An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

16/RD/SusAn/ERA-NET: SUSTAINBEEF - Co-definition and evaluation of SUSTAINable BEEF farming systems based on resources non-edible by humans

Final Report

This project was funded under the Department of Agriculture, Food and the Marine Competitive Funding Programme.

SUMMARY

The ERA-NET project hypothesis was that cattle farming systems that rely on grassland and agro-industrial resources/byproducts which are non-edible by humans are more sustainable for cattle production. EU partners would outline beef production systems and document inputs and outputs which would be modelled in a broader sutainability context, which would include land use and feed-food competition.

The SustainBeef core approach was based on a modelling, using the FarmDyn tool, which simulated the choices of the farmer to optimize profit. The same tool was used to identify ways of increasing farm sustainability and reducing foodfeed competition.

Representative beef farming systems were defined for the regions of partmers involved in SustainBeef. During the participatory process that included beef farmers and actors in the value chain, real-life case studies were used to develop the model and then to define the outcomes from different scenarios. Sustainability indicators were identified to assess the performance of the scenarios. Indicators were chosen to gain insights across three dimensions of sustainability:

environment, economic and social. Indicators for feed-food competition were added as they are of societal concern. The indicators were further refined to be applicable to the FarmDyn model.

The most promising scenarios in terms of sustainability and feed-food competition could be identified whereby, policymakers and researchers can examine the scenarios that are most relevant and which may require additional support to initiate them. However, more technical validation, in experimental farms and validation in larger farm sample and territorial scale, is warranted. The innovations identified by EU partners focusing on greater use of grazed grassland and beef crossing on dairy herds were seen as desirable, and are common place in Ireland.

KEYWORDS

Methane, cattle, rumen

ACRONYM	16/RD/SusAn/ERA-NET SUSTAINBEEF
PROJECT COORDINATOR, INSTITUTION	Dr Edward O'Riordan, Teagasc, Animal & Grassland Research and Innovation Centre
EMAIL	edward.oriordan@teagasc.ie
COLLABORATORS, INSTITUTION	Walloon Livestock Association, Belgium. Institut National de la Recherche Agronomique and Institut de l'Elevage, France. University of Bonn, Germany. Council for Agriculture Research and Economics, Italy.
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Section 1 - Research Approach & Results

Start Date

01 July 2017

End Date

31 December 2020

Select Research Programme

Research Stimulus Fund

Please select the appropriate TRL Scale

TRL 6: Technology demonstrated in relevant environment

NRPE Priority area

Sustainable Food Production and Processing

Total DAFM Award

€136,250.00

Total Project Expenditure

€9,825.73

Rationale for undertaking the Research

Sustainable livestock production is of paramount importance to society. Developing and supporting farming systems that convert non-edible human feedstuffs into valuable human edible food in the form of animal product, would be most beneficial to society. Within the EU partner countries, the project aimed to identify a range of beef farming systems, representative of their regions, spanning soil type and climatic conditions, and examined options for the production of beef in a more sustainable manner. The approach was particularly attractive to Ireland given the dominance of grassland based beef production systems, and the marketing strategy for beef that is strongly focused on emphasising its sustainability, traceability and low carbon footprint. Developing an awareness of the each countries strengths and opportunities in terms of their potential to sustainably produce beef is of importance. The collaboration would hopefully provide new insights (both cross countries and systems) into EU beef production that may benefit the future marketing of beef for export markets. With its strong grassland based livestock sector, reflecting a climate conducive to pasture growth, it was envisaged that Ireland would compare favorably with other EU producers in the broader measures of sustainable beef production.

Methodology

The main approach used in Sustainbeef was based on modelling sustainability, using the FarmDyn modelling programme. Farming systems were defined that are representative of the regions in the partners involved in

SustainBeef. Farm case studies were used to develop the model and define several different baseline scenarios.

Sustainability indicators were identified to assess the performance of the scenarios. Indicators were developed/selected to gain insights using three sustainability (environment, economic and social) dimensions. Indicators for feed-food competition were added and categorised under the social dimension of sustainability, as they were of societal concern. The indicators then were further refined to be applicable to the FarmDyn modelling tool. New indicators of the food security were developed. Three criteria were considered; the production of human edible proteins and energy at farm level, the competition between animals and human food production, and the production costs of beef protein and energy that give an indication of the economic accessibility of this food for the population.

A number of innovations were defined that would to reducing feed-food competition. Through modelling, the most interesting scenarios, in terms of sustainability and feed-food competition (like grass fattening, crossbreeding or new feed stuff (e.g., algae)) would be identified. These innovations could be examined by policy-makers and researchers to further examine the scenarios that are most relevant and which may require additional support to initiate them. Support may mean additional research if knowledge is lacking, or incentives for farmers to change their way of working, or encouragement of the value chain to accept new products.

The application of the FarmDyn model could highlighted innovations that would be of interest to farmers. However, more technical validation, in experimental farms and validation in larger farm sample and territorial scale, may be warranted.

Project Results

Three broad sustainability criteria were considered, the production of human edible proteins and energy at farm level, the competition between animals and human food production, and the production costs of beef protein and energy that give an indication of the economic accessibility of this food for the human population.

At the highest level, results show that the production of milk, and cash crops, makes more efficient use of arable land in terms of human edible protein (HEP) and energy (HEE) production at farm, and in terms of production costs, compared to beef only production. The grassland-oriented systems, and the use of food co-products (by-products), are the most effective responses to increase the HEP and HEE efficiency for beef production and should then be favoured on nontillable land. Although most of HEE and HEP efficient farms often have higher meat production costs, some grassland based systems stand out, positively, for these indicators. These results point to a way for improvements in the contribution of beef production systems to food security.

Various scenarios were modelled through FarmDyn and the results of these simulation were compared to the baseline system in terms of their profitability, environment impacts, protein and energy efficiencies.

Some scenarios were presented to the value chain actors in Belgium, Italy and France through participatory approaches. As a result of the Covid-19/sanitary crises methodology need to be adapted: in Belgium and France it was through a combination of face-to-face and virtual meetings, and individual phone conversations in Italy.

The global results indicated that potential innovations have to be analysed in the context of a region and particularities of the farms where they are planned to be implemented. New feedstuff originating from other sectors, have the potential to both reduce feed food competition and improve sustainability. However, the success of such an innovation depend, for example on its price, if too high, it is not adopted, but if too low, it may replaces otherwise more desirable feedstuff, such as grass silage, from an overall sustainability point of view. New breeding strategies, such as crossbreeding and semen sexing, may improve sustainability as higher performing animals can be selected, and the amount of animals for herd replacement may be reduced. However, this may lead to “over intensification” for instance, by increasing the share of concentrates being fed to animals with unfavourable environmental footprints as a result. Fast rotational grazing, and the use of catch crop for livestock feeding, were among the most promising innovations, although there implementation might be hampered by limited access to adjacent fields and distance from the farmyard in fragmented farms. In an Irish context, some of the innovations suggested by the partners, such as greater use of grazed grassland, rotational grazing, longer grazing seasons, crossbreeding of animals, using beef sires on the dairy herd, are already well established practices in Ireland.

Section 2 - Research Outputs

Summary of Project Findings

The feed-food competition and land use components of sustainability developed in through SustainBEEF have been incorporated into existing Teagasc suckler-beef and dairy-calf-to-beef models, with the latter aspect forming the basis for a PhD thesis by the student recruited under the SustainBEEF project. Beef production systems oriented towards grassland, and those that use food by-products not used for human food, are favourable to increase the HEP (human edible protein) and HEE (human edible energy) efficiency for beef production. Although most of HEE and HEP efficient farms often have higher meat production costs, some grassland based systems, such as those based on permanent grassland with limited alternative use range, stand out, positively, for these indicators. At the highest level, results show that the production of milk, and cash crops, makes more efficient use of arable land in terms of HEP and HEE production and in terms of production costs compared to beef only production. These results point to a way for improvements in the contribution of beef production systems to food security.

For EU partners, greater use of grassland was seen as an innovation or change which could increase the sustainability of their beef sectors. Having animals outdoors on pasture for longer periods, the introduction of rotational grazing, all common in Ireland, were seen as potential innovation for partner countries. Integration of beef and dairying (beef sired on dairy herds) and the use of sexed semen were seen as potential innovations, with the former being widely used in Ireland. Permanent grasslands with a limited alternative use range performed well in terms of HEP and HEE compared to sites with greater land use ranges.

Summary of Staff Outputs

Research Output	Male	Female	Total Number
PhD Students	1	0	1

Summary of Academic Outputs

Research Outputs	Total Number	Details
Publications in Peer Reviewed Scientific Journals	1	Evaluation of the contribution of 16 European beef production systems to food security Claire Mosnier a,*, Anne Jarousse a, Pauline Madrange b, Jimmy Balouzat a, Ma¨eva Guillier a, Giacomo Pirlo g, Alexandre Mertens c, Edward ORiordan e, Christoph Pahmeyer h, Sylvain Hennart c, Louise Legein c, Paul Crosson e, Mark Kearney f, Philippe Dimon b, Carlo Bertozzi d, Edouard Reding d, Miriam Iacurto g, James Breen f, Sara Car`e g, Patrick Veysset a, a Universit´e Clermont Auvergne, INRAE, VetAgro Sup, UMR1213 Herbivores, 63122 Saint-Gen`es Champanelle, France b IDELE, Service productions de viandes, 75595 Paris, France c, Walloon Agricultural Research Centre, 5030 Gembloux, Belgium d, Walloon Livestock Association, 5590 Ciney, Belgiume Teagasc, Animal and Grassland Research and Innovation Centre, Grange, Dunsany, Co. Meath, Ireland f, University of Dublin, Dublin 4, Ireland G, Council for Agriculture Research and Economics, 26900 Lodi, Italy h University of Bonn, 53115 Bonn, Germany Published in Agricultural systems 190 (2021)
Peer Reviewed Conference Papers	1	Whole farm modelling of physical, economic, greenhouse gas emissions and feed-food competition performance in dairy-beef production systems

Summary of other Project Outputs

Project Outputs	Details	Total No.
New Technology	The partnerships has successfully developed, and greatly enhanced, the modelling capability in the Teagasc beef programme. The inclusion of Human edible protein and Human edible energy is a new and welcome addition to broadening a more complete understanding of sustainability.	1

Potential Impact related to Policy, Practice and Other Impacts

Impact	Details
Environmental Sustainability	Compared to production systems in partner countries, Irish beef production compared favourably in a sustainability context. The data shows that the suckler cow producing a weaned calf has a net contributor to Human edible protein, and this was especially true for suckler-weanling systems on the marginal land having a limited land use range

Dissemination Activities

Activity	Details
Seminars at which results were presented	Presentations at; European Association of Animal Production (EAAP conference (Davos, zoom) Animal, Veterinary, Teaching and Research Workers (AVTRW conference, Teagasc, Grange) British Society of Animal Science (BSAS 2022 (April, in Nottingham, England)

Knowledge Transfer Activities

Identify knowledge outputs generated during this project.	Developing the modelling capability in the area of animal feed-human food competition is significant and through the collaboration, that capability is now being integrated into existing Irish beef models. Beef models

	that separately addressed green house gasses and systems economics for dairy- beef have been integrated and the feed-food and land use dimension has been developed.

Section 3 - Leveraging, Future Strategies & Reference

Future Strategies

At a partnership level, working together has forged important collaborative networks in a number of countries, and collectively publishing the project data has cemented a productive relationship among partners. The possibility of future collaboration and joint application for wider EU funding has been enhanced through this project. Similar or other collaborative activities should be strongly encouraged and the possibility of staff mobility and training should be included as an important aim of such future initiatives.

Project Publications

1. Evaluation of the contribution of 16 European beef production systems to food security Claire Mosnier, , Anne Jarousse, Pauline Madrange, Jimmy Balouzat, Ma¨eva Guillier, Giacomo Pirlo, Alexandre Mertens, Edward ORiordan, Christoph Pahmeyer, Sylvain Hennart, Louise Legein, Paul Crosson, Mark Kearney, Philippe Dimon, Carlo Bertozzi, Edouard Reding, Miriam Iacurto, James Breen, Sara Car`e, Patrick Veysset Agricultural systems 190 (2021)

2. Whole-farm Modelling of Dairy Calf to Beef Production Systems. Mark Kearney, E G O'Riordan, J Breen, and P Crosson (AVTRW meeting, Teagasc, Grange, 2021)

3. Whole-farm Modelling of Dairy Calf to Beef Production Systems Mark Kearney, E G O'Riordan, J Breen, and P Crosson EAAP 2021, Davos, Switzerland

4. Whole farm modelling of dairy beef production systems Mark Kearney, E G O'Riordan, J Breen and P Crosson. BSAS April 2022, Nottingham, UK