Reducing Greenhouse Gas Emissions from Agriculture by Finishing Beef Cattle at Earlier Ages

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Summary

- Reducing the finishing age of prime beef cattle has been identified as a key greenhouse gas mitigation measure for the Irish agricultural sector.
- By reducing the finishing age of a beef animal, the total quantity of methane associated with bringing that animal to finish, is reduced.
- Between 2010 to 2022, the average finishing age of prime beef cattle reduced from 27.9 to 25.6 months.
- Challenging weather conditions in 2023, as well as reduction in the number of young bulls being produced, increased average finishing age to 26.1 months.
- Research is ongoing to identify the key factors impeding lifetime live weight performance on beef farms, and assess the barriers to technology adoption of key enabling measures.

Introduction

Reducing the finishing age of prime beef cattle (steers, heifers and young bulls) has been identified as a key greenhouse gas (GHG) mitigation measure for the Irish agricultural sector (Government of Ireland, 2024). The Teagasc Marginal Abatement Cost Curve (MACC; Lanigan et al., 2023), found that a reduction in finishing age by 3 to 3.5 months (from 26 months in 2018 to between 22 and 23 months in 2030), is estimated to reduce annual agricultural emissions by 0.47 to 0.73 Mt CO2 equivalents (eq.). Importantly, earlier finishing of beef cattle, not only has the potential to decrease the quantity of GHG emissions an animal emits over its lifetime, but is also likely to be economically advantageous, by lowering total costs associated with rearing an animal, and thus is a key contributor to on-farm profitability (Taylor et al., 2020; Kearney et al., 2024). However, while a significant reduction in the finishing age of prime beef cattle has been made over the past decade and a half, progress has slowed in more recent years.

In this paper we will firstly, outline the effect of earlier finishing on beef cattle GHG emissions. Following this, an overview of the prime beef cattle performance in both the years before and after the Climate Action Plan will be presented. Finally, some of the on-going research specifically targeted at facilitating an earlier finishing nationally, will be introduced.

Why target earlier finishing for beef cattle?

When cattle ingest feed, especially forages, they produce methane gas as a by-product of the digestive process. The methane produced in this digestive process, which is known as enteric fermentation, accounted for 24% of national GHG emissions in 2023 (EPA, 2024). The amount of methane produced via this process is largely driven by feed intake. Simply put, as an animal's level of feed intake increases, more feed is fermented in the rumen, which increases the supply of energy and protein to the animal, but also elevates the supply of substrates to methanogens (microbes that produce methane), leading to an increased synthesis of methane in the rumen. Based on work conducted by Teagasc Grange, across various different diets and animal types, including intensive finishing rations and pasture based diets, growing beef cattle have been shown to produce 22-27 g of methane for every kg of dry matter intake (DMI). Both rumen size and the voluntary feed intake of an animal increases in order to meet the nutritional demand of an animal as it grows. Thus, at the latter stages of an animal's life, when it is at its heaviest and thus consuming a greater proportion of feed, the quantity of methane an animal produces on daily basis is at highest. As a result, by reducing the finishing age of an animal, the total quantity of methane associated with bringing that animal to finish, is reduced.

Assuming a daily methane output of 230 g/day during the finishing period (Smith et al., 2021), reducing finishing age by one month can reduce emissions by 180 kg of CO2 eq. per animal. In addition, unlike other technologies such as methane inhibiting feed additives which will likely add to the costs associated with rearing an animal, early finishing tends to be economically beneficial. Using data from commercial suckler-to-beef farms, Taylor et al. (2020), found that reducing finishing age by approximately eight months increased net margin by 22% while reducing total farm GHG emissions by 38%.

Why target earlier finishing for beef cattle?

As seen in Table 1, the annual number of prime beef cattle slaughtered, has maintained relatively stable over the period of 2010 to 2023. However, over this period, the average finishing age of the prime beef cattle population has reduced from 27.9 months in 2010 to 26.1 months in 2023. In particular, a significant reduction in the finishing age of steers has been observed over this period, with an average annual reduction of 5.6, 7.3 and 6.5 days for dairy × dairy, dairy × beef and suckler steers, respectively. Over the same time frame, average carcass weight has changed by -1.3, -0.7 and +0.8 kg per annum, respectively, indicating the potential to reduce finishing age with minimal impact on carcass weight. The increased availability of genetic tools (dairy-beef index, commercial beef value (CBV)) focused on the selection of dairy bred animals with a higher genetic merit for carcass traits, and increased usage of beef genetics, has the potential to mitigate further reductions, if not facilitate a potential increase in carcass weight of steers originating from the dairy herd.

As indicated in Table 1, the average finishing age of beef cattle in 2018 (base year for the Climate Action Plan) was 26 months of age. The mean finishing age of the prime beef cattle population had reduced to 25.6 months by 2022, with a reduction of 12, 10 and 34 days in the finishing age of heifers, young bulls and steers, with minimal impact on carcass weights. However, due to challenging weather conditions in 2023, as well as reduction in the number of young bulls being produced, average finishing age increased in 2023 and is now similar to that in 2018.

Table 1. Overview of the prime beef cattle population size and average finishing age.

Year	Prime cattle finished	Finishing age (months)			
		Average	Steer	Heifer	Young bull
2010	1,181,893	27.9	30.5	26.9	20.1
2018	1,269,359	26.0	27.9	26.0	19.4
2019	1,144,155	26.0	28.2	26.1	19.5
2020	1,318,358	26.3	27.9	26.1	19.5
2021	1,263,018	25.7	27.0	25.6	19.0
2022	1,281,522	25.6	26.8	25.6	19.1
2023	1,191,347	26.1	27.3	26.0	19.1

If the average annual reduction in finishing age over the past five years was re-established, finishing age would reduce to 25.6 months by 2030. Even if the annual decrease in finishing age that was proposed in the Teagasc MACC and the government's Climate Action Plan was achieved, finishing age would be nine weeks greater than that projected due to higher finishing age established in 2023. Therefore, in order to meet the targets that have been set, a substantial annual decline in finishing age over the next six years, will be required.

Ongoing Research

Nationally the mean age at finishing is six months later than achieved on grass-based high-performing commercial and research beef farms. The Teagasc lead Beef-Quest Project, recently funded by the Department of Agriculture, Food and the Marine (DAFM) will undertake a multifaceted approach to identify the key factors impeding lifetime live weight performance on commercial beef farms, and assess the barriers to technology adoption on farm. In collaboration with ICBF and UCD, 200 commercial beef herds have been enrolled in the Beef-Quest Project, as part of a new large-scale on-farm study aimed at determining the key animal nutrition, health and on-farm environmental related factors presently constraining growth performance, and subsequently influencing the finishing age of cattle on Irish farms. Data obtained from the on farm study, will be utilised to determine both the environmental and economic benefits associated with the optimisation of animal nutrition, health and on-farm environment, and subsequently aid the identification of the most effective on farm measures for reducing the finishing age of Irish beef cattle.

In addition to this, research is actively underway at Teagasc Grange, to assess the impact of early life nutrition on the lifetime live weight performance of cattle and the subsequent impact it has on producing a carcass that meets industry specification. This research is particularly pertinent to dairy-bred cattle reared within a grass based production system. For example, in 2023, only 13% of dairy-bred steers finished at under 24 months of age achieved the minimum industry carcass fat cover (2+) and produced a carcass weighing at least 280 kg.

Conclusion

Reducing the average finishing age of the prime beef cattle population is one of the main GHG mitigation strategies for the Irish agricultural sector. While steady progress was made up to 2022, this was reversed in 2023 due to adverse weather conditions. In order to meet finishing age targets, whilst minimising adverse effects on carcass output, a rapid increase in the lifetime live weight gain performance of Irish beef cattle over the next six years is urgently required.

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