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LAND-USE COMPETITION BETWEEN ENERGY AND FOOD – THE CASE OF CLIMATE CHANGE MITIGATION IRELAND

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Overview

Combating climate change and achieving food security are one of the most important and interlinked policy challenges for the world at the start of the 21st century. The growth in world population associated with increased income levels and wealth will drive an increase in food demand, which is expected to increase in 2050 by 60% relative to 2005/2007 levels (Alexandratos and Bruinsma, 2012). There is potential to increase global food production to meet this demand, through increased crop yields and expansion of the agricultural area (Schulte et al., 2011). However the expansion of agri-food sector has a possible competitor in the land usage patterns: the energy sector. The urgent need to reduce greenhouse gas emissions and declining petro-chemical resources is driving an increased global demand for biofuels and biomass, which are likely to become the most significant fuel sources of future low carbon economies.

This paper develops and tests a methodology to assess via scenario analysis the implications of land-use competition in delivering food security and climate mitigation for Ireland, which is an interesting case study for a number of reasons, i.e. i) agriculture currently accounts for about 30% of Ireland's GHG emissions, significantly higher than other industrialised countries; ii) the agri-food sector represent approximately 7% of Ireland's economy (in terms of GDP), largely driven by exports; iii) about 60% of Ireland's land available is currently devoted to agriculture. However this work and methodology can be applied elsewhere.

Methods

To carry out this analysis this paper uses the Irish TIMES model, the energy systems model of Ireland, in conjunction with the recently developed Irish Agriculture TIMES module. This integrated energy and agriculture system model has been developed with the TIMES modelling framework, developed and supported by IEA-ETSAP. The agriculture system module was developed to extend the energy systems modelling approach to incorporate non-energy systems and moving towards an integrated modelling approach where the agriculture and energy systems are modelled together to provide richer insights into the dynamics and interactions between the two. The conceptual model structure of the agriculture module is presented in the flowchart of Figure 1.

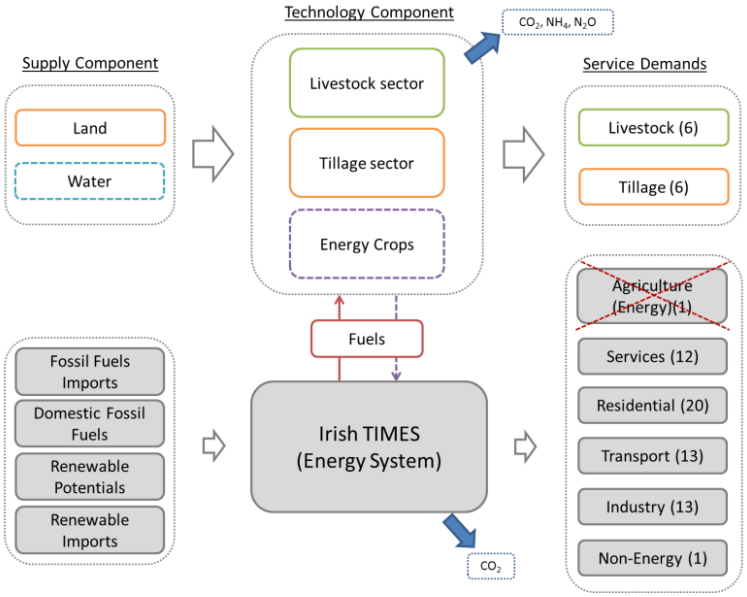

Figure 1 - Flow chart of the agricultural system module and interactions with Irish TIMES

Results

The scenario results provide a range of energy and agriculture system configurations for Ireland that each deliver projected service demand requirements optimised to least cost and subject to a different policy constraints for the period out to 2050. The scenarios explore how, under different GHG mitigation targets for 2050, energy crops compete with agri-food sectors. The results i) evaluates the role of single bioenergy commodities; ii) quantifies the impact in terms of domestic land usage; iii) investigates implications for limited land-use availability; iv) discusses the economic impacts of different mitigation futures. The results show that to deliver cost optimal emissions mitigation trajectories by 2050 the required land for domestic energy crops ranges between 0.7% and 15.1% of total agriculture land.

A detailed description of results and scenarios with constrained land availability (still under development) will be included in the full paper. Below some examples of results:

Unit: kha		REF		GHG-50		GHG-60	
		Land required	Land contracted	Land required	Land contracted	Land required	Land contracted
Domestic	Willow	0	0	22	44	80	160
	Miscanthus	30	30	95	95	95	95
	Biogas from Grass	0	0	389	389	389	389
	Bioethanol from Wheat	0	0	0	0	0	0
	TOTAL	**30**	**30**	**505**	**527**	**563**	**643**
Imported	Bio Ethanol	36	43	452	542	131	157
	Biodiesel	0	0	284	284	0	0
	Wood Chip	46	46	229	229	123	123
	Wood Pellets	0	0	318	318	368	368
	TOTAL	**82**	**89**	**1,282**	**1,372**	**621**	**647**
% of AGR Land	**Domestic**	0.7%	0.7%	11.9%	12.4%	13.2%	15.1%
	Imported	1.9%	2.1%	30.5%	32.7%	14.8%	15.4%

Table 1 – Land required for domestic and imported energy crops in 2050 (kha)

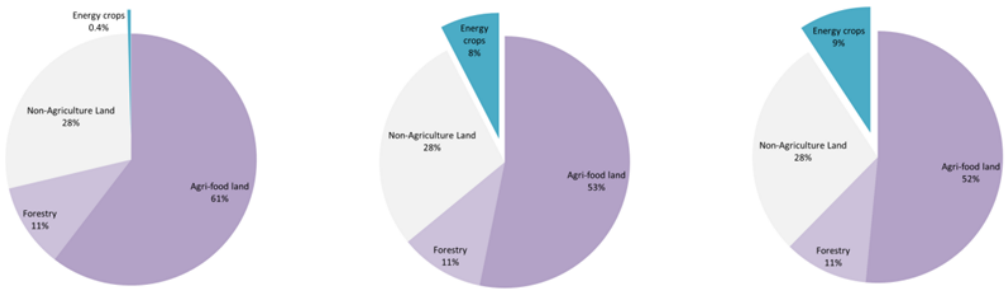

Figure 2 – 2050 land-usage in REF, GHG-50 and GHG-60 scenarios

Conclusions

This paper explores a case for the integration of the agricultural sector into an energy system model to assess implications of competition for land-use between the energy sector and agriculture in a context of an EU goal of 80%-95% reduction. Results show that an integrated modelling approach provides important insights into the most cost effective mitigation pathways and draws evidence for new comprehensive policy strategies able to discern between the full range of technical solutions available for energy, climate and food security.

References

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