Farmers with Attitudes (to the Environment and Agri-environment Schemes)

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Discussion paper prepared for presentation at the 91st Annual Conference of the Agricultural Economics Society, Royal Dublin Society in Dublin, Ireland 24 - 26 April 2017

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Abstract

Decisions made by farmers have a strong impact on the environment. One of the goals of agri-environment schemes (AESs) is to influence farmers into making positive contributions to the environment. They are generally voluntary and encourage farmers to participate by paying them for the provision of environmental services. It is important to understand the drivers of farmer behaviour and the choices they make with regards to AESs as this will aid policy makers in creating schemes that have a wider scope and achieve goals. Using Ireland as a case-study, this paper examines farmers' attitudes to farming, the environment and AESs. A number of attitudinal statements put to 1000 Irish farmers are condensed to seven different attitude groups using factor analysis. These attitudinal variables, along with numerous farm and farmer characteristics, are used in a logistic regression analysis to examine their role in determining participation in AESs. This shows that attitudes especially those pertaining to the benefits and drawbacks of AESs are significant to the participation decision; however there is added complexity from attitudes to farming and the environment. Given the diversity of drivers of farmer behaviour, the design of policies is primordial and must not only be focused on pecuniary aspects but also take into account the wide diversity of farmers in terms of both characteristics and attitudes.

JEL Codes: Q18, Q57, Q12

Key Words: Agri-Environment Schemes, Behaviour and Attitudes

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1. Introduction

Farmer attitudes drive decisions on farms that have a lasting effect on the environment. With the European Union (EU) increasingly leaning towards agri-environmental policy to influence agriculture it is important to analyse the motivations behind decisions made by farmers. These policies are based on the idea that efforts to protect and support the fragile ecosystems upon which we depend should, in part, focus on the activities – including farming – that most directly and tangibly impact our natural resources. Agri-environment schemes (AESs) have emerged as one of the most credible and widely-used policy responses to the environmental problems caused by modern farming practices. Due to their voluntary nature understanding the participation decisions of farmers and the results of incentives is vitally important in ensuring the success of such schemes.

It is worth noting that this paper does not attempt to evaluate the effectiveness of AESs *per se* – there is a rich literature on that subject which highlights the various successes and deficiencies in design associated with AESs around the EU (see Kleijin & Sutherland, 2003; Batáry *et al.*, 2015 etc.). Rather, the objective of this paper is to contribute to our collective knowledge with a deeper and more nuanced understanding of the key factors that influence farmers' willingness to participate in an AES, particularly regarding the effect of farmers' attitudes and motivations. Ensuring a better understanding of the motivations of farmers and the impact of different support structures and incentives on their participation decision is a vitally important ingredient in developing AESs into the future (Lastro-Bravo *et al.*, 2015).

This study employs a reduced form model – building upon the work of Murphy *et al.* (2011) which related farm level information to the behaviour of farmers and on their choice of measures – to meet the stated objectives by utilising additional information on attitudes in relation to the environment, farming and the future; their previous experience with two past AESs in Ireland, the Rural Environment Protection Scheme (REPS) and the Agri-Environment Options Scheme (AEOS); and their attitudes to and reliance on extension support. The results of a nationally-representative survey of 1,000 farmers across Ireland forms the basis for the research. While this is not the first study in the EU to look at the impact of farmers' attitudes and motivations on their decision to participate in an AES (Wilson & Hart, 2000; Defrancesco *et al.*, 2008; Ruto & Garrod, 2009; Barreiro-Hurle *et al.*, 2010; Hammes *et al.*, 2016), our research extends this literature by attempting to deepen our understanding of attitudinal drivers of scheme participation using factor analysis to condense responses to a wide variety of statements referring to farmers' attitudes towards the environment, their farming motivations, and their feelings about AES benefits and drawbacks, into a smaller number of explanatory variables that allow for strong patterns in the survey dataset to be identified. Although a similar method was utilised by Arovuori (2011) in a case study of Finnish farmers' attitudes to environmentally targeted agricultural policies, the analysis in this paper extends to include a broader range of explanatory variables, containing measures for a number of relevant farm and farmer characteristics. In doing so, the paper aims to support policy makers attempting to improve agri-environmental programme design and the associated institutional support, so that: 1) more farmers are incentivised to participate in an AES and to continue to farm in an environmentally conscious manner into the future; 2) policies, advice and interventions can be nuanced to account for differential attitudes and 3) longer-term environmental objectives are ultimately met.

In the next section, we describe the policy background that underpins this analysis. Section 3 describes the data and methodology used. The results are presented and discussed in Section 4 and followed by a conclusion in Section 5.

2. Policy Background

AESs were formally introduced into the EU's Common Agricultural Policy (CAP) in 1992 as part of efforts to mitigate the effects of intensive farming activities, most notably through EEC regulation 2078/92. The intention was that AESs would operate as a financial instrument to encourage farmers to act as custodians of the environment, by engaging in practices that would contribute to the preservation of the countryside, conservation of biodiversity and the sustainability of our natural resources. Although initially brought in as a compulsory measure, AESs have evolved to entail the voluntary provision of environmental services by farmers on their private land in return for compensation – albeit assuming their regulatory duty of care responsibilities are also being met. Payment is usually provided to cover additional costs and lost income arising from the adoption of certain environmentally friendly farming practices according to the terms of the relevant agri-environmental scheme contract set out by the environmental service purchaser (the state or the environmental public authority). Between 2007 and 2013, no less than three million farms covering 39 million hectares across the 27 EU member states were supported by an agri-environment payments envelope worth €34 billion, including national co-financing (Cooper, Hart & Baldock, 2009; Finn & Ó hUallacháin, 2012). Measures set out by agri-environmental schemes differ by member state but generally include the management of low-intensity pasture systems; preservation of landscape features such as hedgerows, ditches and forests; extensification of farming in an environmentally friendly manner; integrated farm management and organic agriculture; and the conservation of high-value habitats and their associated biodiversity (European Commission, 2015).

It is in this EU-level context that the first Irish AES, the Rural Environment Protection Scheme (REPS), was created. Launched in 1994, the broad aims of REPS were to promote environmentally friendly farming methods, protect endangered species of flora and fauna and their habitats, and encourage the use of organic and extensive farming methods. The initial REPS programme was followed by three successive iterations in 2000, 2004 and 2007. The Agri-Environment Options Scheme (AEOS) was established in 2010 to replace REPS, with additional iterations of the programme launched in 2011 and 2012. Its aims were similar to REPS with specific attention drawn to the importance of biodiversity, positive environmental management of core breeding and resting sites for rare and threatened species as well as river catchments, water management/quality, and efforts to combat climate change. This has since been replaced by the Green Low-Carbon Agri-Environment Scheme (GLAS) as part of the Rural Development Programme 2014-2020. The analysis provided later in this study draws on data in relation to Irish farmers' participation in REPS and AEOS.

Researchers have long grappled with the question of how best to encourage farmers to protect or enhance the environment and its biodiversity on their farmland. Traditional economic theory suggests that farmers make decisions based on the expected change in their level of utility, with the related assumption that all farmers are rational profit maximisers (Maybery *et al*., 2005). Contemporary researchers are more likely to attest to the necessity of studying farm and farmer characteristics as well as the associated financial objectives. Frequently identified factors include the age of farmer, his education or the size of the farm, the main activity, and the presence of key environmental features on the farm (Murphy, 2013). Beyond these notable factors, there is a growing literature recognising the importance of social and psychological influences in farmers' decision making, in particular, their attitudes and motivations.

3. Data and Methodology

A nationwide survey of 1000 Irish farms was conducted to examine factors influencing the likelihood of participation in AESs. The survey was representative of farm systems within Ireland. Farms had to be above 10 hectares to be included in the survey. Information was collected regarding characteristics of the farm and farmer as well as the farmers' attitudes towards farming, the environment and the benefits and drawbacks of AESs. Of the 1,000 respondents, just over half (557) had participated in at least one AES.

To explore the relationship between farmer attitudes and their participation in AESs we use a binomial logistic regression model due to the discrete nature of the dependent variable. It is also underpinned by an explanatory factor analysis to group farmers based on their attitudes. A farmer must choose to either participate in AESs valued as 1 or not participate, valued as 0. The theoretical framework used to interpret the results is a standard neoclassical one. This assumes that a farmer will compare the amount of utility received from participating to the amount of utility received from not participating and then maximise their utility by choosing whichever is greater. This utility is dependent on both farm and farmer characteristics as well as attitudes.

The main explanatory variables of interest in the model are seven factor variables created from a factor analysis of responses to 28 statements regarding AESs, farming and the environment. The details of these variables and their creation follow. Also utilised in the model are several structural farm variables such as farm system, farm size, soil type and the stocking rate of the farm in livestock units per hectare. Similarly, the model includes relevant farmer characteristics, such as the percent of household income obtained through farming, whether the farmer has received formal agricultural training, whether the farmer availed of help from Teagasc, a tax advisor or an agricultural consultant, and whether the farmer participated in a discussion group. Farmers were also asked about whether any of their neighbours had opted to join an AES, their response to this question was also included in the model. The selection of the specific farm and farmer characteristics as variables for this model is based on previous research done on the topic of AES participation. Two variables notably missing from the analysis include the age of the farmer and the regional location of the farm. This is due to the high correlation in attitudes and these variables. It could be argued that they are significant in the participation decision due to the difference in attitudes of farmers across age groups and regions; therefore, they would be made redundant if attitudes are included in the analysis. The descriptive statistics for the variables used in the model are presented in Table 1.

Table 1: Descriptive statistics for farm and farmer structural variables

Variable name	Variable description	Total (N=1000) % or Mean(SD)
Dependent variable		
AES participation	=1 if participated in AES =0 if not	55%
Independent variables		
Farm variables		
Dairy	=1 if main activity on farm is dairy =0 otherwise	20%
Cattle rearing	=1 if main activity on farm is cattle rearing =0 otherwise	44%
Cattle other	=1 if main activity on farm is cattle other =0 otherwise	11%
Sheep	=1 if main activity on farm is sheep =0 otherwise	14%

Tillage	=1 if main activity on farm is tillage =0 otherwise	7%
Mixed	=1 if main activity on farm is mixed livestock =0 otherwise	4%
10-20ha	=1 if farm area is 10-20ha =0 otherwise	26%
20-50ha	=1 if farm area is 20-50ha =0 otherwise	45%
50-100ha	=1 if farm area is 50-100ha =0 otherwise	22%
100-150ha	=1 if farm area is 100-150ha =0 otherwise	5%
150+ha	=1 if farm area is 150+ha =0 otherwise	3%
Good soil	=1 if soil type does not limit uses =0 otherwise	55%
OK soil	=1 if soil is somewhat limiting =0 otherwise	40%
Bad soil	=1 if soil is very limiting =0 otherwise	5%
Stocking rate	Livestock unit density per ha	1.24 (0.88)
Farmer variables		
All neighbours joined	=1 if all neighbours joined AES =0 otherwise	4%
Some neighbours joined	=1 if some neighbours joined AES =0 otherwise	70%
No neighbours joined	=1 if no neighbours joined AES =0 otherwise	7%
Don't know who joined	=1 if they do not know if neighbours joined =0 otherwise	19%
25% or less of income	=1 if farming income is 25% or less of household income =0 otherwise	13%
26-50% of income	=1 if farming income is 26-50% or less of household income =0 otherwise	19%
51-75% of income	=1 if farming income is 51-75% or less of household income =0 otherwise	17%
76-100% of income	=1 if farming income is 76-100% or less of household income =0 otherwise	50%
Agricultural Consultant	=1 if farmer received help from agricultural consultant =0 if not	38%
Teagasc	=1 if farmer received help from Teagasc =0 if not	51%
Tax advisor	=1 if farmer received help from tax adviser =0 if not	39%
Discussion group	=1 if farmer took part in a discussion group =0 if not	30%
Agricultural education	=1 if farmer has agricultural education =0 if not	63%

Farmers' attitudes and factor analysis

For the attitudinal section of the survey farmers were asked to rate their agreement with statements on a 1-5 Likert-type scale where 1 = strongly disagree and 5 = strongly agree. The responses to the attitude survey were reduced to seven factors following the implementation of a factor analysis using the principal component method, the details of which will be covered in this section. These factors, the farm and farmer characteristics were used as the independent variables in a binomial logistic regression model to analyse their effect on participation in AESs. The statements and the distribution of the responses are displayed in Figures 1, 2 and 3.

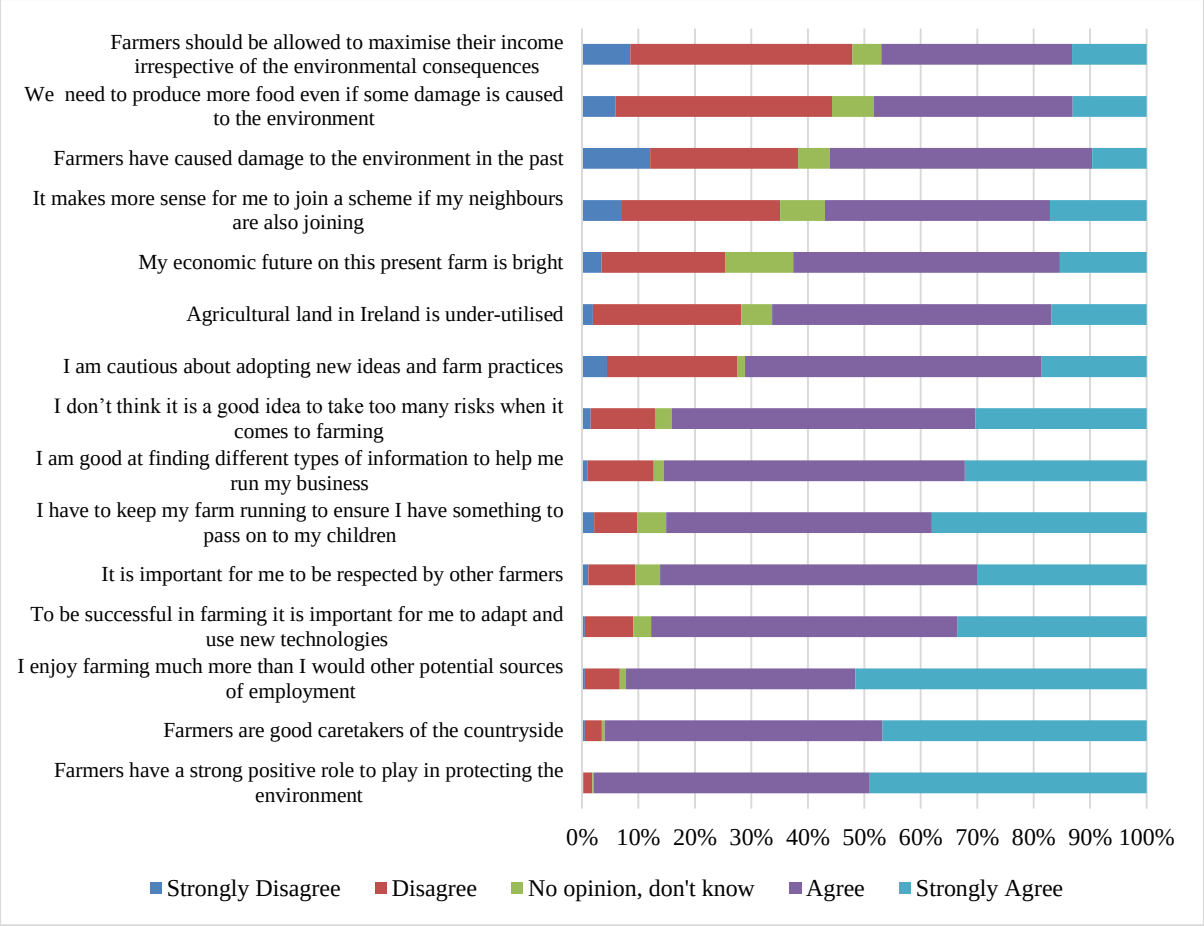

Figure 1: Responses to statements regarding farming and the environment

Figure 1 statements relate to farming and the environment. The distribution of responses indicates that farmers are motivated by a wide range of objectives. Firstly, the statements with the highest level of agreement ('farmers have a strong positive role to play in protecting the environment' and 'farmers are good caretakers of the countryside') and the statements with the highest level of disagreement ('farmers should be allowed to maximise their income irrespective of the environmental consequences' and 'we need to produce more food even if some damage is caused to the environment') indicate that farmers are strongly aware of their role in protecting the countryside and the environment. The responses also indicate that farmers are not only interested in money with 51% of farmers strongly agreeing with the statement 'I enjoy farming much more than I would other potential sources of employment'.

In relation to statements regarding the benefits and drawbacks which are associated with AESs we see that in general there is greater recognition by farmers of the benefits with nearly 80% agreement to all benefits statements. The highest agreement, as seen in Figure 2, comes with statements about how both the farmyards and countryside looks better due to the schemes. Although previous studies have shown that money is not the main motivator for farmers to participate in schemes it is still something they are aware of with the statement 'REPS/AEOS payments are a valuable income source' being the third most agreed upon statement. The negative side of AESs farmers are most aware of relates to the high advisor and consultant costs to enter schemes as seen in Figure 3. This is followed by the greater risk of inspection or penalty and the hassle associated forms and record-keeping. Over 60% of

farmers agree that the lack of continuity between schemes is a drawback and that the payments do not cover the costs of joining.

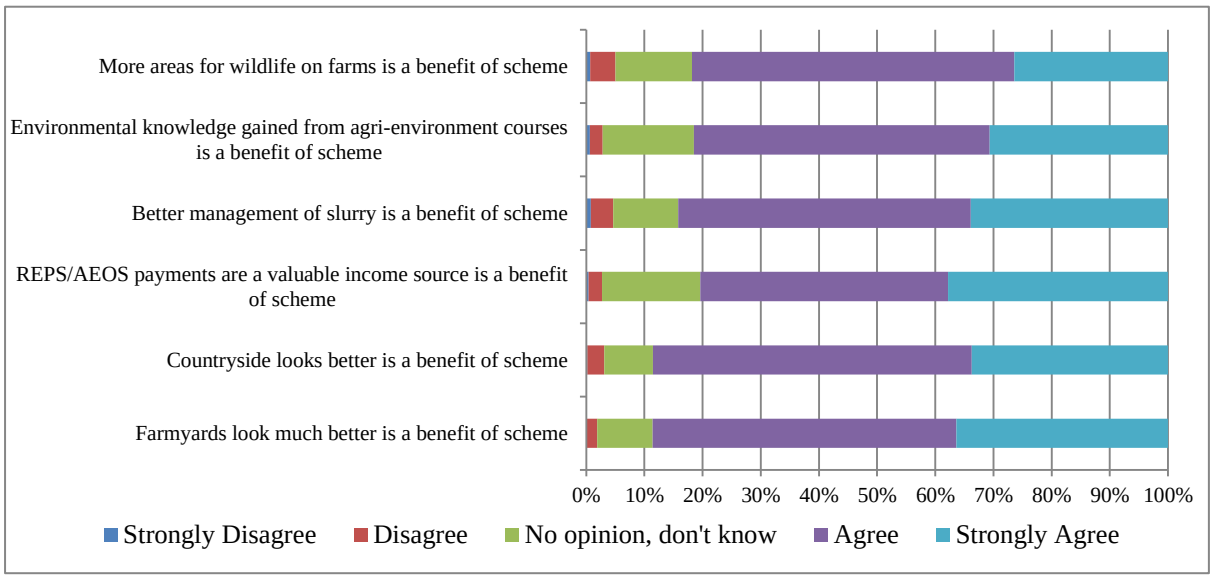

Figure 2: Responses to statements regarding the benefits of AESs

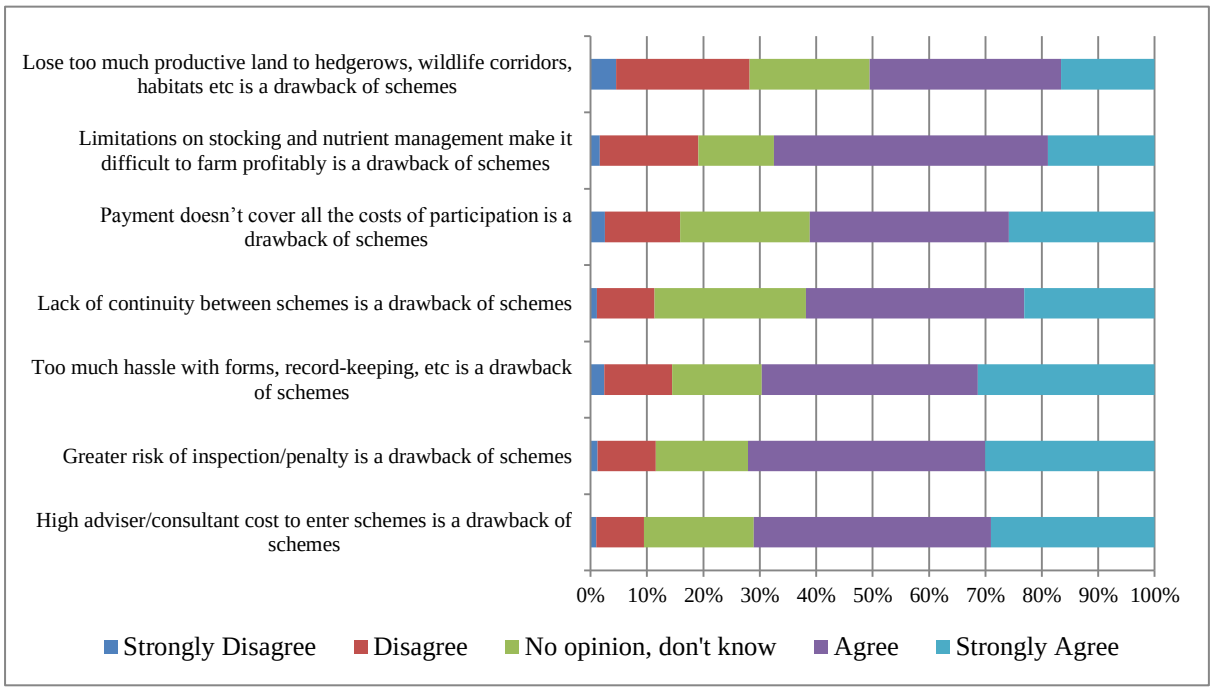

Figure 3: Responses to statements regarding the drawbacks of AESs

Finally, the model includes seven derived explanatory variables which are intended to represent the 28 attitudinal statements from Figures 1, 2 and 3 and provide a better understanding of the data associated with them. Rather than trying to use the unwieldy number of attitudinal statements in the model, the methodology utilises two separate principal component analyses to reduce the number of variables and, importantly, to emphasise strong patterns emerging in the data. Following Arovuori (2011), combining factor analysis with binary logistic estimation allows for a more in-depth analysis on the behaviour of different groups of farmers. Table 2 lists the seven derived explanatory variables alongside a short

description of each. The first two variables, Benefits Conscious and Drawbacks Conscious, pertain directly to the statements related to benefits and drawbacks, respectively, from Figure 2 and Figure 3, and these associations are confirmed strongly using the first principal component analysis as outlined below. The remaining variables originate from the second factor analysis, which reduced the 15 general attitudinal statements to five underlying factor variables.

Table 2: Descriptive statistics for derived explanatory variables representing farmer attitudes

Derived Variable	Short Description	Mean	S.d	Min	Max
Benefits Conscious	More inclined to recognise the upsides of participating in AESs	0	1	-5.17	1.66
Drawbacks Conscious	More inclined to recognise the downsides of participating in AESs	0	1	-3.45	1.78
Innovative Orientation	More open to new technology, using new information to help farm continue to run in the future	0	1	-4.95	2.08
Financial Orientation	More focused on making profit regardless of environmental consequences	0	1	-4.16	2.22
Positive caretakers	Positive attitude to farming and believe farmers are having a positive impact on the environment	0	1	-2.59	2.63
Conservative Orientation	Cautious about new ideas, low risk, important to be respected by other farmers	0	1	-4.22	2.58
Agricultural Optimism	Optimistic about economic potential for farming, feeling that agricultural land is underutilised	0	1	-2.99	2.29

The development of the variables in Table 2 warrants some further explanation. Factor analysis is commonly used in the social sciences as a method of data reduction or simplification – it works by considering the covariance structure of a set of variables (rather than the variances) and transforming the correlated variables into a smaller set of interpretable underlying factors. Rather than categorising variables according to their different criteria – as other grouping techniques such as cluster analysis try to do with, for example, classification of plants – factor analysis attempts to investigate complex concepts that are not easily measured directly by relating variables to each other. Factor analysis presupposes a number of assumptions. First of all, the specific factors are assumed to be independent of each other and of the common factors; an assumption is also made that the common factors are independent of each other. Each variable is assumed to have a zero mean, and the factors are also assumed to a zero mean. Finally, it is considered usual to assume that the common factors and the specific factors each have a multivariate normal distribution (Chatfield & Collins, 2000).

A number of tests were conducted to analyse the suitability of the responses to attitudinal statements for factor analysis. The statements were kept split into two groups: the ones regarding AESs directly and those responding to statements about farming and the environment. The Kaiser-Meyer-Olkin measure of sampling adequacy strongly indicated that the data matrix has sufficient correlation to allow factor analysis for the first group of statements with a value of 0.88. For the second group, regarding farming and the environment, this value was 0.73, which while ‘middling’ on index scale is above the often used cut off point of 0.6 (Kaiser & Rice, 1974). Conducting Bartlett’s test of sphericity on both groups of statements allows us to reject the null hypothesis that the correlation matrix is

the identity matrix and accept the alternative hypothesis that there is a significant relationship between the variables in each group (p-values both 0.000).

In the first factor analysis conducted the original eleven statements regarding the benefits and drawbacks of AESs have been reduced to two factors, which we have labelled 'Benefits Conscious' and 'Drawbacks Conscious'. The factor loading for these are presented in Table 3. This enables us to see the relationship between each statement and the underlying factor with each of the factors having a mean of zero and a standard deviation of one. The eigenvalue listed is a measure of how much variance of the observed variables the factor explains. Any factor with an eigenvalue greater or equal to one were retained following the Kaiser Criterion as they explain more variance than a single observed variable and, therefore, are useful to include in our model.

Table 3: Factor loadings - 'Benefits Conscious' and 'Drawbacks Conscious'

	Benefits Conscious	Drawbacks Conscious
Farmyards look much better	**0.8396**	0.0035
Environmental knowledge gained from agri-environment courses	**0.8037**	-0.0063
Better management of slurry	**0.7962**	-0.109
Countryside looks better	**0.7791**	-0.0346
More areas for wildlife on farms	**0.7529**	0.0389
REPS/AEOS payments are a valuable income source	**0.7299**	-0.0436
Limitations on stocking and nutrient management make it difficult to farm profitably	-0.0687	**0.7492**
High adviser/consultant cost to enter schemes	-0.0056	**0.7324**
Payment doesn't cover all the costs of participation	0.0034	**0.7314**
Too much hassle with forms, record-keeping, etc.	-0.1297	**0.7288**
Lack of continuity between schemes	0.122	**0.7128**
Lose too much productive land to hedgerows, wildlife corridors, habitats etc.	-0.1565	**0.6962**
Greater risk of inspection/penalty	0.0479	**0.6902**
General eigenvalue	3.75467	3.64951

The statements regarding farming and the environment reduced to five factors in the analysis. These are listed with their factor loadings in Table 4. Each statement had high factor loadings on one specific factor indicating that there is a clear division of attitudinal statements. The factor variable 'Innovative Orientation' is most strongly related to statements about the importance of new technologies and the ability of the farmer to find information. The variable 'Financial Orientation' related to the statements regarding maximising production and income regardless on the effect of the environment. The third factor variable is most strongly associated with the statements 'farmers are good caretakers of the countryside' and 'farmers have a strong positive role to play in protecting the environment' and hence has been labelled 'Positive Caretakers'. The statements advocating for avoiding risks and being cautious about new ideas and farm practices as well as the importance of respect from other farmers are most associated with the forth factor variable 'Conservative Orientation'. Finally, the statements 'agricultural land is underutilised' and 'my economic future on this present farm is bright' are strongly associated with the fifth factor variable henceforth known as 'Agricultural Optimism'.

Table 4: Factor loadings - farming and environment attitudes

	Innovative Orientation	Financial Orientation	Positive Caretakers	Conservative Orientation	Agricultural Optimism
To be successful in farming it is important for me to adapt and use new technologies	**0.7373**	0.0255	0.0254	-0.1137	-0.0277
I am good at finding different types of information to help me run my business	**0.679**	0.1019	0.2324	-0.0681	0.1838
I have to keep my farm running to ensure I have something to pass on to my children	**0.6346**	0.0115	0.1241	0.0841	0.1392
Farmers should be allowed to maximise their income irrespective of the environmental consequences	-0.1007	**0.7738**	0.1553	0.0574	0.083
We need to produce more food even if some damage is caused to the environment	0.1808	**0.7344**	-0.1377	0.1043	0.118
It makes more sense for me to join a scheme if my neighbours are also joining	0.3974	**0.5012**	-0.0948	0.3226	-0.0305
Farmers are good caretakers of the countryside	0.1223	0.0768	**0.7629**	0.1244	0.0436
Farmers have a strong positive role to play in protecting the environment	0.2104	-0.1263	**0.6057**	0.0953	0.1266
I enjoy farming much more than I would other potential sources of employment	0.1713	-0.1289	**0.5409**	0.2765	0.2128
Farmers have caused damage to the environment in the past	0.1615	-0.442	**-0.5166**	0.2146	0.3381
I don't think it is a good idea to take too many risks when it comes to farming	0.0007	0.0858	0.1286	**0.7631**	-0.012
I am cautious about adopting new ideas and farm practices	-0.3367	0.2287	0.0241	**0.6375**	0.1179
It is important for me to be respected by other farmers	0.441	-0.1146	0.1574	**0.5134**	-0.092
Agricultural land in Ireland is under-utilised	0.002	0.0697	0.037	0.0138	**0.8142**
My economic future on this present farm is bright	0.2789	0.176	0.1448	-0.0171	**0.5514**
General eigenvalue	2.83266	1.78214	1.44514	1.21033	1.06117

One important advantage of reducing the 28 statements to these seven new variables is that they can be used in regression analysis without losing any meaningful variation in the original data; also as the derived variables are uncorrelated, any potential multicollinearity problems are avoided (Howley & Dillon, 2012). The following section will discuss the outcomes of a binomial logistic regression model when used along with farm and farmer characteristics as independent variables to analyse the effect farmer attitudes have on their choices with respect to AESs.

4. Results and Discussion

The results of a binomial logistic regression model which examines the relationship between participation in AESs and farmers' attitudes, farm and farmer characteristics is presented in Table 5. The regression is based on a sample of 855 farmers and had a pseudo R^2 value of 0.276. Our analysis indicates that the relationship between attitudes and participation in AESs is complex. As expected, the results show that if a farmer is more conscious of the benefits of AESs the more likely they are to participate and the more aware of drawbacks the less likely a farmer is to participate. However, this impact is dependent on the farmers' attitudes to farming and the environment. By themselves these attitudes are not significant to the participation decision; however, it is the interaction between them that is truly important.

Table 5: Logit regression results for participation in AESs

VARIABLES	AES participation	
	Coef (Se)	Odds ratios
Attitudinal variables		
Benefits Conscious	0.913 (0.111)***	2.493
Drawbacks Conscious	-0.493 (0.0991)***	0.611
Innovative Orientation	-0.007 (0.103)	0.993
Conservative Orientation	-0.006 (0.0965)	0.994
Financial Orientation	-0.050 (0.0928)	0.951
Positive Caretakers	0.104 (0.0990)	1.110
Agricultural Optimism	0.001 (0.0927)	1.001
Benefits Conscious*Innovative Orientation	-0.293 (0.100)***	0.746
Benefits Conscious*Financial Orientation	-0.234 (0.0967)**	0.791
Benefits Conscious*Conservative Orientation	0.252 (0.0923)***	1.287
Drawbacks Conscious*Positive Caretakers	-0.219 (0.0965)**	0.804
Drawbacks Conscious*Agricultural Optimism	-0.203 (0.0955)**	0.816
Farm variables		
Dairy[a]	-0.577 (0.244)**	0.561
Cattle other[a]	-0.449 (0.291)	0.638
Sheep[a]	0.285 (0.287)	1.330
Tillage[a]	-0.605 (0.376)	0.546
Mixed[a]	-0.303 (0.454)	0.738
10-20ha[b]	-0.847 (0.236)***	0.429
50-100ha[b]	-0.224 (0.230)	0.799
100-150ha[b]	-0.150 (0.417)	0.860
150+ha[b]	-0.933 (0.597)	0.394
OK soil[c]	0.451 (0.195)**	1.570
Bad soil[c]	-0.111 (0.483)	0.895
Farmer variables		
All neighbours joined[d]	1.942 (0.726)***	6.975
No neighbours joined[d]	-0.337 (0.343)	0.714
Don't know who joined[d]	-0.142 (0.227)	0.868
25% or less of income[e]	0.610 (0.310)**	1.841
26-50% of income[e]	0.628 (0.250)**	1.873

51-75% of income[e]	0.204 (0.244)	1.227
Agricultural consultant	0.953 (0.188)***	2.593
Teagasc	0.766 (0.316)**	2.152
Stocking rate	0.359 (0.164)**	1.432
Teagasc*Stocking rate	-0.428 (0.204)**	0.652
Tax adviser	-0.390 (0.188)**	0.677
Discussion Group	0.419 (0.206)**	1.520
Agricultural education	0.784 (0.204)***	2.190
Constant	-0.820 (0.350)**	0.440
Observations	855	855
Pseudo R-squared	0.276	0.276

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[a] Base farm system is Cattle Rearing, [b] base farm size is 20-50ha, [c] base soil type is Good Soil, [d] base of neighbours joining AES is Some neighbours Joined, [e] base farming household income is 75-100% income

The interaction between 'Benefits Conscious' and 'Innovative Orientation' is negative. Farmers who show an 'Innovative Orientation' believe that new technologies and finding information is important so they can continue to run their farm in the future and pass it on to their children (see Table 4 for associated statements). This concern for the future of their farms may be issue causing the negative relationship to participation. Even when the benefits of AESs are taken into consideration, the short term mature of the AESs may lead innovative farmers to be less likely to participate and invest scarce resources into the schemes.

Farmers with a 'Conservative Orientation' who are also 'Benefits Conscious' are also less likely to participate in AESs. Conservative farmers stated that they are risk averse and cautious about new ideas and farm practices. Therefore it would be understandable if these farmers see AESs as a risky venture requiring new farm practices to choose not to participate. These farmers may also see the short-term nature of AESs as a negative like those with an 'Innovative Orientation' possibly do.

There is a positive interaction between 'Benefits Conscious' and 'Financial Orientation'. 'Financial Orientation' is associated with a desire to maximise income and producing more even if it is at the expense of the environment. They also believe it makes more sense to join a scheme if their neighbours are joining. While this particular attitude group seems to have little interest in environmental management it is possible that one of the benefits, the income source, of AESs is enough to induce these farmers to participate.

The 'Drawbacks Conscious' interaction with 'Positive Caretakers' is negatively related to participation in AESs. Farmers associated with this category enjoy farming and believe that farmers are good caretakers and have a strong positive role in protecting the environment. They do not believe that farmers have caused damage to the environment in the past. The last statement is possibly the key to explaining this interaction. These farmers may not see the benefits of AESs, however, given the large number of drawbacks that they strongly agree accompany participation this leads to them being less likely to participate.

'Agricultural optimism' is also negatively effects participation in AESs when interacted with 'Drawbacks Conscious'. Farmers who strongly believe that agricultural land is underutilised and their economic future on their farm is bright score highly in 'Agricultural Optimism'.

Given that one of the drawbacks of AESs is the loss of productive land, it is likely that this is the main concern of these farmers causing them to be less likely to participate. Another downside which these farmers may also strongly agree with is the limitation on stocking, possibly seeing this as causing underutilisation of land.

Farm and farmer characteristics influence the participation decision of farmers as can be seen by our analysis. One considerable influence on farmers appears to be social, with the farmers who report that all their neighbours joined AESs means they are nearly seven times more likely to participate compared to those with only some neighbours in the schemes. Discussion group participation is also a positive influence with those farmers being 1.5 times more likely to join. It is clear from the original survey that it is important to farmers to be respected by their peers with that statement making the top five in terms of agreement. Defrancesco *et al.* (2008) found a similar relationship in their analysis of Italian farmer participation in AESs. They suggested that this reflects the strong relationships and cultural norms that exist within many rural areas. The impact of social interaction on farmer behaviour in the Irish context has been examined extensively by Macken-Walsh (2009).

The influence of outside advisors and education is important in the participation decision. Recruiting the services of an agricultural consultant, and receiving an agricultural education are positively associated with participation in AESs, while seeing a tax advisor reduces the likelihood of participation. These differences in relationships in the participation are also found in other studies (Lastro-Bravo *et al.*, 2015). Sutherland *et al.* (2013) explained that this is likely due to the relationship between the farmers' production criteria or goals and the type of advisory services that they seek. The impact of receiving help from Teagasc is more complicated. The interaction with stock rate allows for the splitting between two separate groups of Teagasc clients: small family farms and commercial large scale farms with the later having higher stock rates and being less likely to participate as indicated by the results. Another indication that the smaller less intensive farms are more likely to participate is through the variable relating to the percentage of income the household obtains from the farm. Households that receive less than 50% of their income from the farm are nearly twice as likely to participate. Other studies have also found a positive relationship between having an off-farm income and participation (Defrancesco *et al.*, 2008; Wossink, Carolina & van Wenum, 2003; Dupraz *et al.*, 2003 etc.).

In terms of the farm itself, two farm systems differ significantly in their likelihood in being involved in an AES than the base cattle rearing, namely dairy and tillage. These systems are both more intensive which may make the schemes difficult and costly to implement. Somewhat limiting soil is an indicator of participation, with farmers 1.5 time more likely to join than farmers with good soil. Hynes and Garvey (2009) found a similar relationship between soil quality and participation. They related this to the fact that those with poor soil were less intensive so did not cause as much environmental damage. This in turn makes it easier for them to join AESs with fewer changes to farm management. A number of studies have been conducted on the relationship between the intensity of farming and participation in AESs. The cost to intensive farmers of AESs is likely higher both in terms of transaction costs and opportunity costs. This would have an impact of farmer attitudes, especially toward the drawbacks of AESs. The survey used for this analysis also collected detailed information on what farmers estimate these direct and indirect costs to be. This will allow for future research into the effect costs have on the participation decision and their relationship with farmer attitudes. Small farms (10-20ha) are less than half as likely to participate in AESs than

those 20-50ha farms. This is likely due to the high cost of administering the measures required by schemes compared to the payment received which is at a per hectare rate.

This analysis clearly shows that attitudes as well as the characteristics of the farm and farmer play a significant role in the choice of the farmer to participate in AESs. The attitudinal relationship to participation is complex. There are also likely drivers to these attitudes and the following section will discuss the heterogeneity between these attitude groups.

5. Conclusion

Farmers' attitudes have a significant effect on their choice to participate in AESs. We have found that it is not just attitudes towards the AESs themselves that influence behaviour but also the farmers opinions on the environment and farming. This allows us to also consider what types of measures may induce farmers who display certain attitudes to participate. Before doing so it is important to understand the characteristics of farmers in these groups. This is important as inducing certain farmers to participate will have a stronger overall effect on the environment than others due to the differences between farms. This is largely due to the different intensity at which farms are used and also due to variation of practices across farms.

This paper has shown that attitudes are an important determinant in the decisions of farmers. We have gone further to categorise the main attitudes that farmers display based on a representative sample of 1000 farmers. How farmers perceive the benefits and drawbacks of AESs is found to be a major indicator of their participation. It is through these views that other attitudes affect the decision. This nuanced understanding of the interaction between common held views of farmers is important to creating future schemes that have a wider scale and reach targets set by policy makers.

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