Project title: **Precision nutrition in combined suckler beef systems: bridging the performance gap towards net zero**

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Project overview:

Within combined suckler beef systems, grass silage is typically used as the basal forage for the suckler cows themselves, and their progeny. A feedstuff, which although relatively cheap to produce, varies widely in quality due to a plethora of factors as exemplified by cutting date (Kuoppala *et al.*, 2008). Precision feeding techniques utilise technology with an aim to optimise nutrient supply for a target level of animal performance, profitability, or environmental outcome (González *et al.*, 2018). There is subsequently a need to determine if precision livestock feeding techniques, can be used in conjunction with enhanced grass silage quality to improve the efficiency, and reduce the environmental impact of combined suckler beef production systems. Previous dietary formulation and carbon emissions models established at Harper Adams University (McCaughern *et al.*, 2022), were further developed using secondary data to determine the effects of grass silage quality (Poor, moderate and excellent; Table 1) and precision feeding (formulation to metabolisable protein as opposed to crude protein) upon costs of production, and emissions intensity in combined autumn-calving suckler beef systems.

Research Outcomes:

1. When decreasing silage quality is modelled in both the lactating suckler cow and finishing cattle scenarios, the resulting story is one of inadequate energy and protein supply, which is countered by the addition of concentrates. This increased concentrate inclusion serves to increase costs of production across all of the examined scenarios respectively, with an increase in diet costs of £1.42/d to £1.18/d when an excellent as opposed to a poor grass silage is used as the basis for a lactating suckler cow diet. Whilst, the margin over feed for a continental steer decreases from £1.45/kg to £1.18/kg when an excellent silage is substituted for a moderate quality grass silage, respectively.
2. Total carbon emissions intensity also increased with declining silage quality across the various suckler (18.05 versus 19.78 kgCO_2-eq/d for excellent and poor) and finishing (12.93 versus 13.72 kgCO2-eq/kg for excellent and moderate) beef cattle diets. This increase in emissions intensity at higher rates of concentrate inclusion resulted from two factors: 1. an increase in the emissions associated with feed production and consumption, and 2. an increase in enteric emissions resulting from increased energy intake.
3. The scenarios examined in this study utilised grass silage which tends to supply surplus protein in relation to the requirements of beef cattle (AFRC, 1993), with the subsequent finding that precision feeding had little to no effect on the parameters examined in either the finishing or suckler diets, respectively.

Practical application / Sector use:

Increasing silage quality has the potential to improve the sustainability of beef production systems by reducing costs of production, whilst concurrently reducing the intensity of greenhouse gas emissions.

References:

Agricultural and Food Research Council (AFRC). 1993. *Energy and protein requirements of ruminants.* CAB International: Wallingford.

González, L.A., Kyriazakis, I. and Tedeschi, L.O. 2018. Precision nutrition of ruminants: approaches, challenges and potential gains. *Animal*, 12(s2), pp. s246-s261.

Kuoppala, K., Rinne, M., Nousiainen, J. and Huhtanen, P. 2008. The effect of cutting time of grass silage in primary growth and regrowth and the interactions between silage quality and concentrate level on milk production of dairy cows. *Livestock science*, 116(1-3), pp. 171-182.

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Table 1. Chemical composition of the three classifications of grass silage quality (Excellent, moderate or poor) used as the basis for diet formulation.

Item[1]	Silage quality classification		
	Poor	**Moderate**	**Excellent**
Chemical composition, g/kg of DM			
Dry matter, g/kg	290	250	250
Digestibility organic matter	600	650	700
Crude protein	100	120	160
ERDP (0.05)	52	72	103
DUP (0.05)	33	33	30
Ether extract	28	42	47
ME, MJ/kg of DM	9.5	10.5	11.5
FME, MJ/kg of DM	7.2	7.6	8.6
ERDP/FME	7.2	9.5	12.0

[1] ERDP: Effective rumen degradable dietary protein; DUP: Digestible undegraded protein; ME: Metabolisable energy; FME: Fermentable metabolisable energy; MP: Metabolisable protein.