

Climate Change and Irish Agriculture

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1. The Dimensions of the Climate Change Problem

In their latest report, the Intergovernmental Panel on Climate Change (IPCC, 2007a) paint a picture of accelerating problems associated with human misuse of the atmosphere. Unequivocal evidence of warming and a 90% level of confidence that human activities, namely the loading of greenhouse gases on the atmosphere to concentrations not experienced for over 650,000 years, are the drivers of recent changes is reported by this respected body representative of almost all the world's leading atmospheric scientists. In their Fourth Assessment Report, the IPCC have synthesised research output from across the peer-reviewed literature over the past seven years (IPCC, 2007). Among the more significant findings indicative of the quickening pace of global climate change are the following:

- The second half of the 20th Century was the warmest in at least the last 1300 years in the Northern Hemisphere. Temperature extremes have significantly increased in many parts of the world. The oceans have warmed to a depth of 3km.
- Acceleration in the rate of sea-level rise, melting of glaciers, and reductions in snow cover are now apparent. Summer sea ice extent is reducing by 7.4% per decade and may well disappear in the Arctic by mid century with serious consequences for ecosystems dependent on it.
- Precipitation increases in many temperate regions are now occurring while droughts have become more frequent and more intense in many parts of the tropics.

These observed changes are consistent with model projections and provide confidence that the latter are reliable ways of looking into the future, albeit with

acknowledged uncertainties in assumptions especially regarding population, economic and energy growth in the years ahead. Nonetheless the attribution of recent climate change to human activities is more stridently asserted than ever before, with a 90% level of confidence that

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“Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.”

(IPCC,2007)

The increasingly confident assertion of the IPCC reflects better understanding of anthropogenic warming and cooling influences on climate over the past decade. For example there is also now very high confidence that the globally averaged net effect of human activities since 1750 has been at least five times greater than that due to solar output changes.

Impacts are likely to be experienced in a wide range of areas and sectors (IPCC, 2007).

- While water availability is likely to increase in high latitude areas, and in some parts of the wet tropics, many of the presently water-stressed areas of Africa are likely to become more drought-prone, seriously compromising their development potential and their agricultural productivity.
- 20-30% of plant and animal species will face a high risk of extinction if global temperature increases above pre-industrial levels go beyond ~2°C.
- While food production may increase globally in the medium term due to the fertilising effect of higher CO₂ concentrations in the atmosphere, once temperature increases exceed about 3°C, yields are likely to start declining. In dry parts of Africa this will commence sooner, with any rise above present levels, raising the spectre of widespread hunger during drought events.
- Hundreds of millions of people in the densely populated delta regions of the developing world will become more vulnerable to floods and tropical storms. Small island states, especially low lying tropical islands, will also be highly vulnerable.
- Outside of the temperate regions, adverse health effects will be apparent from heat waves, storms, floods, fire and drought as well as changes in water and

vector borne diseases. These will more than counterbalance any improvements due to warmer winters in high latitudes.

It is clear that the burden of climate change falls inequitably on those least able to bear the burden. It is also clear that the developing world will suffer for a problem not primarily of their making. The developed world will, in the medium term at least, have the financial and organisational resources to better adapt to the problem of global climate change though even in areas such as Ireland significant changes in climate will be observed. At a global scale, the impacts on agriculture and food production are likely to be considerable.

2. Global Agricultural Impacts

The impact of global climate change on crop production is the result of an interaction between two sets of factors. Firstly, the Direct Effect of having more CO₂ in the atmosphere is generally beneficial to the process of photosynthesis and other things being equal will improve the net biomass production of many agricultural crops. This is particularly true of many temperate crops grown in Ireland such as wheat and barley, and grass. Crops originating in warmer climatic regimes such as maize do not fare so well. Secondly, running counter to this, is the indirect impact of unfavourable climate changes, such as drought or excessive temperatures. These may stress the growing crop and negate the positive impact of extra CO₂ 'fertilisation'.

Modelling a variety of crops for their response to these factors leads the IPCC to conclude that crop yield potential is likely to increase at higher latitudes for global average temperature increases of up to 1-3°C depending on the crop, and then decrease beyond that. At lower latitudes, especially the seasonally dry tropics, crop yields are likely to decrease for even small global temperature increases. This raises issues of food security which have emerged onto the political agenda in the past year. As with many environmental hazards, the disadvantaging of the less developed countries is evident. The relative advantages enjoyed by the developed world agricultural systems results in a conclusion that global agricultural production potential is likely to increase with increases in global average temperature up to about 3°C, but above this it is very likely to decrease. The extra warmth of the temperate regions, as well as opening up new areas polewards of the present limits of cultivation, will generally not be as disastrous to adapt to as the projected rainfall reductions in parts of Africa in particular. For many tropical regions, increased

frequency of droughts and floods will affect local agricultural production negatively, especially in subsistence sectors.

3. Irish Agricultural Impacts

Earlier work led by ICARUS at NUIM to examine climate change impacts on Irish agriculture focussed on crop yield changes (Holden and Brereton, 2003). While this indicated that the viability of some crops such as potatoes would be compromised in drier parts of eastern Ireland, and that grass growth during dry summers in the south-east would be reduced considerably, it did not indicate how Irish farmers might adapt their farm management practices to cope better with the changing agroclimatic conditions. More recent work indicates that adaptive practices can diminish considerably the stresses of climate change. Modelling key farm enterprises for a range of locations around Ireland enables the nature and potential benefits of adaptive management practices to be identified (Holden et al, in Sweeney *et al* (in print)). These show a range of results relating to likely impacts of climate change and how Irish agriculture might better position itself to adapt as follows:

- In east Leinster and east Ulster water stress in grass, barley, potato and to a lesser extent maize will occur on a much increased frequency. Summer soil moisture deficits will be problematical for dairying, losses from which may be partially compensated by reductions in fertiliser inputs. Late summer feed deficits may require supplementation or the introduction of a mid season housing period during particularly dry summers.
- In the midlands, less stresses are apparent in summer and good yields of grass, barley, maize, potato and, later in the century, soybean can be expected. Scope for reduced fertiliser inputs will be greater in areas of poorly drained soils.
- In the extreme northwest cool temperatures and relatively wet conditions will produce lower grass, maize and soybean yields, but good barley and potato yields. On poorly drained soils, agriculture will be slightly more productive than at present. Dairying will not be heavily impacted.
- In south and south-west Munster, warm temperatures and relatively moist conditions will lead to good grass, barley and maize yields and provide potential for new crops such as soybean. Potato yield is limited. The relative advantages of this region for dairying will be maintained though summer droughts will become more common than at present.

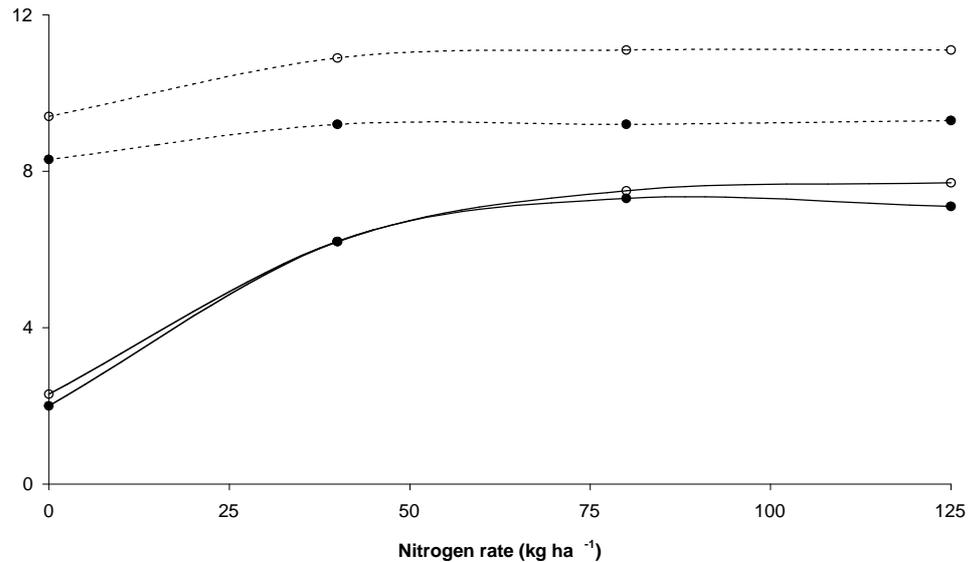


Figure 1: The nitrogen response (t/ha) with and without irrigation for: barley averaged over eight sites where the crops are most commonly grown. (Non-irrigated=solid lines, 2055 = open circles, present day = closed circles)

4. Conclusions

Irish agriculture faces several challenges in the next few decades if it is to remain competitive as global climate change accelerates. It may be suggested that:

- Irish agriculture will be capable of adapting to climate change and most of the current crops will remain viable.
- Extensification will be facilitated by climate change in many areas.
- Summer water will become the determinant of productivity. But who else will be looking for water in the summers of mid century?
- Changed occurrences of pests/diseases may alter conclusions significantly
- Adaptation to climate change for Irish agriculture will centre either on maximising outputs or minimising inputs. Generally the potential for considerable reduction in nitrogen application rates will occur (Figure 1).
- For the key dairying sector, a range of response options exists which should mean the continuing viability and profitability of this sector.

All of this reinforces the logic of REPS as an instrument of adaptation to climate change and as means of protecting the competitive position of Irish agriculture during times when more drastic pressures will adversely affect the productivity of

neighbouring countries as well as raising issues of food security at a more global level.

References

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