**Application**

Dual-purpose breeds are suggested as an alternative to the separate UK dairy and suckler herds, yet potential reductions in total greenhouse gas emissions (GHGe) are relatively small.

**Introduction**

Over the past century, traditional dual-purpose cattle breeds in the UK have been replaced by specialized high-yielding dairy breeds (e.g. Holstein Friesian, HF). Half of UK beef is sourced from dairy cattle, with the remainder being produced by suckler beef cattle. Under current GHGe accounting methods, dairy-beef has a lower GHGe because maternal emissions are allocated to dairy production. Shifting to dual-purpose breeds selected for both milk and meat production may therefore reduce total GHGe from UK cattle if an increase in dairy-beef displaces suckler beef. Norwegian Red (NR) cattle, which are selected less intensively for milk production and with a greater emphasis on health, fertility and carcase yield are a potential alternative breed.

The objectives of this work were to model the effect of replacing HF cattle with a dual-purpose breed (NR) on:

1. Milk and beef production from the UK dairy herd
2. Total GHGe from the UK cattle herd (dairy and beef)

**Materials and Methods**

Literature reviews were undertaken to source data on the relative performance of HF and NR dairy cattle and their purebred and crossbred calves, using appropriate search terms in internet databases (Science Direct, PubMed, Google Scholar and CAB Abstracts). These data (Table 1), in conjunction with UK-specific dairy and beef performance data, were used to populate two deterministic models adapted from Capper and Cady (2020) and Capper et al. (2021). Based on population demographics, metabolism and nutrient requirements of dairy and beef cattle, the models quantified the GHGe impact of changing the UK dairy herd from primarily HF to NR. Emissions were quantified per 1 million metric tonnes (t) of energy-corrected milk (ECM; current UK dairy production is 14.9 million t/annum) plus 53,755 t carcase weight (CW) beef, based on a 50:50 dairy-beef:suckler beef split in the control (HF) population. System boundaries extended from the production of feeds to ECM and CW beef at the farm gate. Cropping data were sourced from national databases and feed GHGe data from the GLFI (2023) database.

**Table 1. Comparative key performance indicators of Holstein and Norwegian Red cattle1**

|  |  |  |
| --- | --- | --- |
|  | **Holstein** | **Norwegian Red** |
| Energy corrected milk yield (kg/d) | 27.5 | 24.7 |
| Lactation length, d | 331 | 323 |
| Mature bodyweight, kg | 570 | 537 |
| Calving interval, d | 391 | 383 |
| Lactations in the herd | 3.6 | 4.2 |
| Cow mortality, % | 6.3 | 3.5 |
| Heifer replacement rate, % | 27.8 | 23.8 |
| Age at first calving, mo | 26.6 | 26.9 |
| Cows producing a live calf/yr, % | 86.6 | 91.5 |
| Calf birthweight, kg | 42.2 | 39.7 |
| Pre-weaning calf mortality, % | 7.2 | 4.0 |

1 Data sourced from 18 published papers

**Results**

Maintaining total milk production from NR cattle required an 11.7% increase in dairy cow numbers because of the lower ECM yield. This was partially offset by health improvements that reduced the number of heifer replacements required (-3.16%), to give an overall increase in dairy cattle numbers of 5.94%. With concurrent increases in resource use, this increased total dairy GHGe by 2.29%. Changing from a HF to a NR dairy population reduced total beef GHGe by 8.90%. This was primarily driven by a 32.8% reduction in suckler cows as the increased NR herd size shifted more dairy calves into beef. Nevertheless, the overall reduction was moderated by NR cattle having a lower growth rate than HF cattle, which increased the emissions intensity by 2.81%. Changing from a HF to a NR dairy population reduced total GHGe per 1 million t of milk plus 53,755 t beef by 2.59% (-68,002 t CO2e). In context, this reduction would be equal to removing ~37,600 UK cars from the road, based on 0.152 kg CO2 per km driven (Department for Business Energy & Industrial Strategy, 2019) and 11,909 km driven per year.

**Table 2. Effects of changing the UK dairy population from Holstein to Norwegian Red cattle on GHGe from dairy and beef cattle if total dairy and beef production were kept constant1**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Holstein** | **Norwegian Red** | **% difference** |
| Dairy cows, ‘000 head | 118.8 | 132.7 | 11.7 |
| Dairy heifers, ‘000 head | 75.3 | 72.4 | -3.16 |
| Total dairy cattle, ‘000 head | 194.3 | 205.6 | 5.94 |
| Dairy GHGe, kg CO2e/kg ECM | 1.478 | 1.512 | 2.29 |
|  |  |  |  |
| Prime beef from dairy herd, t CW | 21,057 | 29,258 | 39.0 |
| Cull cow beef from dairy herd, t CW | 7,124 | 7,303 | 2.51 |
| Dairy beef GHGe, kg CO2e/kg beef CW | 17.17 | 17.65 | 2.81 |
|  |  |  |  |
| Suckler cows, ‘000 head | 96.4 | 64.8 | -32.8 |
| Prime beef from suckler herd, t CW | 21,057 | 14,157 | -32.8 |
| Cull cow beef from suckler herd, t CW | 4,516 | 3,036 | -32.8 |
| Suckler beef GHGe, kg CO2e/kg beef CW | 32.44 | 32.44 | - |
|  |  |  |  |
| Total dairy (milk) GHGe, t CO2e | 1,477,819 | 1,511,690 | 2.29 |
| Total dairy beef GHGe, t CO2e | 361,446 | 516,034 | 42.8 |
| Total suckler beef GHGe, t CO2e | 783,477 | 526,746 | -32.77 |
| Total beef GHG, t CO2e | 1,144,923 | 1,043,050 | -8.90 |
| Total cattle industry GHGe, t CO2e | 2,622,742 | 2,554,740 | -2.59 |

1 Milk production 1,000,000 t ECM; beef production 53,755 t CW

**Conclusions**

Changing to NR cattle would confer a relatively small change in GHGe from the UK cattle industry, although the absolute quantity of emissions reduced is not inconsiderable when compared to transport emissions. Producer behavioural and cultural changes required to switch from HF to NR might also render this conversion unfeasible. Future efforts should be targeted at improving health and reproduction, reducing age at slaughter and improving grassland management, which would be expected to confer greater reductions in GHGe from suckler cattle production (Taylor et al., 2020).

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