Project number: 5623
Funding source: DAFF (RSF/06/316)

Date: February, 2010
Project dates: Jan 2006 – Feb 2010

The impact of climate change on Irish farming

Key external stakeholders:

Policy makers, national government, farm bodies, farmers, industry

Practical implications for stakeholders:

- Climate change impacts will vary both spatially and between farm systems.
- Tillage producers are, potentially, most exposed to the negative implications of climate change.
- Pasture based systems may experience an increase in productivity as a consequence of improved growing conditions, particularly in the north and west of the country.

Main results:

- Results show that cereal production, in all regions, would be negatively affected under the climate change scenario used in this research.
- Production of maize silage is, however projected to increase in all of the regions.
- The effect of climate change differs across farm types and regions. However, the most common feature is that all livestock farms could increase profitability by exploiting the increase in grass production.

Opportunity / Benefit:

The primary benefits arising from this research relate to, firstly, providing indications as to the sectoral implications of climate change and, secondly, spatial implications. The research also highlights future policy issues that will arise as a consequence of changing patterns of agricultural production in response to climate change.

Collaborating Institutions:

Met Eireann, Department of Agriculture, Fisheries and Food, Environmental Protection Agency

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1. Project background:

There is growing concern about the potential impact of climate change on the viability of farming in Ireland. In relation to livestock agriculture, there are concerns that climate change will affect production directly through animal health, reproduction and productivity. For example, a rise in temperature may induce heat stress in animals that can lower productivity by decreasing appetite and increase susceptibility to parasitic diseases. However, this direct effect on livestock production is expected to be minimal in comparison to the potential indirect effects, namely the implications for grass growth. Many studies suggest that due to the carbon dioxide (CO_2) -fertilization mechanism, increased levels of atmospheric CO_2 concentration can increase grass yield by 20-30%. Similarly, a higher rainfall will be beneficial for grass growth in regions where water is currently a limiting factor, but it will have detrimental effects on grazing and grass conservation in areas with poor water drainage.

Profit maximizing farmers adapt their farm practices to changing circumstances. Previous research has shown that studies that do not allow for this farmer adaptation tend to overestimate the impact of climate change on farming. Hence it is important to consider how farmers may best adapt in response to the challenges and opportunities that climate change may bring. The main objectives of this study were initially to explore how climate change might affect the growing conditions for Ireland's major crops, and subsequently to quantify how farmers could best respond to these changes.

2. Questions addressed by the project:

Three key issues were addressed in this project:

- How is climate change likely to affect the yields of major arable crops (cereals), yields of grass and field time availability?
- How are these changes likely to affect farming practices?
- What are the best strategies that farmers can adopt in response to the challenges and opportunities that climate change may bring?

3. The experimental studies:

The research project was broken into two principal phases:

(1) To determine crop and grass yields under climate change

The objective was to project crop and grass yields under a climate change scenario for different Irish regions. For this purpose, growth models, DSSAT for crop production and Johnstown Grass Growth model for grass production, were used. The growth models used the National Farm Survey data, 2007 (NFS) and weather data to project the crop and grass yields. Farm survey data was separated for each of the 7 NUTS region. The weather data was 30-year averaged data for each of the regions for a baseline scenario and a climate change scenario. Besides crop and grass yields, another parameter, field time availability, was also determined for the baseline and climate change scenario under this task by using a soil moisture deficit simulator (JSMD).

(2) To determine the impact of climate change on farms and farmers responses to the change

An optimising linear programming model was developed for this study. The model is a farm level model which maximises farm profits within restricted farm resources. The model consists of a choice set of all possible farm activities a farmer may adopt to maximize profit. The major component of the model contains three livestock enterprises; diary, beef and sheep production as well as tillage production systems. These systems are constrained by fixed endowments of land, feed and labour. Land is fixed on a farm but feed and labour can be brought in if profitable. There are two major data inputs for the model; (i) farm level data, which is taken from the National Farm Survey (2007) and (ii) climate data taken from growth models generated under the first phase outlined above. Where data was not available from these two sources, such as livestock coefficients and costs and prices of some of the farm variables, are taken from various published

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sources.

4. Main results:

(1) Summary results from the growth models

Results show that cereal production would be affected substantially under the climate change scenario in all regions of the country. Yields are estimated to reduce significantly; yields for winter wheat decreasing up to -11 % in the South East region, spring barley yields decreases by up to -10% in both East and South East regions. Maize silage however, had a substantial increase in yields in all of the regions. The highest increase in the yield (+98%) was projected in the Border region. Grass yield also increases ranging from a maximum (+56%) in the South East region to a minimum (+49%) in the South West region. There is also an increase in field time availability especially during summer when grass is conserved. The availability of grassland for grazing also increases in all regions except the Border region where grazing period remained the same under the climate change.

(2) Summary results from the farm level model

The effect of climate change differs across farm types and regions. However, the most common feature is that all livestock farms can increase profit by exploiting the increase in grass production. On all farms it is optimal to reduce the use of concentrate feed. However, in the South East the increase in grass yields is not sufficient to decrease production costs. Tillage farms suffer from reduced yields in all regions. It is optimal for tillage farmers to increase livestock production to maximise profit. There is little benefit to be gained from the earlier (by one month) turn out of stock turning out as the grass yield in the extra month is insufficient. The viability of miscanthus as an alternative crop, was explored, however, it was not optimal for the vast majority of farms. The main conclusion from this study is that there is no big difference in farm adaptations adopted by farms in different regions. Farms in all regions would benefit under climate change if they exploit the increase in grass yield under climate change. Generally livestock farms are capable of minimising loses in farm margins by changing their feed regime alone, where as tillage farms in all regions loose out.

5. Opportunity/Benefit:

The primary benefits arising from this research relate to, firstly, providing indications as to the sectoral implications of climate changes and, secondly, spatial implications. The research also highlights future policy issues that will arise as a consequence of changing patterns of agricultural production in response to climate change.

6. Dissemination:

Shrestha, S. (2010). Optimising Irish Farms Under Climate Change: A Farm-Level Study. Paper presented at the Seminar on Climate Change, Stuttgart-Hohenheim, Germany. June 2010

Dillon, E. and Hennessy, T. (2010). Modelling Farm-level Sustainability. Paper presented at the annual Agricultural Economics Society Conference, Edinburgh, Scotland. March 2010.

Shrestha, S. and Hennessy, T. (2010) The Impact of Climate Change on Irish Farming. An End of Project Report. Teagasc.

Main publications:

Abdalla, M., Kumar, S., Jones, M., Burke, J. and Williams, M., Testing DNDC model for simulating soil respiration and assessing the impacts of climate change on CO2 effects from Irish Agricultural soils. Working Paper, School of Botany, Trinity College Dublin.

7. Compiled by: Dr Thia Hennessy

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