

Project number: 6409
Funding source: Department of Agriculture
Food & the Marine (Stimulus Fund)

Date: October 2017
Project dates: Dec 2012 – Nov 2016

Increased environmental efficiency of ruminant production systems through the incorporation of a Life Cycle Assessment into a quality assurance scheme



Key external stakeholders:

Dairy Processors, beef, sheep and dairy farmers, Irish Cattle Breeding Federation (ICBF), Bord Bia, consultancy agencies, ORNUA

Practical implications for stakeholders:

- Quantified biodiversity levels of beef, sheep and dairy farms
- Developed mitigation strategies to improve sustainability on farm across the metrics of electricity, water, nutrient use efficiency and GHG emissions
- Developed decision support tools to aid farmers in making decisions in regards to improving sustainability at farm level
- Integrated milk carbon footprint model within the National Farm Survey for annual assessments of carbon footprints

Main results:

- Across the 65 dairy farms approximately 13% of the total area was defined as a wildlife habitat
- The total water footprint of this group of Irish dairy farms was 690L of water per litre of milk with 684L of that water made up of green water and 6L defined as blue water
- Each litre of milk required 42 watt hours of electricity to produce, which corresponded to approximately 0.5c/l in monetary terms
- Integrating a certified carbon footprint model into the national farm survey in 2014 provided the first representative carbon footprint for Irish dairy systems. The carbon footprint averaged 1.11 kg of CO₂-equivalent/kg milk for the first year assessed, 2012.
- Subsequent analysis using economic information from the national farm survey revealed that as farm profit improved carbon footprint declined. The key strategy identified that improved profit and reduced farm carbon footprints was increasing milk yield/ha via greater pasture utilization.

Opportunity / Benefit:

Across the food supply chain there is an increasing focus on sustainable farming systems. The Origin Green initiative provides a significant and real opportunity to communicate the sustainability credentials of Irish ruminant production systems. However, to satisfy consumers, this must be based on valid scientific numbers and facts which are underpinned by scientifically robust methodologies. This project has advanced the development of these methodologies.

Collaborating Institutions:

Irish Cattle Breeding Federation, Bord Bia, UCD

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1. Project background:

A central requirement within the Food Harvest 2020 and Food Wise targets is that output is increased in a sustainable manner. The Food Harvest and Wise reports call for the development of a sustainability audit system that uses recognized international standards to benchmark the overall sustainability of Irish farms, locally and globally. To realise the Food Harvest 2020 vision this project updated or developed new models and metrics according to international standards to enable Ireland's producers verify their "green" credentials and help promote "Brand Ireland". The methods recommended to evaluate farm sustainability are life cycle assessment (LCA) and whole farm systems analysis. This project updated and created LCA models to feed into an assurance scheme and unlike previous studies evaluated several sustainability criteria simultaneously. The sustainability criteria we chose to evaluate were based on those chosen in key EU and FAO reports and included biodiversity, water and energy consumption, greenhouse gas emissions and nutrient losses.

2. Questions addressed by the project:

- This project answers industry and consumer questions around quantifying the sustainability of Irish ruminant producers from several resource and environmental perspectives.
- It addresses the requirements of stakeholders to develop a sustainability audit system that can benchmark Ireland's performance over time and offers the potential to carry out this monitoring through a quality assurance scheme or system.

3. The experimental studies:

A group of 75 beef, dairy and sheep farms were selected to participate in this project over a two-year period. Information was collected for several sustainability metrics through direct measurement, surveys and websites. Energy and water was measured on farm after installing monitoring equipment. The information from these measuring devices was remotely transferred to Moorepark via the mobile phone network at 15 minute intervals or manually read. Habitats were measured on farms to assess biodiversity levels and mapped online. Farm facilities were also measured e.g., cubicles per slatted unit to determine farm infrastructure levels. Animal number and activity information for the farms along with monthly milk volumes supplied to dairy processors was transferred by technicians from the Irish Cattle Breeding Federation website to the Moorepark Oracle database. Data that could not be captured directly or indirectly (e.g., cattle or sheep housing dates) was provided by farmers using detailed on-line monthly surveys.

A number of models were developed to international best practice standards to quantify sustainability across the different metrics. These models applied holistic systems approaches to quantify resources used and pollutants generated throughout a product's life cycle, from raw-material acquisition through to production of the farm product. Examples of new LCA models developed included a water footprint model for Irish dairy systems and a carbon footprint model for primary sheep production systems. Existing certified dairy carbon footprint LCA models were updated using the latest research and embedded within the national farm survey database.

4. Main results:

- Embedding the certified LCA model in the national farm survey showed the average carbon footprint of Irish dairy farms in 2012 was 1.11 kg of CO₂-equivalent/kg milk with the 95% confidence interval ranging from 0.67 to 1.56 CO₂-eq/kg milk.
- Relating carbon footprint to dairy farm profitability generally showed as profit increased carbon footprint decreased. For instance, the carbon footprint of milk for the top one-third of farms ranked in

terms of net margin/ha was 7% lower than the middle third and 14% lower than the bottom third. The main farm strategy identified that improved farm profitability and reduced farm carbon footprints was increasing milk yield/ha from pasture.

- Productivity increases, after the removal of milk quota in 2015, on 58 of the project dairy farms, led to the average annual carbon footprint of milk declining from 1.15 kg to 0.99 kg of CO₂-equivalent/kg of milk. For the same period, there was little change in the projects beef and sheep footprints, which averaged 13.1 and 8.3 kg of CO₂-equivalent per kg of live weight, respectively. Nevertheless, both were below national average estimates of 14.1 and 10.4 kg of CO₂-equivalent/kg of live weight for beef and sheep farms, respectively.
- Seventy five percent of the E-Ruminant farms could be classified as improved grassland or semi improved grassland across dairy, beef and sheep farms
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5. Opportunity/Benefit:

The current project has developed the scientific methodologies to quantify sustainability on farms in Ireland. It has developed models to internationally recognized standards and resulted in the deployment of the models in databases e.g., national farm survey that can be used to benchmark sustainability across farms and over time. The current national initiatives built around Bord Bia and Origin Green require robust scientific methodologies to underpin the claims being made around the sustainability of Irish products across ruminant production systems.

6. Dissemination:

Main publications:

O'Brien, D., Bohan, A., McHugh, N., Shalloo, L., 2016a. A life cycle assessment of the effect of intensification on the environmental impacts and resource use of grass-based sheep farming. *Agricultural systems*, 148, 95-104.

O'Brien, D.; Hennessy, T.; Moran, B.; Shalloo, L., 2015. Relating the carbon footprint of milk from Irish dairy farms to economic performance. *Journal of Dairy Science* 98 10 7394-7407

Upton, J., M. Murphy, P. W. G. Groot Koerkamp, I. J. M. D. Boer, L. Shalloo. 2014. Investment Appraisal of Technology Innovations on Dairy Farm Electricity Consumption. *J Dairy Sci.* 2015 Feb;98 (2) :898-909.

International conferences

Results were presented at numerous conferences such as the FAO Leap committee workshop in Rome, Lifecycle assessment food conference in Dublin, Greenhouse Gases and Animal Agriculture Conference in Australia, International Manufacturing conference in Northern Ireland, Global Science Conference in France and the Agriculture Engineering Conference in Switzerland.

National conferences and seminars

Presented at national dairy, beef and sheep conferences and at the Agricultural Research Forums throughout the duration of the project as well as presenting to Dairy Degree students that undertake their undergraduate programmes at Teagasc Moorepark

Open days:

Presented at Moorepark and Grange open days, as well as at a number of open days that were held on individual farms throughout the country.

Industry consultation

Different industry groups were collaborators on this project and therefore got first-hand knowledge of the projects findings. For other national industry groups there were many other meetings at different points throughout the project.

Farmer discussion groups

Results were presented and discussed at several farmer discussion groups and seminars. There were also intensive sessions completed with the farmers involved in the overall study on a number of occasions throughout the project to provide feedback on an on-going basis.

7. Compiled by: Dr Laurence Shalloo