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Agri-environmental diversification: Linking environmental, forestry and renewable energy engagement on Scottish farms

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ABSTRACT

In this paper we broaden the debate on agri-environmental scheme participation to include farm woodland expansion and renewable energy production, developing a conceptualisation of 'agri-environmental diversification'. Utilising structural equation modelling, we assess a telephone survey of 2416 Scottish farmers, undertaken in 2013. Findings demonstrate the path dependencies of farming participants, with those already engaged in each of these activities the most likely to plan to be involved in future. Similar factors have influenced the uptake of all three activities since 2005, and intention to increase involvement by 2020. Farmers who are: younger, better educated, information-seeking, certified as organic, receive subsidies, have non-farming income and plan to continue farming in the medium term, are more likely to plan for future engagement in the three activities. Environmental attitudes are also important, but a stronger relationship was found between observation of environmental gains from agri-environmental schemes and the three forms of agri-environmental diversification, suggesting that scheme involvement enables farmers to learn to produce, recognise and value environmental goods. We argue that when assessed within the broader perspective of agri-environmental diversification, agri-environmental scheme participation may represent an initial step on a farming trajectory that involves multiple forms of agri-environmental engagement.

1. Introduction

Although recent CAP reforms have added additional 'greening' measures tied to farm supports, food shortages in the late 2000s and concerns about population increases have created market incentives (real and perceived) for farmers to return to highly productivist behaviour (if indeed they ever transitioned to post-productivism – see Gorton et al., 2008; Walford, 2003; Wilson, 2001). At the same time, other forms of agri-environmental (AE) engagement have risen on national and European policy agendas. Climate change in particular has become a key feature in EU policy, reflected in binding national renewable energy production targets (EREC, 2011). Climate change policies have led to new interest in carbon sequestration through woodland expansion, as well as energy production from renewable sources. Both can be undertaken as forms of farm diversification, although the literature in these areas is less developed than for more traditional diversification activities. In this paper we assess the relationship between engagement in AE schemes, farm afforestation and renewable energy production, in order to better understand the drivers of agri-environmental engagement and place it within the context of whole-farm development. To do so, we bring together the literature on AE scheme engagement and farm diversification, developing a conceptualisation of "agri-environmental diversification".

To date, AE scheme participation has been assessed in isolation from farm diversification activities. AE engagement became a major topic in rural studies in the 1980s and 1990s: voluntary AE schemes were instituted in a number of EU countries in the 1980s, and became widespread following the 1992 MacSherry reforms to the Common Agricultural Policy (CAP) (Burton et al., 2008). The

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academic literature focused on identifying factors underlying scheme uptake, particularly farmer motivations, following the rationale that understanding motivations was essential to maximising farmer uptake. Findings from these studies have been mixed, demonstrating that there is a relationship between environmental values and action but that engagement in AE schemes is often primarily instrumental, representing efforts to access subsidy funding, rather than reflecting environmental values (Siebert et al., 2006; Dwyer et al., 2007; Morris and Potter, 1995; Wilson and Hart, 2000; Schenk et al., 2007; Sutherland, 2010). Although there are farmers who engage in AE schemes as a result of their environmental orientation (see for example Morris and Potter, 1995), the instrumental emphasis of many participants has been problematized as (potentially) representing short-term opportunism (e.g. Lowe et al., 1999; Morris and Potter, 1995).

Over the past decade several researchers have argued that farmers' instrumental objectives for agri-environmental scheme participation reflect a socialised preference for productivity; on this basis, Burton (2004) and colleagues (e.g. Burton et al., 2008; Sutherland and Darnhofer, 2012) suggest that incentivising farmers to produce appreciable environmental goods would increase up-take and longevity of AE activities. In this paper, we test this argument empirically by assessing the relationship between scheme participation, environmental values, observation of environmental gains from AE scheme participation, and ongoing plans for AE scheme engagement. In addition, we argue that these environmental actions are not limited to those encouraged by AE schemes, but include farm afforestation and on-farm renewable energy production. In assessing the three activities together as 'agri-environmental diversification', we consider the prospect that engagement in AE schemes not only leads to production of appreciable environmental outputs, it may lead to up-take of other forms of AE action.

Conceptualising AE scheme participation as a form of farm diversification represents the progression of work by Sutherland (2010), who contended that UK farmers are pursuing AE schemes as part of long-term business development strategies. The literature on farm diversification developed largely in parallel to the AE scheme literature in the 1980s and 1990s, partly in response to the introduction of diversification grant schemes, but more so in relation to concerns about overall farm household adjustment and the intellectual opportunities presented by the introduction of modified political economy concepts (Evans, 2009). The low economic returns on many European farms led to the establishment of grant schemes to encourage engagement in 'alternative farm enterprises': "the introduction of a non-traditional source of income into the pre-existing farm business, a process widely recognised in the published literature as 'farm diversification' (Gasson, 1988; Ilbery, 1991)" (Bowler et al., 1996, pp. 285). A potential relationship between AE scheme and farm diversification engagement is evident in the demographic features of participants: the factors influencing adoption of both practices are broadly similar, including age, educational level, tenure, and farm size (compare Ilbery and Bowler, 1993; Bowler et al., 1996 with Vanslembrouck et al., 2002; Morris and Potter, 1995). As the literature developed, the complexity of motivations for farm diversification also came under scrutiny; although the instrumental orientation of diversifying farmers was not considered problematic, it was recognised that whereas larger farms could pursue diversification as an accumulation strategy, smaller-scale farms often did so as a survival strategy (Evans and Ilbery, 1993; Meert et al., 2005; López-i-Gelats et al., 2011). More recently, researchers have demonstrated that diversification can also reflect expression of farm household members' (often gendered) personal interests (e.g. Brandth and Haugen, 2011).

Assessment of farmer engagement in both diversification and AE activities were largely subsumed within the post-productivism and multifunctionality literature in the 1990s and 2000s. Basic to both concepts is the premise that agricultural policies had shifted from a central, common focus on production, towards a broadening array of goods and services produced by agricultural land and businesses. These debates set AE scheme engagement and farm diversification within broader discourses about the best use of agricultural land, and policy shifts towards production of public goods (e.g. the protection, production and consumption functions of agricultural land – Holmes, 2012). The precise use and definition of the terms 'post-productivism' and 'multifunctional agriculture' have been the source of considerable debate (see for example Evans et al., 2002; Mather et al., 2006; Wilson, 2008). In this paper we utilise Marsden and Sonnino's (2008) conceptualisation, in which post-productivism is characterised as a subtype of multifunctionality, which emphasises the different functions of agricultural land (e.g. farmland diversification).

Although conceptually, AE scheme engagement and farm diversification are both considered options for multifunctional farming transitions, empirically the two have continued to be addressed separately. Maye et al. (2009), for example, intentionally excluded AE scheme participation from their study of diversification on tenant farms. This approach has considerable historical precedent: farm business diversification (in the UK) has not typically been environmental in orientation – the most popular diversification activities were closely related to production (e.g. contracting out labour, equipment and buildings), renting buildings or related to tourist accommodation (Keep, 2009; Evans and Ilbery, 1993). In addition, the revenues for AE scheme engagement were very small in relation to other sources of farm income (Hanley et al., 1999) – and thus arguably too small to for AE schemes to be considered viable options for farm business diversification. Evans (2009) pointed out that it is only over the past decade that it has become feasible to enter AE schemes in order to generate substantive business income.

Integrating these two literature offers the opportunity to update debates on the nature of AE engagement in light of current market and policy contexts, and to further develop the implications of the apparent instrumental orientation of many farmers towards AE scheme participation. It also enables us to build on the substantial body of literature on agri-environmental engagement to better understand farmer responses to new policy measures encouraging afforestation and renewable energy production. In the UK, incentives for farmers to afforest were introduced at the same time as AE measures (1987), prior to their European-wide application in the 1992 MacSharry Reforms, and have continued to feature in the Rural Development Programmes (RDP) (Crabtree et al., 2001). However, in light of climate change concerns, the urgency of afforestation has substantively increased in UK policy rhetoric over the past decade. Although farming subsidies for renewable energy production were also introduced in the UK in the late 1980s, included within RDP-based farm diversification grant schemes, it was renewable energy production subsidies introduced in the 2000s through the energy sector that made production viable on farms (Sutherland et al., 2015).

Within the UK, Scotland is strongly pursuing afforestation and renewable energy production as part of its commitments to a reduction in greenhouse gas emissions. Scotland has set a target of sourcing the equivalent of 100% of its electricity consumption from renewable sources by 2020, representing 30% of energy consumed (Scottish Government, 2011); this is substantially higher than the UK government goal of 15% of energy consumed (Department of Energy and Climate Change, 2011). Scotland's target for afforestation is substantial but less clear: in the 2006 Scottish Forestry

Strategy (Scottish Executive, 2006) the strategic objective was to see overall cover percentage increase from 17.1% to 25% (approximately 65,000 additional ha); in the Climate Change Delivery Plan (Scottish Government, 2009), the target was 10–15,000 ha per year; and in the first Report on Policies and Priorities (RPP1) the implementation plan for low carbon Scotland, the target was stated as 10,000 ha per annum (Scottish Government, 2011), for a 65 year term. In the 2015 discussion document on the Future of Scottish Agriculture, diversification is identified as a key factor, but as part of a wider strategy promoting cooperation (between farms and within supply chains) and adoption of efficiency increasing technologies and information systems. Farm diversification into renewable energy production and forestry are thus particularly important state objectives in the Scottish context.

The paper is structured as follows. A comparison of the literature on AE schemes and farm diversification, presented in Section 2, demonstrates remarkable similarities in the objectives and characteristics of farms and farmers that engage in AE schemes, afforestation and renewable energy production, and details our conceptualisation of 'agri-environmental diversification'. In Section 3 we present the methods: a survey of 2416 Scottish farmers, undertaken in 2013, which assessed the recent and intended future engagement in AE schemes, woodland expansion and renewable energy production, as well as environmental values, perceived environmental benefits of AE scheme participation, and profit-orientation. Findings from the survey are presented and discussed in Sections 4 and 5. We conclude in Section 6 with a brief summation of the major contributions of the paper, policy implications and directions for future research.

2. Agri-environmental diversification

2.1. Defining agri-environmental (AE) diversification

Although there has been considerable conceptual development addressing the nature of farmer–environment interaction, to date definitions of farmers' AE engagement have been simplistic, with participation largely equated to enrolment in a state-funded AE schemes. In contrast, farm diversification has been the subject of highly varying definitions, owing to the variety of forms it can take. Farm diversification often occurs without state assistance; farm diversification therefore cannot be operationalised on the basis of scheme-based definitions, unless scheme uptake is the purpose of the study (e.g. Ilbery and Bowler, 1993). The degree to which diversification includes off-farm employment has also been the subject of considerable debate (Evans and Ilbery, 1993; Maye et al., 2009). Estimates of the ubiquity of farm diversification thus vary widely (see McNally, 2001). Several authors have attempted to define typologies of farm diversification; Ilbery's (1991) typology has been particularly influential, distinguishing 'structural diversification' (adding value to conventional enterprises, for example through tourism, direct marketing, processing, leasing buildings) from 'agricultural diversification' (adoption of unconventional commodities for production, ranging from new hybrids of wheat to woodland, also including contracting of farm machinery).[1] More recently, Barbieri and Mahoney (2009, pp. 59) catalogued six types of diversification:

- production of non-traditional crops, livestock or adoption of unusual agricultural practices (such as organic or 'free range' approaches)
- direct marketing, merchandising and associated multi-media engagement
- recreation, tourism and hospitality enterprises
- leases and rental agreements, easements and time share of farm and its resources (e.g. buildings and equipment)
- provision of contract services (e.g. for crop production, farm management)
- adding value to agricultural products (e.g. packaging 'regional' farm products)

AE schemes, woodland expansion and renewable energy production would appear to fall generally within their first type. Although Barbieri and Mahoney (2009) do not mention these types specifically as forms of diversification, they do identify organic farming as a form of diversification. A similar position is taken by Maye et al. (2009), who categorise organic farming as representing production of a 'specialist product'.

For the purposes of this paper, we define AE diversification as *the reallocation and recombination of farm resources to undertake actions on-farm which are expected to lead to environmental preservation or gains, and which will generate additional income or add to the farm's value*. As such, we distinguish between AE behaviour – which can be defined simply as farming activities which are expected to lead to environmental preservation or gains; AE scheme participation – which can be quantified on the basis of enrolment in specific state-funded activities; and AE diversification – a business development strategy which necessarily involves pursuit of financial gain. However, as has been ably demonstrated in the diversification literature (e.g. Barbieri and Mahoney, 2009; Brandth and Haugen, 2011), undertaking AE diversification is expected to involve multiple aims (i.e. including environmental and social, as well as economic objectives). In identifying AE scheme engagement, woodland expansion and renewable energy production as forms of business diversification, we place AE behaviour within the context of whole farm business development. As such, the three activities are framed as potential components of farming trajectories, in contrast to preceding literature that has identified them as isolated behaviours.

2.2. The conceptual model

At a basic level, empirical studies of both AE scheme participation and farm diversification typically identify farm and farmer characteristics as important for uptake (Ilbery and Bowler, 1993; Wilson, 1997). As discussed in Section 1, perceptions and attitudes, particularly towards the environment, are also important factors. We developed a conceptual model demonstrating the variables under consideration in this study in Fig. 1. Although normative influences on AE engagement are also well recognised (e.g. the importance of neighbour's opinions and actions, see for example Burton, 2004; Burton et al., 2008; Sutherland and Darnhofer, 2012), it was beyond the scope of this present study to assess these features.

In terms of farmer characteristics, better educated individuals are more likely to undertake AE schemes (Vanslembrouck et al., 2002) and renewable energy production (Villamil et al., 2008; Tranter et al., 2011; Tate et al., 2012). Conversely, Schirmer and Bull (2014) found no significant correlations between education level and the willingness of Australian landowners to adopt forestry, either generally or in the case of three different scenarios of afforestation. However, research among Irish farmers found a significant association between education level and reasons given for not afforesting (Duesberg et al., 2014). Age is frequently also identified as an important variable, but with mixed findings – although younger people have been found to be more likely to take

[1] Cited over 200 times at the time of writing.

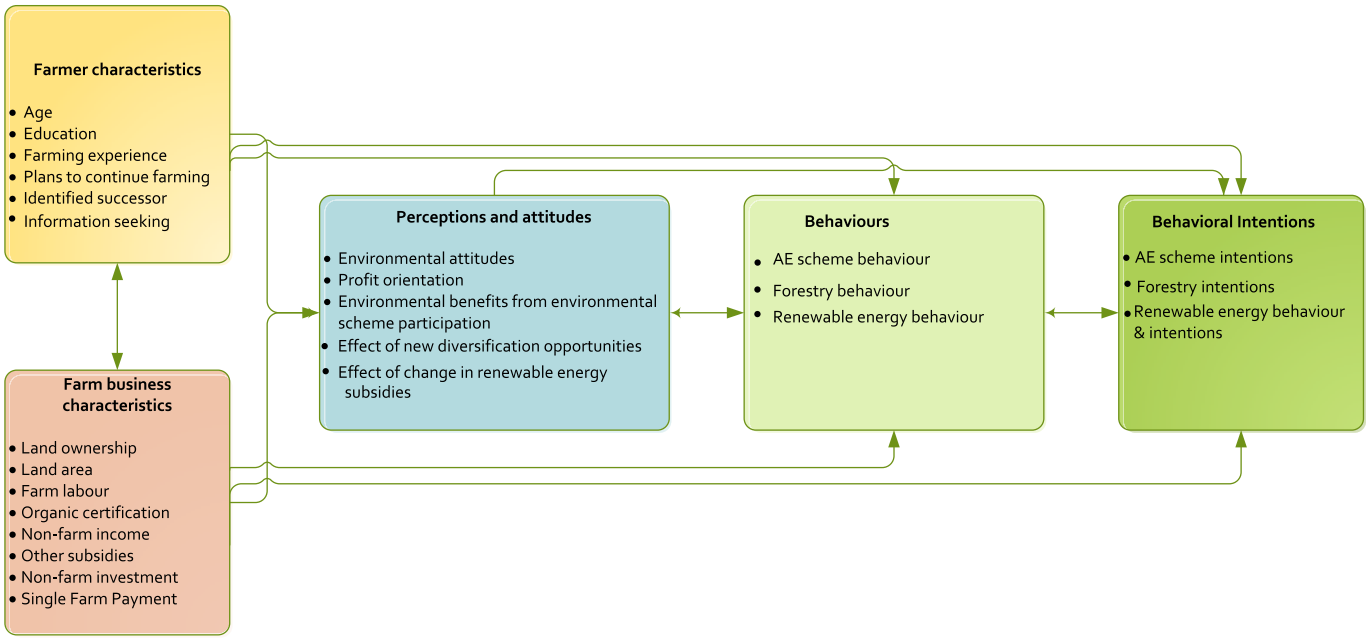

Fig. 1. Conceptual path diagram of agri-environmental diversification behaviour.

up AE schemes (Vanslembrouck et al., 2002) it has also been argued that older farmers (particularly those without successors) may scale back the intensity of their farming production and engage in schemes as a form of semi-retirement (Potter and Lobley, 1992). With regards to farm afforestation, Howley et al. (2015) found that middle-aged (40–64) farmers were more likely to afforest than relatively younger and older farmers. Schirmer and Bull (2014) found a significant negative correlation between landowner age and general willingness to afforest. The slower accumulation of income from forestry (relative to agricultural income) may deter older farmers from afforestation (Watkins et al., 1996). Similar distinctions are found in the diversification literature, but for different reasons – although the existence of a successor is generally accepted as important for farm development (including diversification), new entrants and young farmers are unlikely to have the capital to invest in substantive diversification enterprises, even with state assistance – this was a finding of Sutherland and Holstead (2014) in their study of agri-renewable uptake. Burton (2006) argues that it is not the age of the 'primary farmer' but the composition of the household, which is indicative of the farm's adaptive capacity.

Both the diversification and the AE scheme literature identify complex combinations and hierarchies of motivations and socialisation processes associated with uptake. The purpose of this paper is not to review these approaches, but to identify generalisable findings within the studies for exploration. Overall, the aims of farm household engagement in both activities are consistently identified as multiple (i.e. neither AE scheme nor diversification are undertaken in pursuit of a single goal). Within these combinations of goals, some emerge as stronger than others. As demonstrated in Section 1, numerous studies have demonstrated that economic motivations are important to AE scheme uptake. Studies suggest that farm woodland expansion is limited by similar attitudinal constraints to AE scheme engagement, particularly a resilient farming cultural orientation towards agricultural production (McDonagh et al., 2010; Schirmer and Bull, 2014). Although Watkins et al. (1996) argued that the financial incentives for afforestation were insufficient to motivate farmer uptake, Duesberg et al. (2013) note the importance of 'intrinsic' farming values, and views related to culture and landscape, in dissuading farmers from afforestation even in cases where engagement would be profitable. Howley et al. (2015) similarly found that AE understanding of the role of forests in a 'natural landscape' influenced farmers' willingness to afforest. Renewable energy production of farms has recently been approached from an attitudinal perspective, with similarly mixed findings about the relative importance of environmental attitudes to engagement in renewable energy production (Sutherland and Holstead, 2014; Huttunen, 2012; Tranter et al., 2011).

In terms of farm characteristics, farm size, tenure, land suitability and proximity to markets have been identified as important. It is generally recognised that larger farms are more likely to engage in both AE schemes and in diversification activities. Larger farms can be expected to have more land available for both activities; larger farmers are also more likely to have lower quality land which therefore represents less of a financial loss when taken out of production. In terms of forestry, this lower quality land is more easily relinquished for woodland creation. For renewable energy, larger farms are more likely to have land which is suited to activities such as wind energy production. Tenure is important to diversification in general, owing to the restrictions on diversification set within tenancy agreements (Ilbery, 1991; McNally, 2001). Maye et al. (2009) also argues that longer term investments into diversification activities are less feasible for tenants on short duration tenancies. Although forestry and renewable energy are not included in their study, both clearly represent long-term investments.

In summary, in conceptualising AE diversification, we identified a basic set of factors which could credibly impact on uptake of all three activities. We hypothesise that farmers who engage in AE schemes are more likely to engage in woodland and renewable energy production because: all three are expected to reflect environmental values; the same types of farm and farmer are likely to have the capacity to engage in all three activities (e.g. larger farms with sufficient labour and capital); all three activities represent options for farm business diversification.

3. Methods

The data and analysis presented in this paper are drawn from a telephone survey of Scottish agricultural holdings, conducted in the summer of 2013. The primary purpose of the survey was to assess structural changes on Scottish farms, particularly in relation to the effect of 2005 CAP reforms, and to identify planned future changes under proposed reform of the CAP. A spatially representative sample of 10,000 holdings was selected using information from the June Agricultural Census based on region, activity, size and farming enterprise (see Table 1). This led to a response of 2416 fully completed returns, a response rate of (24%). Utilising survey data enabled the quantification of statistically significant relationships between the three forms of AE diversification and associated future intentions, relating these to environmental values and profit orientation, as well as farmer and farm business characteristics. Undertaking a survey of this scale was particularly valuable for establishing the relative levels of engagement in the three activities across Scotland.

The questionnaire was composed of three main sections: socio-economic, demographic and attitudinal characteristics of the farmer; changes and influences on the farm since 2005; and proposed intentions for the farm up to 2020. In this paper we focus on the factors relating to past and anticipated future AE diversification (in the form of AE scheme engagement, forestry expansion and renewable energy production). For specific questions, see Appendix A. Data were analysed utilising structural equation modelling (SEM) built to assess the strength of the relationships between the six types of engagement (recent and intended future AE scheme engagement, recent and intended future forest expansion and recent and intended future renewable energy production) and between these and other *a priori* identified influences. Our overall hypothesis was that the six types of AE engagement can be explained by the same set of variables. Effectively, a series of factors were tested to establish their impact on AE diversification behaviours and intentions. These are listed in Fig. 1.

We used SEM with observed and latent variables to test the strength of relationships between the various determinants and the behavioural latent variables (i.e. how much these factors influence one another and primarily the three AE diversification behaviours and intentions). The strength of SEM is that it allows the simultaneous assessment of both direct and indirect relationships between variables, thus explaining more of the variance in behaviours and intentions. SEM has been used previously in the analysis of AE behaviour (Toma and Mathijs, 2007; Islam et al., 2013; Price and Leviston, 2014; Ficko and Boncina, 2015). We performed model estimation with the diagonally weighted least squares (DWLS) method using the statistical package Lisrel 8.80 (Jöreskog and Sörbom, 2007). Table 2 includes a description of the latent variables and their corresponding indicators included in the SEM model. The observed variables (e.g., socio-economic characteristics) were included in the model as single-indicator latent variables (consistent with Lisrel requirements), while others (such as perceived usefulness of a number of information sources) were used to build multiple-indicator latent variables in a procedure similar to factor analysis (as part of the measurement component of SEM).

The survey has a number of limitations. Business holdings with less than 0.5 standard labour units are under-represented within the Census; the sample was also stratified to reflect the major types of farming business in Scotland. There may therefore be some under representation of small-scale farms. In order to keep the questionnaire fairly short, the survey did not probe the different types of AE scheme engagement, forestry expansion or renewable energy. As a result, it is not possible to identify which subtypes of these activities were most common, or popular for future expansion. Expansion intentions were addressed simply as 'increase/decrease/no change' and as such the direction of travel is evident but the magnitude of potential future change is not. It is also important to note that AE scheme participation by nature is subsidised, as are most forms of renewable energy production; this is not necessarily true for afforestation.

Although organic farming is included in definitions of diversification, and can be considered a form of AE diversification, in this analysis we opted to include it as a variable rather than to explore a fourth type of AE diversification. Organic farming is far less common in the study than the three forms explored, representing only 6.0% of the sample.

4. Descriptive statistics of the sample

In this section of the paper we present the characteristics of the farms and farmers in the study, in order to provide context for the following section, which presents the findings and discussion based on the structural equation model.

The survey responses were matched to their holding codes with the June Agricultural Census data in order to provide further information on activity levels, such as size, main activities and regions. Table 1 shows descriptive statistics for the main variables matched within the JAC. Statistical comparison, conducted through t-tests for the four NUTS2 region levels, yielded no significant differences between key identifiers in the sample and those in the census.

Full details of the descriptive characteristics of study participants are included in Appendix A. In summary, the majority of farmers in the survey were over the age of 55. Nearly half had

Table 1
Survey respondents by NUTS2 region classification, mean and standard deviations.

	Total Farm Area (Ha)	Total Crop Area (Ha)	Total Grass and Rough Grazing (Ha)	Woodland Area (Ha)	Standard Labour Requirement[a] (No)	Total Sheep (No)	Total Cattle (No)
Eastern Scotland	308.9	53.3	237.7	13.6	3.5	837.0	106.5
Standard Deviation	*509.3*	*89.2*	*481.4*	*68.6*	*3.3*	*1267.1*	*158.8*
Highlands & Islands	362.4	8.0	330.1	15.2	1.5	345.5	68.1
Standard Deviation	*1507.5*	*23.3*	*1398.1*	*133.8*	*2.2*	*605.1*	*114.5*
North Eastern Scotland	147.9	44.2	93.6	8.0	1.8	158.5	111.5
Standard Deviation	*349.7*	*63.9*	*294.2*	*74.0*	*2.5*	*350.9*	*177.5*
South Western Scotland	190.2	6.6	173.4	7.8	2.9	550.1	200.1
Standard Deviation	*334.3*	*14.2*	*303.5*	*44.8*	*3.5*	*948.3*	*325.6*

[a] Standard labour requirements (SLR) gives an indication of the individual labour usage at a farm enterprise level. It is used here as a proxy for available capacity.

Table 2
Participation in agri-environmental diversification.

	Since 2005	By 2020
Participated in agri-environmental schemes	41.9%	41.6%
Increased the area of forestry	13.5%	11.3%
Increased the amount of renewable energy production	23.3%	30.8%
Participated in environmental schemes and increased forestry area	7.2%	5.8%
Participated in environmental schemes and have increased amount of renewable energy production	9.7%	13.7%
Increased forestry area and renewable energy production	3.6%	5.2%
Participated in environmental schemes, increased forestry area and renewable energy production	2.8%	0%

school-level qualifications only, but about one third had college qualifications and some 20% had university education. The majority of respondents were owner-occupiers (62%), 21% were tenanted, with the remainder mostly claiming some mixture of the two. Very few, 4% of the responses, claimed to be solely managers. Farmers in the study were typically long-term: nearly three quarters of the respondents had occupied their farms for more than 20 years, and the vast majority (88%) plan to continue farming until 2020. Farm sizes ranged from under 10 ha to more than 1000, with nearly half of farms falling between 100 and 1000 ha in size. Almost half of farms had an identified successor.

Farms in the survey were largely dependent on income from primary agricultural production, with nearly 65% indicating that none of their holding's income was from non-farming activities, and 56.1% indicating that they had no off-farm investments. However, nearly 80% reported receiving a Single Farm Payment and nearly half indicated that they receive other forms of state subsidies. These are most likely AE subsidies through the RDP, as this percentage is only slightly higher than that of farmers who had engaged in AE schemes.

Environmental attitudes were assessed in three questions about the condition of respondent's land and greenhouse gas emissions, which were combined into a single variable. In addition, nearly half of respondents indicated that they had seen the environmental benefits of state-funded AE schemes. Profit orientation was assessed simply by asking if they operate the farm for profit, aim to break even, or make a loss, with nearly 83% of respondents indicating that they farm for profit.

As demonstrated in Table 2, a substantial majority (41.9%) of the surveyed respondents had participated in AE schemes since 2005, with approximately the same percentage (41.6%) planning to remain or become involved in the schemes by 2020. Renewable energy production was planned to increase, with nearly a quarter of participants (23.3%) indicating they had increased production since 2005 (there was very little renewable energy produced on farms in Scotland prior to that point) and nearly a third (30.8%) planning to increase renewable energy production by 2020. Forestry was less popular, with only 13.5% increasing since 2005, and somewhat less (11.3%) planning to increase forestry by 2020. Recent and planned decreases to forestry and renewable energy production were very minor (typically less than 2%).

Fitting with the hypothesis underlying the paper, AE scheme participation is clearly related to participation in other forms of AE diversification: over 70% of the total percentage of forest expanders (recent and intended future) were also engaged in AE schemes, but only about half were planning to undertake both in future. A somewhat smaller proportion of participants were involved in both AE schemes and renewable energy production, but this number is set to increase, in line with an overall increase in the percentage aiming to undertake renewable energy production by 2020. The overlap between forestry and renewable energy producers suggests that renewable heat production will form part of this increase. Only a very small percentage (2.8%) of participants were involved in all three types of AE diversification, with none of the participants planning to increase their activity across all three by 2020. This suggests that although AE scheme engagement may be an important stepping stone to further AE diversification, it may also subsequently be dropped when other opportunities prove to be more appealing. This issue is further discussed in Section 5.4.

5. Findings from the structural equation model (SEM)

The path diagram for the estimated SEM is presented in Fig. 1. The model is a good fit for AE scheme engagement, explaining 51% of the variance in scheme participation since 2005, and 60% of planned participation by 2020. A similar level of variance is addressed for increases in renewable energy production, explaining 62% of variance to increases since 2005 and 53% of intended future increases to renewable energy production by 2020. Forestry was less well accommodated in the model, explaining 42% increases to forestry since 2005 and 43% of planned future increases by 2020. Table 3 presents the goodness of fit indicators, all showing excellent model fit, while Table 4 presents the total standardized effects.

Table 3
Goodness of fit indicators.

Goodness of fit indicators	Value	Recommended value
Degrees of freedom	455	–
Satorra-Bentler scaled Chi-Square	746.94	–
Normed Chi-Square	1.64	[1–3]
Root Mean Square Error of Approximation (RMSEA)	0.021	0.00–0.10
90 Percent confidence interval for RMSEA	(0.019; 0.024)	(0.00; 0.10)
P-Value for test of close fit (RMSEA <0.05)	1.00	1.00
Standardized RMR	0.046	0.00–0.10
Normed Fit Index (NFI)	0.98	0.90–1.00
Non-Normed Fit Index (NNFI)	0.99	0.90–1.00
Comparative Fit Index (CFI)	0.99	0.90–1.00
Incremental Fit Index (IFI)	0.99	0.90–1.00
Relative Fit Index (RFI)	0.97	0.90–1.00
Goodness of Fit Index (GFI)	0.98	0.90–1.00
Adjusted Goodness of Fit Index (AGFI)	0.97	0.90–1.00

Table 4
Total standardized effects (t values in parentheses).

	Total effects on:															
	labours	organics	contin	successo	invest	sfps	info	effect	envattd	benefit	**escheme**	**intschem**	**forests**	**intfors**	**reneweg**	**intrenew**
age	-	-	-0.38 (-8.73)	0.21 (6.90)	0.00 (2.29)	- -	-0.02 (-2.72)	-0.06 (-3.46)	-0.01 (-2.47)	0.01 (2.72)	**-0.00 (-2.51)**	**-0.10 (-4.16)**	**-0.01 (-2.02)**	**-0.16 (-5.45)**	**-0.04 (-3.36)**	**-0.09 (-4.91)**
education	-	-	0.00 (1.96)	- -	0.26 (6.63)	- -	0.09 (2.32)	0.18 (5.62)	0.04 (2.17)	0.02 (2.37)	**0.25 (6.37)**	**0.18 (6.39)**	**0.16 (5.28)**	**0.22 (4.50)**	**0.16 (6.39)**	**0.16 (5.97)**
profit	-0.40 (-5.40)	-	-0.03 (-2.27)	-0.11 (-4.46)	-	-0.55 (-7.84)	-0.51 (-10.08)	-0.20 (-7.30)	0.11 (2.12)	-	**-0.14 (-3.65)**	**-0.13 (-4.30)**	**0.13 (3.82)**	**0.04 (2.04)**	**-0.11 (-5.09)**	**-0.18 (-6.46)**
status	0.07 (3.68)	-	0.01 (2.50)	0.02 (3.49)	-	-0.19 (-5.44)	-	0.19 (5.89)	-	-	**-0.06 (-3.64)**	**-0.04 (-3.71)**	**0.09 (4.42)**	**0.04 (3.49)**	**0.29 (6.34)**	**0.10 (4.99)**
experience	0.07 (3.59)	-	-0.02 (-4.29)	0.02 (3.45)	-0.01 (-3.20)	0.19 (4.87)	-0.27 (-5.49)	-	-0.13 (-4.01)	-0.07 (-4.84)	**0.04 (2.29)**	-	**-0.06 (-4.34)**	**-0.03 (-4.00)**	-	**-0.08 (-5.69)**
area	0.15 (2.05)	-	0.02 (2.02)	0.04 (2.03)	0.11 (2.79)	0.19 (2.83)	-	0.05 (2.63)	-	-	**0.22 (5.53)**	**0.15 (5.36)**	-	-	**0.05 (3.84)**	**0.05 (3.13)**
income1	0.16 (3.84)	0.31 (5.49)	0.02 (3.39)	0.04 (3.44)	0.17 (4.20)	-0.05 (-2.45)	-	0.31 (9.25)	-	-	**0.09 (3.76)**	**0.19 (4.68)**	**0.27 (6.23)**	**0.11 (4.02)**	**0.28 (8.82)**	**0.16 (6.91)**
income2	0.04 (2.71)	-	0.03 (2.78)	0.01 (2.65)	-	0.12 (3.34)	-	0.18 (5.00)	-	0.17 (5.73)	**0.32 (9.08)**	**0.22 (8.75)**	**0.14 (5.08)**	**0.07 (4.44)**	**0.13 (5.46)**	**0.06 (4.90)**
labour	-	-	0.11 (5.60)	0.27 (8.69)	0.00 (2.32)	-	0.03 (2.79)	0.02 (3.84)	0.01 (2.54)	0.01 (2.75)	**0.00 (2.54)**	-	**0.00 (2.49)**	**0.05 (4.42)**	**0.01 (3.79)**	**0.22 (6.48)**
organic	0.05 (2.61)	-	0.01 (3.13)	0.01 (2.47)	-	-0.16 (-2.82)	-	-	-	-	**0.28 (5.56)**	**0.20 (4.99)**	**0.20 (4.98)**	**0.09 (3.31)**	**0.12 (2.73)**	**0.10 (4.37)**
continue	-	-	-	-	-	-	-	0.16 (3.95)	-	-	-	**0.21 (4.44)**	**0.03 (2.26)**	**0.43 (7.12)**	**0.10 (3.88)**	**0.24 (6.65)**
successor	-	-	0.39 (7.95)	-	0.01 (2.39)	-	0.10 (2.95)	0.08 (4.22)	0.05 (2.64)	0.03 (2.88)	**0.01 (2.65)**	-	**0.02 (2.60)**	**0.17 (5.38)**	**0.05 (4.13)**	**0.11 (5.24)**
investment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.09 (2.32)**	**0.02 (2.09)**
SFP	0.35 (4.57)	-	-0.03 (-2.64)	-0.09 (-4.18)	-	-	0.13 (2.01)	0.24 (5.79)	0.06 (1.98)	0.03 (2.04)	**0.29 (5.01)**	**0.21 (5.25)**	**-0.25 (-4.82)**	**-0.11 (-3.65)**	**0.12 (3.75)**	**-0.06 (-2.00)**
Information	-	-	0.05 (3.92)	-	0.05 (3.50)	-	-	0.15 (4.62)	0.48 (6.24)	0.26 (9.69)	**0.07 (4.90)**	**0.13 (4.30)**	**0.06 (3.95)**	**0.05 (4.87)**	**0.11 (4.64)**	**0.23 (10.76)**
effect	-	-	-	-	-	-	-	-	-	-	-	-	**0.20 (2.60)**	**0.08 (2.35)**	**0.66 (15.82)**	**0.21 (5.50)**
env. attd	-	-	0.11 (3.15)	-	0.11 (3.47)	-	-	0.02 (2.35)	-	0.55 (5.26)	**0.14 (3.89)**	**0.12 (3.96)**	**0.07 (3.50)**	**0.07 (3.57)**	**0.03 (3.35)**	**0.04 (3.56)**
benefit	-	-	0.19 (4.15)	-	-	-	-	0.03 (2.86)	-	-	**0.25 (6.40)**	**0.21 (7.00)**	**0.13 (4.74)**	**0.13 (5.24)**	**0.04 (4.40)**	**0.07 (5.11)**
AE scheme	-	-	-	-	-	-	-	-	-	-	-	**0.67 (17.52)**	**0.50 (7.66)**	**0.20 (3.92)**	**0.06 (3.23)**	**0.11 (4.60)**
AE sch int.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
forestry beh.	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.40 (4.90)**	**0.13 (3.31)**	**0.23 (6.17)**
forestry int.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.49 (10.31)**
renew. energy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.26 (4.41)**
renew energy int.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R-square	0.30	0.09	0.34	0.10	0.15	0.68	0.30	0.39	0.20	0.33	**0.51**	**0.60**	**0.42**	**0.43**	**0.62**	**0.53**

5.1. Farm business characteristics

Overall, the SEM demonstrates that there is remarkable consistency in the factors influencing engagement in the three forms of AE diversification explored here. In terms of farm business characteristics, ownership of land is important, although there is a negative relationship with recent AE scheme participation, indicating that AE scheme engagement is more common on tenanted land. This may reflect the relatively short-term nature of AE schemes relative to afforestation and renewable energy production. The finding is supported by the stronger effect of land ownership on afforestation and renewable energy production as compared to its impact on participation in AE schemes.

Holding sizes tend to be larger (in terms of acreage) for all but recent forestry expansion; in the cases of future renewable energy expansion and forestry, farms are also characterised by higher amounts of labour. This is consistent with the relationship identified in the SEM between recent and planned renewable energy production, and off-farm investments. The relationship between other government subsidies and AE diversification is also to be expected, as all three activities are subject to considerable state supports. The study's findings are thus consistent with the literature in identifying structural barriers to renewable energy production (e.g. Sutherland and Holstead, 2014): whereas AE schemes can easily be taken up on tenanted land, diversification into renewable energy (i.e. going beyond energy crop production into on-site generation of electricity or heat) is primarily accessible to larger-scale, owner operated farming operations, most likely in reflection of the high capital investment required.

The relationship between non-farming income and AE diversification suggests that these farms are also involved in other forms of diversification. This diversification activity may be attributable to changes in farming trajectories following the 2005 CAP reforms: participants in forestry and renewable energy expansion, both recently and intended future, were statistically more likely to have been strongly impacted upon by recent changes to state subsidies. Interestingly, access to the Single Farm Payment is positively associated with AE scheme engagement and increased renewable energy production but is negatively associated with recent and anticipated forestry expansion. For AE schemes, this may reflect a sense of entitlement to subsidies, which Sutherland (2010) argued leads to a desire amongst farmers to recoup lost production subsidy payments through engagement in AE schemes. It may also reflect the need to have at the managers' disposal sufficient agricultural land in order to activate Single Farm Payment entitlements: Scotland shifted to a 'historic' payment approach in 2005, following decoupling of the CAP. Although maintenance of the land in good agricultural condition was required, production *per se* was not, seeing large areas of *de facto* land abandonment (Thomson, 2011). Post 2014, Scotland has shifted to an area based payment scheme, where the amount and type of agricultural land held is a determining factor in the amount of subsidy received, subject to meeting the minimum activity requirements specified. As the status of afforested land within these conditions was not clear at the time of the study, farmers could reasonably be expected to refrain from forestry expansion for fear of reducing their SFP entitlements.[2]

5.2. Farmer characteristics

In terms of farmer characteristics, participants in AE diversification are consistently more educated, and active in accessing multiple types of information. With the exception of recent AE scheme engagement, they also tend to be younger (although this relationship is indirect, through intentions to continue farming and existence of a successor). The importance of age to the different types of AE diversification has been contested, in that it can be reflective of different farming trajectories – Potter and Lobley (1992) demonstrate that younger farmers are often more environmentally conscious, and willing to take up schemes, but older farmers may be scaling back their production activities as a form of semi-retirement. The latter may or may not do so through AE scheme engagement. This may explain the lack of a significant relationship between AE scheme participation and intention to continue farming to 2020, and to identification of a successor. These lacks in connection most likely reflect the relatively short-term nature of AE scheme engagement – five year contracts – in comparison to the much lengthier commitment of forestry or many forms of renewable energy production.[3]

This apparent enthusiasm of younger people for diversification is supported by the relationship between the existence of a successor and current and future forestry and renewable energy production. Sutherland (2010) argues that farmers require sufficient available labour to undertake AE schemes; this is consistent with the relationship (albeit indirect) between scheme participation and labour. Interestingly, the duration of time operating the farm is negatively associated with forestry (recent and future) and future renewable energy production, suggesting that these two trajectories are particularly appealing to individuals who have not long been invested in the farm. Increasing these two activities could reasonably be considered a more major shift in farming practices than AE scheme engagement, and may thus represent a change in farm trajectory post-succession or upon new entrance, in some cases.

5.3. Environmental values

The motivations for engaging in AE diversification were not directly assessed in the survey. Instead, the survey included questions about profit orientation in general, and environmental attitudes and experiences of AE scheme participation. As could be expected, all three forms of AE diversification were related to environmental values, but this was not absolute – participants in all three included individuals who did not score highly on the indicators of environmental values. Importantly, all three anticipated future behaviours were associated more strongly with seeing the environmental benefits of AE scheme engagement than with environmental values. This suggests that successful engagement in schemes, more so than environmental orientation, is important to ongoing participation. At the same time, there are clearly participants in the study who expressed low environmental values but who still saw the environmental benefits of AE scheme engagement, suggesting that it is not solely the establishment of environmental values which leads to longevity in engagement, but increased understanding of how environmental goods are produced and maintained. The findings thus support the contention (Burton, 2004; Burton et al., 2008; Sutherland and Darnhofer, 2012) that recognition of the environmental benefits of AE schemes participation can lead to longer term engagement.

AE diversification was also related to profit orientation, but not in a consistent direction: recent and anticipated AE scheme and

[2] New woodlands will be eligible for basic and greening payment at the rate determined by their land quality. However, this change in eligibility was not known to farmers at the time of the survey.

[3] Energy crop production, for example, is an annual decision, whereas investment in wind turbines, wood burners, solar panels, and biogas are typically substantial long-term investments.

renewable energy engagement were more likely on profit-oriented farms, whereas recent and anticipated increases to forestry were less likely on profit-oriented farms (i.e. afforesting farms are more likely to be intentionally operated to break even or experience a loss). Afforestation thus appears more likely on hobby farms (or recreational estates), whereas renewable energy and AE scheme engagement are part of business-oriented trajectories. This suggests that forestry may be part of a lifestyle transition on the farm, rather than an economic diversification strategy.

5.4. Future development of agri-environmental diversification

Table 2 demonstrates that although the number of farmers involved in AE schemes in Scotland is likely to remain fairly stable, with similar numbers of farmers initiating or ceasing their engagement, AE diversification is set to increase by 2020. The path dependency of contemporary farms is well established in the literature: once engaged in a particular trajectory, farms typically remain 'locked in' for lengthy periods of time, owing in large part to the costs – economic and cultural – of making major transitions (Sutherland et al., 2012; Wilson, 2008). Consistent with these arguments, the SEM identified a similar level of recent and anticipated future engagement for all three types. However, it is important to note that this relationship was not 100% – although there was a very strong relationship between AE scheme participation and future AE scheme engagement, there were clearly a cohort who plan to discontinue engagement, and a correspondingly sized group who are planning to start. The relationship between past and future forestry and renewable energy production were similarly related, with weaker but still significant relationships: farmers who have recently expanded their forestry or increased their renewable energy production are more likely to keep moving in these directions, but there are clearly also farmers who, having increased these activities in the past, now plan to maintain their new status quo. Very few farmers planned to decrease these activities.

McNally (2001) found that similar numbers of farmers were initiating and discontinuing their diversification activities, suggesting that a plateau had been reached. This appears to have occurred for AE scheme engagement, but not for forestry and renewable energy production. Forestry is likely to increase, but at a slower rate than in recent years, which have seen an increase in new planting from very low rates in 2009 and 2010 and strong growth in the area of reported farm woodland. Additionally, renewable energy production is set to increase or be taken up for the first time on a growing percentage of farms. Indeed, the planned increase on some 30% of Scotland's farms could suggest that a major shift is underway. The SEM also demonstrates that increased renewable energy production is planned by a cohort of farmers who have not increased their renewable energy production in the past. Renewable energy production is a relatively new form of farm diversification: although renewable energy has been produced on farms for decades (and subsidised through the SRDP since the 1980s), it is only within the past ten years that it has been financially viable to produce energy for sale off-farm.

5.5. Does agri-environmental scheme engagement lead to other forms of agri-environmental diversification?

The underlying premise of this paper is that engagement in AE schemes not only leads to further AE scheme participation, but also to engagement in other forms of AE activity, such as forestry and renewable energy production. Although the model establishes correlations, not cause and effect, this hypothesis would appear to be supported – recent participation in AE schemes is positively associated not only with future AE scheme participation, but also recent and anticipated future afforestation and renewable energy production. Critically, as established in Section 5.3, all three behaviours were associated more strongly with seeing the environmental benefits of AE scheme engagement than with measures of environmental values. The authors suggest that positive engagement in AE scheme participation – specifically seeing the resultant environmental benefits – leads farmers to consider adopting other forms of AE activity.

It is important to note that there is an existing synergy between forestry and renewable energy production: the intention to adopt renewable heat production, identified as a farm diversification strategy by Huttunen (2012) can be expected to coincide with afforestation. The precise nature of this shift was not identified in the survey, as it did not explore the specific types of renewable energy farmers were planning to adopt. Recent studies in England have demonstrated that some types of renewable energy are more popular than others, with solar and wind heading the lists (Bailey et al., 2008; Tate et al., 2012; Mbzibain et al., 2013). It is also possible that farmers are over-estimating their intentions: examining farmer intentions is somewhat contentious, as the identified intentions may not lead to actual behaviours (Viaggi et al., 2011; Latruffe et al., 2013). Further research is needed to track the extent to which farmer intentions are reflected in actual behaviour, and whether particular types of AE diversification follow on from AE scheme engagement.

5.6. A note on organic farming

All three forms of AE diversification were also influenced by certification as an organic farmer. Although the reasons for taking up organic farming were not addressed in the survey, it appears evident that organic farming can reasonably be identified as a form of AE diversification, with similar underlying factors. In line with the AE literature, there has also been a lengthy debate about the 'conventionalisation' of organic farming (i.e. the instrumental orientation of increasing numbers of organic farmers), raising questions about the loss of environmental rewards associated with altruistic organic production, as a result of compromises made in order to achieve commercial viability (for reviews of the conventionalisation debate see Lockey and Halpin, 2005; Darnhofer et al., 2010). To date, although identified as here form of farm diversification, organic farming has not been evaluated from this perspective. The authors suggest that organic farm conversion may also represent a progression of AE scheme participation, and as such represent a trajectory of increasing engagement of conventional farms in AE diversification, developing associated values and skills. This is an important topic for future research.

6. Conclusion

The primary motivator for studies of AE scheme engagement in the 1980s and 1990s was to assess how to maximise farmer engagement in these schemes (Siebert et al., 2006). Once enrolled, farmers were expected to continue as environmental values and knowledge increased over time. Findings from this study suggest that this is indeed the case: once involved in AE schemes, farmers are more likely to continue, particularly if they have seen the environmental benefits of those schemes. This suggests that new learning about how to produce or maintain environmental goods is equally or more important than environmental motivations. Although this new skill development should be directly assessed in future research, the authors suggest that efforts to increase farmers' AE engagement could usefully involve equipping farmers to recognise and assess the observable signs of environmental gains

(e.g. biodiversity), for example by actively involving them in impact assessments of AE schemes.

Study findings go beyond this contention to demonstrate that engagement in AE schemes also correlates to afforestation and renewable energy production. Through utilising the concept of 'agri-environmental diversification', the ongoing integration of AE activities into commercial farming trajectories becomes evident. We suggest that a multifunctional transition is indeed occurring within Scottish agriculture, as committed, young(er), well-educated and information-seeking farmers increasingly come to recognise production of environmental goods as a viable farm diversification strategy. Although participation in AE schemes appears to be stable, the study provides evidence for a growing amount of AE activity, in the form of woodland expansion and renewable energy production. However, the utility of considering the three activities together as AE diversification should not be taken as an indication that all environmental behaviour on farms is commercially driven. Rather, our argument is that AE behaviour should be understood within the context of other diversification activities, and can form part of a long-term business strategy. Further research could usefully elucidate the precise mechanisms by which AE scheme engagement influences subsequent AE behaviour, and the range of unsubsidised environmental activities undertaken on commercial farms.

In terms of policy implications, to date, much like the academic literature, the three types of AE diversification have been treated separately. Although both farm forestry and AE measures are now administered in the Scottish Rural Development Programme through a single payment agency, strategy, policy and implementation rules reflect historical roles and responsibilities divided between agriculture, environment and forestry departments and agencies. The budgets available are also very small, partly since Scotland has the lowest spend per hectare on RDP in Europe and also because it has devoted a significant proportion of funding to support agriculture in less favoured areas (37% of Axis 2 funds from 2007 to 13). Grants for diversification into renewable energy are also available through the RDP, but it is not possible to take up these grants and subsequently receive (far more lucrative) renewable energy production subsidies. Findings suggest that to meet its afforestation and renewable energy production targets, existing AE scheme participants would be a useful target population. In addition, if AE scheme participation does indeed represent the first step on a trajectory towards adoption of multiple forms of AE diversification, it should be supported in this manner, with more effort made to reduce current barriers to engagement, particularly high levels of transaction costs (Falconer, 2000) and low perceived financial rewards (Sutherland, 2010).

Forestry represents an additional challenge, demonstrating the previous barrier posed by Single Farm Payment restrictions and the comparative reluctance of profit-seeking farmers to engage in afforestation, unless they are able to integrate it into renewable energy production. The authors suggest that a three-fold strategy is necessary: targeting supports for renewable heat production towards commercial farms, enabling tenant farmers to engage in afforestation and aiming other afforestation targets towards non-commercial farmers. Owing to the smaller scale of these farms, and the lack of commercial orientation, simplification of support measures or simply providing information and advice on woodland planting, could be beneficial. Wilson (2008) argued that hobby farmers are more likely to take up non-productivist activities, specifically AE actions, but that they are potentially also constrained in doing so, owing in part to smaller farm sizes. It is notable here that it is forestry which these non-commercial farms are likely to adopt, rather than AE schemes or renewable energy production. Although AE diversifiers in this study were clearly information seekers, hobby farmers are less likely to be integrated into traditional agricultural knowledge systems. New strategies may be needed for reaching these farmers.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jrurstud.2016.07.011.

References

Barbieri, C., Mahoney, E., 2009. Why is diversification an attractive farm adjustment strategy? Insights from Texas farmers and ranchers. J. Rural. Stud. 25, 58–66.
Bowler, I.R., Clark, G., Crockett, A., Ilbery, B., Shaw, A., 1996. The development of alternative farm enterprises: a study of family labour farms in the Northern Pennines of England. J. Rural. Stud. 12, 285–295.
Brandth, B., Haugen, M.S., 2011. Farm diversification into tourism – implications for social identity? J. Rural. Stud. 27, 35–44.
Burton, R.J.F., 2004. Seeing through the 'good farmer's' eyes: towards developing an understanding of the social symbolic value of 'productivist' behaviour. Soc. Rural. 44, 195–215.
Burton, R.J.F., 2006. An alternative to farmer age as an indicator of life-cycle stage: the case for a farm family age index. J. Rural. Stud. 22, 485–492.
Burton, R.J.F., Kuczera, C., Schwarz, G., 2008. Exploring farmers' cultural resistance to voluntary agri-environmental schemes. Soc. Rural. 48, 16–37.
Darnhofer, I., Lindenthal, T., Bartel-Kratochvil, R., Zollitsch, W., 2010. Conventionalisation of organic farming practices: from structural criteria towards an assessment based on organic principles. A review. Agron. Sust. Dev. 30, 67–81.
Duesberg, S., Ní Dhubháin, Á., O'Connor, D., 2014. Assessing policy tools for encouraging farm afforestation in Ireland. Land Use Policy 38, 194–203.
Duesberg, S., O'Connor, D., Ní Dhubháin, Á., 2013. To plant or not to plant – Irish farmers' goals and values with regard to afforestation. Land Use Policy 32, 155–164.
Dwyer, J., Mills, J., Ingram, J., Taylor, J., Burton, R.J.F., Blackstock, K., et al., 2007. Understanding and influencing positive behaviour change in farmers and land managers. In: Report for Defra, 30th November 2007. Prepared by CCRI and the Macaulay Institute, Aberdeen.
European Renewable Energy Council (EREC), 2011. Mapping Renewable Energy Pathways towards 2020: EU Roadmap. Accessed 10 Sept 2014 at: http://www.erec.org/media/publications/eu-roadmap.html.
Evans, N., 2009. Adjustment strategies revisited: Agricultural change in the Welsh Marches. J. Rural Stud. 25, 217–230.
Evans, N., Ilbery, B.W., 1993. The pluriactivity, part-time farming, and farm diversification debate. Env. Plan. A 25, 945–959.
Evans, N., Morris, C., Winter, M., 2002. Conceptualising agriculture: a critique of post-productivism as the new orthodoxy. Prog. Hum. Geog 26, 313–332.
Falconer, K., 2000. Farm-level constraints on agri-environmental scheme participation: a transactional perspective. J. Rural. Stud. 16, 379–394.
Ficko, A., Boncina, A., 2015. Forest owner representation of forest management and perception of resource efficiency: a structural equation modelling study. Ecol. Soc. 20, 36.
Gasson, R., 1988. The Economics of Part-Time Farming. Longman Scientific & Technical.
Gorton, M., Douarin, E., Davidova, S., Latruffe, L., 2008. Attitudes to agricultural policy and farming futures in the context of the 2003 CAP reform: a comparison of farmers in selected established and new Member States. J. Rural. Stud. 24, 322–336.
Hanley, N., Whitby, M., Simpson, I., 1999. Assessing the success of agri-environmental policy in the UK. Land Use Policy 16, 67–90.
Holmes, J., 2012. Cape York Peninsula, Australia: a frontier region undergoing a multifunctional transition with indigenous engagement. J. Rural. Stud. 28, 252–265.
Howley, P., Buckley, C., O'Donoghue, C., Ryan, M., 2015. Explaining the economic 'irrationality' of farmers' land use behaviour: the role of productivist attitudes and non-pecuniary benefits. Ecol. Econ. 109, 186–193.
Huttunen, S., 2012. Wood energy production, sustainable farming livelihood and multifunctionality in Finland. J. Rural. Stud. 28, 549–558.
Ilbery, B.W., 1991. Farm diversification as an adjustment strategy on the urban fringe of the West Midlands. J. Rural. Stud. 7, 207–218.
Ilbery, B.W., Bowler, I.R., 1993. The farm diversification grant scheme: adoption and nonadoption in England and wales. Environ. Plan. C. Gov. Pol. 11, 161–170.

Islam, M., Barnes, A., Toma, L., 2013. An investigation into climate change scepticism among farmers. J. Environ. Psychol. 34, 137–150.
Jöreskog, K.G., Sörbom, D., 2007. Structural Equation Modeling with the SIMPLIS Command Language. LISREL8·80. IL Scientific Software International, Chicago, USA.
Keep, M., 2009. Farming Diversification in England: Statistics. Standard Note SN/SG/2879 House of Commons Library. Accessible at: file:///C:/Users/ls40359/Downloads/SN02879%20(1).pdf.
Latruffe, L., Dupuy, A., Desjeux, Y., 2013. What would farmers' strategies be in a no-CAP situation? An illustration from two regions in France. J. Rural. Stud. 32, 10–25.
Lockey, S., Halpin, D., 2005. The 'conventionalisation' thesis reconsidered: structural and ideological transformation of Australian organic agriculture. Soc. Rural. 45, 284–307.
López-i-Gelats, F., Milán, M.J., Bartolomé, J., 2011. Is farming enough in mountain areas? Farm diversification in the Pyrenees. Land Use Policy 28, 783–791.
Lowe, P., Ward, N., Potter, C., 1999. Attitudinal and institutional indicators for sustainable agriculture. In: Brouwer, F., Crabtree, B. (Eds.), Environmental Indicatand Agricultural Policy. CABI Pub, Wallingford, Oxon, UK, pp. 263–278.
Marsden, T., Sonnino, R., 2008. Rural development and the regional state: denying multifunctional agriculture in the UK. J. Rural. Stud. 24, 422–431.
Mather, A.S., Hill, G., Nijnik, M., 2006. Post-productivism and rural land use: cul de sac or challenge for theorization? J. Rural. Stud. 22, 441–455.
Maye, D., Ilbery, B., Watts, D., 2009. Farm diversification, tenancy and CAP reform: results from a survey of tenant farmers in England. J. Rural Stud. 25, 333–342.
McDonagh, J., Farrell, M., Mahon, M., Ryan, M., 2010. New opportunities and cautionary steps? Farmers, forestry and rural development in Ireland. Eur. Countrys. 4, 236–251.
McNally, S., 2001. Farm diversification in England and Wales – what can we learn from the farm business survey? J. Rural. Stud. 17, 247–257.
Meert, H., Van Huylenbroeck, G., Vernimmen, T., Bourgeois, M., van Hecke, E., 2005. Farm household survival strategies and diversification on marginal farms. J. Rural. Stud. 21, 81–97.
Morris, C., Potter, C., 1995. Recruiting the new conservationists: farmers' adoption of agri-environmental schemes in the UK. J. Rural. Stud. 11, 51–63.
Potter, C., Lobley, M., 1992. Aging and succession on family farms – the impact on decision-making and land-use. Sociol. Rural. 32, 317–334.
Price, J.C., Leviston, Z., 2014. Predicting pro-environmental agricultural practices: the social, psychological and contextual influences on land management. J. Rural. Stud. 34, 65–78.
Schenk, A., Hunziker, M., Kienast, F., 2007. Factors influencing the acceptance of nature conservation measures—A qualitative study in Switzerland. J. Environ. Manag. 83, 66–79.
Schirmer, J., Bull, L., 2014. Assessing the likelihood of widespread landholder adoption of afforestation and reforestation projects. Glob. Environ. Change 24, 306–320.
Scottish Executive, 2006. The Scottish Forestry Strategy. Forestry Commission Scotland, Edinburgh.
Scottish Government, 2009. Climate Change Delivery Plan: Meeting Scotland's Statutory Climate Change Targets. Scottish Government, Edinburgh.
Scottish Government, 2011. Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010–2022: the Report on Proposals and Policies. Scottish Government, Edinburgh.
Scottish Government, 2015. The Future of Scottish Agriculture: a Discussion Document. Scottish Government, Edinburgh. Available at: http://www.gov.scot/Resource/0047/00479616.pdf.
Siebert, R., Toogood, M., Knierim, A., 2006. Factors affecting European farmers' participation in biodiversity policies. Sociol. Rural. 46, 318–240.
Sutherland, L.-A., 2010. Environmental grants and regulations in strategic farm business decision-making: a case study of attitudinal behaviour in Scotland. Land Use Pol. 27, 415–423.
Sutherland, L.-A., Darnhofer, I., 2012. Of organic farmers and 'good farmers': changing habitus in rural England. J. Rural. Stud. 28, 232–240.
Sutherland, L.-A., Holstead, K., 2014. Future-proofing the farm: on-farm wind turbine development in farm business decision-making. Land Use Policy 36, 102–112.
Sutherland, L.-A., Burton, R.J.F., Ingram, J., Blackstock, K.L., Slee, B., Gotts, N., 2012. Triggering change: towards a conceptualization of major change processes in farm decision-making. J. Env. Man. 104, 142–151.
Sutherland, L.-A., Peter, S., Zagata, L., 2015. Conceptualising multi-regime interactions: the role of the agriculture sector in renewable energy transitions. Res. Policy 44, 1543–1554.
Tate, G., Mbzibain, A., Shaukat, A., 2012. A comparison of the drivers influencing farmers' adoption of enterprises associated with renewable energy. Energy Policy 49, 400–409.
Thomson, S., 2011. Response from the Hills: Business as Usual or a Turning Point? an Update of Retreat from the Hills? SAC Rural Policy Centre, Scotland, UK. Accessible at: file:///C:/Users/ls40359/Downloads/responsefromthehills.pdf.
Toma, L., Mathijs, E., Environmental risk perception, environmental concern and propensity to participate in organic farming programmes, J. Environ. Manag. 83, 145–157.
Tranter, R.B., Swinbank, A., Jones, P.J., Banks, C.J., Salter, A.M., 2011. Assessing the potential for the uptake of on-farm anaerobic digestion for energy production in England. Energy Pol. 39, 2424–2430.
Vanslembrouck, I., Van Huylenbroeck, G., Verbeke, W., 2002. Determinants of the willingness of Belgian farmers to participate in agri-environmental measures RID F-8373-2010. J. Ag. Econ. 53, 489–511.
Viaggi, D., Raggi, M., Gomez, y P., Aloma, S., 2011. Farm-household investment behaviour and the CAP decoupling: methodological issues in assessing policy impacts. J. Policy Model. 33, 127–145.
Villamil, M.B., Silvis, A.H., Bollero, G., 2008. Potential miscanthus' adoption in Illinois: information needs and preferred information channels. Biomass Bioenergy 32, 1338–1348.
Walford, N., 2003. Productivism is allegedly dead, long live productivism. Evidence of continued productivist attitudes and decision-making in South-East England. J. Rural. Stud. 19, 491–502.
Watkins, C., Williams, D., Lloyd, T., 1996. Constraints on farm woodland planting in England: a study of Nottinghamshire farmers. Forestry 69, 167–176.
Wilson, G.A., 1997. Factors influencing farmer participation in the environmentally sensitive areas scheme. J. Environ. Man. 50, 67–93.
Wilson, G.A., 2001. From productivism to post-productivism… and back again? Exploring the unchanged natural and mental landscapes of European Agriculture. Trans. Inst. Brit. Geog 26, 77–102.
Wilson, G.A., 2008. From 'weak' to 'strong' multifunctionality: conceptualising farm-level multifunctional transitional pathways. J. Rural. Stud. 24, 367–383.
Wilson, G.A., Hart, K., 2000. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Env. Plan. A 32, 2161–2185.