approximately 30,000 are likely to be located in the targeted areas, meaning that circa 3% of  
171 the target farmers participated in the discussion groups. Although the PEP was the only policy  
172 focused on reducing on-farm GHG emissions specifically, some of the farmers in the target  
173 area were part of the Nitrate Vulnerable Zone (NVZ), designated areas requiring farmers to  
174 comply with a nutrient management plan (Scottish Government 2019), which might lead to  
175 different soil management practices outside the influence of the PEP. However, due to the lack  
176 of geospatial data, we were not able to account for this in the evaluation. Furthermore, due to  
177 the lack of baseline data collection, this was a ‘retrofit’ evaluation, i.e. only data collected after  
178 programme participation is used for evaluation given the lack of an initial set up of an  
179 evaluation framework.

## 180 2.2 Evaluation framework

181 We used the results from a previously conducted literature review of published PEP evaluation  
182 studies (Knook et al. 2018) as the basis for our evaluation framework. This review provided  
183 insight into the key characteristic aims of PEPs, and recommended these characteristic aims as  
184 the basis for an evaluation framework.. The characteristic aims of PEPs were identified as: i)  
185 *Practice adoption*; ii) *Social learning*, iii) *Resilience to challenges and uncertainties*; and iv)  
186 *Management skills and decision-making abilities*, and the resulting structure of the evaluation  
187 framework is illustrated in Figure 1.





189

190 ■ **Figure 1: The evaluation framework.** RE means renewable energy, QN refers to measuring the indicator by  
 191 a quantitative approach. QL refers to measuring the indicator by a qualitative approach.

192 *Social learning* is seen as an essential component of successful participatory approaches (Muro  
 193 and Jeffrey 2008; Prager and Creaney 2017). In the field of participatory natural resource  
 194 management, social learning is generally defined as including communication and interaction  
 195 of different actors within a participatory setting, which results in social outcomes, such as  
 196 knowledge generation, acquisition of technical and social skills, and the development of trust  
 197 and relationships. We based the selection of indicators on the compound model proposed by  
 198 Muro & Jeffrey (2008), which suggested the following indicators: i) facilitation, which  
 199 indicates the level of skills of the facilitator to lead a group and build trust, and the neutrality  
 200 of the facilitators' role; ii) small group work, which refers to the possibility to learn in a small  
 201 group setting by being helped by experts; iii) egalitarian atmosphere, which refers to the  
 202 equality of researchers, extension agents and farmers in their process of interaction; iv)  
 203 repeated meetings, which refers to a series of meetings being organised; v) opportunities to  
 204 influence the process, which includes the possibility to influence the agenda; vi) open  
 205 communication between actors, in which (on-farm) experiences are shared; vii) diverse  
 206 participation of stakeholders, which refers to a number of stakeholders from different

207 backgrounds participating in the meetings; viii) multiple sources of knowledge, such as  
208 theoretical knowledge as well as practical demonstrations.

209 *Practice adoption* refers to the permanent integration of a new practice into the existing  
210 farming system. Measuring the rate of adoption was achieved by conducting a quantitative  
211 evaluation using performance indicators, which were selected based on: the key aims of the  
212 case study PEP, and the measurability amongst all survey respondents. The indicators selected  
213 were: renewable energy generation (renewable heat and electricity); nutrient management plan  
214 implementation; and soil testing.

215 Insight into the third aspect of a PEP, *Management skills and decision-making abilities*, also  
216 known as managerial capacity, was obtained by measuring the cognitive and intellectual skills  
217 of the farmer using a knowledge test (Rougoor et al. 1998). Although managerial capacity is  
218 influenced by more than intellectual skills, such as farmers' motivations, background, and  
219 experience, we were not able to capture this data in the quantitative survey. Hence, we decided  
220 to use a knowledge test as a proxy indicator for management skills as such tests have been  
221 widely applied in other studies (Feder, Murgai and Quizon 2004b; Khan, Ahmad and Walter-  
222 Echols 2005; Mancini, Van Bruggen and Jiggins 2007; Rejesus et al. 2012). The test consisted  
223 of six questions about 'using electricity and fuel efficiently' and 'locking carbon into the soil',  
224 which were both part of the five topic areas targeted by the PEP. The test indicated whether  
225 PEP farmers are more aware of mitigation measures compared to non-participating farmers.

226 *Resilience* is defined as the capacity of a system to cope with stress, overcome adversity, or  
227 adapt positively to change (Meuwissen 2018) in order to meet future food and development  
228 needs without depleting the earth's resources (Bennett et al. 2014). At the farm level, resilience  
229 can be measured by: robustness, which refers to the ability to maintain a similar level of outputs  
230 when faced with perturbations (Urruty, Tailliez-Lefebvre and Huyghe 2016); adaptability,  
231 which is the capacity of actors to adjust responses to influence resilience (Folke et al. 2010);  
232 and transformability, which is the capacity to respond to untenable environmental, economic  
233 or social structures by creating a fundamentally new system (Walker et al. 2004). We only  
234 included indicators for robustness and adaptability, because transformability was considered  
235 outside the scope of the PEP. The following proxy indicators were selected: i) implementation  
236 of RE, because securing a source of power for the future increases resilience (this indicator is  
237 also used to assess *Practice adoption*); and ii) including new stakeholders in management  
238 (advice) of the farm, because collaboration of farmers with peers, researchers, extension agents

239 and policy actors regarding climate change activities can increase robustness and adaptability  
240 by being exposed to new knowledge these actors bring.

### 241 2.3 Data collection and analysis

242 The quantitative effect of the programme was estimated using a quasi-experimental approach,  
243 while for the qualitative indicators observations and semi-structured interviews were  
244 conducted.

#### 245 2.3.1 Quantitative approach

246 A 20-minute phone survey was conducted to collect data on the quantitative indicators (see  
247 Fig. 1) of *Practice adoption, Management skills and decision-making* and *Resilience* amongst  
248 the respondents. The survey (Appendix 1) was conducted targeting three groups, consisting of  
249 340 farmers in total:

- 250 i) 2010-2013 PEP ( $n = 36$ ): farmers who participated in the discussion groups of the  
251 programme in this period
- 252 ii) 2014 - 2017 PEP ( $n = 114$ ): farmers who participated in the discussion groups of  
253 the programme in this period
- 254 iii) Control group ( $n = 190$ ): farmers who did not participate in any of the PEP  
255 activities

256 We obtained the contact details for the treatment group from the recorded attendance list of  
257 meetings, while contact details for the control group were recruited via a stratified randomised  
258 sample from the Scottish Government national database of agricultural producers. The survey  
259 was conducted by a professional data collection team in December 2017 and January 2018.

260 To estimate the Average Treatment Effect (ATT) on the treatment group the data from the  
261 phone survey was analysed using a quasi-experimental approach, propensity score matching  
262 (Rubin 1974; Stuart 2010), to account for self-selection bias (Salhofer and Streicher 2005;  
263 Pufahl and Weiss 2008). Firstly, we estimated the propensity score of the respondents based  
264 on the covariates. A statistical summary of the matching characteristics before matching is  
265 provided in Appendix 2, Table 1. The matching characteristics were selected based on previous  
266 studies (e.g. Läpple and Hennessy 2015) and were known not to be directly linked to the  
267 outcome variables. The multivariate analysis (Appendix 2, Table 2) showed that the PEP and  
268 control group differ on: agricultural education; rented land; limited soil type; years of

269 experience; and presence of livestock on the farm. By matching the PEP and control group the  
270 differences between these groups were removed, which then accounted for potential adoption  
271 bias between the groups.

272 Secondly, the farmers from the treatment and control groups were matched based on their  
273 propensity score, by applying *k:1* nearest neighbour matching<sup>1</sup> (Stuart 2010). A caliper of 0.25,  
274 as suggested by Rosenbaum & Rubin (1985a), was implemented to avoid poor matches  
275 (Rosenbaum and Rubin 1985b).

276 Thirdly, the matching quality was checked to assure that the mean of all variables are  
277 statistically the same between the treatment and control group. We used numerical and  
278 graphical diagnostics to assess the quality of the matches, which was based on the covariate  
279 balance (Stuart 2010). In order to select the best model, which differed based on explanatory  
280 variables and model specification, we used the log-likelihood and Akaike information criterion  
281 values (Cameron and Trivedi 2005). Matching was considered successful because the  
282 significant differences between the covariates disappeared (Appendix 2, Table 3). Furthermore,  
283 the overall significance of the logit model should be rejected after matching (Caliendo and  
284 Kopeinig 2008), which is observed in our model: pre-matching the likelihood ratio chi-square  
285 was significant, whereas after matching joining significance of all models was rejected. Also,  
286 the pseudo- $R^2$  is supposed to be low, which is observed when we compare the pre-matching  
287 (Appendix 2, Table 2) with the after-matching (Appendix 2, Table 3).

288 Lastly, to compare both treatment groups with the control group after successful matching, two  
289 comparisons were made (Heckman, Tobias and Vytlačil 2001):

290 Comparison I: 2010 – 2013 PEP farmers and control farmers

291 Comparison II: 2014 – 2017 PEP farmers and control farmers

292 Subsequently, the data was analysed by conducting a linear regression based on the outcomes  
293 of the treatment and control group and quantifying the ATT.

294 Comparison I:  $ATT_1$  (Eq. 1)

295 Comparison II:  $ATT_2$  (Eq. 2)

$$ATT_1 = E [Y(1)|D = 1] - E [Y(0)|D = 1] \quad (1)$$

---

<sup>1</sup> While applying nearest neighbour matching, our results are robust to other matching techniques, such as kernel matching.

296  $ATT_1$  is the average treatment effect on the farmers who participated in the PEP from 2010 until  
297 2013, where  $D = 1$  indicates PEP participation and  $D = 0$  indicates the farmer did not participate  
298 at all.  $Y$  refers to each observed farmer in the participation (1) or non-participation (0) state and  
299  $E$  is the expected value.

$$ATT_2 = E [Y(2)|D = 2] - E [Y(0)|D = 2] \quad (2)$$

300  $ATT_2$  is the average treatment effect on the farmers who participated in the PEP from 2014 until  
301 2017, where  $D = 2$  indicates PEP participation and  $D = 0$  indicates the farmer did not participate  
302 at all.

303 Due to participation in the PEP, we expected a positive ATT on the performance indicators  
304 *production of RE, implementation of nutrient management plan, soil testing and knowledge*  
305 *acquisition* for the PEP farmers in Comparisons I and II (described in Appendix 2, Table 1).

### 306 2.3.2 Qualitative approach

307 To gain insight into *Social learning, Resilience* and farmers' perception of *Practice adoption*,  
308 qualitative data was collected by conducting semi-structured interviews (Appendix 4),  
309 analysing meeting notes, and observing discussion group meetings. We selected the interview  
310 participants based on: i) participation in the PEP; ii) interest in participating in further research  
311 after participation in the phone survey; iii) meeting attendance: only respondents who had  
312 attended more than two meetings were invited; and iv) the geographical location, to allow  
313 inclusion of respondents from different farm discussion groups. An overview of the 20  
314 respondents is provided in Appendix 3. Interview themes included the background of the  
315 farmer and the farm; the farmers' views on participation in the PEP; the views on the facilitator,  
316 experts and peer interaction; and the practice and behavioural changes made due to  
317 participation in the PEP.

318 All interviews were recorded and fully transcribed. Subsequently, we conducted open coding  
319 on the first three interview transcripts to ensure important aspects of the data were not missed  
320 and to ensure the codes based on the indicators of the framework covered the remarks made by  
321 the interviewees (Fig.1). Furthermore, to ensure the suitability of the framework we allowed  
322 for data triangulation by adding the findings from the meeting observations and notes. After  
323 confirming the suitability of the coding framework, we started deductive coding by going

324 through all transcripts and placing interviewees' remarks under each of the indicators of the  
 325 framework. Remarks were categorised as 'supportive' if an interviewee was positive about an  
 326 indicator or 'unsupportive' if the interviewee had negative remarks on an indicator.

### 327 3. Findings

328 The findings for each of the indicators is summarised in Table 1 and elaborated on in the  
 329 subsections below.

PEP elements	Indicators	Findings		Overall assessment
		Findings 2010-2013 group	Findings 2014-2017 group	
Practice Adoption	Production of renewable electricity	0.47** (0.056)	0.27*** (0.025)	Positive, practice adoption is higher under PEP participants.
	Production of renewable heat	0.31** (0.046)	0.18 (0.023)	
	Implementation of nutrient management plan	0.58 (0.057)	0.84*** (0.03)	
	Soil testing	0.97* (0.037)	0.99*** (0.022)	
Social learning	Facilitation	n/a	+/-	Mixed, repetitive meetings are organised, but farmers only attend a small number of these meetings. This leads to lack of egalitarian atmosphere and open communication.
	Small group work	n/a	-	
	Egalitarian atmosphere	n/a	-	
	Repeated meetings	n/a	+	
	Opportunities to influence the process	n/a	-	
	Open communication	n/a	-	
	Diverse participation	n/a	+	
Resilience to challenges and uncertainties	Production of renewable electricity	0.47** (0.056)	0.27*** (0.025)	Mixed, PEP farmers show higher generation of RE compared to control farmers, but the interviews show this is not attributable to PEP participation.
	Production of renewable heat	0.31** (0.046)	0.18 (0.023)	
	Stakeholder engagement	n/a	-	
Management skills and decision-making abilities	Knowledge acquisition	4.78 (0.12)	4.83** (0.07)	Mixed, farmers who recently participated in the PEP show a higher level of knowledge, whereas farmers participated >4 years ago do not.

330

331 ■ Table 1: Estimation of average treatment effect on the treated (for quantitative indicators). \*\*\*,\*\*,\*  
 332 Significant at 0.1%, 1%, 5% level, respectively. The evaluation of the qualitative indicators is depicted by  
 333 using '-' for a negative effect, '+' for a positive effect and +/- if the evaluation is not positive or negative. n/a  
 334 refers to 'not applicable', for these indicators no data is available.

#### 335 3.1 Participation

336 Farmers were included in the 'PEP group' based on attendance records showing that they had  
 337 participated in the PEP. However, a number of members of the PEP group did not recall

338 participating in the programme: 9 respondents indicated having attended one meeting; 36  
339 indicated having attended 2-3 meetings; 30 indicated having attended more than 3 meetings;  
340 and 75 respondents indicated not having attended any meeting. The significance of the  
341 awareness of participation is discussed below.

### 342 3.2 Practice adoption

343 The ATTs for *Practice adoption* mostly indicate positive returns. However, the semi-structured  
344 interviews show only three respondents mentioned the adoption of a practice specifically due  
345 to participation in the PEP and one respondent indicated that attending the meetings offered an  
346 opportunity to explore and reflect on current management practices, leading to a potential  
347 change:

348 *'The likes of the cover crops ideas, I am coming around to that, but I don't know if that's*  
349 *specifically because of the meeting, it's maybe more the people I met at the meeting and where*  
350 *I discussed with what they were doing and checking whether I could give them a ring about*  
351 *that.'* – Respondent 3

352 However, respondent 18 could not attribute a specific change to participation in the PEP:

353 *'I wouldn't say so that it only comes from the meetings. I think that's almost like a change in,*  
354 *just all the different media that you get different things from.'* – Respondent 18

355 Secondly, respondents discussed the implementation of nutrient management plans during the  
356 interviews. Some farmers implement a nutrient plan because of the Nitrate Vulnerable Zone,  
357 which indicates a potential attribution problem, i.e. the farmers implemented nutrient  
358 management plans because they are obliged to do so, and not because of participation in the  
359 PEP. As discussed in the Methods section, due to the lack of geospatial data we could not  
360 correct for this in the quantitative analysis.

### 361 3.3 Social learning

362 Overall, respondents indicated that they considered the facilitators to be good organisers, well-  
363 prepared, and good at communicating. However, due to discussion groups being facilitated by  
364 different facilitators, there was variation in respondents' views. Respondents from two different  
365 discussion groups both mention the influence the facilitator had on the group, which in one  
366 case has had a positive and in the other case a negative effect:

367 *'Facilitator x is pretty good, yes. He has been around the block a bit, he knows quite well what's*  
368 *going on and what we've been doing. He also tells people to shut up and go on with it, because*  
369 *otherwise we get very side tracked and we end up waffling on about things that aren't really*  
370 *relevant. But the facilitator is actually very important.'* – Respondent 2

371 *'I didn't think it was maybe quite, I don't know if firm enough is the right word, but there should*  
372 *have been more leadership I think. But that's hard if that's the personalities that are involved.'*  
373 – Respondent 3

374 Respondents indicated that the facilitators organised sufficient opportunities to discuss with  
375 peers and experts during the meetings, by planning small group sessions for example. Although  
376 meetings were attended by a diverse group of participants and theoretical sessions as well as  
377 practical demonstrations were provided, respondents did not experience an egalitarian  
378 atmosphere. Respondents mentioned the lack of understanding from experts during the  
379 meetings:

380 *'Well I manage to say things, but they all seem to think I'm crazy about what I do. It's not the*  
381 *normal idea.'* - Respondent 1

382 *'The theory and practice is just too different. Until we get somebody there who understands all*  
383 *that and puts it in the practical sense.'* - Respondent 15

384 The meeting notes show eight to twelve meetings were organised for each of the focus farms.  
385 Approximately half of the interviewed farmers attended more than three meetings. Other  
386 farmers indicated that they only attended two to three meetings, based on their interest in the  
387 topic of the meeting. Respondents' views on influencing agenda-setting were mixed, with  
388 approximately half of the farmers experiencing the opportunity to influence agenda topics:

389 *'We actually hosted one [meeting] here, that was one of the climate things. We took people out*  
390 *to the hydro. It was one of the meetings connected to [focus farm x]. That would be one of the*  
391 *inputs that I brought in.'* - Respondent 12

392 The other half had the impression the agenda for the meetings was already set by the organising  
393 institution:

394 *'I would say it was already a predetermined agenda. And they have their ideas and that's it.*  
395 *And they are like 'oh you can discuss it', but they didn't pay any attention.'* - Respondent 1



396 *'I think the agenda was already set for the meetings. I never had much input into the meetings.'*  
397 – Respondent 18

398 Overall, the participating farmers responded positively to the frequency of meetings, the  
399 diversity of participation, the presence of small group sessions and the multiple sources of  
400 knowledge. There were mixed responses on agenda-setting and the facilitation of meetings,  
401 possibly due to different facilitators. Respondents generally expressed negative views about  
402 the egalitarian atmosphere and the openness of communication.

### 403 3.4 Management skills and resilience

404 The analysis shows that PEP participants produced significantly more RE compared to the  
405 control farmers (Table 1). However, interviewees did not attribute this change to PEP  
406 participation, but stated that they decided to implement RE independently of the PEP, because  
407 of the financial benefit to the farm:

408 *'It was most about diversifying, just to get another income. Because we needed another stream*  
409 *of income for profitability, it's just another thing to bring into the pot.'* – Respondent 4

410 *'I thought it was an expensive fuel bill and I thought let's try to decrease that a wee bit.'* –  
411 Respondent 7

412 The second indicator, stakeholder engagement, shows that some respondents obtained contacts  
413 due to the meetings:

414 *'The company I'm now buying my feed for the cows, he left his business card here when I wasn't*  
415 *at home that day. Then I ended up speaking with him at one of these climate change event*  
416 *things. From that I ended up buying feed from them. That was due to the climate change*  
417 *meeting. So it was worthwhile like that.'* – Respondent 16

418 However, there was no indication that PEP farmers included new stakeholders, such as experts  
419 or advisors, in running their farms.

420 A significant effect for the knowledge test was only found in Comparison II, whereas  
421 participants in Group I, who participated in the PEP longer time ago (2010 to 2013), do not  
422 show a significant effect. The implication of this result is discussed below.

## 423 4. Discussion

424 The purpose of this study was to: i) evaluate the effectiveness of PEPs in enhancing the uptake  
425 of climate friendly farming practices; and ii) contribute to the development of an effective  
426 evaluation framework for such participatory programmes. The discussion below explores the  
427 main implications of the findings in terms of the contribution of the PEP to climate friendly  
428 farming, and then draws out the main theoretical and practical implications.

#### 429 4.1 PEP contribution to climate sustainable farming

430 The main aim of the PEP studied in this paper was to contribute towards climate friendly  
431 farming. The evaluation in the current paper shows that PEP participants had a higher rate of  
432 adoption of climate change mitigation practices, i.e. production of renewable energy,  
433 implementation of a nutrient management plan and soil testing. The positive finding of practice  
434 adoption after PEP participation is supported by other studies conducted in developed countries  
435 (Läpple et al. 2013; Läpple and Hennessy 2015; Goodhue, Klonsky and Mohapatra 2010;  
436 Tamini 2011). The semi-structured interviews however, show that not all respondents attribute  
437 the changes to the PEP. This is divergent to findings reported by Hill et al. (2017), in which  
438 farmers' self-assessment on the effect of the 'Farmer Connect' programme (a programme  
439 delivering knowledge transfer and advice to farmers in Wales) shows a straightforward positive  
440 effect. This divergence might be caused by the set-up of the Farmer Connect programme:  
441 participants were required to meet a share of the cost, leading to an optimism bias (Sharot 2011)  
442 in which participants possibly overestimated programme benefits. Farmers are willing to pay  
443 for extension services if relevant to their needs (Prager et al. 2016; Ozor, Garforth and  
444 Madukwe 2013), but research has not yet focused on the effect co-funding in PEPs might have  
445 on farmer motivation to take up new practices. This is an area to explore in the design of future  
446 PEPs.

447 Another explanation of the more positive outcome of the quantitative analysis compared to the  
448 qualitative analysis, is that farmers might not attribute the adoption of practices to being  
449 concerned about climate change. A paper by Tripathi & Mishra (2017) shows that although  
450 farmers implement climate change mitigation practices, such as changing cropping patterns  
451 and agroforestry, they do not attribute that change to a motivation to contribute to climate  
452 change mitigation. Instead, they indicate that practice change is motivated by having to deal  
453 with a changing socio-economic situation, such as changing market prices. We hypothesise  
454 that something similar might be happening amongst the Scottish farmers. The climate change  
455 PEP stimulated the uptake of practices that were 'win-win': both climate and cost effective.

456 Hence, farmers might have adapted climate change mitigation practices, but do not recognise  
457 them as such, because they have implemented these practices to make the farm more cost-  
458 effective. Thus, they do not link their practice adoption to a climate focused PEP. We find that  
459 in the qualitative interviews most farmers mentioned financial reasons as the main motivation  
460 to take up climate change practices, which supports our hypothesis of farmers not recognising  
461 climate change mitigation measures as such.

462 However, we question the successful sustained adoption of such practices when climate change  
463 mitigation measures are framed as cost-effective. Finding strong financial motivations to adopt  
464 suggests that the programme achieved limited ‘cultural embeddedness’, i.e. where the focus  
465 for practice change is on non-economic motivations such as wider public goods and doing the  
466 ‘right thing’. A common criticism of financial incentives for promoting the uptake of  
467 environmental practices is that they do not achieve long lasting change, as they fail to redefine  
468 a ‘good farmer’ identity (Burton and Paragahawewa 2011; de Snoo et al. 2013; Lokhorst et al.  
469 2011; Van Herzele et al. 2013). Historically, the dominant ‘good farmer’ identity has consisted  
470 of maximising on-farm production, with ‘good farming’ practices being ‘productivist’  
471 practices (Haggerty, Campbell and Morris 2009), such as good crop appearance and financial  
472 viability. Climate change mitigation practices might clash with such historic ‘good farming’  
473 beliefs: farmers are interested in uptake of farm measures that demonstrate economic success,  
474 than less tangible signs of ‘good environmental farming’ (Burton, Kuczera and Schwarz 2008).  
475 Therefore, farmers might be less likely to adopt new, e.g. climate sustainable, practices if this  
476 does not align with the beliefs of ‘good farming’ (Burton 2004; Inman et al. 2018; McGuire,  
477 Morton and Cast 2013). Hence, we question whether PEP participants are likely to take up  
478 climate change mitigation practices after programme participation if they are motivated to do  
479 so because of financial reasons. Future programmes might benefit from reimagining the ‘good  
480 farmer’ identity to gain embedded practice change by focusing less on financial motivations  
481 and more on social norms (Burton 2004; Flemsæter, Bjørkhaug and Brobakk 2018).

#### 482 4.2 PEP design

483 In our study, *Practice adoption* and *Social learning* might have been hampered by the lack of  
484 repeated farmer attendance at meetings. The majority of the farmers did not attend more than  
485 2-3 meetings, whereas the literature suggests that a stable discussion group over extended  
486 periods, with personal interaction between farmers with experts or peers, is necessary for  
487 building trust and achieving behavioural change (Sutherland et al. 2013; Mills et al. 2008; Muro

488 and Jeffrey 2008; Muro and Jeffrey 2012). Encouraging farmers to attend multiple meetings  
489 might improve *Social learning* and can be enhanced by explicitly showing the ‘benefits’ a  
490 programme brings to farmers (Kraaijvanger et al. 2016; Mapfumo et al. 2013). Furthermore,  
491 allowing farmers to influence the choice of practices promoted by a PEP is also likely to  
492 motivate participation. Additionally, our findings are supported by the recommendation in  
493 Islam et al. (2011): the selection of group leaders and facilitators should not only be based on  
494 technological competency, but also on personality traits, such as innovativeness, sincerity and  
495 trustworthiness, and could play an important role in successful programme design and the  
496 sustainability of the groups. Furthermore, similar to Vrain and Lovett (2016) and Cristóvão et  
497 al. (2012), our findings show the importance of increasing understanding of the influence of  
498 different facilitators on establishing a stable discussion group. Therefore, further evaluation  
499 should explore the influence of training facilitators, researchers and extension experts involved  
500 in the programme.

501 Lastly, results from the survey and interviews suggested that some of the PEP farmers have a  
502 poor recollection of attending the meetings, or do not associate attending meetings with the  
503 PEP when it was named. The observation of low recognition of the PEP name despite positive  
504 effects shown by participation questions whether programme recognition matters for the  
505 success of the PEP and for future policy aims associated with such PEPs. Furthermore, we have  
506 observed that there is a large number of farmers who only attended a few meetings. These  
507 questions are worth exploring in further research, particularly concerning the issues of focusing  
508 on project attribution and programme attendance versus project impact.

#### 509 4.3 Methods and data for evaluation

##### 510 4.3.1 Additions to the evaluation framework

511 By stimulating *Practice adoption, Social learning, Resilience, and Management skills*, PEPs  
512 generally aim to contribute to the cultural embeddedness of the practices being promoted.  
513 However, measuring the effect of PEPs based on these four indicators does not provide insight  
514 into the cultural embeddedness of ideas stimulated by a PEP. Therefore, for future evaluation  
515 frameworks we suggest the development of indicators from institutional theory which focuses  
516 on the processes involved in establishing long term change (Smets, Morris and Greenwood  
517 2012; e.g. Gray, Purdy and Ansari 2015). Institutional theory studies change by looking at  
518 institutional logics, which are ‘the socially constructed, historical patterns of cultural symbols  
519 and material practices, including assumptions, values, and beliefs, by which individuals and

520 organisations provide meaning to their daily activity, organise time and space, and reproduce  
521 their lives and experiences' (Thornton, Ocasio and Lounsbury 2012 p. 2). The culture of  
522 farming consists of multiple logics, which are thus each constituted by a set of practices, beliefs  
523 and values. Institutional theory states that to establish change, we need to focus on changing  
524 these logics by shifting not only practices, but also beliefs and values. Hence, when we conduct  
525 an evaluation and we want to measure sustained change, only studying practice change does  
526 not provide sufficient insight. Therefore, the change in beliefs and values underlying those  
527 practices should be studied as well. Studying these values, beliefs and practices can be done by  
528 interviewing farmers about their day-to-day activities and their motivations behind these  
529 activities, as well as by visiting the farm and understanding farm systems. By including farmers  
530 before and after the programme may provide insight in not only change due to the programme,  
531 but might also help in identifying the mechanisms that are responsible for this change.

532 Another point to take into account in future PEP evaluation is the assessment of goals set by  
533 the participants themselves. In the current evaluation, no baseline data was available, which  
534 led us to only evaluate the indicators set by the PEP organisers/funders. However, in a truly  
535 participatory programme participants are able to set their own programme goals. Hence, future  
536 evaluation data should be collected on the goals formulated by the funders and/or programme  
537 designers as well as by the participants, to account for the participatory process in which the  
538 participants' goals cannot be rigidly defined at the start of the PEP (Dart 2000). Following the  
539 baseline data collection, a mid-term evaluation should be conducted to reflect and analyse  
540 whether the PEP is achieving its objectives, both from a funders' and participants' perspective.  
541 At the end of the PEP an ex-post evaluation should be conducted to gain insight into the goals set  
542 out by funders, organisers, and participants at the initiation of the programme (Faure et al.  
543 2012). Based on the evaluation learnings, the design of future programmes can be optimised.  
544 Ideally, this leads to funders' goals increasingly aligning with participants' goals.

#### 545 4.3.2 Limitations of the evaluation methods

546 The quasi-experimental method used in this study has a limitation in terms of correctly  
547 measuring the magnitude of change. For example, in the propensity score matching  
548 unobservable characteristics cannot be taken into account, which McKenzie et al. (2010)  
549 suggest can lead to a 20% estimation bias. For the present study, this could mean that there is  
550 no significant positive effect from the PEP in reality. Secondly, the knowledge test used to  
551 evaluate *Management skills* only shows a significant result for farmers who recently

552 participated in the PEP. The lack of a significant difference in the 2010-2013 group may be  
553 caused by the complexity of the knowledge disseminated by the PEP, or the effect may be too  
554 small to be detected by the econometric analysis, which has previously been observed in a  
555 study by Feder et al. (2004a). Thirdly, the qualitative interviews were only conducted with  
556 farmers who were members of the PEP group, and we were not able to interview farmers who  
557 had not participated in the PEP. Fourthly, an inherent difficulty of evaluating PEPs like these  
558 is controlling for different information channels. Farmers might receive their information via  
559 multiple pathways, such as other discussion groups, field days and the internet, which is  
560 difficult to control for when only having access to cross-sectional data.

561 To improve the quality of the econometric analysis and increase the accuracy of measurement,  
562 we highlight the importance of baseline data collection for future evaluation (Feder et al.,  
563 2004a). To gain insight into the motivations for making (or not making) changes on farms, we  
564 suggest that future research should also aim to conduct qualitative interviews with farmers not  
565 involved in a programme. To account for different information channels, longitudinal data  
566 collection is required, which, via for example a randomised controlled trial or the differences-  
567 in-differences approach, accounts for unobservable characteristics.

## 568 **5. Conclusion**

569 This evaluation contributes to the limited published information on the success of climate  
570 change PEPs. The divergence between the findings from the quantitative and qualitative  
571 method shows that the use of mixed methods is highly important to gain understanding in the  
572 overall functioning of PEPs. Furthermore, the lack of proof for sustained change leads us to  
573 suggest that programmes such as the PEP evaluated in this study need to be part of a broader  
574 suite of measures, e.g. together with regulation, subsidies, and customer pressure, as they are  
575 currently not sufficient to create a climate sustainable farming culture on their own. Further  
576 research into other PEPs would be useful, e.g. how to change farmer beliefs and values to  
577 establish long-term change. To gain insight into this long term change, quantitative and  
578 qualitative baseline data, in combination with continuous observations, might prove useful to  
579 collect new insights. This would also allow for increased insight into the processes that lead to  
580 change due to participation in extension programmes.

581

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854

855



856 **Appendix 1. The survey questions for the quantitative evaluation. Only the parts used**  
857 **for this evaluation are included in this appendix.**

858 **READ OUT TO RESPONDENT:** I would like to invite you to participate in a phone survey conducted by  
859 xxx, also known as xxx, which will be carried out by professional interviewers from xxx. The survey seeks to  
860 improve our understanding of the implementation of environmental measures in agriculture. This survey is  
861 aimed at farmers or farm managers who are involved in the main on-farm decision-making. The survey lasts 20  
862 min, but before I can start the survey I would like to ask you two questions to make sure you are part of the  
863 group of farmers we are targeting.

864 **INSTRUCTION INTERVIEWER: CHECK IF RESPONDENT HAS TIME TO PROCEED WITH THE**  
865 **INTERVIEW. OTHERWISE OFFER OPTION TO CALL BACK AT A LATER TIME.**

866

867 **SECTION 1. GENERAL QUESTIONS BEFORE INITIATION OF THE SURVEY**

868 **Q.1** Are you a farmer, farm manager or crofter? **SINGLE CODE**

869 **INSTRUCTION INTERVIEWER: WHEN RESPONDENT ANSWERS ‘FARMER’ (OR FARMER’S**  
870 **WIFE), ‘FARM MANAGER’ OR ‘CROFTER’ THEN CODE ‘YES’**

871	YES	1
872	NO	2
873	DON’T KNOW	98
874	REFUSED TO ANSWER	99

875 **IF RESPONSE IS YES (CODE 1) CONTINUE WITH SURVEY. OTHERWISE THANK THE**  
876 **RESPONDENT AND ASK FOR CONTACT INFORMATION OF THE MAIN DECISION-MAKER**  
877 **(THE PERSON WHO IS RESPONSIBLE FOR MOST LONG TERM DECISIONS):** Unfortunately, this  
878 survey is designed to be completed by the person who is a farmer, farm manager or crofter.

879

880 **Q.2** Are you involved in the main decision-making on the farm? **SINGLE CODE**

881	Yes	1
882	No	2
883	DON’T KNOW	98
884	REFUSED TO ANSWER	99

885 **IF RESPONSE IS NO (CODE 2) THANK THE PARTICIPANT AND ASK FOR CONTACT**  
886 **INFORMATION OF THE MAIN DECISION-MAKER IN Q2B:** Unfortunately, this survey is designed to  
887 be completed by the person who is involved in most of the long-term planning decisions.

888

889 **Q.2B** Is someone else in your household responsible for the long-term decision making?

890 Yes → would it be possible to contact this person now or at a later point in time? (or at a different number)

891 **PROBE INTERVIEWER: THE MAIN DECISION MAKER MIGHT LIVE IN THE SAME**

892 **HOUSEHOLD, THEREFORE ASK WHETHER IT IS POSSIBLE TO CONTACT VIA THE SAME**  
893 **NUMBER AT A DIFFERENT TIME, OR WHETHER IT IS EASIER TO CONTACT THIS PERSON**  
894 **AT A DIFFERENT PHONE NUMBER**

895 No → Could provide that person's contact information so we can invite him or her to participate in the survey?

896  
897 Name .....

898 Telephone number.....

899

900 **IF RESPONSE IS YES (CODE 1) CONTINUE WITH SURVEY. READ OUT TO**

901 **RESPONDENT:** Thank you for agreeing to participate in our survey. Your answers will remain strictly

902 confidential and no individual farmer will be identified as having participated in this research. You are

903 free to stop participation or refuse to answer a question at any time. There is no wrong or right answer

904 and if you do not know the answer to a question, you can always respond with 'don't know' or if the

905 question is not applicable to your situation, you can always answer with 'not applicable'.

906

907 **SECTION 3. PEP QUESTIONS**

908 **INTERVIEWER READ OUT:** I would now like to ask you questions about Focus Farm discussion meetings

909 organised by xxx.

910 **Q.8** Have you ever participated in xxx discussion meetings organised xxx? **SINGLE CODE**

911 Yes 1

912 No 2

913 Don't know 98

914 REFUSED TO ANSWER 99

915

916 **IF YES (CODE 1), PROCEED TO Q.9. IF NO (CODE 2) OR DON'T KNOW (CODE 98), PROCEED TO**

917 **Q.11**

918

919 **INTERVIEWER READ OUT:** in the following questions I will refer to xxx as 'focus farm meetings'

920

921 **Q.9** Approximately how many times have you attended Focus Farm meetings since 2010? Would you say  
922 once, 2-3 times or more than 3 times? **SINGLE CODE**

923 Once 1

924 2-3 times 2

925 More than 3 times 3

926 NEVER 97

927 DON'T KNOW 98

928 REFUSED TO ANSWER 99

929 **PROBE INTERVIEWER WHEN RESPONSE (SPONTANEOUS) IS ‘NEVER’ (CODE 4):** You indicated  
930 in the previous question that you have attended climate change focus farm discussion meetings, are you sure  
931 your answer is ‘never’? **IF YES, GO BACK TO Q.8 AND CHANGE ANSWER. THEN CONTINUE Q.11.**  
932 **IF NO, ASK Q.9 AGAIN AND CONTINUE WITH Q.10.**

933 **READ OUT TO RESPONDENT:** I will be reading out a number of questions about the focus farm  
934 meetings. Please provide an answer to these questions with ‘yes’ or ‘no’.

935

936 **THE INTERVIEWER DOES NOT NEED TO READ OUT THE ANSWERS ‘YES’, ‘NO’ AND**  
937 **‘DON’T KNOW’ FOR EACH QUESTION. READ OUT FOR AT LEAST THE FIRST TWO**  
938 **QUESTIONS AND THEN ONLY READ OUT ANSWER OPTIONS WHEN A RESPONDENT**  
939 **FORGETS OR GIVES A DIFFERENT RESPONSE**

940

941 **INSTRUCTION INTERVIEWER FOR ALL Q.6: IF RESPONSE IS ‘SOMETIMES’, ‘OFTEN’**  
942 **OR A SIMILAR TERM, PLEASE PROBE THE RESPONDENT AND ASK FOR A ‘YES’ OR**  
943 **‘NO’. IF THE RESPONDENT STAYS WITH HIS ANSWER YOU CAN CODE ‘SOMETIMES’**  
944 **OR ‘OFTEN’ AS ‘YES’ (CODE 1). IF RESPONSE IS ‘RARELY’ CODE AS ‘NO’ (CODE 2)**

945

946 **Q.10a** Have you discussed the changes suggested during focus farm meetings with farmers who did  
947 not attend the meetings?

948	YES	1
949	NO	2
950	DON’T KNOW	98
951	REFUSED TO ANSWER	99

952

953 **Q.10b** Have you sought advice from peers or experts whom you have met at focus farm meetings?

954	YES	1
955	NO	2
956	DON’T KNOW	98
957	REFUSED TO ANSWER	99

958

959 **Q.10c** Were you aware of climate change mitigation measures you could implement on farm before  
960 participation in the focus farm meetings?

961

962	YES	1
963	NO	2
964	DON’T KNOW	98
965	REFUSED TO ANSWER	99

966

967 **Q.10d - 1** Have you implemented changes suggested during focus farm meetings on your farm?

968	YES	1
969	NO	2
970	DON'T KNOW	98
971	REFUSED TO ANSWER	99

972

973 **IF YES (CODE 1) CONTINUE TO 10.D-2. OTHERWISE CONTINUE WITH Q.11**

974

975 **INTERVIEWER READ OUT:** I would like to ask you about the change or changes you have  
 976 implemented. I will be reading out five key areas of the PEP programme and please identify with either  
 977 'yes' or 'no' whether you have implemented changes in this area.

978

979 **Q.10d – 2** Locking carbon on the farm?

980	YES	1
981	NO	2
982	DON'T KNOW	98
983	REFUSED TO ANSWER	99

984

985 **Q.10d – 3** Developing renewable energy?

986	YES	1
987	NO	2
988	DON'T KNOW	98
989	REFUSED TO ANSWER	99

990

991 **Q.10d – 4** Using energy and fuel efficiently?

992	YES	1
993	NO	2
994	DON'T KNOW	98
995	REFUSED TO ANSWER	99

996

997 **Q.10d – 5** Optimising livestock performance?

998	YES	1
999	NO	2
1000	DON'T KNOW	98
1001	REFUSED TO ANSWER	99

1002 NOT APPLICABLE 5 (in survey doc)

1003

1004 **Q.10d – 6** Soil, fertiliser and manure management?

1005	YES	1
1006	NO	2

1007 DON'T KNOW 98  
 1008 REFUSED TO ANSWER 99

1009  
 1010

1011 **SECTION 4. IMPACT INDICATORS**

1012 **4.1 KNOWLEDGE TEST**

1013 **READ OUT TO RESPONDENT:** I will read out 6 questions about environmentally friendly farm practices.  
 1014 Please answer the question with either 'yes' or 'no'.

1015 **NOTE TO INTERVIEWER: THERE IS NO NEED TO READ OUT THE ANSWER OPTIONS 'YES'**  
 1016 **OR 'NO' FOR EACH QUESTION. READ OUT FOR AT LEAST THE FIRST TWO QUESTIONS AND**  
 1017 **THEN ONLY TO READ OUT THE ANSWER OPTIONS AGAIN IF THE RESPONDENT DOES NOT**  
 1018 **REPLY WITH 'YES' OR 'NO'.**

1019 **Q.11a** Do you think regularly servicing of heating devices, such as boilers, saves heating costs?

1020 YES 1  
 1021 NO 2  
 1022 NOT APPLICABLE 96  
 1023 DON'T KNOW 98  
 1024 REFUSED TO ANSWER 99

1025 **Q.11b** Do you think insulation of heating devices, such as boilers and hot water tanks, is an effective way of  
 1026 decreasing energy usage?

1027 YES 1  
 1028 NO 2  
 1029 NOT APPLICABLE 96  
 1030 DON'T KNOW 98  
 1031 REFUSED TO ANSWER 99

1032 **Q.11c** Do you think a carbon footprint of the farm is useful to identify the largest emissions sources?

1033 YES 1  
 1034 NO 2  
 1035 NOT APPLICABLE 96  
 1036 DON'T KNOW 98  
 1037 REFUSED TO ANSWER 99

1038 **Q.11d** Do you think the amount of carbon locked on the farm can be increased by changing how existing  
 1039 woodlands are managed?

1040 YES 1  
 1041 NO 2

1042	NOT APPLICABLE	96
1043	DON'T KNOW	98
1044	REFUSED TO ANSWER	99

1045 **Q.11e** Do you think the use of cover crops increases nitrate leaching?

1046	YES	1
1047	NO	2
1048	NOT APPLICABLE	96
1049	DON'T KNOW	98
1050	REFUSED TO ANSWER	99

1051 **Q.11f** Do you think the soil pH is a relevant factor in calculating fertiliser needs?

1052	YES	1
1053	NO	2
1054	NOT APPLICABLE	96
1055	DON'T KNOW	98
1056	REFUSED TO ANSWER	99

1057

1058 **4.2 RENEWABLE ENERGY**

1059 **READ OUT TO RESPONDENT:** The upcoming part focuses on the generation of renewable energy on your  
1060 farm.

1061 **Q.12** Do you receive a subsidy for producing renewable energy on your farm?

1062	Yes	1
1063	No	2
1064	DON'T KNOW	98
1065	REFUSED TO ANSWER	99

1066 **READ OUT TO RESPONDENT:** I will first ask you questions about the generation of renewable electricity  
1067 and then about renewable heat.

1068 **Q.13** Do you produce renewable electricity on the farm, for instance from wind, solar power, hydro power or  
1069 biogas?

1070	Yes	1
1071	No	2
1072	DON'T KNOW	98
1073	REFUSED TO ANSWER	99

1074 **IF YES CONTINUE WITH Q.14. OTHERWISE CONTINUE WITH Q.19**

1075 **Q.14a** Do you produce renewable electricity from wind?

1076 Yes 1

1077 No 2

1078 DON'T KNOW 98

1079 REFUSED TO ANSWER 99

1080 **IF YES (CODE 1) CONTINUE WITH Q.14B. OTHERWISE CONTINUE WITH Q.15**

1081 **Q.14b.** How much renewable electricity was generated by this source in 2016? Please express in kWh.

1082 \_\_\_\_\_

1083 DON'T KNOW 98

1084 REFUSED TO ANSWER 99

1085

1086 **Q.14c.** In which year was this source implemented on your farm?

1087 \_\_\_\_\_

1088

1089 DON'T KNOW 98

1090 REFUSED TO ANSWER 99

1091 **Q.15a** Do you produce renewable electricity from solar energy?

1092 Yes 1

1093 No 2

1094 DON'T KNOW 98

1095 REFUSED TO ANSWER 99

1096 **IF YES (CODE 1) CONTINUE WITH Q.15B. OTHERWISE CONTINUE WITH Q.16**

1097 **Q.15b.** How much renewable electricity was generated by this source in 2016? Please express in kWh.

1098 \_\_\_\_\_

1099 DON'T KNOW 98

1100 REFUSED TO ANSWER 99

1101

1102 **Q.15c.** In which year was this source implemented on your farm?

1103 \_\_\_\_\_

1104 DON'T KNOW 98

1105 REFUSED TO ANSWER 99

1106 **Q.16a** Do you produce renewable electricity from hydro power?

1107	Yes	1
1108	No	2
1109	DON'T KNOW	98
1110	REFUSED TO ANSWER	99

1111 **IF YES (CODE 1) CONTINUE WITH Q.16B. OTHERWISE CONTINUE WITH Q.17**

1112 **Q.16b.** How much renewable electricity was generated by this source in 2016? Please express in kWh.

1113 \_\_\_\_\_

1114	DON'T KNOW	98
1115	REFUSED TO ANSWER	99

1116 **Q.16c.** In which year was this source implemented on your farm?

1117 \_\_\_\_\_

1118	DON'T KNOW	98
1119	REFUSED TO ANSWER	99

1120 **Q.17a** Do you produce renewable electricity from biogas?

1121	Yes	1
1122	No	2
1123	DON'T KNOW	98
1124	REFUSED TO ANSWER	99

1125 **IF YES (CODE 1) CONTINUE WITH Q.17B. OTHERWISE CONTINUE WITH Q.18**

1126 **Q.17b.** How much renewable electricity was generated by this source in 2016? Please express in kWh.

1127 \_\_\_\_\_

1128	DON'T KNOW	98
1129	REFUSED TO ANSWER	99

1130 **Q.17c.** In which year was this source implemented on your farm?

1131 \_\_\_\_\_

1132	DON'T KNOW	98
1133	REFUSED TO ANSWER	99

1134 **Q.18a** Do you produce renewable electricity from any other source?

1135	Yes	1
1136	No	2



1137	DON'T KNOW	98
1138	REFUSED TO ANSWER	99
1139	<b><u>IF YES CONTINUE WITH Q. 18B OTHERWISE CONTINUE WITH Q.19</u></b>	
1140	<b>Q.18b</b> Which source?	
1141	_____	
1142	DON'T KNOW	98
1143	REFUSED TO ANSWER	99
1144	<b>Q.18c</b> How much renewable electricity was generated by this source in 2016? Please express in kWh.	
1145	_____	
1146	DON'T KNOW	98
1147	REFUSED TO ANSWER	99
1148	<b>Q.18d</b> In which year was this source implemented on your farm?	
1149	_____	
1150	DON'T KNOW	98
1151	REFUSED TO ANSWER	99
1152	<b>Q.19</b> Do you produce renewable heat on the farm, for example from biogas or wood pellets?	
1153	Yes	1
1154	No	2
1155	DON'T KNOW	98
1156	REFUSED TO ANSWER	99
1157	<b><u>IF YES (CODE 1), CONTINUE WITH Q.20. OTHERWISE CONTINUE WITH Q.25</u></b>	
1158	<b>Q.20a</b> Do you produce renewable heat from wood logs or chips?	
1159	Yes	1
1160	No	2
1161	DON'T KNOW	98
1162	REFUSED TO ANSWER	99
1163	<b><u>IF YES (CODE 1) CONTINUE WITH Q.20B. OTHERWISE CONTINUE WITH Q.21</u></b>	
1164	<b>Q.20b</b> How much renewable heat was produced by this source in 2016? Please express this amount in	
1165	kWh.	
1166	_____	

1167 DON'T KNOW 98  
1168 REFUSED TO ANSWER 99

1169 **Q.20c.** In which year was this source implemented on your farm?

1170 \_\_\_\_\_

1171 DON'T KNOW 98

1172 REFUSED TO ANSWER 99

1173 **Q.21a** Do you produce renewable heat from wood pellets?

1174 Yes 1

1175 No 2

1176 DON'T KNOW 98

1177 REFUSED TO ANSWER 99

1178 **IF YES (CODE 1) CONTINUE WITH Q.21B. OTHERWISE CONTINUE WITH Q.22**

1179 **Q.21b** How much renewable heat was produced by this source in 2016? Please express this amount in  
1180 kWh.

1181 \_\_\_\_\_

1182 DON'T KNOW 98

1183 REFUSED TO ANSWER 99

1184 **Q.21c.** In which year was this source implemented on your farm?

1185 \_\_\_\_\_

1186 DON'T KNOW 98

1187 REFUSED TO ANSWER 99

1188 **Q.22a** Do you produce renewable heat from grass or straw?

1189 Yes 1

1190 No 2

1191 DON'T KNOW 98

1192 REFUSED TO ANSWER 99

1193 **IF YES (CODE 1) CONTINUE WITH Q.22B. OTHERWISE CONTINUE WITH Q.23**

1194 **Q.22b** How much renewable heat was produced by this source in 2016? Please express this amount in  
1195 kWh.

1196 \_\_\_\_\_

1197	DON'T KNOW	98
1198	REFUSED TO ANSWER	99
1199	<b>Q.22c.</b> In which year was this source implemented on your farm?	
1200	_____	
1201	DON'T KNOW	98
1202	REFUSED TO ANSWER	99
1203	<b>Q.23a</b> Do you produce renewable heat from biogas?	
1204	Yes	1
1205	No	2
1206	DON'T KNOW	98
1207	REFUSED TO ANSWER	99
1208	<b><u>IF YES (CODE 1) CONTINUE WITH Q.23B. OTHERWISE CONTINUE WITH Q.24</u></b>	
1209	<b>Q.23b</b> How much renewable heat was produced by this source in 2016? Please express this amount in	
1210	kWh.	
1211	_____	
1212	DON'T KNOW	98
1213	REFUSED TO ANSWER	99
1214	<b>Q.23c.</b> In which year was this source implemented on your farm?	
1215	_____	
1216	DON'T KNOW	98
1217	REFUSED TO ANSWER	99
1218	<b>Q.24a</b> Do you produce renewable heat from any other source?	
1219	Yes	1
1220	No	2
1221	DON'T KNOW	98
1222	REFUSED TO ANSWER	99
1223	<b><u>IF YES CONTINUE WITH Q. 24B OTHERWISE CONTINUE WITH Q.25</u></b>	
1224	<b>Q.24b</b> Which source?	
1225	_____	
1226	DON'T KNOW	98
1227	REFUSED TO ANSWER	99

1228 **Q.24c** How much renewable heat was produced by this source in 2016? Please express in kWh.

1229 \_\_\_\_\_

1230 DON'T KNOW 98

1231 REFUSED TO ANSWER 99

1232 **Q.24d** In which year was this source implemented on your farm?

1233 \_\_\_\_\_

1234 DON'T KNOW 98

1235 REFUSED TO ANSWER 99

1236 **4.3 SOIL NUTRIENT AND ANIMAL MANAGEMENT**

1237 **READ OUT TO RESPONDENT:** I will now ask you some questions about soil nutrient and animal  
1238 management.

1239

1240 **Q.25** Do you conduct soil testing on your fields? **SINGLE CODE.**

1241 Yes 1

1242 No 2

1243 NOT APPLICABLE 96

1244 DON'T KNOW 98

1245 REFUSED TO ANSWER 99

1246 **CONTINUE AT Q.26 IF YES (CODE 1). OTHERWISE CONTINUE WITH Q.28**

1247 **Q.26** How often do you on average conduct soil testing on your fields (Not including rough/mountain grazing  
1248 and any common land from your estimation)? Would you say yearly, every 2-5 years, or every 6 years or less  
1249 often? **SINGLE CODE.**

1250 Yearly ..... 1

1251 Every 2 to 5 years..... 2

1252 Every 6 years or less often ..... 3

1253 DON'T KNOW..... 98

1254 REFUSED TO ANSWER..... 99

1255

1256 **Q.27** What proportion of your farm did you have soil tested in the past 5 years (exclude  
1257 rough/mountain grazing and any common land from your estimation)? Would you say less than 25%,  
1258 25-75 %, or more than 75 %? **SINGLE CODE**

1259

1260 Less than 25% ..... 1

1261 25 to 75% ..... 2

1262 More than 75% ..... 3

1263 DON'T KNOW..... 98

1264 REFUSED TO ANSWER..... 99

1265

1266 **INTERVIEWER READ OUT:** Before asking the next questions, I would like to mention that a nutrient  
1267 management plan is also known as a fertiliser plan or NMP. This plan can be developed individually or with an  
1268 advisor and can tell you generally on which fields fertiliser is needed and in what quantities.

1269

1270 **Q.28** Do you have a nutrient management plan? **SINGLE CODE**

1271

1272 Yes ..... 1

1273 No..... 2

1274 NOT APPLICABLE..... 96

1275 DON'T KNOW..... 98

1276 REFUSED TO ANSWER..... 99

1277

1278

1279 **IF YES (CODE 1) AT Q.28 CONTINUE WITH Q.29. ALL OTHERS PROCEED TO Q.32**

1280 **Q.29** Who created your formally developed nutrient management plan? Would that be yourself, an  
1281 advisor, yourself together with an advisor or someone else? **SINGLE CODE**

1282

1283 Myself..... 1

1284 An advisor ..... 2

1285 Myself and an advisor ..... 3

1286 Other..... 4

1287 DON'T KNOW..... 98

1288 REFUSED TO ANSWER..... 99

1289

1290 **WHEN RESPONSE IS 'MYSELF' (CODE 1) OR 'MYSELF AND AN ADVISOR (CODE 3)**  
1291 **THEN CONTINUE WITH Q.30, OTHERWISE PROCEED TO Q.31**

1292

1293 **INTERVIEWER READ OUT:** I will read out different information tools. Please identify if you use  
1294 these tools in the development of your management plan by responding 'yes' or 'no'.

1295

1296 **INSTRUCTION: THE INTERVIEWER DOES NOT NEED TO READ OUT THE ANSWERS**  
1297 **'YES' AND 'NO' FOR EACH QUESTION. ONLY READ OUT THE STATEMENT AND**  
1298 **REMEMBER THE PARTICIPANT THEY CAN ANSWER 'YES', 'NO' OR 'DON'T KNOW'**  
1299 **TO A QUESTION WHEN THEY FORGET OR GIVE A DIFFERENT RESPONSE**

1300

1301 **30a** PLANET? **SINGLE CODE**

1302 YES 1

1303 NO 2

1304	DON'T KNOW	98
1305	REFUSED TO ANSWER	99
1306	<b>30b</b> xxx technical notes? <b><u>SINGLE CODE</u></b>	
1307	YES	1
1308	NO	2
1309	DON'T KNOW	98
1310	REFUSED TO ANSWER	99

1311	<b>30c</b> GPS mapping? <b><u>SINGLE CODE</u></b>	
1312	YES	1
1313	NO	2
1314	DON'T KNOW	98
1315	REFUSED TO ANSWER	99

1316	<b>30d</b> Any other information tool? <b><u>SINGLE CODE</u></b>	
1317	YES	1
1318	NO	2
1319	DON'T KNOW	98
1320	REFUSED TO ANSWER	99

1321

1322 **IF YES (CODE 1) CONTINUE TO Q.30D-2. OTHERWISE CONTINUE WITH Q.31**

1323

1324 **30D-2** Which information tool(s)?

1325 \_\_\_\_\_

1326

1327 **Q.31** Do you apply manure or slurry on your farm? **SINGLE CODE**

1328 Yes 1

1329 No 2

1330 NOT APPLICABLE 96

1331 DON'T KNOW 98

1332 REFUSED TO ANSWER 99

1333

1334 **IF YES (CODE 1) CONTINUE WITH Q.32. OTHERWISE CONTINUE WITH Q.34**

1335

1336 **Q.32** What method do you use to apply manure or slurry? Do you 1: inject it into the soil, 2: band spread it by  
1337 training hose or shoe, or 3: broadcast? **MULTI CODE**

1338

1339 Inject into the soil 1

1340 Band spread by training horse or shoe 2

1341 Broadcast 3

1342	DON'T KNOW	98
1343	REFUSED TO ANSWER	99
1344		
1345	<b>Q.33</b>	How soon after application would you typically plough in manure or slurry? Would you say within 4
1346		hours, between 5 and 6 hours, or after more than 6 hours? <b><u>SINGLE CODE</u></b>
1347		
1348	Within 4 hours	1
1349	Between 5 and 6 hours	2
1350	After more than 6 hours	3
1351	DON'T KNOW	98
1352	REFUSED TO ANSWER	99
1353	NOT APPLICABLE	6 (in survey data)
1354		
1355	<b><u>INTERVIEWER READ OUT:</u></b>	Variable rate application techniques are a precision farming tool. The techniques
1356		are used for application of material, such as fertiliser or lime, in a way that the rate of application is based on the
1357		precise location of the area that the material is being applied to.
1358		
1359	<b>Q.34</b>	Do you use variable rate application techniques when applying nitrogen fertiliser or lime? <b><u>SINGLE</u></b>
1360	<b><u>CODE</u></b>	
1361	Yes	1
1362	No	2
1363	NOT APPLICABLE	96
1364	DON'T KNOW	98
1365	REFUSED TO ANSWER	99
1366		
1367	<b>Q.35</b>	Do you conduct arable farming on your farm? <b><u>SINGLE CODE</u></b>
1368	Yes	1
1369	No	2
1370	DON'T KNOW	98
1371	REFUSED TO ANSWER	99
1372		
1373	<b><u>IF YES, CONTINUE WITH Q.36. OTHERWISE CONTINUE WITH Q.37</u></b>	
1374		
1375	<b>Q.36</b>	Do you include legumes in your crop rotations? <b><u>SINGLE CODE</u></b>
1376	Yes	1
1377	No	2
1378	DON'T KNOW	98
1379	REFUSED TO ANSWER	99
1380		
1381	<b><u>IF YES (CODE 1) CONTINUE WITH Q.36B. OTHERWISE CONTINUE WITH 37.</u></b>	

1382

1383 **Q.36b** How often do you include legumes in your crop rotations? Would you say yearly, every 2 to 5 years or  
1384 every 6 years or less often? **SINGLE CODE**

1385	Yearly	1	
1386	Every 2 – 5 years	2	
1387	Every 6 years or less often	3	
1388	NOT APPLICABLE		96
1389	DON'T KNOW	98	
1390	REFUSED TO ANSWER	99	

1391

1392 **Q.37** Do you have animals on your farm? **SINGLE CODE**

1393	Yes	1	
1394	No	2	
1395	DON'T KNOW	98	
1396	REFUSED TO ANSWER	99	

1397

1398 **IF YES (CODE 1) CONTINUE TO Q.37B. OTHERWISE CONTINUE WITH Q.42**

1399

1400 **Q.37b** I will now read out different enterprises. Please estimate the total number of animals on your farm in 2017  
1401 per enterprise. **MULTICODING ALLOWED, E.G. FARMER CAN OWN DIFFERENT TYPE OF**  
1402 **ANIMALS**

1403

Dairy?	<input type="text"/>
Beef ?	<input type="text"/>
Sheep?	<input type="text"/>
Other?	<input type="text"/>

1404

1405 **Q.38a** Do you use a mix containing red clover when you reseed your grassland? **SINGLE CODE**

1406

1407	Yes	1	
1408	No	2	
1409	DON'T KNOW	98	
1410	REFUSED TO ANSWER	99	
1411	NOT APPLICABLE		5 (in survey)

1412

1413 **Q.38b** Do you use a mix containing white clover when you reseed your grassland? **SINGLE CODE**

1414

1415	Yes	1	
1416	No	2	
1417	DON'T KNOW	98	



1418	REFUSED TO ANSWER	99
1419	NOT APPLICABLE	5 (in survey)
1420		
1421	<b>Q.39</b> Do you have a herd health plan? <u>SINGLE CODE</u>	
1422	Yes	1
1423	No	2
1424	NOT APPLICABLE	96
1425	DON'T KNOW	98
1426	REFUSED TO ANSWER	99
1427		
1428	<b>Q.40</b> How often do you consult a vet for non-essential check-ups of your livestock? Would you say	
1429	never, at least every 6 months, every 7 to 12 months, or less often than annually? <u>SINGLE CODE</u>	
1430		
1431	At least every 6 months	1
1432	every 7 to 12 months	2
1433	Less often than annually	3
1434	NOT APPLICABLE	96
1435	Never	97
1436	DON'T KNOW	98
1437	REFUSED TO ANSWER	99
1438		
1439	<b>Q.41</b> When making decisions on breeding stock, including bull, tup or ram hire, would you say	
1440	you mainly base your decision on estimated breeding value, preferred traits, costs, or intuition? <u>MULTI</u>	
1441	<u>CODE</u>	
1442		
1443	Estimated breeding value	1
1444	Preferred traits	2
1445	Intuition	3
1446	Cost	4
1447	NOT APPLICABLE	96
1448	DON'T KNOW	98
1449	REFUSED TO ANSWER	99
1450		
1451	<b><u>SECTION 5. FARM AND FARMER CHARACTERISTICS</u></b>	
1452		
1453	<b><u>READ OUT TO RESPONDENT:</u></b> We have reached the final section of the survey. I will now ask you some	
1454	questions about the characteristics of you and your farm. I will start with your characteristics and then continue	
1455	with the characteristics of the farm.	
1456		
1457	<b>Q.42</b> What is your age? <u>SINGLE CODE</u>	

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**INSTRUCTION INTERVIEWER Q.42: DO NOT READ OUT THE AGE BANDS, BUT CIRCLE THE AGE CATEGORY THE PARTICIPANT FALLS INTO. IF THEY DO NOT WANT TO SHARE THEIR AGE DIRECTLY, THEN READ OUT AGE BANDS.**

UNDER 25 .....	1
25-34 .....	2
35-39 .....	3
40-44 .....	4
45-54 .....	5
55-64 .....	6
65 AND OVER .....	7
DON'T KNOW	98
REFUSED TO ANSWER	99

**Q.43** How many years have you been farming?

**INSTRUCTION INTERVIEWER Q.43: DO NOT READ OUT THE BANDS, BUT CIRCLE THE CATEGORY THE PARTICIPANT FALLS INTO**

LESS THAN 10 YEARS	1
10 TO 20 YEARS	2
21 TO 30 YEARS	3
MORE THAN 30 YEARS	4
DON'T KNOW	98
REFUSED TO ANSWER	99

**Q.44** What describes the highest level of training undertaken? Would you say you have 1: practical agricultural experience only, 2: less than 2 years basic agricultural training, or 3: a full agricultural training course of 2 years or more? **SINGLE CODE**

Practical agricultural experience only.....	1
Basic agricultural training course – less than 2 years long.....	2
Full agricultural training course – 2 years long or more .....	3
DON'T KNOW	98
REFUSED TO ANSWER	99

**INTERVIEWER READ OUT:** I will now continue with asking about characteristics of your farm.

**Q.45** What is the total number of hectares or acres farmed by you in 2017? [This includes rented or leased land] **SINGLE CODE**

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\_\_\_\_ ha or \_\_\_\_ ac

**INSTRUCTION INTERVIEWER: IF THEY DO NOT WANT TO MENTION THE EXACT NUMBER,  
PLEASE READ OUT AREA BANDS**

LESS THAN 10 HA (25 ACRES) ..... 1  
10-19 HA (25-50 ACRES)..... 2  
20-49 HA (50-123 ACRES)..... 3  
50-99 HA (123-247 ACRES) ..... 4  
100-149 HA (247-370 ACRES)..... 5  
150 HA OR MORE (370 + ACRES)..... 6  
DON'T KNOW..... 98  
REFUSED TO ANSWER..... 99

**Q.46** Is any of this land leased or rented from others? **SINGLE CODE**

Yes ..... 1  
No..... 2  
DON'T KNOW..... 98  
REFUSED TO ANSWER..... 99

**IF YES, PROCEED TO Q.47 OTHERWISE CONTINUE WITH Q.48.**

**Q.47** What is the total number of hectares or acres you rented from others?

\_\_\_\_ ha or \_\_\_\_ ac

**INSTRUCTION INTERVIEWER: IF THEY DO NOT WANT TO MENTION THE EXACT NUMBER,  
PLEASE READ OUT AREA BANDS**

LESS THAN 10 HA (25 ACRES) ..... 1  
10-19 HA (25-50 ACRES)..... 2  
20-49 HA (50-123 ACRES)..... 3  
50-99 HA (123-247 ACRES) ..... 4  
100-149 HA (247-370 ACRES)..... 5  
150 HA OR MORE (370 + ACRES)..... 6  
DON'T KNOW..... 98  
REFUSED TO ANSWER..... 99

**Q.48** Have you identified a successor to take over the farm? **SINGLE CODE**

1538		
1539	Yes .....	1
1540	No.....	2
1541	DON'T KNOW.....	98
1542	REFUSED TO ANSWER.....	99
1543		
1544	<b>Q.49</b> Which of the following terms best describes the <b>soil type</b> of most of your land? Would you say 1: no	
1545	limitations and suitable for a wide range of agricultural uses, 2: somewhat limited by for instance poor drainage	
1546	or altitude or 3: very limited by for instance mountain areas? <b><u>SINGLE CODE</u></b>	
1547		
1548	Suitable for a wide range of agricultural uses .....	1
1549	Somewhat limited e.g. by poor drainage or altitude .....	2
1550	Very limited for agriculture e.g. mountain areas .....	3
1551	DON'T KNOW.....	98
1552	REFUSED TO ANSWER.....	99
1553		
1554	<b>Q.50</b> Which of the following most closely reflects your major farm activity? Would you say 1: mainly dairying,	
1555	2: mainly beef, 3: mainly sheep, 4: mainly arable, 5: mixed livestock, 6: mainly forage or 7: mixed farm? <b><u>SINGLE</u></b>	
1556	<b><u>CODE</u></b>	
1557		
1558	Mainly dairying .....	1
1559	Mainly beef.....	2
1560	Mainly sheep.....	3
1561	Mainly arable.....	4
1562	Mainly mixed livestock .....	5
1563	Mainly forage.....	6
1564	Mixed farm .....	7
1565	DON'T KNOW.....	98
1566	REFUSED TO ANSWER.....	99
1567		
1568	<b>Q.51</b> I would like to ask for your approximate annual farm income before taxes. Please do not include the	
1569	household income. <b><u>SINGLE CODE</u></b>	
1570		
1571	<b>Q.51a</b> Is it below or above £30,000 per annum (£580 per week)?	
1572		
1573	BELOW	1
1574	ABOVE	2
1575	DON'T KNOW	98
1576	REFUSED TO ANSWER	99
1577		

1578 **IF BELOW (CODE 1) CONTINUE WITH Q.51B. IF ABOVE (CODE 2) CONTINUE WITH Q.51D.**

1579

1580 **Q.51b** Is it below or above £20,000 per annum (£385 per week)?

1581 BELOW 1

1582 ABOVE 2

1583 DON'T KNOW 98

1584 REFUSED TO ANSWER 99

1585

1586 **IF BELOW (CODE 2) CONTINUE WITH Q.51C. IF ABOVE (CODE 2) CONTINUE WITH Q.52**

1587

1588 **Q.51c** Is it below or above £10,000 per annum (£195 per week)?

1589 BELOW 1

1590 ABOVE 2

1591 DON'T KNOW 98

1592 REFUSED TO ANSWER 99

1593

1594 **FOR BELOW AND ABOVE (CODE 1 AND 2) CONTINUE TO Q.52**

1595

1596 **Q.51d** Is it below or above £40,000 per annum (£770 per week)

1597 BELOW 1

1598 ABOVE 2

1599 DON'T KNOW 98

1600 REFUSED TO ANSWER 99

1601

1602

1603 **IF BELOW (CODE 1) CONTINUE WITH Q.52. IF ABOVE (CODE 2) CONTINUE WITH Q.51E**

1604

1605 **Q.51e** Is it below or above £50,000 per annum (£960 per week)

1606 BELOW 1

1607 ABOVE 2

1608 DON'T KNOW 98

1609 REFUSED TO ANSWER 99

1610

1611 **Q.52** What is the agricultural holding number of your farm? **INSTRUCTION INTERVIEWER: MOST**

1612 **FARMERS WILL NOT MENTION THE FIRST TWO DIGITS AND THE CODES MAY DIFFER IN**

1613 **LENGTH, SO NOT ALL THE 9 DIGITS WILL BE MENTIONED.**

1614        -- / --- / ----

1615 DON'T KNOW 98

1616 REFUSED TO ANSWER 99

1617 **Q.53** What is your post code?

1618

1619 \_\_\_\_\_

1620

1621 DON'T KNOW 98

1622 REFUSED TO ANSWER 99

1623 **INTERVIEWER READ OUT:** Thank you for participating in our survey. In the future we might like to  
1624 conduct follow-up research, therefore I would like to ask whether you are willing to participate in a follow-up  
1625 survey? **SINGLE CODE**

1626 **Q.54**

1627 Yes 1

1628 No 2

1629 DON'T KNOW 98

1630 REFUSED TO ANSWER 99

1631 **INTERVIEWER READ OUT:** This is the end of the survey. Thank you for participating.

1632 **INSTRUCTION TO INTERVIEWER: AFTER EACH INTERVIEW NOTE DOWN THE**  
1633 **FOLLOWING (DO NOT ASK THIS TO THE RESPONDENT):**

Extra details respondent

Answer

Caller ID of respondent

Gender of respondent

Number of attempt

Duration of the interview in minutes and seconds

Starting time of the interview

Date the interview took place


1634

1635

**Appendix 2. Overview of the 20 respondents included in the interviews**

<b>Res pon den t</b>	<b>Area</b>	<b>Years of experi ence</b>	<b>Agricul tural educati on</b>	<b>Size of farm (ha)</b>	<b>Rente d land (yes/n o)</b>	<b>Succe ssor (yes/n o)</b>	<b>Soi l typ e</b>	<b>Type of farm</b>	<b>Nr of meetings (as indicated in survey)</b>	<b>Nr of meetings (as indicated in interview</b>
<b>1</b>	Scottish borders	>30	Yes (full)	194	no	yes	very lim ited	mixed farm	>3	>3
<b>2</b>	Scottish borders	>30	Yes (full)	500	no	no	suit abl e	mixed livestock	>3	>3
<b>3</b>	East Lothian	21-30	Yes (full)	170	yes	no	lim ited	arable	>3	>3
<b>4</b>	Angus	>30	Yes (full)	165	no	yes	suit abl e	arable	>3	>3
<b>5</b>	Angus	>30	Yes (full)	300	no	no	suit abl e	arable	2 to 3	?
<b>6</b>	Aberde enshire	21-30	Yes (full)	15	yes	yes	lim ited	mixed livestock	2 to 3	2 to 3
<b>7</b>	Aberde enshire	21-30	Yes (full)	29	no	no	lim ited	arable	2 to 3	?
<b>8</b>	Aberde enshire	>30	no (practic al experie nce)	202	no	yes	suit abl e	mixed farm	2 to 3	2 to 3
<b>9</b>	Aberde enshire	>30	Yes (full)	60	no	no	lim ited	forage	>3	>3
<b>10</b>	East Ayrshir e	>30	Yes (full)	220	yes	yes	lim ited	mixed livestock	>3	>3
<b>11</b>	East Ayrshir e	21-30	Yes (full)	240	yes	no	lim ited	dairy	2 to 3	2 to 3

<b>12</b>	Dumfri es and Gallow ay	21-30	Yes (basic)	52	no	no	suit abl e	forage	>3	>3
<b>13</b>	Stirling	>30	Yes (full)	160	no	yes	lim ited	dairy	>3	?
<b>14</b>	Fife	21-30	Yes (basic)	242	yes	no	lim ited	mixed farm	2 to 3	2 to 3
<b>15</b>	Aberde enshire	21-30	Yes (basic)	2226	yes	no	lim ited	mixed farm	>3	2 to 3
<b>16</b>	Aberde enshire	21-30	Yes (full)	53	yes	no	suit abl e	mixed farm	>3	>3
<b>17</b>	Aberde enshire	>30	Yes (full)	440	yes	no	lim ited	beef	2 to 3	2 to 3
<b>18</b>	Fife	21-30	Yes (full)	250	yes	yes	suit abl e	dairy	>3	>3
<b>19</b>	Midlot hian	21-30	yes (full)	1100 0	yes	no	suit abl e	mixed farm	>3	2 to 3
<b>20</b>	Eastlot hian	>30	yes (full)	360	no	yes	suit abl e	mixed farm	2 to 3	?

1637



1638 **Appendix 3. Overview of the questionnaire used for the qualitative analysis**

- 1639 • Could you please describe your role on the farm?
- 1640 • How would you describe your type of farm?
- 1641 • How many ha is the farm you are farming on? (how much is owned/how much is  
1642 leased?)
- 1643 • how many employees do you have?
- 1644 • What is the herd size?
- 1645 • Are you a member of a farming group? E.g. discussion groups
- 1646 ○ for each of the groups mentioned: how often have you met them over the past  
1647 year?
- 1648 • How would you describe your experience working on this specific farm and in the  
1649 farming sector in general?
- 1650 • How would you describe the management of the farm (governance)?
- 1651 ○ if multiple people are involved in management: who is responsible for which  
1652 decision-making?
- 1653 • How much longer do you intend to be on the property?
- 1654 ○ Do you have a successor?
- 1655 • Do you receive any subsidies?
- 1656 ○ if yes, what type of subsidies? (e.g. based on voluntary participation etc.)
- 1657 • What are your goals/aspirations for the farm?
- 1658 ○ Are these any different to what they were 5-10 years ago?

1659 I would like to gain insight into how you have experienced meetings of the PEP.

- 1660 • Which focus farm did you visit mostly?
- 1661 • Can you describe how you have experienced your participation in the programme?
- 1662 • Can you describe why you attended the meetings?
- 1663 • About the structure of the meeting:
- 1664 ○ Can you describe what the meetings looked like?
- 1665 ○ Did you have the opportunity to raise your own issues or share experiences?
- 1666 ○ Did you have discussion at the meeting in small groups?
- 1667 • About peers
- 1668 ○ Please describe the nature of the interaction with peers during the meetings?

- 1669           ○ Did you know any of the other participants of the meeting?
- 1670           ○ Have you met with any other farmers at the meetings more than once?
- 1671           ○ What type of information did you share about your farm? What did others
- 1672           share?
- 1673           ○ Did you discuss with any of your peers outside the meetings?
- 1674           ● About the facilitator
- 1675           ○ Please describe the nature of the interaction with the facilitator during the
- 1676           meetings?
- 1677           ○ Would you consider going to meetings with the same facilitator again? Why?
- 1678           ○ Would you take up changes if recommended by the facilitator?
- 1679           ● About the experts
- 1680           ○ Please describe the nature of the interaction with the experts during the
- 1681           meetings?
- 1682           ○ How credible was the information presented by the experts?
- 1683           ● About how they feel their thinking has changed
- 1684           ○ To what extent did participating change your concerns about the topics
- 1685           discussed?
- 1686           ○ The most interesting thoughts were rather from peers, or the facilitator, or the
- 1687           experts?
- 1688           ○ Have you experimented with any of the suggested practices?
- 1689           ○ Can you name any other changes you have made due to participation in the
- 1690           programme?
- 1691           ○ What aspect of the programme stimulated you to make this change?
- 1692

1693 **Appendix 4. Overview of the data for the quantitative evaluation**

1694 **Table 1. Variable description and descriptive statistics of the sample before matching.**  
 1695 **The means and standard deviation are depicted in parentheses. The indicated**  
 1696 **significance levels in the column ‘PEP 2010-2013’ indicate differences in covariates**  
 1697 **between PEP 2010-2013 farmers and control farmers (Comparison I). In the column**  
 1698 **‘PEP 2014-2017’ the differences between PEP 2014-2017 farmers and control farmers**  
 1699 **are indicated (Comparison II). \*\*\*,\*\*, \* Significant at 0.1%, 1%, 5% level, respectively**

		Farmer categories		
		PEP 2010-2013 farmers (n=36)	PEP 2014-2017 farmers (n=114)	Control farmers (n=190)
<b>Explanatory variables</b>				
Years of experience	Years of experience as farmer, where 0 = 0 years, 1 = 1 to 10 years, 2 = 11 to 20 years, 3 = 21 to 30 years, 4 = 31 or more	3.30 (1.00)	3.31 (0.98)	3.32 (0.98)
Agricultural education	is 1 if farmer has agricultural education	0.50*** (0.50)	0.55 *** (0.50)	0.44 (0.50)
Size	amount of land (ha) farmed in 2016	303.02 (1688.28)	384.76 (1655.33)	298.37 (1837.30)
Rented land	is 1 if farmer has land rented from others	0.39 (0.49)	0.42* (0.50)	0.38 (0.49)
Successor	is 1 if farmer has a successor	0.41 (0.49)	0.43 (0.50)	0.42 (0.50)
Soil type	is 1 if soil type is limited	0.42 (0.50)	0.47*** (0.50)	0.41 (0.49)

Livestock on farm	is 1 if livestock is present on farm	0.56 (0.50)	0.53 (0.50)	0.56 (0.50)
<b>Outcome variables</b>				
Production of renewable electricity	Is 1 if farmer is producing renewable electricity	0.25*** (0.43)	0.28*** (0.45)	0.20 (0.40)
Production of renewable heat	Is 1 if farmer is producing renewable heat	0.16*** (0.37)	0.17*** (0.38)	0.12 (0.33)
Implementation of nutrient management plan	Is 1 if farmer has implemented a nutrient management plan	0.46 (0.50)	0.59*** (0.49)	0.44 (0.46)
Soil testing	Is 1 if farmer conducts soil testing	0.74*** (0.44)	0.81*** (0.40)	0.69 (0.46)
Knowledge acquisition	Knowledge acquisition measured by amount of questions correctly answered, where 0 represents no questions correctly answered and 6 represents all questions correctly answered	4.52*** (1.13)	4.62*** (1.08)	4.47 (1.12)

1700

1701 **Table 2. Propensity score estimates for Comparison I and Comparison II. \*\*\*, \*\*, \***  
1702 **Significant at 0.1%, 1%, 5% level, respectively.**

	<b>Comparison I</b>	<b>Comparison II</b>
<b>Variable</b>		
<i>Years of experience</i>	-0.26 (0.20)	-0.09 (0.13)
<i>Agricultural education</i>	1.63 (0.46) ***	1.18 (0.27) ***
<i>Size</i>	0.00 (0.00)	0.0001 (0.00)
<i>Rented land</i>	0.01 (0.41)	0.24 (0.26)
<i>Successor</i>	-0.33 (0.41)	0.15 (0.26)
<i>Soil type</i>	0.36 (0.39)	0.63 (0.26) *
<i>Livestock</i>	-0.19 (0.40)	-0.52 (0.25) *
<b>Number of observations</b>	226	304
<b>Pseudo R<sup>2</sup></b>	0.094	0.092
<b>Log-likelihood</b>	-89.82	-182.45
<b>LR chi-square</b>	18.58 **	37.32 ***

<b>AIC</b>	195.64	380.91
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1703

1704 **Table 3. Assessment of matching quality. LR refers to likelihood ratio.**

	<b>Comparison I</b>		<b>Comparison II</b>	
	2010-2013	Control	2014-2017	Control
<b>Variable</b>				
<i>Years of experience</i>	3.19	3.22	3.31	3.25
<i>Agricultural education</i>	0.78	0.75	0.73	0.67
<i>Size</i>	327.57	197.22	535.61	401.82
<i>Rented land</i>	0.44	0.47	0.5	0.47
<i>Successor</i>	0.33	0.3	0.44	0.41
<i>Soil type</i>	0.53	0.55	0.56	0.49
<i>Livestock</i>	0.56	0.58	0.48	0.51
<b>Pseudo R<sup>2</sup></b>	0.05		0.01	
<b>LR chi-square</b>	4.95		3.44	

1705

1706