Project title: **Developing a low-cost method to monitor the feed efficiency of beef cattle at farm level**

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Project overview:

One of the most influential factors affecting the profitability of beef cattle production is the provision of feed, which is estimated to account for up to 75% of enterprise variable costs. Feed efficiency is generally used to describe the relationship between feed inputs and growth outputs, although there are many definitions of feed efficiency at the animal level. Traditionally, feed conversion efficiency (FCE; gain: feed), or it's mathematical inverse, feed conversion ratio (FCR; feed: gain) have been utilised widely. More recently however, the preferred measurement for feed efficiency has become residual feed intake (RFI), defined as the difference between intake and the animal's requirements for growth and maintenance. RFI is typically expensive to measure, but behavioural monitoring technologies such as activity sensors potentially provide a low-cost option to facilitate the measurement of beef cattle feed efficiency at farm level. There is subsequently a need to determine if activity sensors can be used as a lower cost alternative to automated feed intake recording systems, when monitoring feed efficiency in beef cattle. The subsequent study was conducted at Harper Adams University, where 24 Hereford cross dairy steers were fed a concentrate-based diet and monitored for feed efficiency traits using the Beef Improvement Federation guidelines for performance data collection. Prior to commencing the study, all steers were fitted with IceQube 3-axis accelerometers (IceRobotics Ltd, Edinburgh, UK) to monitor standing, lying, and activity behaviours respectively. Statistical models were then constructed to determine if behaviour can be utilised to predict cattle feed efficiency on farm.

Research Outcomes:

1. The observed trends in feed efficiency traits are consistent with the findings of others who have reported on the grouping of animals according to RFI status. Steers that were classified as low RFI, consumed 8% less feed per day (Table 1), resulting in a lower FCR, but ADG remained unaffected.
2. Overall, some associations were made between behaviour and measures of performance to include ADG and RFI. Despite the feeding of a concentrate diet, which should have allowed the steers to better demonstrate their true feed efficiency, the resulting statistical models showed limited predictive value in the field. It can therefore be concluded that the monitoring of behaviour in this manner will not adequately predict animal performance on farm to facilitate increased genetic selection for efficiency traits.
3. The importance of feed efficiency to the farmer should not however be disregarded, the 8 % decreased intake of low RFI steers observed in the present study, represents a saving of approximately £73 /head from 3-months of age to slaughter, based on feed prices in March of 2022 (assuming a 13-month beef production system). Genetics companies are however, starting to select for feed efficiency in beef cattle, and as these metrics become increasingly available, those within supply chains should aim to adopt them. Nevertheless, industry wide acceleration in the selection for more efficient beef cattle is still hindered by the lack of a widespread reference population.

Practical application / Sector use:

Behaviour can't be utilised to reliably predict cattle feed efficiency on-farm. There are however significant economic returns associated with selection for improved feed efficiency, and as these parameters start to become available for genetic selection within the industry, farmers should seek to utilise them.

Table 1. Mean growth and efficiency traits of Hereford cross dairy steers ranked as low or high for residual feed intake

	Residual feed intake group			
Trait	Low	High	SEM	P-value
Residual feed intake, MJ/d	-4.74	5.00	1.189	<0.001
Start BW[1], kg	284	286	3.4	0.813
Final BW, kg	391	389	5.9	0.755
DMI[2], kg/d	7.4	8.1	0.15	0.007
MEI[3], MJ/d	94.9	104.0	1.92	0.007
Mid-test BW, kg	338	338	4.5	0.986
ADG[4], kg/d	1.54	1.50	0.058	0.663
Feed conversion ratio, kg/kg	4.84	5.43	0.143	0.014

[1] BW: bodyweight
[2] DMI: Dry matter intake
[3] MEI: Metabolisable energy intake
[4] ADG: Average daily gain