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Exploring the Effect of Policy Reform on the Economic, Social and Environmental Sustainability of Irish Farms.

Key external stakeholders:

Policy makers including Department of Agriculture, Fisheries and Food officials, agricultural and agri-food representative organisations, academics, farmers and food processors.

Practical implications for stakeholders:

- This project integrates the three dimensions of farm sustainability into one policy analysis tool with the overall objective of providing quality scientific based policy advice to government so that policy makers may negotiate solutions that maximise the competitiveness of the Irish agricultural sector without compromising the environmental or social sustainability of farming.
- The modelling techniques developed allow for further investigation by researchers in the examination of a variety of policy questions relevant to rural and regional development and environmental issues.

Main results:

- Indicators encompassing the multi-dimensional nature of sustainability (economic, environmental and social) were developed using Irish Teagasc National Farm Survey (NFS) data over an eleven year period (1996-2006). Economic viability was found to be generally in decline over the timeframe, however, when individual farming systems were considered, some were found to perform relatively better than others. From an environmental perspective, the more intensive farming systems were found to pollute more on average, while in more general terms the levels of methane emissions produced per hectare fell over the reference period. With regard to social sustainability a slight decline in demographic viability was found across systems.
- Future trends in agricultural sustainability were also examined using a number of hypothetical policy scenarios:
  - *The potential effect on farm-level sustainability of milk quota expansion (post-2009)* - results indicate an improvement in economic and social sustainability across farms on average, at the expense of environmental sustainability.
  - *The potential impact on farm-level sustainability of a carbon equivalent tax to reduce methane emissions* – results indicate that there would be significant regional variation in the burden of such a tax.
  - *The potential willingness to pay (WTP) of farmers to conserve an endangered Irish farmland bird, the Corncrake (Crex crex)* – findings suggest that farmers WTP for the restoration of the corncrake is positively correlated with participation in existing agri-environment schemes.
- In examining the participation of farmers in the Rural Environmental Protection Scheme (REPS) participants were found to be most likely operating on extensive and less environmentally degrading farming systems.

Opportunity / Benefit:

These research findings and the methodological approach employed will help inform future research in the area of agricultural sustainability.

Collaborating Institutions:

National University of Ireland, Galway.

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1. Project background:

The principle of ensuring the sustainability of agriculture is enshrined in the objectives of the EU's Common Agricultural Policy. In line with this, the Irish government are committed to fostering a sustainable agriculture, as echoed in the AgriVision 2015 report which stated that policy that supports a sustainable agriculture and rural community should remain at the core of Irish economic policy (Department of Agriculture, 2005). Indicators that include the three central components of sustainability; economic, environmental and social, exist internationally but there has been relatively little research on the issue in Ireland to date. This project builds on previous research to adapt pre-existing modelling tools and databases to explore farm-level sustainability. The project aimed to provide quality scientific based policy advice and recommendations on (i) the state of farm sustainability in Ireland and (ii) the effect of hypothetical policy scenarios on the economic, social, quality of life and environmental sustainability of farming practices. The overall objective was to develop an all-encompassing modelling system that can show the effect of policy on all three dimensions of sustainability simultaneously.

2. Questions addressed by the project:

- How best to measure sustainability at the farm-level?
- What is the state of farm sustainability in Ireland?
- What is the effect of a number of hypothetical policy scenarios on the economic, social and environmental sustainability of Irish farming?
- What types of farms are being protected under the agri-environmental programme REPS?

3. The experimental studies:

Indicators encompassing the multi-dimensional nature of sustainability (economic, environmental and social) were developed using Teagasc NFS data over an eleven year period (1996-2006) to assess the overall sustainability of Irish agriculture at the farm level. An indicator tool capable of generating sustainability indicators annually using NFS data was subsequently designed. Taking regional implications into account, using the SMILE model (Spatial Microsimulation Model of the Irish Local Economy) developed in the Rural Economy Research Centre, GIS tools were then used to demonstrate how these indicators can be derived at a spatial level below the national scale. The FAPRI farm-level model was then linked with the SMILE model to investigate the effect of a number of policy scenarios on the economic viability of farm businesses, the sustainability of farm households, the implications for the environment and the social status of farm households in the rural economy. In addition, using NFS data from 1995 to 2005 an examination of the types of farming systems participating in the agri-environmental programme REPS was also undertaken.

4. Main results:

- **Calculation of Indicators**

A series of farm-level sustainability indicators for Ireland were developed using Teagasc NFS data. Three dimensions, reflecting the multifaceted nature of sustainability (economic, environmental and social) were considered. Sustainability indicators are quantifiable and measurable attributes of a system that are judged to be related to its sustainability. They are statistical constructs which support decision-making by revealing trends in data that can then be used to analyse results of policy actions. A summary of some of the key indicators developed within the project are reported upon below:

Economic Sustainability

Based on previous research, an economically viable farm was defined here as having (a) the capacity to remunerate family labour at the average agricultural wage and (b) the capacity to provide an additional 5 per cent return on non-land assets. Results indicated a poor degree of economic viability on average across farms. Over the period 1996-2006 the proportion of farms classified as *'economically viable'* only lay between 29 and 41 percent. However, when individual farming systems were taken into account, some were found to perform relatively better than others. Furthermore, direct payments as a percentage of gross output were found to be greater in 2006 than in 1996 for all systems. Only the dairying and tillage systems were seen to show a significantly positive market return (defined as family farm income minus direct payments) at

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the beginning and end of the time period in question.

Environmental Sustainability
In general terms the levels of methane emissions produced per hectare was found to be falling over the reference period however the more intensive farming systems were found to pollute more on average. In calculating market return in terms of methane emissions (€ per kg) only the dairying systems were seen to be making a positive return per kg of methane produced. All other systems were in fact polluting at a loss.

Social Sustainability
Taking into account the percentage of farm households which have at least one household member below 45 years of age a slight decline in demographic viability is found over the period across systems. This indicator can be thought of as an indicator of succession with the likelihood of someone taking over the farm being worse when no member of the farm household is aged below 45. However, since those individuals not living at home are excluded from the data it is likely that the true presence of a successor is underestimated here. In addition, this analysis found that there was relatively little change in the number of one-person farm households over the period; however there were differences across systems.

Summary
The characteristics and complexity of sustainability (multi-dimensional, global, dynamic), make it a concept, which gives a certain direction for policy making rather than serving as a precisely defined benchmark. Sustainability indicators should allow one to judge whether a certain development contributes to movement in *'the right direction'*. In reality the interpretation of a set of multi-dimensional indicators can prove difficult and it can therefore sometimes be useful to aggregate a multi-dimensional set of indicators into a single index or composite indicator. These are becoming increasingly popular for sustainability assessments and can be more straightforward when interpreting data than trying to find a common trend in separate indicators. However, there is some debate as to their usefulness; they are helpful in that they can summarise complex or multi-dimensional issues and are easy to interpret, but, they may lack accuracy if poorly constructed. Furthermore, the choice of indicators is subjective and the weighting process by which the variables are combined is arbitrary. In our analysis the amalgamation of indicators into one composite indicator proved not very useful. The economic and environmental results were highly negatively correlated and in effect cancelled each other out; meaning that the social indicators were the main drivers of the composite indicator. Results highlight the complexity of the concept of farm sustainability and the difficulty of providing a comprehensive measure.

- **Future Trends in Sustainability – policy scenarios**

Analysis has also been completed within this project on a number of hypothetical policy scenarios; the first examined the impact on farm-level sustainability of milk quota expansion (quota expansion of 3 percent per annum was assumed from 2008-2014). Employing an integrated modelling approach, with farm entry and exit and quota trade modelled exogenously using econometric models the policy effect on farm income, farm numbers, off-farm labour supply and trade of quota as well as sustainability indicators were assessed. Key findings included an improvement in economic sustainability with average family farm income increasing under quota expansion from 2009. Quota expansion would result in a decline in the active population of farmers but with those remaining performing better on average i.e., the proportion of economically viable farms improved under a quota expansion scenario. However, environmental sustainability worsens under such a scenario with an increase in average methane emissions and organic nitrogen across farms. In terms of social sustainability, demographic viability improves (i.e., the proportion of households with a lower age profile increases) and the number of one person farm households decreases.

The potential effect of a carbon equivalent tax to reduce methane emissions was also examined within the scenario analysis. The economic impact was assessed by analysing family farm income at a regional level using a micro-simulation modelling technique called simulated annealing to match the Irish Census of Agriculture data to the NFS. The results of the modelling process highlight the fact that there would be significant regional variation in the burden of an agricultural tax that was based on a rate per unit of methane emissions. The results also demonstrated that if the methane tax revenue raised was redistributed in the form of an environmental subsidy to farmers participating in an agri-environmental scheme it would encourage farmers to participate in the scheme and could also have the effect of moving low income farms up the earnings distribution ladder.

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A final policy simulation considered farmers WTP to conserve an endangered Irish farmland bird, the Corncrake (Crex crex). NFS data was used to produce individual farm-level WTP estimates with figures then aggregated to obtain a total value figure for the farming community of corncrake conservation in Ireland. It is evident from the model results that farmers WTP for the restoration of the corncrake is positively correlated with participation in existing agri-environment schemes. Furthermore, the yearly total non-market value of corncrake conservation to the farming community, estimated using a valuation function approach, of €1,541,819 was six times the cost of corncrake conservation programs (€264,530) in operation in Ireland for the reference year 2006.

- **Modelling Participation in REPS**

The structure of the NFS data set allowed us to employ pooled, fixed and random effects panel data logit models taking into account changes in the participation decision of farmers over time rather than simply examining the participation decision at just one point in time. An eleven year panel containing information on approximately 1,100 farmers for each year was used. The results point to the fact that systems of farming that are more extensive and less environmentally degrading (i.e., extensive drystock) remain those most likely to participate in REPS. This is a classic case of an adverse selection problem, whereby the undesirable members of a population are more likely to participate in a voluntary exchange. The impact of REPS participation on farm chemical input usage and the production of negative externalities was also investigated using NFS data. The analysis showed that REPS has had a substantial impact on the use of chemical nitrogen, phosphorous and potassium. Furthermore, participation in REPS may have resulted in a more significant reduction in the production of organic nitrogen, organic phosphorous and methane emissions than would have been the case if the REPS farmers in the NFS had not joined the scheme.

5. Opportunity/Benefit:

This project has begun the task of assessing the sustainability of Irish agriculture at the farm-level. In addition, the effect of policy reform on the sustainability of Irish farms was also explored. Further work in this area and the development of additional indicators is necessary if such tools are to guide future policy.

6. Dissemination:

Research was published in peer reviewed publications and was presented at numerous national and international conferences.

Main publications:

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7. Compiled by:

Emma Dillon, Thia Hennessy and Stephen Hynes.

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Department of Agriculture and Food (2005). Agri-Vision 2015 Report. Report published by the Irish Department of Agriculture and Food, Dublin 2.

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