FLINT

THE ROLE OF EXTENSION IN AGRICULTURAL SUSTAINABILITY

Noreen Brennan[1], Mary Ryan[1], Thia Hennessy[2], Emma Jane Dillon[1], Paula Cullen[1]

[1] Agricultural Economics and Farm Surveys Department, Rural Economy and Development Programme, Teagasc, Athenry, Co. Galway, Ireland

[2] University College Cork, Cork, Ireland

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ABOUT THE FLINT PROJECT

FLINT will provide an updated data-infrastructure needed by the agro-food sector and policy makers to provide up to date information on farm level indicators on sustainability and other new relevant issues. Better decision making will be facilitated by taking into account the sustainability performance of farms on a wide range of relevant topics, such as (1) market stabilisation; (2) income support; (3) environmental sustainability; (4) climate change adaptation and mitigation; (5) innovation; and (6) resource efficiency. The approach will explicitly consider the heterogeneity of the farming sector in the EU and its member states. Together with the farming and agro-food sector the feasibility of these indicators will be determined.

FLINT will take into account the increasing needs for sustainability information by national and international retail and agro-food sectors. The FLINT approach is supported by the Sustainable Agriculture Initiative Platform and the Sustainability Consortium in which the agro-food sector actively participates. FLINT will establish a pilot network of at least 1000 farms (representative of farm diversity at EU level, including the different administrative environments in the different MS) that is well suited for the gathering of these data.

The lessons learned and recommendations from the empirical research conducted in 9 purposefully chosen MS will be used for estimating and discussing effects in all 28 MS. This will be very useful if the European Commission should decide to upgrade the pilot network to an operational EU-wide system.

PROJECT CONSORTIUM:

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7	Teagasc - The Agriculture and Food Development Authority of Irelan	Ireland
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9	INRA - Institut National de la Recherche Agronomique	France
10	CROP-R BV	Netherlands
11	University of Hohenheim	Germany

MORE INFORMATION:

Drs. Krijn Poppe (coordinator)	e-mail: krijn.poppe@wur.nl
Dr. Hans Vrolijk	e-mail: hans.vrolijk@wur.nl
LEI Wageningen UR	phone: +31 07 3358247
P.O. Box 29703	
2502 LS The Hague	www.flint-fp7.eu
The Netherlands	

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LIST OF ACRONYMS

CAP	Common Agricultural Policy
CO_2	carbon dioxide
EU	European Union
FADN	Farm Accountancy Data Network
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
NFS	National Farm Survey
NGO	Non-Governmental Organisation

EXECUTIVE SUMMARY

This case study examines the use of extension services by farm households across eight European countries by exploring the type of extension service engaged with, the degree of engagement and the type of information sought. In addition, the impact of extension on economic, environmental and social sustainability is also considered. European data were collected from a pilot sample of 820 households in 2014/2015 as part of the EU FLINT project. The Irish data from the FLINT survey are incorporated with Irish Farm Accountancy Data Network (FADN) data. Results outline the key contrasts across the countries investigated and suggest that the degree to which households engage with extension services is primarily influenced by national policies. In addition, this analysis indicates that the extent to which households engage with extension services has implications for sustainability at the farm-level. Final conclusions and policy recommendations in this case study support the development of a large scale version of the FLINT pilot survey.

1 INTRODUCTION

The global demand for food is increasing rapidly, resulting in agricultural expansion and a growth in associated environmental degradation. It has been projected that by 2050 the demand for crops will be 100-110% higher than 2005 levels. If current trends in agricultural production in developed and developing nations continue, then 1 billion hectares of land will be cleared globally by 2050, resulting in vast increases in CO_2 emissions and nitrogen use (Tilman et al., 2011). As the global population edges towards 9 billion, the required increase in food production must become more sustainable, socially, environmentally and economically. The provision of knowledge, research and innovative technologies through farm advisory systems will play a vital role in this sustainable development (EU SCAR, 2012).

In Ireland, two key policies which focus primarily on increased food production, have recently been introduced namely, Food Harvest 2020 and Food Wise 2025. The first of these policies, published in 2010, aims to increase the value of the primary output of the agriculture, fisheries and forestry sector by 33% over the 2007-2009 average; to improve the value added in the sector by €3 billion; to achieve an export target of €12 billion, to increase milk production by 50%; to add 20% to the value of the beef sector and to double the industry spend on research and development by 2020 (DAFF, 2010). Food Wise 2025 expands on this, with the core aims of increasing the value of agri-food exports by 85%; increasing value added in the agri-food, fisheries and forestry sector by 70%; increasing the value of primary production by 65% and creating 23,000 direct jobs in the agri-food sector by 2025 (DAFM, 2015). An environmental analysis of Food Harvest 2020 concluded that, in a scenario without best practice knowledge and innovation, the policy could lead to negative impacts on biodiversity, flora and fauna, water quality, air quality and climatic factors. This report indicated that the introduction of best practice technology from farm advisors through increased knowledge and skills could mitigate these negative impacts and enhance environmental outcomes (Farrelly et al., 2014).

The European Union (EU) has introduced measures designed to achieve continued food security while also maintaining environmental and social sustainability standards. Under the 2003 Common Agricultural Policy (CAP), EU member states had the obligation to formally introduce a system to advise farmers on land and farm management, known as the Farm Advisory System (FAS). The primary goal of the FAS was to assist farmers in becoming aware of issues relating to the environment, food safety, animal health and welfare and to fulfil EU requirements and avoid any associated financial penalties. Farmer participation in this scheme was voluntary. The FAS evaluation report concluded that while FAS did improve farmers awareness of issues related to the environment, food safety and animal welfare, the effectiveness of the programme was limited as few farmers actively sought advice (EC, 2010).

Agricultural extension services are a mechanism by which policy relevant research can be transferred to the farm level. Agricultural extension comprises public and private sector activities relating to technology transfer, education, attitude change, human resource development and the dissemination and collection of information (Marsh and Pannell, 2000, 607). Such services can assist farmers by assessing their socio-economic situation and informing them of their potential and of barriers to development. This can be conducted through direct or indirect interaction with the farmer by way of an agent or intermediary organisation and with the use of education services and information provision via mass media. This interaction with farmers can take the form of advice, awareness creation, the development of skills and education. There is much evidence within the literature to indicate that farmer knowledge can be fortified through agricultural education and extension (Weir and Knight, 2000; Uaiene et al., 2009). This can aid farmers by increasing their capabilities in the forms of improved problem solving, decision making and management (Vanclay and Leach, 2011). Indeed, according to Cotching et al. (2009) the diffusion of new technologies was enhanced by educated farmers who as early innovators provided an example for those less educated farmers through a process of so-called 'social learning'.

Extension services can also provide valuable feedback to policymakers and researchers on farmers' adoption of new technology by creating links between farmers and researchers, planners and the private sector and can assist in monitoring the performance of schemes at the farm level (Farrington,

1994). By providing information about optimal inputs and techniques, extension services can result in more efficient methods of production. These extension services can therefore result in higher yield growths and incomes in rural areas than that which would otherwise exist (Birkhauser et al., 1991) as well as improved productivity and income (Marsh et al., 2004, Davis et al., 2012). Veblen (1908) identifies knowledge as the most important factor of production. If this is true then the use of extension services as tools to disseminate knowledge should allow for an increase in sustainability, if only in the form of economic sustainability. Should the extension services in their various forms also concentrate on environmental issues, participation should also lead to an increase in environmental sustainability.

From a policy perspective, the effect of extension services on the general sustainability of farms will become increasingly important as the goal of sustainable agriculture rises in importance for policy makers. The sustainability of agriculture can be measured through the use of farm-level sustainability indicators. A comprehensive overview of such an approach can be found in Hennessy et al. (2013) and Dillon et al. (2016). The role of extension in the sustainable intensification of agriculture which will be addressed in this paper has not been heretofore examined in detail although a recent paper by Nordin et al. (2016) outlines the positive impact of extension contact on land use management and fertiliser use efficiency in Sweden. Furthermore, it is widely accepted within the literature that an improved understanding and uptake of technologies as well as advances in areas such as agroecology, biogeochemistry and biotechnology are crucial for the continued sustainability of agriculture (Tilman et al., 2002; Thornton, 2010; Firbank, 2012) and extension contact is the most logical mechanism for the transfer of such knowledge to farmers. However, in an Irish context, several studies have investigated the economic impact of extension service interaction (Läpple and Hennessy, 2015; Dillon et al., 2015; Läpple and Hennessy, 2014; Hennessy and Heanue, 2012; Cawley et al., 2015; Bogue, 2014; Heanue and O'Donoghue, 2014).

An important obstacle in undertaking this analysis has up to now been the lack of data. The analysis here will rely on the data collected via the FLINT project. These are farm-level data for a sample of farmers of the Farm Accountancy Data Network (FADN) in several EU countries (The Netherlands, Hungary, Finland, Poland, Spain, Ireland, Greece, France and Germany). The data include accountancy data from FADN (here after: 'FADN data'), as well as additional data on economic, environmental and social sustainability of farms. These additional data, the 'FLINT data', were collected via face-to-face survey or merging of existing data, depending on the country. The FADN and FLINT data relate to the 2015 accountancy year, except for France and Germany for which it is 2014.

This research differs from those cited as the environmental and social impacts of extension use are also explored. In addition, a more in-depth examination of the type of extension services utilised, the specific information requested and the frequency of engagement are also taken into account. This work investigates pilot data from eight European countries (participating in the FLINT project), and incorporates the Irish results with data from the Teagasc National Farm Survey (NFS) Irish FADN data. This analysis will examine the value of the additional data on extension service participation provided by the FLINT data and analyse the impact of the intensity of extension service use on sustainability outcomes. This paper continues as follows: firstly a background to the literature on extension services and output is established, secondly the methods and data used are outlined, thirdly there follows the descriptive and econometric results and finally key conclusions and policy implications are highlighted.

2 METHODOLOGY AND DATA

2.1 Methodology

In order to assess if there are statistically significant differences between those who engage with extension services and those who do not, relevant sustainability indicators are selected, highlighted in the following sections. The differences in means of extension services users and non-users for each of the sustainability indicators used in this study will be tested using either a t-test or chi square test using the Irish FADN data. Following this, several ordinary least squares (OLS) regressions will be conducted using this Irish FADN data, one for each of the sustainability indicators. These sustainability indicators will be the dependant variable. Each regression will include the same independent variables, outlined in the following section. These will include information on farm system, soil type etc. The independent variable of interest for this part of the study will be “extension”; a dummy variable taking a value of 1 if the respondent engages with extension services.

Using the new information provided by the FLINT data, respondents will be classified as “low” or “high” extension service engagers. With this information, the difference in means of those who engage with extension services less frequently and more frequenty will be tested using either a t-test or chi square test. Following this, two sets of OLS regressions will be conducted using the selected sustainability indicators. The first set of regressions using the sustainability indicators as the dependent variables will select a dummy variable representing “low” extension participants as the independent variable of interest. The second set will select a dummy variable representing “high” extension participants as the independent variable of interest. The results for the extension, low extension and high extension coefficients for each of the sustainability indicators will be presented in the results section, with full results for all of the other independent variables outlined in Appendix A.

2.2 Data

The following section outlines the concept of economic, environmental and social sustainability. It then outlines the data used in this analysis, namely the Irish FADN, collected through the Teagasc NFS and the FLINT data, collected from eight countries in Europe.

The FADN data are used to indicate the impact of extension service participation on sustainable farm outcomes in Ireland. Although the Irish FADN data provides a range of information on economic, environmental and social outcomes, they are limited in terms of detail on the degree of farmer engagement with extension services. More detail provided by the FLINT data, including types of advisory services used, information obtained and the mean number of engagements for each European partner, is presented and the impact of the intensity of engagement on sustainability indicators for Ireland is also presented.

It is hypothesised that engagement with extension services will have a positive influence on sustainability indicators; the degree of engagement and type of advisory services used will differ amongst the European countries due to national policy differences and that more intensive engagement with extension services will result in more sustainable farm outcomes.

2.2.1 Sustainability indicators

The concept of sustainable development was first introduced in the late 1980’s by the ‘Brundtland report’ (WCED, 1987). From an economic point of view, it is defined as preserving or enlarging capital stock in the form of economic, social and natural capital (Pingault, 2007). It is becoming increasingly

important to agriculture, with concerns regarding both the sustainability of the agricultural system itself and its contribution to sustainable development becoming important to policymakers (Bockstaller et al., 2009). Sustainability of the agricultural sector is measured as a function of three parts: economic (the production of goods and services), environmental (the management of natural resources) and social (the contribution to rural dynamics) (Diazabakana et al., 2014). These three categories are known as the sustainability pillars.

Measuring sustainability allows for comparisons, in this case between farmers who use extension services and those who do not. To do this, indicators are selected under each of the pillars. Indicators are defined by the OECD (2001) as 'a representative measure involving raw data on a phenomenon that is important for policy makers'. Indicators for this study were selected with consideration for both the available data and the topic of extension services under consideration and are based on those designed by Hennessy et al. (2012). Table 2.1 presents these indicators, along with the method of calculation.

Table 2.1: Sustainability indicators

Indicator		Measure	Unit
Economic	Productivity of land	Gross output per hectare (ha)	€/hectare
	Profitability	Market based gross margin per ha	€/hectare
	Productivity of labour	Family farm income per unpaid labour unit	€/labour unit
	Viability of investment	Farm is economically viable*	1= viable, 0= not viable
	Market orientation	Output derived from market	%
Environmental	Greenhouse gases (GHG) per ha	GHG per ha using IPCC estimates[1]	Kg CO_2 equivalent/hectare
	Nitrogen per ha	Risk to water quality	Kg nitrogen surplus/hectare
Social	Household vulnerability	Farm is not viable and no off farm employment	1= vulnerable, 0= not vulnerable
	Education	Agricultural education attainment	1= educated, 0= not educated
	Isolation risk	Live alone	1= yes, 0= no
	Work life balance	Number of hours worked	Hours worked on the farm

*Farm is viable if the farm could pay for family farm labour at the minimum agricultural wage plus a 5% return on non-land assets.

2.2.2 FADN data

Irish FADN data for 2015 are used for this analysis. This is collected through the Teagasc NFS, which surveys a statistically representative random sample of farms. A series of face-to-face interviews are conducted by a professional data collection team. The NFS also provides more detailed information used to supplement the FADN in this study. This analysis looks at all the farm systems of which data are

[1] The methodology utilises a combination of Tier 1 and Tier 2 approaches to estimate GHG emissions per farm (tonnes of carbon dioxide equivalent (t CO_2 eq) by applying relevant Intergovernmental Panel on Climate Change (IPCC) coefficients to animal numbers (on the basis of age category). IPCC Tier 1 utilises simple methods with default values. Tier 2 methods include country-specific emission factors. Tier 3 includes more complex approaches, possibly models.

collected namely dairy, cattle rearing, cattle other, sheep, tillage and other. These are classified on a standard gross margin basis.

The FADN data are used in this analysis to examine the impact of extension participation on each sustainability indicator in Table 2.1. The sustainability indicators are the dependent variables of interest and the independent variable of interest is a binary variable indicating whether or not extension services are used.

Other variables included in this analysis are a range of farm characteristics including the farm system, (detailed above) and soil type. This variable is comprised of three classifications: class 1 indicating soil with little or minor limitations in terms of agricultural use; class 2 comprising of soils with more limitations, poorer drainage and those that are generally unsuitable for tillage; and class 3, consisting of soils that are greatly limited in terms of agricultural use, primarily found in the West of Ireland and mountainous areas.

Variables are included to classify those areas designated as "less favoured"[2]. Three dummy variables are included: the first consisting of those regions not classed as disadvantaged; the second comprising of less severely disadvantaged areas and the third, indicating regions regarded as severely disadvantaged. The number of people in the household is also included. Region variables are also included, however the Dublin region is excluded from the analysis due to the small sample size. The final Irish FADN data set consists of 877 observations.

2.2.3 FLINT data

The FLINT survey included information on the type of extension service used, the frequency of engagement and the type of information that is requested. These data are not available from the FADN dataset and so the new information is subsequently incorporated with the FADN data in OLS regressions, outlined in the results section. Following the methodology established in the previous section, the sustainability indicators are the dependent variables of interest. The FLINT data can then provide two important independent variables: a binary variable indicating whether or not the farmer is a low extension user and a binary variable indicating whether or not the farmer is a high extension user. As above, the FADN and NFS data will provide the other explanatory variables such as farm system, soil type etc.

The full FLINT sample in this paper includes data from 820 farms for eight European countries, as represented in Table 2.2. Although France is a project partner, the results for this country were not available at the time of this analysis. The FLINT sample is not nationally or geographically representative, however it provides useful pilot information on the type of information and extension services availed of by the sample respondents. The partner countries adopted different strategies for collecting this data, with some using agricultural researchers and others availing of students. In Ireland, these data were collected in conjunction with the annual NFS by Teagasc surveyors. The data relate to 2015 accountancy year (2014 for Germany).

[2] The Disadvantaged Area Scheme, introduced under EEC Council Directive 268/753 sought to "ensure the continued conservation of the countryside in mountain areas and in certain other less-favoured areas". It established that farmers in these areas were disadvantaged due to permanent natural handicaps and as a result were prevented from receiving a "level of income similar to that enjoyed by farms of a comparable type in other regions." (DAFM, 2014).

Table 2.2: FLINT national farm samples

	Number of farms sampled
Ireland (IE)	64
Germany (DE)	52
Netherlands (NL)	155
Greece (EL)	124
Spain (ES)	128
Finland (FI)	50
Hungary (HU)	102
Poland (PL)	145
Total	820

3 RESULTS

3.1 Summary statistics using the FLINT data

The FLINT data provide greater detail into the type of extension service being used and the frequency of engagement with these service providers, than the Irish NFS data. Such information is useful as previous research by Akobundu et al. (2004) indicates that the intensity of participation or level of interaction with extension services is an important factor in increasing net farm income. The following section outlines the summary statistics for the FLINT data for the type of extension service being used and the information that is requested.

3.1.1 Extension service use

Figure 3.1 outlines the mean number of engagements with each advisory service for each country in the FLINT sample. These means reflect a summary of the number of times a farm obtained information from the relevant advisory services on a range of topics. Each instance of a specific information request is regarded as an additional engagement regardless of whether or not the farmer has used the same service on the same day e.g. requesting accountancy information and crop information from a public advisory service in one day is calculated as two engagements.

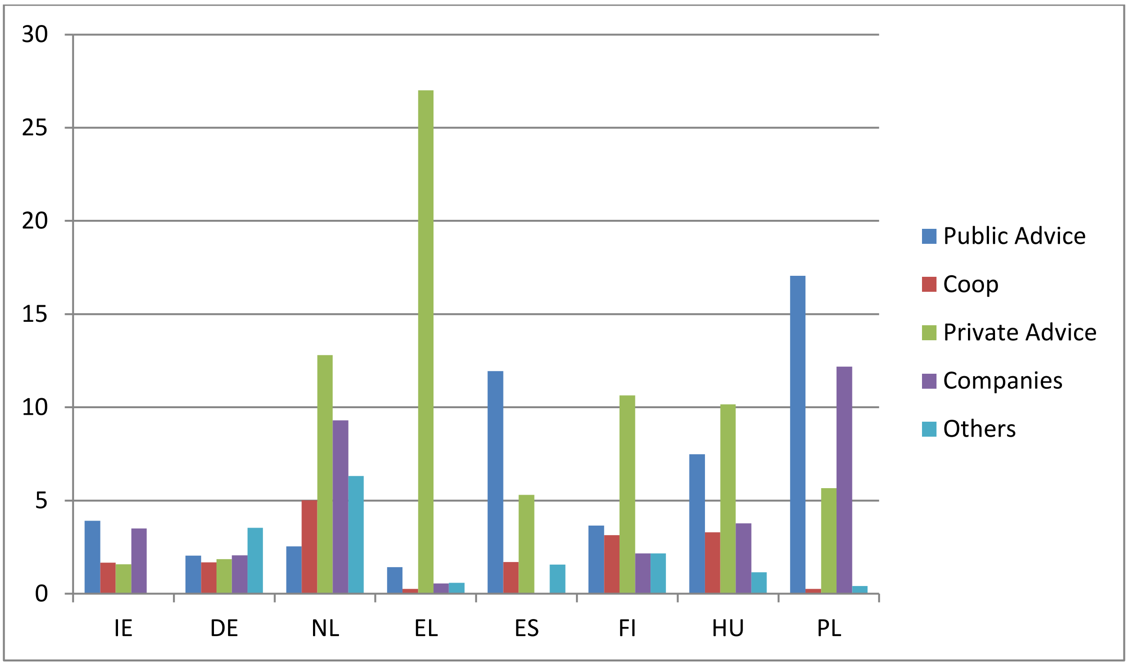

Figure 3.1: Mean number of engagements in 2015 (2014 for Germany) with each advisory service per country: FLINT samples

Public advice refers to all public advisory services or public extension agents offering direct advice services to farmers e.g. advisory centres, chambers of agriculture, agricultural authorities, state-owned advisory firms and public research institutes. Poland has the highest number of engagements with this advisory type for the FLINT sample, with a mean of 17 in 2015. The lowest for this category is found in Greece, with a mean of just 1.4 engagement. The next service type includes farmers' cooperatives or

organisations which offer direct advisory services to the farm. This service type is most popular in the Netherlands, with a mean engagement of five, and least popular in Poland with a mean of 0.25 engagement. Private advisors include all independent private consultants or consultancy firms e.g. accountancy firms, veterinary experts, private advisory companies. Greece presents an interesting result for this service type, with a mean engagement of 27 per farm in 2015. One farm in Greece interacted with private advisors 315 times in 2015, and four farms in total engaged with private advisors over 100 times. Excluding these four farms brings the mean number of engagements to 22, which still remains the highest mean for all service types.

Following this, 'companies' includes all firms downstream and upstream along the value chain whose principal business is not the provision of advisory services. These include input traders, processors, and wholesalers (example: input shops, bank officers, buyers). Poland avails of this service the most, with a mean engagement of 12, and Spain the least, with just two farms in the Spanish sample using this type of service.

The survey provided to respondents also included an 'others' and 'other farm based providers' category, which incorporated all of the providers not covered in the previous categories; such as universities, environmental non-governmental organisations (NGOs), private research institutes and religious organisations. This was amalgamated into one "others" category for the purpose of this analysis. This service type was used the most in the Netherlands with approximately six engagements per farm and the least in Ireland, with no farm using this type of service. To further analyse Irish engagement with extension services, Table 3.1 outlines the mean proportion of Irish sample respondents that use each service. Approximately 71% of Irish respondents availed of public advisory services; farmer cooperatives were used by 58% of the sample, private advisory services were availed of the least by respondents, with just 36% of the sample using this service type. In addition, companies were used by 77% of the sample, the highest for all service types in Ireland.

The mean number of engagements with all extension services for the Irish sample was 10. Four respondents did not engage with any extension services. 44% of respondents in the Irish FLINT sample were classified as low extension users that is, they engaged with extension services between zero and eight times in 2015. 22% were classified as medium extension users, availing of extension services between eight and 12 times in 2015. Finally, 34% of the Irish FLINT sample respondents were categorised as high extension users, using extension services 13 times or more in 2015.

Table 3.1: Extension service descriptive statistics: Irish FLINT sample

Extension type	Mean users	Mean visits	Min visits	Max visits
Public advice service	0.71	3.92	0	15
Farmers cooperative	0.58	1.67	0	9
Private advisors	0.36	1.59	0	12
Companies	0.77	3.51	0	30
Number of observations	64			

3.1.2 Information requested

The FLINT data also provide greater detail on the type of information requested by each farm in the sample. Figure 3.2 outlines the proportion of respondents that requested specific information for each country in the FLINT sample.

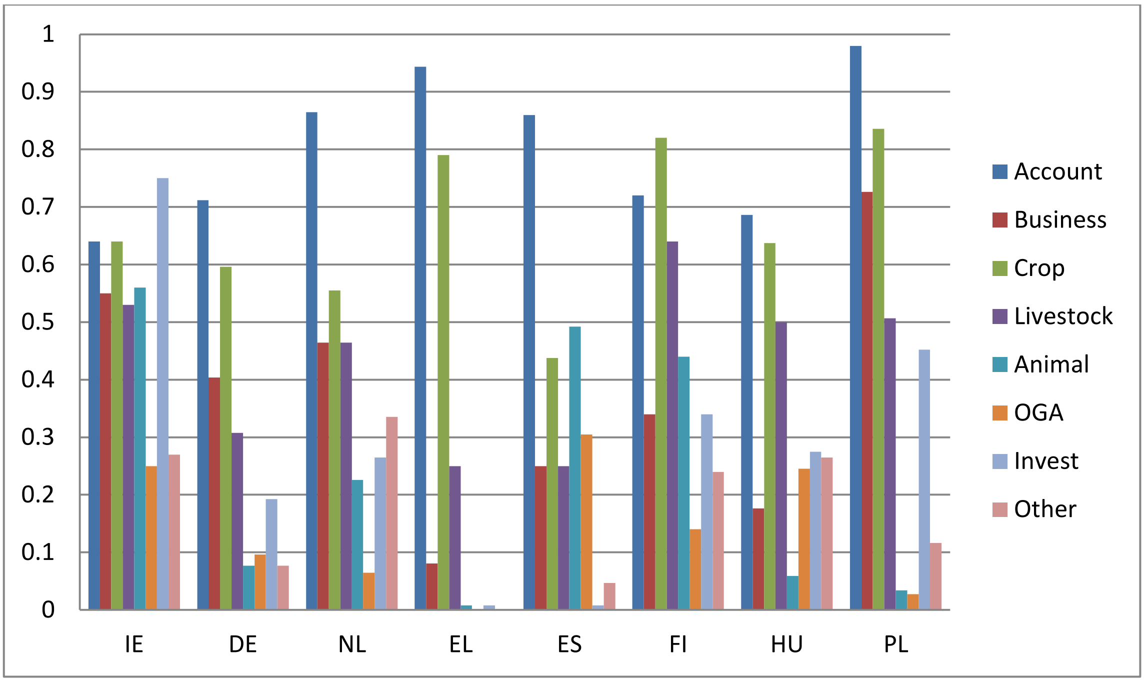

Figure 3.2: Proportion of respondents requesting information in 2015 (2014 for Germany) by information type: FLINT samples (OGA: other gainful activities)

In the FLINT sample, accountancy information ('Account') was requested the most by Polish farms, with approximately 98% of the Polish sample asking for accountancy assistance. This includes advisory services for bookkeeping, accountancy, taxes and FADN. For all countries except Ireland and Finland, this category was the most sought after by the sampled farms. The Irish farmers were least interested in this type of information, with just 64% of the sample seeking accountancy assistance. The next category ('Business') comprised of advisory services for planning, monitoring or executing plans. It included business/financial/marketing planning, human resources, management, marketing advice and marketing information services. Again, Poland was most interested in this type of information with 73% of the sample pursuing help for these issues. The lowest proportion of respondents requesting assistance on this topic came from Greece, with just 8% of the sample farms requesting this information.

The next information topic included advisory services which deal with issues related to the production of crops ('Crop'). Yet again the Polish farmers were keenest to gain advice on this issue, as 83% of the sample requested information. Spanish farmers sought this advice the least, as just 44% of the sample requested crop assistance from advisory services. Finland requested the most assistance on issues related to livestock production ('Livestock') (64%), while Spain and Greece were joint lowest with just 25% of each countries sample expressing an interest in livestock issues.

The subsequent information type included advisory services which aim to solve problems and implement solutions relating to animal products and services ('Animal'). This information was requested most in Ireland (56%) and least in Greece with just one farm requesting this information.

Other gainful activities (OGA) covered advisory services which assist with issues related to other activities not comprising of farm work but those that are directly related to the holding e.g. tourist facilitation. This was sought most in Spain (30%) and least in Greece, with no farms demanding this information.

Next, investment ('Invest') included all advisory services related to a determined investment. This advice was requested most in Ireland, with 75% of the sample seeking this information. Spanish and Greek sample farms were equally disinterested in this topic, as only one farm in each sample demanded investment assistance.

Finally, the last category ('Other') covered all other advice provided to the farm. Farmers in the Netherlands sample sought this advice the most (34%) and Greek farmers the least, as no farms requested this information.

Looking back to Ireland's results, we can see that the highest proportion of respondents (75%) sought information about investment issues in 2015, the largest proportion of any FLINT country sample for this information type. Two national policies, Food Harvest 2020 and Food Wise 2025, which focus on increased production and investment in research and development, could have encouraged farmers in the Irish sample to seek investment advice in order to increase their productivity and improve their efficiency.

3.2 Irish FADN results

The differences in means of extension services users and non-users for each of the sustainability indicators used in this study are presented in Table 3.2. This preliminary analysis indicates that there are significant differences between the two groups for all but one of the indicators, isolation risk. Extension users have a higher output per hectare on average by more than €600 compared to their non-extension user counterparts. Extension users are also doing better on average for all of the other economic indicators. The environmental indicators show the opposite with extension users faring worse in both the greenhouse gases (GHG) per hectare measure and nitrogen surplus per hectare. This is likely due to the fact that those who engage with extension services are more intensive farmers, and as a result they are likely to have a greater GHG output per hectare than their less intensive counterparts. It is probable that due to increased efficiencies their GHG emission per kg of output is lower than those who do not engage with extension services. Intensive farmers are also more likely to have a greater nitrogen surplus per hectare (however efficiency measures for GHG emissions and nitrogen surplus are beyond the scope of this analysis). This is consistent with the 2016 Teagasc NFS Sustainability Report (Lynch et al., 2015).

Socially, extension users scored better on both household vulnerability and education, but worked over 200 hours more than non-extension users.

These calculations do not take into account the presence of self-selection bias. Farmers who already run their farms more efficiently than their counterparts often are those who choose to participate in extension programmes (Dercon et al., 2009). On the other hand, it may be the poorer performing farmers, in greater need of advice, who seek out the extension programmes. This would result in the over or under estimation of the effect of extension services especially in relation to economic variables.

As only one year of data (2014 for Germany, 2015 for the remaining countries) were available for this analysis, the undertaking of more elaborative analyses, such as instrumental variable regressions or endogenous switching regression analysis, could not be conducted due to a lack of suitable instruments. However, these data are used subsequently in the OLS analysis conducted in the results section, which provides a basic outline of the importance of extension participation and the level of engagement in extension programmes for economic, environmental and social indicators.

Table 3.2: Difference in means for sustainability indicators for extension and non-extension users: full FLINT sample

	Non-extension users		Extension users		Difference	
	mean	sd	mean	sd	value	t
Output per ha	1567.26	1053.87	2208.98	1255.15	-641.73	-7.90***
Gross margin per ha	684.37	612.60	1058.29	745.94	-373.92	-7.84***
Family farm income per labour unit	23166.60	22851.69	38584.11	36652.14	-15417.52	-7.60***
Viability	0.39	0.49	0.58	0.49	-0.20	29.19***(χ^2)
Market orientation	0.70	0.15	0.77	0.14	-0.07	-6.60***
GHG per ha	4.44	2.59	5.62	3.06	-1.18	-5.91***
Nitrogen per ha	65.79	60.44	96.39	74.92	-30.60	-6.46***
Household vulnerability	0.44	0.50	0.31	0.46	0.13	13.26***(χ^2)
Education	0.47	0.50	0.65	0.48	-0.18	26.66***(χ^2)
Isolation	0.16	0.36	0.13	0.34	0.02	0.32(χ^2)
Hours worked	1854.72	710.36	2088.29	710.81	-233.56	-4.53***
Number of observations	280		597		877	

*** p<0.01, ** p<0.05, * p<0.1
Chi square (χ^2) results reported for binary variables

The results of the Irish FADN regressions, with each sustainability indicator as the dependent variable are presented in Table 3.3. The coefficients of the extension variables are presented for each of the regressions conducted, along with standard errors and R-squared results. Full regression results, that is to say with all explanatory variables, can be found in Appendix A. These results incorporate only questions which are part of the Irish FADN and NFS survey, including those outlining whether or not a farmer engaged with an extension service. These data include the full Irish FADN database of 877 farms, though outliers are excluded from the sample, as discussed previously, leaving 872 observations for all indicators except hours worked, which has 871 observations due to one farm not completing this question correctly.

Table 3.3: Results for each regression with sustainability indicator as the dependent variable: extension users in Irish FADN sample

Indicators	Coefficient for extension	Standard error	R-squared	Number of observations
Economic				
Output per ha	129.1**	55.41	0.634	872
Gross margin per ha	79.16**	33.33	0.649	872
Family farm income per labour unit	6,469***	1872.00	0.295	872
Viability	0.058*	0.034	0.268	872
Market orientation	0.0155**	0.01	0.608	872
Environmental				
GHG per ha	0.141	0.13	0.65	872
Nitrogen per ha	5.24	3.56	0.552	872
Social				
Household vulnerability	-0.053	0.04	0.139	872
Education	0.080**	0.03	0.189	872
Isolation	-0.000	0.03	0.037	872
Hours worked	88.51*	50.37	0.228	871

Robust standard errors reported
*** p<0.01, ** p<0.05, * p<0.1

These results indicate that participation in extension programmes has a positive impact on economic indicators, with all suggesting positive outcomes. The effect on family farm income in particular is significant, with those who participate in extension programmes experiencing on average €6,469 in additional farm income per labour unit.

The environmental indicators suggest that those who participate in extension programmes have the poorest performance in terms of GHG emissions and risk of loss of nutrients to water (nitrogen surplus per hectare), although this result is not statistically significant.

The results for the social indicators signify that those who participate in extension schemes are less likely to suffer from household vulnerability and isolation (though these results are not statistically significant)[3] and more likely to be educated. On average, farmers who participate in extension schemes work 88.5 hours per annum more than those who do not participate.

3.3 Irish FLINT + FADN results

Table 3.4 presents the difference in means for the Irish FLINT sample of low extension services users (fewer than eight times) and those which were categorised as medium and high users (eight times or greater), incorporating the sustainability indicators from the Irish FADN database. The significance of these differences was tested using either a t-test or chi square test. Though this sample was small, consisting of 64 respondents, this preliminary analysis indicated that there were significant differences

[3] The lack of statistical significance in the analyses is likely to relate to the small sample size.

between the two groups for several of the indicators. Low extension users had a lower output per hectare on average by approximately €571 in comparison to their higher extension user counterparts. As with the FADN difference in means outlined earlier, the environmental indicators showed the opposite with low extension users faring better in both the GHG per hectare and nitrogen surplus per hectare measures. Low extension are less likely to be educated than the others in the sample and worked over 226 hours fewer than medium and high extension users.

Table 3.4: Difference in means for sustainability indicators for low extension and non-low extension users: Irish FLINT sample

	Medium and high extension users		Low extension users		Difference	
	mean	sd	mean	sd	value	t
Output per ha	2703.08	1438.66	2132.02	1356.93	571.06	1.61*
Gross margin per ha	1269.05	855.86	1059.94	853.12	209.11	0.97
Family farm income per labour unit	35607.91	27510.59	37981.44	36290.34	-2373.53	-0.30
Viability	0.61	0.49	0.50	0.51	0.11	0.79 (χ^2)
Market orientation	0.81	0.12	0.77	0.14	0.03	1.21
GHG per ha	7.22	3.45	5.71	3.02	1.50	1.81**
Nitrogen per ha	144.47	93.66	97.75	72.68	46.71	2.2***
Household vulnerability	0.28	0.45	0.42	0.50	-0.15	1.59 (χ^2)
Education	0.69	0.47	0.46	0.51	0.23	2.48** (χ^2)
Isolation	0.14	0.35	0.14	0.36	0.00	0.00 (χ^2)
Hours worked	2245.63	478.71	2019.00	643.19	226.64	1.61*
Number of observations	42		22		64	

*** p<0.01, ** p<0.05, * p<0.1
Chi square (χ^2) results reported for binary variables

Table 3.5 and Table 3.6 present the supplementary Irish FLINT results for those who partake in extension activities fewer than eight times in 2015 (low extension) and 13 times or more in 2015 (high extension), incorporating the FADN and NFS data. These regressions are run only for those farms who participated in the FLINT study. One farm was excluded as an outlier, leaving 63 observations.

Table 3.5 outlines the results for the low extension users. The economic results indicate that low extension farms are significantly less viable than those that use extension services more frequently. The rest of the economic indicators results suggest that these respondents have a lower output per hectare, lower family farm income per labour unit, are less likely to have market orientation and have a slightly higher gross margin per hectare, though these results are not statistically significant.

While the results for the environmental indicators are not statistically significant, they suggest that these farms have lower GHG emissions and nitrogen surplus per hectare.

In terms of social indicators, low extension households are statistically more likely to be vulnerable than those that use services more frequently and are less likely to be educated. These respondents are less likely to be isolated and work, on average, 166 fewer hours per annum than their more participatory counterparts, though these results are again not statistically significant.

Table 3.5: Results for each regression with sustainability indicator as the dependent variable: low extension users in Irish FLINT sample

Indicators	Coefficient for low extension user	Standard error	R-squared	Number of observations
Economic				
Output per ha	-83.6	310.50	0.741	63
Gross margin per ha	6.775	180.30	0.748	63
Family farm income per labour unit	-5,040	8097.00	0.577	63
Viability	-0.230*	0.118	0.502	63
Market orientation	-0.00874	0.02	0.882	63
Environmental				
GHG per ha	-0.515	0.72	0.708	63
Nitrogen per ha	-28.75	19.20	0.685	63
Social				
Household vulnerability	0.312**	0.135	0.404	63
Education	-0.317**	0.145	0.371	63
Isolation	-0.031	0.087	0.264	63
Hours worked	-166.6	178.30	0.361	63

Robust standard errors reported
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6 presents the results for the high extension users. Though not significant, the results suggest that high extension use has a positive outcome on all of the economic indicators, in comparison to the negative results of the low extension users.

Though the results for the environmental indicators are again not statistically significant, they suggest that, in contrast to the low extension users, these farms have higher GHG emissions per hectare and risk of loss of nutrients for water (nitrogen surplus per hectare).

In terms of social indicators, high extension households are statistically more likely to be educated. These households are less likely to be vulnerable or isolated and work on average 180 hours more per annum than their less engaged counterparts, though again, these results are not statistically significant.

Table 3.6: Results for each regression with sustainability indicator as the dependent variable: higher extension users in Irish FLINT sample

Indicators	Coefficient for high extension user	Standard error	R-squared	Number of observations
Economic				
Output per ha	332.4	302.70	0.749	63
Gross margin per ha	197.80	173.50	0.756	63
Family farm income per labour unit	12,342	8,207	0.596	63
Viability	0.0743	0.115	0.364	63
Market orientation	0.0129	0.02	0.883	63
Environmental				
GHG per ha	0.994	0.81	0.718	63
Nitrogen per ha	34.71	22.25	0.692	63
Social				
Household vulnerability	-0.192	0.129	0.258	63
Education	0.309*	0.158	0.312	63
Isolation	-0.0271	0.088	0.410	63
Hours worked	180	181.50	0.364	63

Robust standard errors reported
*** p<0.01, ** p<0.05, * p<0.1

4 CONCLUSION

4.1 Conclusions on the analysis

The results provided in this case study point to stark differences in the preferred type of extension service for each country in the European FLINT sample. In countries like Ireland, Spain and Poland, public extension services provide the most frequent interaction with farming households, whereas in the Netherlands, Greece, Finland and Hungary private advisory services are most commonly used. This represents the different policy frameworks that operate across Europe. In Ireland, Teagasc, a state body, is the primary advisory service for farmers, providing advice on a wide range of issues including farm management, nutrition, investment and up-to-date research to fee-paying clients, with basic advisory contracts starting at €145 per annum (Teagasc, 2016). This broad range of advice is reflected in the somewhat even spread of the type of information being requested. Over 50% of farmers in the Irish sample requested information on issues related to accountancy, business, crop, livestock, animal welfare and investment opportunities.

In Spain, the type of advice being provided by public advisory services has changed in recent times, moving from their traditional role of personalised advice to farmers to focus primarily on the management of grants to farmers from CAP, or other issues related to EU regulations (Esparcia et al., 2014). Again, this is represented by the type of information requested with 86% of farmers requesting information on accountancy issues but fewer than 50% seeking information on any other issue. In Poland, the majority of advisory services became public in 1995, meaning that all farmers can now avail of free advice (Kania et al., 2014). The results from this case-study indicate that this policy influences the uptake of services, as Polish farmers in the sample engage with public advisory services more frequently than any other country and Polish farmers are more likely to seek information on issues related to accountancy, business and crop production than any other country.

One apparent outlier in terms of the number of engagements with advisory services is Greece. This country had by far the largest number of mean engagements with private advisory services and fewer engagements with public advisory services than any other country in the sample. This result is perhaps a reflection of the lack of funding and organisation for public agricultural advisory services in Greece. Over the last 30 years in Greece, the provision of public agricultural extension services has been limited and focussed primarily on maximising outputs and subsidies to farmers rather than training and education. Though attempts were made in 2005 by the Ministry for Rural Development and Food (MRDF) to establish Local Centres for Rural Development, these Centres were closed in 2010 due to funding issues. All levels of the MRDF are also understaffed and restrictions on travelling minimise the degree of contact possible between advisors and farmers. Due to a lack of public advice, private advisors have become the main supporters of farmers. Some private advisors make a living by selling inputs to farmers. These advisors provide information on improvement of quality and quantity, cost reduction and environmental protection. Others are paid from fees by farmers and provide information on participation in and application preparation for specific EU programmes such as Young Farmers Scheme and Early Retirement Scheme (Koutsouris, 2014). This focus on funding is reflected in the results in this paper, with 94% of Greek farmers seeking information on accountancy issues.

The results of this analysis also highlight the type of information considered most valuable to farmers. For all countries bar Ireland and Finland, accountancy information was sought by the greatest majority of respondents. This is not surprising given the complicated processes involved in claiming benefits and the introduction of new schemes such as the Basic Payment System, Greening and the Young Farmers Scheme which came into effect in 2015. In Ireland, for example, many farm advisors have been overwhelmed with requests for assistance because of the introduction of these schemes (Coughlan, 2015).

The results also suggest that a large proportion of farmers requested advice on crop production. This could have arisen due to the introduction of the Greening payment in 2015. This payment obligates all

farmers with 10 acres or more of arable crops (unless they qualify for an exception) to sow a number of different crops. Farmers with more than 15 acres of arable land must declare at least 5% of their land as an 'Ecological Focus Area' (DAFM, 2015). As discussed previously, Ireland's national food policies, specifically Food Harvest 2020 and Food Wise 2025, could also account for the high proportion of Irish farmers seeking investment advice in 2015.

4.2 Conclusions on the data

There are limitations to this work. The European FLINT and Irish FLINT samples are small and not geographically or nationally representative. However, as this work was undertaken as a pilot test study, it provides a considerable level of groundwork and valuable learnings from which a full scale project could be established.

The economic analysis does not take into account self-selection bias, which may have over or under estimated the effect of extension services especially in relation to economic variables. OLS regressions could potentially be improved with the use of logit regressions for the binary dependent variables, however, particularly in the case of the FLINT data, the sample size was too small for this to be undertaken.

4.3 Conclusions on the usefulness of FLINT data

The results from the large FADN dataset indicate that engagement in extension services has a significant and positive influence over economic indicators of sustainability. Socially, farmers who participate in extension programmes appear more likely to be ducated and work longer hours than those who do not engage in these services. Though not statistically significant, the environmental indicators suggest that extension users fare worse in both the GHG per hectare measure and nitrogen per hectare measure due to their greater farming intensity.

By exploring the frequency of participation through the incorporation of the small FLINT dataset, we see that those who engage with extension services between zero and eight times in 2015 are less likely to be economically viable and more likely to be from a vulnerable household. Those who engage with extension services more frequently are more likely to be educated. Though not statistically significant, there is a large difference in all of the economic indicators for those farmers who engage with extension services 13 times or more in 2015 and those who engage fewer than eight times, with more active farmers faring better for each of these indicators.

The findings of this research indicate that a large scale FLINT study could prove very useful as a measure of farming sustainability throughout Europe. Future work of this kind could provide policymakers with information on the types of extension service that are most valuable to farmers in their country and with data on possible improvements to services that may be required. With this information in place, policymakers could predict the information burden that a new policy will place on farmers, and adequately provide expertise and education in these areas in advance of its introduction. This information could be used to measure the success of various extension services, information provision and specific national and EU policies in terms of their impact on economic, environmental and social indicators of sustainability.

4.4 Recommendations

Generally, a larger sample size would have improved the accuracy of the econometric analysis. A greater sample size per country would also allow for detailed descriptive statistics and specific country-by-country comparisons on economic, environmental and social outcomes. Analysis could have also been

conducted with the full FLINT sample and not just one nation, as in this case study, which could provide a broader European perspective.

Due to the small sample size, logit regressions were not conducted for the binary variables (i.e. viability, household vulnerability, education, and isolation). This type of regression could improve the accuracy and statistical significance of the variables. A larger sample size would allow for this without the necessity of dropping observations.

The economic analysis does not take into account self-selection bias, which may have over or under estimated the effect of extension services especially in relation to economic variables. This could be corrected for in a large scale study over a number of years, which would increase the probability of finding appropriate instrumental variables based on policy introductions as in Cawley et al. (2015) or a change in farm circumstances over time as in Läpple et al. (2013).

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APPENDIX A

Table 0.1: Results for each regression on sustainability indicators: extension users in Irish FADN sample

Variables	(1) Output per ha	(2) Gross margin per ha	(3) Farmily farm income per labour unit	(4) Viability	(5) Market orientation	(6) GHG per ha	(7) Nitrogen per ha	(8) Household vulnerability	(9) Education	(10) Isolation	(11) Hours worked
Extension user	129.1**	79.16**	6,469***	0.0580*	0.0155**	0.141	5.240	-0.0528	0.0806**	-0.000295	88.51*
	(55.41)	(33.33)	(1,872)	(0.0346)	(0.00759)	(0.129)	(3.558)	(0.0364)	(0.0347)	(0.0285)	(50.37)
Cattle rearing[4]	-1,896***	-1,050***	-28,017***	-0.427***	-0.176***	-3.995***	-101.4***	0.191***	-0.235***	0.119***	-643.3***
	(82.20)	(49.09)	(2,931)	(0.0484)	(0.0104)	(0.195)	(5.115)	(0.0529)	(0.0507)	(0.0408)	(70.81)
Cattle other	-1,837***	-1,091***	-27,086***	-0.361***	-0.191***	-3.910***	-91.37***	0.204***	-0.205***	0.131***	-502.7***
	(78.13)	(44.29)	(2,756)	(0.0441)	(0.00873)	(0.180)	(5.157)	(0.0438)	(0.0455)	(0.0348)	(65.84)
Sheep	-1,832***	-1,050***	-26,897***	-0.350***	-0.234***	-4.370***	-101.3***	0.218***	-0.126**	0.00478	-387.6***
	(85.30)	(48.02)	(2,925)	(0.0548)	(0.0146)	(0.224)	(6.006)	(0.0578)	(0.0573)	(0.0364)	(72.90)
Tillage	-1,683***	-1,008***	-11,492**	-0.120*	-0.148***	-6.531***	-133.9***	0.0466	-0.00725	0.104**	-573.6***
	(95.65)	(56.82)	(5,526)	(0.0633)	(0.00864)	(0.230)	(6.694)	(0.0599)	(0.0593)	(0.0516)	(98.23)
Other	-1,053***	-702.6***	-6,700	-0.220**	-0.0868***	-3.157***	-68.50***	0.252**	0.0239	0.0508	-71.64
	(316.6)	(118.0)	(9,733)	(0.0946)	(0.0218)	(0.424)	(11.91)	(0.0978)	(0.101)	(0.0762)	(145.4)
Soil class 2[5]	-238.2***	-122.1***	-4,642**	-0.0647*	-0.0168**	-0.608***	-9.797**	0.0298	-0.0218	0.0326	-97.84**
	(56.66)	(33.77)	(2,223)	(0.0345)	(0.00689)	(0.135)	(3.982)	(0.0358)	(0.0356)	(0.0257)	(48.89)
Soil class 3	-536.3***	-278.2***	-3,900	-0.0479	-0.102***	-1.551***	-21.51***	0.0555	-0.148**	0.0749	-117.3
	(76.89)	(44.86)	(2,914)	(0.0602)	(0.0182)	(0.233)	(5.140)	(0.0638)	(0.0593)	(0.0484)	(85.63)
Number of residents in household	50.63***	47.01***	2,794***	0.0420***	0.00747***	0.125***	1.442	-0.0572***	0.0611***		32.22**
	(18.77)	(10.48)	(759.7)	(0.0101)	(0.00203)	(0.0429)	(1.094)	(0.0104)	(0.0106)		(14.75)
Region 1[6,7]	119.2	3.479	826.1	-0.123**	0.0471***	0.0484	-5.509	0.0928	-0.0110	0.0263	-318.7***

[4] Dairy farming dropped as base category
[5] Soil class 1 dropped as base category
[6] Region 7 dropped as base category: includes counties Cork and Kerry
[7] Region 1: includes counties: Louth, Leitrim, Sligo, Cavan, Donegal, Monaghan

	(96.46)	(59.38)	(3,595)	(0.0619)	(0.0139)	(0.229)	(7.012)	(0.0628)	(0.0602)	(0.0440)	(86.97)
Region 3[8]	187.7	53.00	9,621***	0.102*	0.0473***	0.427	-1.117	-0.0689	-0.0377	0.00203	-296.9***
	(118.0)	(60.89)	(3,668)	(0.0593)	(0.0121)	(0.267)	(7.531)	(0.0583)	(0.0622)	(0.0446)	(85.53)
Region 4[9]	201.3*	111.0*	13,957***	0.0844	0.0464***	0.323	-4.693	-0.0574	-0.0170	0.0109	-175.9**
	(108.8)	(59.36)	(4,578)	(0.0593)	(0.0130)	(0.241)	(6.597)	(0.0592)	(0.0577)	(0.0444)	(86.81)
Region 5[10]	147.6	168.4**	11,226***	0.0856	0.0466***	0.222	-7.716	-0.0629	0.0771	0.0138	-40.22
	(117.8)	(73.46)	(3,651)	(0.0658)	(0.0134)	(0.292)	(7.376)	(0.0659)	(0.0637)	(0.0475)	(81.89)
Region 6[11]	174.8*	95.70	13,624***	0.111**	0.0294***	0.364*	-0.538	-0.0673	0.0242	-0.00254	-291.1***
	(94.80)	(60.69)	(3,370)	(0.0462)	(0.0105)	(0.216)	(6.171)	(0.0465)	(0.0477)	(0.0349)	(74.20)
Region 8[12]	145.2	85.59	5,705*	0.0352	0.0153	0.259	-8.168	-0.128*	-0.170***	0.0512	-252.2***
	(94.14)	(58.46)	(2,964)	(0.0668)	(0.0165)	(0.252)	(6.703)	(0.0667)	(0.0638)	(0.0499)	(89.06)
Less severely disadvantaged area	-280.3***	-189.7***	-1,614	0.00786	-0.0425***	-0.551***	-7.592	0.00150	0.00537	-0.0166	82.77
	(73.38)	(43.85)	(2,869)	(0.0380)	(0.00710)	(0.175)	(4.920)	(0.0381)	(0.0411)	(0.0301)	(58.86)
Severely disadvantaged area	-391.6***	-290.6***	-8,207***	-0.0885*	-0.0632***	-0.820***	-10.43*	0.0663	-0.120**	-0.0545	13.08
	(80.19)	(47.74)	(3,175)	(0.0503)	(0.0111)	(0.198)	(5.745)	(0.0514)	(0.0514)	(0.0396)	(71.52)
Constant	3,150***	1,581***	34,119***	0.584***	0.858***	8.166***	158.9***	0.440***	0.522***	0.0710*	2,392***
	(123.4)	(73.43)	(3,944)	(0.0644)	(0.0119)	(0.275)	(7.752)	(0.0650)	(0.0655)	(0.0410)	(94.95)
Number of observations	872	872	872	872	872	872	872	872	872	872	871
R-squared	0.634	0.649	0.295	0.268	0.608	0.650	0.552	0.139	0.189	0.037	0.228

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[8] Region 3: includes counties: Kildare, Meath, Wicklow
[9] Region 4: includes counties: Laois, Longford, Offaly, Westmeath
[10] Region 5: includes counties: Clare, Limerick, Tipperary North
[11] Region 6: includes counties: Carlow, Kilkenny, Wexford, Tipperary South, Waterford
[12] Region 8: includes counties: Galway, Mayo, Roscommon

Table 0.2: Results for each regression on sustainability indicators: low extension users in Irish FLINT sample

Variables	(1) Output per ha	(2) Gross margin per ha	(3) Farmily farm income per labour unit	(4) Viability	(5) Market orientation	(6) GHG per ha	(7) Nitrogen per ha	(8) Household vulnerability	(9) Education	(10) Isolation	(11) Hours worked
Low extension user	-83.60	6.775	-5,040	-0.230*	-0.00874	-0.515	-28.75	0.312**	-0.317**	0.0310	-166.6
	(310.5)	(180.3)	(8,097)	(0.118)	(0.0170)	(0.722)	(19.20)	(0.135)	(0.145)	(0.0867)	(178.3)
Cattle rearing [13]	-1,986***	-1,171***	-15,530	-0.232	-0.198***	-4.595***	-124.6***	-0.144	-0.0777	0.260	-602.0***
	(324.3)	(203.2)	(9,404)	(0.183)	(0.0246)	(0.745)	(20.19)	(0.183)	(0.182)	(0.160)	(214.8)
Cattle other	-2,258***	-1,352***	-25,663***	-0.258	-0.213***	-5.045***	-135.2***	0.182	-0.227	0.331**	-246.2
	(263.8)	(176.5)	(8,575)	(0.161)	(0.0227)	(0.609)	(20.44)	(0.163)	(0.168)	(0.137)	(158.8)
Sheep	-2,524***	-1,465***	-18,898**	-0.290	-0.313***	-6.614***	-140.2***	-0.0282	-0.00724	-0.0597	-306.8
	(396.3)	(279.8)	(9,313)	(0.194)	(0.0423)	(0.798)	(20.12)	(0.338)	(0.497)	(0.0971)	(269.2)
Other	1,117***	620.8***	18,538	0.555**	0.0451***	-1.644**	-103.3**	-0.519***	0.175	-0.0717	-637.0***
	(266.7)	(130.7)	(11,562)	(0.216)	(0.0157)	(0.711)	(42.02)	(0.188)	(0.166)	(0.0817)	(218.4)
Soil class 2	-488.6*	-233.9	-105.7	0.0943	-0.00983	-1.064*	-18.03	-0.169	-0.216	-0.0808	-230.7
	(263.4)	(150.8)	(7,772)	(0.135)	(0.0165)	(0.621)	(17.02)	(0.133)	(0.131)	(0.108)	(158.2)
Soil class 3	-309.6	-152.5	-258.8	0.0261	-0.0265	-0.831	-42.59*	0.0141	-0.277	-0.170	-398.3*
	(447.2)	(327.5)	(11,428)	(0.201)	(0.0287)	(0.943)	(22.05)	(0.224)	(0.215)	(0.132)	(201.3)
Number of residents in household	-67.26	-19.68	3,975	0.0194	0.00230	-0.132	-7.547	-0.0443	0.0851*		-15.63
	(71.44)	(37.54)	(2,441)	(0.0389)	(0.00535)	(0.181)	(5.849)	(0.0375)	(0.0432)		(50.56)
Region 1	170.5	-7.100	-16,811	-0.513	0.0276	0.689	-27.79	0.469	0.0461	0.391*	-701.7**
	(566.4)	(287.2)	(15,574)	(0.388)	(0.0407)	(1.430)	(45.02)	(0.430)	(0.286)	(0.212)	(315.1)
Region 3	989.8**	638.3***	27,999*	0.159	0.0506	2.116**	1.416	-0.294	-0.232	0.127	-1,089***
	(394.7)	(193.1)	(15,132)	(0.379)	(0.0331)	(0.998)	(36.76)	(0.404)	(0.260)	(0.151)	(291.1)
Region 4	401.1	344.7	17,230	0.290	0.0815*	0.834	-17.20	-0.268	0.360	0.182	-400.7
	(493.9)	(254.1)	(13,051)	(0.386)	(0.0432)	(1.089)	(35.56)	(0.429)	(0.239)	(0.200)	(271.6)
Region 5	70.80	167.6	3,519	0.0306	0.0777*	1.154	-43.48	0.0482	0.280	0.267	-528.8
	(492.1)	(262.6)	(16,315)	(0.443)	(0.0388)	(1.171)	(39.81)	(0.456)	(0.262)	(0.208)	(315.5)
Region 6	113.0	45.81	-677.3	0.151	0.0411	0.288	-67.24	-0.0853	-0.262	0.384	-622.9**
	(507.8)	(240.6)	(15,274)	(0.370)	(0.0354)	(1.345)	(43.56)	(0.410)	(0.279)	(0.232)	(280.3)

[13] Tillage farms were not surveyed as part of the FLINT study, so this variable was omitted.

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Region 8	523.4	337.4	-4,140	-0.190	0.0397	1.630	-34.78	0.361	0.129	0.334	-697.2*
	(549.8)	(320.0)	(15,487)	(0.420)	(0.0412)	(1.379)	(43.49)	(0.460)	(0.308)	(0.246)	(347.3)
Less severly disadvantaged area	-585.9	-298.4	-4,113	0.0519	-0.0276*	-1.783*	-22.58	0.0372	-0.0442	-0.0825	254.4
	(357.5)	(185.2)	(12,992)	(0.162)	(0.0147)	(0.976)	(24.09)	(0.159)	(0.181)	(0.144)	(182.3)
Severely disadvantaged area	-557.3	-285.3	-11,188	0.00997	-0.0476**	-1.476	-39.89	-0.106	-0.339*	-0.0931	8.946
	(425.5)	(225.6)	(13,442)	(0.184)	(0.0199)	(1.128)	(27.40)	(0.168)	(0.187)	(0.150)	(182.1)
Constant	4,009***	1,945***	42,848***	0.753*	0.877***	10.25***	288.5***	0.314	0.783***	-0.156	3,162***
	(462.0)	(238.1)	(12,810)	(0.375)	(0.0371)	(1.102)	(43.67)	(0.410)	(0.271)	(0.152)	(328.0)
Number of observations	63	63	63	63	63	63	63	63	63	63	63
R-squared	0.741	0.748	0.577	0.502	0.882	0.708	0.685	0.404	0.371	0.264	0.361

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 0.3: Results for each regression on sustainability indicators: high extension users in Irish FLINT sample

Variables	(1) Output per ha	(2) Gross margin per ha	(3) Farmily farm income per labour unit	(4) Viability	(5) Market orientation	(6) GHG per ha	(7) Nitrogen per ha	(8) Household vulnerability	(9) Education	(10) Isolation	(11) Hours worked
High extension user	332.4	197.8	12,342	0.0743	0.0129	0.994	34.71	-0.192	0.309*	-0.0271	180.0
	(302.7)	(173.5)	(8,207)	(0.115)	(0.0151)	(0.805)	(22.25)	(0.129)	(0.158)	(0.0884)	(181.5)
Cattle rearing	-1,968***	-1,137***	-15,638*	-0.313*	-0.199***	-4.648***	-130.8***	-0.0480	-0.157	0.268	-641.1***
	(299.9)	(177.8)	(9,070)	(0.176)	(0.0228)	(0.731)	(20.27)	(0.184)	(0.178)	(0.163)	(214.1)
Cattle other	-2,230***	-1,332***	-24,754***	-0.265	-0.213***	-4.979***	-133.6***	0.183	-0.216	0.330**	-239.0
	(261.3)	(174.1)	(9,092)	(0.170)	(0.0236)	(0.624)	(21.33)	(0.171)	(0.172)	(0.136)	(171.0)
Sheep	-2,450***	-1,384***	-17,402*	-0.410**	-0.313***	-6.564***	-145.4***	0.0997	-0.0934	-0.0504	-345.2
	(336.6)	(264.5)	(9,790)	(0.180)	(0.0390)	(0.777)	(21.67)	(0.343)	(0.479)	(0.0952)	(264.5)
Other	1,003***	535.5***	14,890	0.594***	0.0423***	-1.905***	-109.1**	-0.534***	0.142	-0.0699	-661.7***
	(265.5)	(122.1)	(11,113)	(0.221)	(0.0152)	(0.673)	(42.17)	(0.190)	(0.155)	(0.0806)	(189.0)
Soil class 2	-443.8*	-189.1	937.7	0.0367	-0.00985	-1.015*	-19.76	-0.110	-0.251*	-0.0766	-245.4
	(237.3)	(132.0)	(7,286)	(0.136)	(0.0142)	(0.553)	(14.78)	(0.136)	(0.127)	(0.106)	(146.3)
Soil class 3	-349.5	-172.9	-1,859	0.00446	-0.0284	-0.967	-47.97*	0.0531	-0.329	-0.166	-427.3**
	(461.9)	(339.8)	(12,233)	(0.207)	(0.0293)	(1.003)	(25.03)	(0.245)	(0.230)	(0.133)	(210.2)
Number of residents in household	-62.45	-15.17	4,097	0.0144	0.00232	-0.125	-7.629	-0.0394	0.0826*		-16.56
	(72.53)	(35.94)	(2,464)	(0.0414)	(0.00539)	(0.193)	(6.129)	(0.0426)	(0.0432)		(51.44)
Region 1	19.20	-141.2	-20,922	-0.382	0.0260	0.444	-27.99	0.351	0.0922	0.384*	-689.1**
	(520.4)	(262.2)	(14,616)	(0.378)	(0.0382)	(1.417)	(45.91)	(0.419)	(0.279)	(0.227)	(323.1)
Region 3	933.7**	585.4***	26,583*	0.219	0.0503	2.040*	2.459	-0.352	-0.201	0.124	-1,078***
	(403.9)	(188.0)	(14,152)	(0.362)	(0.0326)	(1.116)	(38.67)	(0.379)	(0.261)	(0.156)	(282.5)
Region 4	346.8	288.7	16,020	0.366	0.0817*	0.782	-14.51	-0.347	0.409*	0.176	-379.4
	(480.4)	(259.4)	(12,232)	(0.350)	(0.0422)	(1.057)	(34.85)	(0.393)	(0.218)	(0.197)	(265.6)
Region 5	107.2	173.7	5,401	0.0966	0.0806**	1.336	-34.19	-0.0451	0.380	0.257	-475.8
	(482.8)	(256.2)	(15,829)	(0.434)	(0.0389)	(1.200)	(41.07)	(0.454)	(0.253)	(0.210)	(310.4)
Region 6	105.6	9.075	152.9	0.270	0.0439	0.417	-56.57	-0.232	-0.132	0.371	-557.6**
	(457.4)	(211.4)	(13,270)	(0.340)	(0.0335)	(1.319)	(43.63)	(0.385)	(0.257)	(0.229)	(259.9)
Region 8	478.8	279.5	-4,722	-0.0834	0.0410	1.644	-28.33	0.240	0.221	0.324	-654.0*
	(503.5)	(286.9)	(14,170)	(0.406)	(0.0391)	(1.317)	(42.63)	(0.455)	(0.298)	(0.254)	(345.5)
Less severly disadvantaged	-577.6	-295.8	-3,723	0.0627	-0.0271*	-1.747	-20.86	0.0213	-0.0264	-0.0839	264.0

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area	(375.4)	(180.5)	(12,419)	(0.167)	(0.0150)	(1.058)	(26.37)	(0.163)	(0.189)	(0.141)	(174.2)
Severely disadvantaged area	-560.5	-297.9	-10,939	0.0493	-0.0466**	-1.435	-36.43	-0.154	-0.297	-0.0971	30.24
	(436.5)	(222.1)	(12,927)	(0.188)	(0.0194)	(1.184)	(27.65)	(0.164)	(0.187)	(0.144)	(170.1)
Constant	3,874***	1,906***	36,466***	0.571	0.868***	9.658***	260.0***	0.582	0.486*	-0.127	3,002***
	(356.9)	(192.7)	(10,629)	(0.351)	(0.0362)	(0.864)	(39.81)	(0.393)	(0.249)	(0.132)	(295.2)
Number of observations	63	63	63	63	63	63	63	63	63	63	63
R-squared	0.749	0.756	0.596	0.474	0.883	0.718	0.692	0.365	0.368	0.264	0.364

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1