# GROFarmS (Growing Resilient Organic Farm Systems)

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## Summary

GROFarmS is a four year organic research project that commenced in March 2024 and is co-funded by DAFM and Teagasc. The project is led by Teagasc, in collaboration with UCD research partners and industry partners and will support the sustainable development of Irish organic production systems. A multi-disciplinary team has been assembled for the project, which includes researchers in the areas of animal production and systems, socio-economics, tillage, soil health and biodiversity as well as a team of Knowledge Transfer Organic Specialists in organics across beef, sheep and tillage enterprises.

## Summary

The GROFarmS project aims to provide timely research to underpin the rapid expansion of the area farmed organically in recent years and ambitious targets to grow the sector further. GROFarmS addresses three primary research areas:

- to evaluate and further develop organic knowledge transfer interventions in order to demonstrate technically efficient systems of production to build the knowledge and confidence of farmers in organic production
- to undertake scientific research on organic beef (and lamb) finishing systems in order to develop efficient technology blueprints which will support farmers to finish animals organically
- to measure the sustainability of organic farming systems in Ireland.

**Introduction**

The Climate Action Plan (2024) has set ambitious targets to increase land farmed according to organic standards from the current area of 225,000 ha (5% of total farmed area) to 450,000 ha (10%) by 2030. This is anticipated to abate 300 kt of $CO_2$eq due to a reduction in animal numbers and lower levels of fertiliser application, particularly nitrogen. This ambition is currently being incentivised through financial support from government in the form of an enhanced Organic Farming Scheme.

The largest organic sector in Ireland is beef cattle production. According to DAFM, there are now over 5,000 organic farms in Ireland in 2024 with approximately half of these being cattle farms. There are an estimated 20,000 organically-farmed suckler cows in Ireland with 12,500 cattle finished for organic beef production. This highlights that a major issue for the organic beef sector is the high 'leakage' rate between organic suckler cow systems and finished beef output, estimated at 30%. To address this leakage, research is needed to demonstrate the financial viability and sustainability of efficient finishing system in order to support best practice adoption by farmers.

Central to this project is the demonstration of these best-practices for organic beef finishing systems in order to expedite technology transfer to the organic farming sector and address the lack of scientific evidence in the area. In the case of beef systems, Teagasc is currently converting the 98.8-acre Kildavin farm at Johnstown Castle in Co. Wexford to a fully certified organic holding. This farm will be developed as an organic finishing systems research and demonstration farm. The research undertaken will assess a range of beef finishing options to develop clear guidelines for efficient and profitable organic-beef finishing systems. Complementary research trials will be conducted identifying optimal finishing diets at the Grange Centre which will subsequently inform systems experiments in Johnstown Castle. The research conducted in these trials will provide the basis for further investigation into organic production systems by supporting cross cutting studies in product quality and environmental impact assessments.

The Johnstown Kildavin farm will support a detailed dissemination plan led by the organic knowledge Transfer specialists on the project team, Joe Kelleher, Elaine Leavy, Martin Bourke, which will ensure that the outputs from the study are communicated effectively to industry.

The sustainability of organic beef farms will also be measured by gathering detailed production information on a sample of commercial organic farms within the nationally representative Teagasc National Farm Survey (NFS). These commercial organic farms will provide in-depth socioeconomic and environmental sustainability benchmarking data to compare the performance of organic and conventional farms nationally but also to benchmark farm performance internationally. A supplementary Teagasc NFS survey will be used to identify the drivers of conversion to organics, or in the case of conventional farmers, the barriers to conversion.

**Beef Research component of GROFarmS**

**Objectives**

Given the expected continued influx of farms into organic beef systems, it is paramount to develop clear guidelines for efficient and profitable systems. Key considerations are: optimising lifetime growth rates
so as to reach target carcass weight/fat scores as early as possible (i.e. 'young' slaughter age), producing adequate forage of sufficiently high quality in the absence of inorganic fertilisers, minimising the importation of expensive supplementary concentrate feeds and, maintaining the highest levels of animal health and welfare with minimal use of antimicrobials and producing high quality food products.

The overall aim of this work is to develop production blueprints for beef production systems that conform to organic standards.

**Specific objectives of this research are:**

1. Quantify the feed intake, growth, digestibility, nitrogen balance and methane emissions of spring-born early- and late-maturing breed suckler 'weanling' steers offered contrasting clover silage-based diets (red clover silage + concentrate, Multi-species sward (MSS) silage + concentrate) during their 'first' indoor winter (task 1).
2. Compare the methane emissions, feed intake, growth and carcass characteristics of weaned early- and late-maturing breed suckler steers that are reared according to organic-farming production standards and slaughtered at the end of the 'second' grazing season (~19 months old), the end of the 'second' winter (~24 months old) or during the 'third' grazing season (~28 months old) (task 2).
3. Evaluate the intake, growth, nitrogen balance, methane production, and carcass characteristics of 'finished' suckler-bred steers offered alternative 'organic' forage-concentrate diets (task 3).
4. Whole-farm systems modelling of the impact of alternative 'organic' beef cattle production systems on farm profitability, GHG emissions and food/feed ratios (task 4)
5. Assessing soil health, biodiversity and carbon turnover benefits of organic farming systems (task 5)

**Task 1.** Intake, growth, digestibility, nitrogen balance and methane emissions of spring-born early- and late-maturing breed suckler 'weanling' steers offered contrasting clover silage-based 'organic' diets

Spring-born early- and late-maturing breed weaned suckler steers (n = 36 of each breed-type, i.e. 72 in total), approximately 330 kg live weight and 8 months of age, will be identified through the Teagasc organic specialist team and purchased from commercial beef farms operating according to organic-farming production standards, and assembled at Teagasc Johnstown Castle. Animals will be the progeny from early- and late-maturing breed sires bred to late-maturing breed cows. Within 'Breed Type' (late- and early-maturing), steers will be blocked together on live weight, age and genetic merit ('Terminal' Breeding Index) and randomly assigned to one of a number of organic forage-based diets comprising: Feed sampling and analysis will be as previously conducted in comparable traials and described in Lenehan et al. (2017). Animal measurements will include dry matter intake, live weight gain, ultrasonic measures of

body composition (Lawrence et al., 2012; Lenehan et al., 2017) and enteric methane output will be measured using Greenfeed units (Smith et al., 2021).

An additional 16 weanlings will be purchased and assembled at Teagasc Grange to determine apparent digestibility and nitrogen balance of the two diets (O'Connor et al., 2019; Kennedy et al., 2023).

**Task 2.** Methane emissions, feed intake, growth and carcass characteristics of weaned early- and late-maturing breed suckler steers reared on 'organic' weanling-to-beef production systems and slaughtered at 19-, 24- and 28 months of age

At the end of the 'first' winter, yearling steers from Task 1 (n=72) will be turned out to pasture and rotationally grazed on a mixture of perennial ryegrass and white clover swards. At the end of the 'second' grazing season (200 days), animals will be blocked, within Breed type and first-winter dietary treatment, on live weight, age and genetic merit and randomly assigned to one of three 'Slaughter Ages'; (i) 19 months: slaughtered at the end of the 'second' grazing season (i.e. immediately), (ii) 24 months: subsequently housed indoors and finished at ~24 months of age (finishing diet will be determined by the 'optimal' diet indicated by Task 3), and (iii) 28 months: subsequently housed and offered grass silage only for the 'second' winter, followed by 120 days at pasture. Animals will be managed in replicated grazing groups as described previously (Doyle et al., 2021; 2022; 2023).

Measurements will be carried out as described for Task 1. Additionally, animal dry matter intake (Doyle et al., 2021; 2022; 2023) and enteric methane (Smith et al., 2021) will be determined during the grazing season. Following slaughter, carcasses will be weighed, and graded for fat and conformation according to a 15-point EUROP scale (Fitzsimons et al., 2014).

**Task 3.** Intake, growth, nitrogen balance, methane production, and carcass characteristics of 'finishing' suckler-bred steers offered alternative 'organic' forage-concentrate diets.

Spring-born suckler-bred steers (n=72), approximately 500 kg live weight and 19 months of age, will be identified through the Teagasc organic specialist team and purchased from commercial beef farms operating according to organic-farming production standards.

Steers will be blocked according to weight, age and genetic merit and randomly assigned to one of four 'finishing diets', namely: (i) perennial ryegrass silage (PRG) + 5.0 kg 'conventional' concentrates per head daily (control treatment), (ii) white clover silage + 3 kg of 'combi crop' (iii) red clover silage (iv) ad lib (combi) crop; a mixture of a legume - peas or beans & a cereal crop of barley, oats, wheat or triticale.
An additional 32 cattle will be purchased and assembled at Teagasc Grange to determine apparent digestibility and nitrogen balance of the four diets. Measurements will be carried out as described above.

**Task 4.** Whole-farm systems modelling of the impact of alternative 'organic' beef cattle production systems on farm profitability, GHG emissions and food/feed ratios

Data obtained from Tasks 1, 2 and 3 will be used to augment existing Teagasc beef models (Taylor et al., 2020; Kearney et al., 2022). These whole farm models are single year, static, deterministic simulation models that facilitate the technical and economic evaluation of a range of different grass-based beef production systems. GHG emissions can be modelled using either life-cycle assessment approaches or IPCC inventory boundaries. For farm systems analysis, the latter does not consider emissions generated outside of national boundaries (e.g. fertilisers imported into Ireland) or emissions which arise outside of the agricultural sector (e.g. energy emissions). These updated models will be used to conduct a wide ranging and comprehensive scenario analyses of organic beef cattle production systems

**Task 5.** Assessment of soil physical, chemical and biological health benefits of organic systems

This task aims to measure soil health benefits associated with organic farming. Soil health measurements will be conducted across the organic farm and adjacent conventionally managed beef systems experiments at Johnstown Castle.
The physical, chemical and biological soil health properties will be characterised at all field sites. Soil Organic Carbon (SOC) stocks and the allocation of SOC between labile and recalcitrant pools will be measured at depth across the scenarios. This will help to disentangle the efficiency of organic systems to cycle carbon (C). A range of physicochemical and microbiological properties related to soil function will also be measured in selected samples.

Laboratory analysis will include:
- Bulk density, texture, and water holding capacity.
- pH, organic matter, Total N, Total C, Mehlich III Extraction of Macro & Micronutrient
- SOM chemical fractionation. This will include: hot water extractable C and N, humic acids, fulvic acids, particulate OC (POC), dissolved OC (DOC), light fraction OC (LFOC).
- Isotopic natural abundance of 13C and 15N to assess the state of SOM decomposition
- Bacterial and fungal abundance by qPCR
- Community structure and diversity of prokaryotic and fungal communities by 16S rRNA and ITS sequencing

Soil samples collected during this task will primarily be handled at Teagasc Johnstown Castle (JC) lab facilities. C and N stable isotope natural abundance analysis will be conducted on these samples.