The relationship between climate change and agriculture is a contentious, complex and important one.

In this series of twelve blogs, UCD Adjunct Professor Frank Convery will explore the context, challenges and potential solutions for dairy, beef and sheep farming in Ireland. Each blog presents key evidence to underpin informed debate and the series seeks to help plot a sustainable future for the sector.

Responses are invited via earth.institute@ucd.ie and the UCD Earth Institute will host a workshop in association with the UCD School of Agriculture and Food Science and the National Economic and Social Council at the end of the series in December 2022 to discuss the evidence and its implications.

Professor Tasman Crowe, Director, UCD Earth Institute

1. Climate Performance by Irish Ruminant Farming (Dairy, Beef, Sheep) - Looking Back

Frank Convery, Adjunct Professor, University College Dublin

How to cite this blog (APA): Convery, F. (2022, September 21). Climate Performace by Irish Ruminant Farming (Dairy, Beef, Sheep) - Looking Back. *UCD Earth Institute Climate Policy for Ruminant Agriculture in Ireland*. https://www.ucd.ie/earth/newsevents/climate-policy-agriculture-ireland-blog/climatepolicyforruminantagricultureinirelandblog1/.

See https://libguides.ucd.ie/academicintegrity on how to cite in other formats.

*"Ireland will become a **world leader** in Sustainable Food Systems over the next decade. This will deliver significant benefits…and will also provide the basis for the future competitive advantage of the sector".*
Food Vision 2030 *[1]*

"It doesn't matter how beautiful your guess is or how smart you are or what your name is. If your idea disagrees with experience, it's wrong. That's all there is to it".

Richard Feynman, (Nobel Prize Physics, 1965)

Some Key Points

Ireland has little hope of becoming a world leader in Sustainable Food Systems (SFS) unless it understands and acknowledges the reality of its climate performance. Rural Ireland is hugely dependent on the export earnings (€7.9 billion in 2021) of its ruminant farming, almost two thirds of which is earned by the dairy sector. In rank order, the EU, UK, and the US account for the majority (69.2% in 2021) of its farming exports by value. Consumers in these markets, and the climate policies that are implemented therein, will determine whether the carbon footprint of Irish farming is competitive in these markets. There has been no improvement in Ireland's carbon footprint (Kg CO_2/Kg Product) since 2015, most of the case making to the effect that Ireland is top of class in this regard depends on data that is 18 years old (2004) limited to one geography (EU), and it uses a counterfactual – performance by producers with the average emissions intensity globally – that does not reflect the competition we face in our key markets.

Introduction

In Ireland, we have four key sources of Irish-based data on agriculture's climate performance that would be credible in a court room. The first is the Irish Environmental Protection Agency's reporting; the second is the national farm survey (sustainability) data published by Ireland's Agriculture and Food

Development Authority (Teagasc). A third source is the ex-post analyses of public expenditure undertaken by the Irish Government Economics and Evaluation Service (IGEES). A fourth credible source of data on trade and other performance metrics is the Central Statistics Office (CSO). These four sources are credible because: they follow best international practise; are independent and up to date; use methodologies that are transparent, their work is subject to peer review; and you could put witnesses forward who could defend such evidence in ways that would maximize the prospects of convincing a judge and/or jury of their independence and skills, and the veracity of their data.

Why courtroom? Two reasons: first, claims about performance often end up being adjudicated there; second, they are places where blather usually gets eviscerated, and credibility tends to prevail. This was the case when Ornua's ('Kerrygold') grass fed claims were challenged in federal court in a class action suit in California. In deciding in favour of Ornua on February 3, 2019, Judge Marilyn Huff was influenced by the quality of the evidence from the "Sustainable Dairy Assurance Scheme (SDAS)" [1] and its timeliness.

Below, I summarize a few examples of recent evidence on performance as regards: market and climate outcomes by the ruminant livestock sectors (dairy, beef, and sheep) which account for ~82% of the sector's total greenhouse gas emissions; Ireland's recent carbon footprint performance and comparisons with other countries based on data from 2004 and 2017. I then touch on the carbon leakage issue, and conclude with a personal assessment as to what the evidence implies.

Evidence

I. Export Market Performance

Most of the food produced in Ireland is exported. Ruminant exports (Table 1) in 2021 were valued in aggregate at €7.9 billion, of which 64.4% were delivered by dairy products; total exports rose by 23.2% since 2015, with most of the growth occurring in the dairy sector. In rank order, the top three destinations – EU (37.0), UK (26.3) and the US (6.0) - accounted for 69.3% of sales (Table 2)

Table 1 Exports (Volume and Value) 2015 – 2022 Ireland, Dairy, Beef, Sheep

Sector	**ROW**	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022 (Q1)**
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dairy										Jan-Feb
	(1)	Tonnes	1,184,506	1,216,261	1,365,941	1,431,185	1,725,162	1,713,568	1,650,933	233,034
	(2)	€000	3,885,159	3,991,095	4,673,230	4,586,929	5,084,601	5,108,914	5,059,581	702,199
	(3)	Per Tonne €	3280	3281	3421	3205	2947	2981	3065	3013
Beef										
	(4)	Tonnes	486,102	532,612	547,153	534,542	528,379	524,710	451,352	95,584
	(5)	€000	2,209,079	2,267,544	2,402,516	2,434,586	2,348,872	2,334,846	2,406,477	421,143
	(6)	Per Tonne €	4544	4257	4391	4492	4445	4450	5332	4406
Sheep										
	(7)	Tonnes	48,017	55,845	62,434	59,761	61,960	64,096	57,928	9,548
Value	(8)	€000	241,893	277,106	310,054	316,004	317,840	355,680	385,230	64,072
	(9)	Per Tonne €	5038	4962	4966	5288	5130	5549	6650	6711

TOTAL VALUE	(10)	€000	6,371,344	6,535,745	7,385,800	7,337,519	7,751,313	7,799,440	7,851,288	1,187,414

Source: response by Carol Forrester, International Trade in Goods Section, Central Statistics Office Ardee Road, | Dublin 6. to request I sent to: Trade@cso.ie

Table 2. Exports by Destination Dairy, Beef, Sheep, (000 €) 2021 IRELAND

Destination	**ROW**	**DAIRY**		**BEEF**		**SHEEP**		**TOTAL**	
		Value (000 €)	%	Value (000 €)	%	Value (000 €)	%	Value (000s €))	%
EU	(1)	1,555,043	30.7	1,107,183	46.0	239,288	62.1	2,901,514	37.0
CHINA	(2)	416,652	8.2	1,553	0.6	87	-	418,792	5.3
US	(3)	431,197	8.5	36,206	1.5	1,547	0.4	468,950	6.0
UK									
Great Britain	(4)	602,619	11.9	857,154	35.6	40,366	10.5	1,500,139	19.1
Northern Ireland	(5)	357,065	7.1	196,137	8.2	7,290	1.9	560,492	7.1
TOTAL UK	(6)	959,784	19.0	1,053,291	43.8	47,656	12.4	2,060,631	26.2
EU, China US and UK	(8)		66.4		91.9		74.9	5,850,407	74.5
EU, UK, US	(9)		58.2		91.3		74.9	5,430,937	69.2
GRAND TOTAL	(10)	5,059,581	100	2,406,477	100	385,250	100	7,851,308	100

Source: response by Carol Forrester, International Trade in Goods Section, Central Statistics Office Ardee Road, | Dublin 6. to request sent to: Trade@cso.ie

Note: EU total is an aggregation of the sales to the (other) 26 individual member states.

II. Greenhouse Gas Emissions and Removals Performance

Total greenhouse gas emissions show an increasing trajectory since 2014 (Table 3), There is a net leakage of C02 from land use, with removals in 2019 of 5.2 million tons being exceeded by leakage of 9.3 million tons (Table 4). The rate of annual afforestation (the main means of achieving removal in the future) has more than halved since 2012 (Table 5)

Table 3. Greenhouse Gas Emissions, Total and Agriculture, Ireland, 2012-2021, Million tons CO2e

EMISSIONS	ROW	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total	(1)	59.7	59.4	58.9	61.4	63.7	63.1	63.4	60.9	58.8	61.5
Agriculture	(2)	20.2	20.9	20.4	20.9	21.5	22.2	23.1	22.1	22.4	23.1
Of which enteric methane	(3)	12.4	12.5	12.4	12.8	13.2	13.6	14.0	13.6`	13.8	14.0

Source: EPA-Ireland's-Provisional-GHG-Emissions-1990-2021_July-2022v2.pdf, p. 29

Table 4. Total Removals and Leakage Ireland, 2019

	000 tons CO2e
Removals	
Forest Land	4,433.7
Cropland	110.1
Harvested wood products	617.9
Total Removals	5,161.7

Leakage	
Grassland	7,014.0
Wetland	2,331.5
Total Leakage*	9,345.5
Net Leakage (Leakage-Removals)	4,183.8

* This excludes leakage from 'Settlements' (209.8) and 'Other Land' (49.0)

Source: IRL_ghg_profile.pdf (unfccc.int) p. 4

Table 5. Afforestation 2012-2020, Ireland

YEAR		**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Hectares		6653	6252	6156	6293	6500	5536	4026	3500	2434

Source: Ireland's Forests - Annual Statistics 2019 (teagasc.ie) p. 28 for data up to 2019; for 2020 forest statistics ireland 2020 - Search (bing.com)

III. Carbon Footprint

'Carbon footprint' signifies the emissions associated with a particular activity. The word 'carbon' in this context is used generically to characterize all greenhouse gas emissions which in the case of ruminant farming means methane (CH_4), nitrous oxide (N_2O) and Carbon Dioxide (CO_2)

Table 6 Global Warming Potential (GWP) - Weighting per metric ton of Methane (CH_4) and Nitrous Oxide (N_2O) relative to one ton of Carbon Dioxide (CO_2)

Gas	**100 Year Period**			**20 Year Period**		
	2007	2014	2021	2007	2014	2021
CO2	1	1	1	1	1	1
CH4						
Fossil Origin	25	28	29.8	72	84	82.5
Non-Fossil origin			27.2			80.8
N2O	298	265	273	289	264	273

Source: IPCC Sixth Assessment Report (AR6) Global Warming Potentials - (ercevolution.energy), August 26, 2021.

The weightings per ton are applied to provide aggregate emissions in tons of carbon dioxide equivalent (CO2e), typically using the weightings from 2014 for a 100-year period but some will be updated using the 2021 coefficients. The carbon footprint can be estimated using different bases, and estimated either within the farm gate, or also including emissions associated with the production and delivery of inputs, and those associated with processing and transport of output, the aggregate characterised as based on 'life cycle analysis' (LCA). For farmers, emissions per farm or per hectare are important and the performance of an average farm is a useful benchmark (Table 7)

Table 7. Greenhouse Gas Emissions Average Farm, by system, Ireland 2020, Tons of CO2e

Farm Type	**Average GHG Emissions (Tons of CO2e)**	
	Per Average Farm	Per Average Hectare
Dairy	510.7	8.6
Cattle	131.6	4.1
Sheep	126.8	3.1

Source: 2020-Sustainability-Report.pdf (teagasc.ie) pp. 71, 72, 73.

This provides a useful metric for farmers with which to compare their own current performance, and to plan future emissions reductions. It has two limitations: it does not include estimates of carbon removals or leakage - some farmers will be removing carbon (hedgerows, trees, some soils) and others leaking it

(draining peaty soils or wetlands) and the Teagasc data does not capture these; secondly, there are issues around the accuracy of measurement at farm level, and its cost[2].

Carbon Footprint per Kg of Product - Relative Performance

The findings from four published sources are summarized below:

1. Intensity Data Ireland 2012-2020

Carbon intensity of production improved up to 2015, but since then shows no statistical improvement for dairy and beef; there may be some improvement in sheep meat (Table 8).

Table 8. Emissions per unit of product, Average Farm, 2012-2020, Ireland

Sector		Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020
DAIRY	(1)	Kg CO2e/Kg Milk FPCM (LCA)	1.31	1.24	1.14	1.03	1.06	1.08	1.11	1.03	1.04
CATTLE	(2)	Kg CO2e /Kg liveweight beef	13.3	13.5	13.0	11.2	10.8	11.0	11.5	11.0	10.5
SHEEP	(3)	Kg CO2e /Kg liveweight sheep	9.2	9.2	9.4	9.7	8.9	8.7	9.1	7.8	9.7

Source: 2020-Sustainability-Report.pdf (teagasc.ie) pp. 70, 71, 74 for 2015-2020 data. Earlier sustainability reports for 2012-2014.

2. Intensity Data EU Member States 2004

In an evaluation of the livestock sector's contribution to the EU greenhouse gas emissions published in 2010, based on 2004 data, the Joint Research Centre published data on emissions of CO2e per kg of product by member state, across 27 member states. It included emissions attributable to methane, nitrous oxide, carbon dioxide, and land use and land use change.

Table 9. Ireland Performance and Ranking within EU, Emissions of CO2e per Kg Product, 2004

Product	~Emissions of CO2e/Kg Product, Ireland	Ireland Ranking	MS Better performing than Ireland
Milk	0.95	1	Shares top ranking with Austria
Beef	19	6	Germany, Italy, Netherlands, Austria, Sweden
Sheep and Goat	21	14	Over half

Source: Leip et al, 2010. Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS) – final report. European Commission, Joint Research Centre (JRC), November, pp 323.

Beef: Figure 6.1, p. 164; Cow Milk: Figure 6.7, p. 167; Sheep and Goat Meat Production: Figure 6.15, p. 175

Note: Emissions per Kg are based on interpolations from Figures and therefore approximate.

3. Intensity Data, Ireland compared with Mercosur Countries, 2017

The FAOSTAT (within the farm gate) emissions intensities for the Mercosur countries and Ireland are shown in Table 8; It is clear that, in 2017, Ireland's average emissions per kg of beef were lower than all four, ranging from 38% (Paraguay) to 61% (Argentina) emissions. However, it is notable that three of the four show considerable efficiency improvement since 1990, and this improvement is continuing while Ireland's has not.

Table 10. CO2 Intensity of Beef Production, Mercosur Countries, and Ireland, 1990 and 2017

Country	CO2e Intensity (Kg CO2e/Kg product	
	1990	2017

Argentina	28.0	29.4
Brazil	51.9	34.6
Paraguay	71.9	46.9
Uruguay	40.2	34.8
Ireland	16.4	17.8

Source: Department of Enterprise Trade and Employment, 2021. "Table D1 Emissions intensity of beef production in Ireland vs. Mercosur countries" Economic and Sustainability Impact Assessment for Ireland of the EU-Mercosur Trade Agreement, June, p. 131. economic-and-sustainability-impact-assessment-for-ireland-of-the-eu-mercosur-trade-agreement.pdf (enterprise.gov.ie). See also: comparing-life-cycle-greenhouse-gas-emissions-dairy-pork-systems_0.pdf (wri.org)

4. Intensity Data Compared for Thirteen Countries, 2017

In a more recent assessment of the carbon efficiency of dairy farming for 13 countries undertaken by the World Resources Institute (Table 11) the most carbon efficient milk producer is Sweden (1.21 Kg Co2e/Kg Milk) and the least efficient is Brazil (2.08). Ireland 1.44) is ranked joint 9th with Poland (Column (1) When the emissions are adjusted to account for the carbon that would have been removed if the land were no longer in use for dairy production, its ranking falls slightly, to 11th.

Table 11. Emissions (Kg CO_2e/Kg MILK) for Dairy by Country and Emissions Category, 2017

COUNTRY	**Kg CO_2e/Kg MILK**		
	Total Production Emissions (PEM) – rank ordered	Land Costs (COC)	Total Emissions (1)+(2)
	(1)	(2)	(3)
Sweden	1.21	2.39	3.61
Denmark	1.22	1.89	3.11
Germany	1.30	1.88	3.17
France	1.34	2.43	3.77
Spain	1.37	2.06	3.44
Netherlands	1.37	1.65	3.02
New Zealand	1.40	1.95	3.35
UK	1.40	2.48	3.88
Ireland	**1.44**	**3.14**	<p**4.58**
Poland	1.44	3.64	5.08
USA	1.49	1.47	2.96
Italy	1.50	2.22	3.72
Brazil	2.08	5.05	7.13

Source: World Resources Institute (Searchinger et al), 2021. A Pathway to Carbon Neutral Agriculture in Denmark, WRI, carbon-neutral-agriculture-denmark.pdf (wri.org) p. 53 (Table 3.1)

IV. Climate Policy Performance 2014-2020

The main progress in this period has been:

- The integration of climate and other sustainability metrics into the commercial and social accounting of Ireland's farming sector (this is touched on again in Evidence Based Blog 2 'The Coming Metrics Revolution').
- The development of the marginal abatement cost curve (MACC) which began the process of identifying and costing the most promising emissions abatement and carbon removal strategies.[3]
- The European Innovation Projects (EIPs) demonstrated that if you pay for performance, you get it, and that a grass-roots consortium of farmers can find ways that work to deliver public goods (mainly biodiversity). Such outcomes were highlighted in an Interview on RTE's Countrywide 13

August 2022 conducted by Ella McSweeney with Patsy Carrucan, a successful part time suckler farmer[4] with 43-44 cows (mixed shorthorns), Fenore (Burren), County Clare.

- In the Beef Data Genomics Programme (BDGP), over 24,000 beef suckler had their farms assessed by Navigator (a tool developed by Teagasc to estimate greenhouse gas emissions), with consultants who were paid €160 per assessment[5]. This demonstration of baselining emissions performance at scale is an important step.

However, there are two major failures:

- The flagship policy to address greenhouse gas emissions under the 2014-2020 Common Agricultural Policy was the Green Low-Carbon Scheme (GLAS); it was evaluated by the Irish Government Economics and Evaluation Service[6]. It cost €1.54 billion, co-shared between the European Union (53%) and the Irish Exchequer (47%). Notwithstanding the 'low carbon' in its title, while it delivered valued income to many low-income sheep and beef farmers, and some biodiversity gains, it has negligible impacts on reducing greenhouse gas emissions.
- The collapse in tree planting (Table 5) means that our main instrument to remove carbon has atrophied, and this gap means that the resulting addition to CO2 stocks in the atmosphere will blight our posterity for over a century.

Assessment

Ireland has no hope of becoming a world leader in Sustainable Food Systems (SFS) over the next decade unless it understands and acknowledges the reality of its climate performance.

Export Market Performance

These data highlight two things for me:

- How dependent rural Ireland is on the export earnings (€7.9 billion in 2021) of Irish ruminant farming, almost two thirds of which is earned by the dairy sector. As well as farmers this accrues to individuals, families, businesses and social infrastructure (e.g., schools) in rural Ireland. If a lack of carbon competitiveness results in even a 5% reduction in export revenues, this loss would amount to €395 million annually; we can afford to spend a lot of money to ensure that such shrinkage does not happen.
- In rank order, the EU, UK, and the US account for the majority (69.2% in 2021) of our ruminant farming exports by value. Consumers in these markets, and the climate policies that are implemented therein, will determine whether the carbon footprint of Irish farming is sufficiently low to continue to find favour with consumers in all three, and to overcome any climate-related border adjustments that emerge in the UK and/or the US. What happens in these three jurisdictions is so important that I devote Evidence Based Blogs 4 (EU), 5 (UK) and 6 (US) to what I see emerging therein.

Greenhouse Gas Emissions and Removal

The climate costs imposed by the sector are high and have been rising. In 2021, of the 23 million tons emitted, about 9 million tons (mainly nitrous oxide) will be in the atmosphere for well over 100 years, damaging the prospects of our posterity for over a century. A further 14 million tons (mainly methane) will be in the atmosphere for a much shorter period, but these emissions are a key cause of the climate change we are already experiencing, costs which today are borne mainly by the poorest in the developing world.

Carbon Footprint

There are three things I worry about:

- No improvement in carbon footprint (Kg CO2/Kg Product) since 2015.
- Most of the case making to the effect that Ireland is top of class in this regard depends on data that is 18 years old and limited to one geography (EU)
- Widespread ignoring of current and prospective developments on both the production and market side in key markets, where the carbon footprint competition will be mainly from domestic producers not Brazil.

This issue is so important that I devote Evidence Based Blog 2 ('Complacents vs. Worriers') thereto.

Policy Performance

Some good data and other infrastructure have been put in place, but climate policy only delivers at scale when there is pay for performance and/or penalty for non-performance and where this is accompanied by a mission focussed innovation strategy directed at addressing key constraints (mainly enteric methane reduction at scale suited to pasture based ruminant farming). These (except for the European Innovation Projects which have embraced pay for performance) have been absent so far.

I devote Evidence Based Blogs 9 ('Some essentials'), 10 ('CAP 2023-2027'), 11 ('Other Policy Instruments') and 12 ('Methane Reduction Innovation Strategy') to helping find a policy mix that would work to deliver remissions reduction and carbon storage at scale.

Biography

Frank Convery has degrees [B. Ag and M.Ag (Forestry)] from UCD. Encouraged by the late Seamus Sheehy, he went to the US and took a PhD in Forestry Economics (State University of New York). After a distinguished academic career in the US (Duke University) he returned to Ireland as research professor at ESRI before being appointed as Heritage Trust Professor of Environmental Studies at UCD where he led the successful application for the funding of the UCD Earth Institute. He chaired the boards of the Sustainable Energy Authority of Ireland (SEAI) (2002-2007), Comhar Sustainable Development Council (2006-2010) and served on the Climate Change Committee (2016-2020) chaired by John FitzGerald, and the AgriFood 2030 Committee chaired by Tom Arnold. The latter produced *Food Vision 2030*. From 2014 to 2018, he was chief economist with the Environmental Defense Fund, New York. His passion is finding ways to bring the weight of learning down to where things are done; his ambition for the sector is the same as Food Vision 2030's: "Ireland will become a **world leader** in Sustainable Food Systems (SFS) over the next decade. This will deliver significant benefits…and will also provide the basis for the future competitive advantage of the sector".

Footnotes and references

[1] This addresses housing, manure management, feeding, silage, water use, fertilizer, soils, pesticides and herbicides, biodiversity, economic and social sustainability, energy. More details at: SDAS_Standard.pdf (agridata.ie)

[2] In the Beef Data Genome Programme (BDGP), over 24,000 beef suckler producers had their farms assessed by Navigator (a tool developed by Teagasc to estimate greenhouse gas emissions), with consultants who were paid €160 per assessment. [Cawley, A., and A. Cronin. 2019. *Spending Review 2019: Beef Data Genomics Programme*. Irish Government Economic and Evaluation Service – IGEES]. 4092b0f1c806495485644360f489c63c.pdf (assets.gov.ie)

[3] Lanigan, Gary J and Trevor Donnellan, Eds 2019 March An-Analysis-of-Abatement-Potential-of-Greenhouse-Gas-Emissions-in-Irish-Agriculture-2021-2030.pdf (teagasc.ie)

[4] Patsy Carrucan - Farming for Nature

[5] Cawley, A., and A. Cronin. 2019. *Spending Review 2019: Beef Data Genomics Programme* 4092b0f1c806495485644360f489c63c.pdf (assets.gov.ie)

[6] McDermott, Cathal, 2019. Spending Review, 2019. *The Green, Low-carbon Agri-environment Scheme,* Irish Government Economic and Evaluation Service (IGEES). 197ea0c01c5840a0b2255bd8d446cea8.pdf (assets.gov.ie)