SEFARI

Leading ideas for livestock

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Leading Ideas for Scotland's Livestock

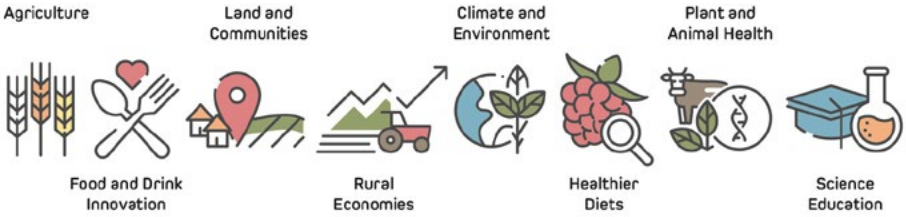
The Scottish Environment, Food and Agriculture Research Institutes (SEFARI) is a collective of six research institutes, each with their own global capability, expertise and reputation.
The six institutes are:

- Biomathematics and Statistics Scotland
- James Hutton Institute
- Moredun Research Institute
- Rowett Institute
- Royal Botanic Garden Edinburgh
- Scotland's Rural College

Through collaborative interdisciplinary research, SEFARI are responsible, with Higher Education Institute partners, for delivering the Scottish Government (Rural and Environment Science and Analytical Services, RESAS) funded Strategic Research Portfolio on environment, agriculture, land, food, and rural communities (2016-2021). The Portfolio includes the Strategic Research Programme, Centres of Expertise, Innovation Partnerships and Underpinning Capacity funding of national resources within SEFARI.

The SEFARI Gateway is the knowledge exchange and impact hub for SEFARI. The Gateway works to enhance stakeholder access to the expertise of the Portfolio; to improve the flow of research and knowledge to and from the portfolio across Scotland's policy, industry-sector and public audiences and to increase the impacts from those activities. Gateway also seeks to ensure that Portfolio research is actively informed by stakeholders and knowledge networks across Scotland, UK and internationally.

SEFARI focuses its work under eight 'Leading Ideas'



This leaflet highlights key strategic research impacts for Scotland's livestock sector including to: reduce climate impact, protect the environment, improve productivity and to continue to deliver world class animal health and welfare.

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Housing systems for free-range laying hens

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Research has highlighted the need to improve housing systems for the welfare of laying hens. Free-range hens have access to pasture, plus a shed with litter floors and resources (feed, water, perches and nest boxes) provided either on one platform (single tier or 'flat-deck', FD) or across several platforms (multi-tier, MT). In MT systems, more hens can be housed per shed. To investigate the effects on production, health and welfare, in collaboration with BFREPA[1] and ADAS[2], a study of 42 commercial laying flocks housed in these two systems (to 70 weeks of age) was undertaken.

- 25 FD and 17 MT flocks participated. Flock sizes ranged from 2,000-16,000 hens
- Mortality and egg production did not differ significantly between system types, but there was a financial benefit to MT flocks (£1.28/hen) due to slightly lower mortality and slightly higher % eggs/hen with MT
- Feather cover (an indication of feather pecking, a major welfare concern in hens) was good in both systems
- Keel bone damage was consistently higher in hens from MT systems than FD hens

The research agrees with other studies on MT systems and keel bone damage risks. Damage is likely to occur during descents and falls from upper tiers. Although profit margins are increased, improvements to MT designs must be considered to safeguard hen welfare, as keel bone damage is likely to be painful.

[1]BFREPA, British Free Range Egg Producers' Association, https://www.bfrepa.co.uk/

[2]ADAS, Agricultural Development and Advisory Service, https://www.adas.uk/

Trough half empty: are pregnant sows satiated?

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How we house, handle and feed pregnant farm animals has an impact on their health and welfare as well as that of their developing offspring. One concern for pregnant sows is the level of food restriction they are under in order to maintain healthy weight and production. They typically receive one concentrated ration a day (~2.5–3kg). They show behavioural signs of hunger and can be aggressive when competing for food.

Regulations require that sows are "given a sufficient quantity of bulky or high-fibre food as well as high energy food". However, industry consultation suggests typical sow diets are relatively low in fibre, assuming sows have straw bedding to supplement their ration. Our review suggests that insoluble fibre (e.g. straw) is ineffective at increasing sow satiety. Furthermore, pregnant sow feeding has hardly changed in the last 30 years, but sows have changed; they are heavier, producing more piglets. Sow nutrition requires a rethink.

In a recent study we gave typical commercial pregnant sows 3 days access to *ad libitum* food. We found that:

- They ate twice as much as usual, suggesting their ration provides only 50% of what they would prefer to eat during pregnancy
- They showed fewer behavioural signs of hunger – both oral behaviours and restlessness were reduced

Long-term *ad libitum* feeding is not sensible. Rationing sow energy intake reduces lameness, obesity and reproductive failure. To safeguard welfare, health and improve satiety, dietary fibre should be added to diets. How best to achieve this for optimal outcomes needs further investigation.

Precision livestock farming - use of Electronic Identification (EID) for livestock management

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Precision livestock farming uses equipment, data or software which allows information at an individual animal level for targeting decisions, inputs and treatments, and can be a powerful management tool. In the UK, the use of EID tags for traceability is a mandatory requirement since 2010 but some farmers found them burdensome. To investigate the potential benefits of EID for sheep management, SEFARI scientists, carrying out research at SRUC's Hill & Mountain Research Centre farms near Crianlarich tested two management systems on a flock of 900 ewes: one using EID-based technology and the other a conventional means to assess weight and condition of the animals. The EID-based technology was combined with an auto-drafting weighing crate to help monitor body weight and weight change. The research found that EID-based technology can:

- Aid sheep management when taking decisions on feeding, worming, drawing animals for slaughter and selection for breeding.
- Save farmers time and labour, reduce handling stress for the animals, reduce paperwork and increase ease and accuracy of recording
- Improve farm efficiency, welfare and economic margins

A calibrated sheep auto-drafting weighcrate can record and sort up to 500 animals per hour, leading to annual savings of 30-40%. Average differences in net margin between the two systems were ~ £4/ewe; meaning for 900 ewes a minimum of 3 years to pay back an initial equipment cost of £10,000.

Sustainable worm control through Targeted Selective Treatment (TST) of lambs

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Around 80% of lowland flocks and 55% of upland flocks in Scotland show evidence of anthelmintic (wormer) resistance. Trying to maintain a susceptible parasite population in flocks, by only treating animals that need it, can help avoid the build-up of resistant worms. This requires accurate identification and targeting of wormer to only those animals that will most benefit, which can be achieved by assessing individual short-term weight change, using EID technology. Work was carried out at the SRUC Hill & Mountain Research Centre, using Scottish Blackface and Lleyn lambs, in two different systems:

One based on assessing individual lamb growth using EID (targeted worming, TST group); the other based on treating the whole flock if worm egg counts in faecal samples exceed 500 eggs/g (control).The lambs in the TST group were weighed monthly, and only treated if they did not reach their individual target weight, which was calculated based on expected growth rates and grass availability (using the Happy Factor algorithm, developed by Moredun).

- Lamb performance, economic and labour data have been collected over 3 years
- Led to 52% savings in wormer costs
- Provided up to 75% of labour savings without compromising lamb growth

This collectively equates to savings of around £1.60 per lamb, as well as slowing down selection for wormer resistance.

A One Health approach for protecting animals, water quality and public health

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Zoonotic diseases are very important in terms of both animal and public health. *Cryptosporidium parvum* and *E. coli O157* are two such pathogens, which can be passed from animals to humans causing disease, water contamination and, for *C. parvum*, livestock health issues.

- Transmission studies involving *C. parvum* have implicated wildlife species, notably geese and deer, in the spread of the parasite in the environment and in particular into water courses
- Cattle are the main reservoir of *E. coli O157*, but our knowledge of other animal sources of infection is limited. Recent studies have assessed the risk of *E. coli O157* from eating wild venison and showed that the prevalence of *E. coli O157* in wild Scottish deer is low. A vaccine has also been developed to control *E. coli O157* in animals

Research has led to a better understanding of zoonotic disease risk, and has provided solutions which reduce pathogen burdens on farm, in the environment and in water courses, leading to improved animal and human health and welfare, food safety, water quality and public health.

Selecting the best performing animals with low methane emissions

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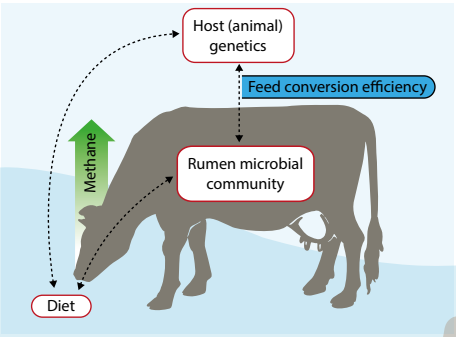
Methane is a highly potent greenhouse gas (GHG) produced by ruminants, mainly cattle and sheep. A reduction of these emissions will help to meet the legally-binding national target of net-zero GHG emissions by 2045 to limit climate change and build long-term environmentally sustainable livestock production. Specific feed additives, such as seaweed or 3-Nitrooxypropanol, can reduce methane emissions from cattle, but are costly. Animal breeding is efficient, permanent and cumulative in its response and thus cost-effective. The challenge to breed low methane-emitting animals is to cost-effectively measure or predict emissions continuously on large cohorts of animals. SEFARI scientists in collaboration with the University of Edinburgh and University of Aberdeen have found a way to predict methane emissions from cattle, based on their microbiome, specifically the bacteria and methanogenic Archaea living in the cow's largest stomach - the rumen.

- Specific ruminal bacteria are essential for the animal to convert food into nutrients used to produce milk and meat, whereas the methane producing Archaea are non-essential and their reduction mitigates methane emissions
- The composition of the microbiome in the rumen can be used to predict methane emissions and is linked to the animal host genetics
- Selective breeding, based on rumen microbiome composition can be used to reduce methane emissions from cattle but also improve characteristics, such as feed conversion efficiency and meat quality

Based on this, SEFARI scientists are developing a system based on the rumen microbiome to implement selection for low methane emitting animals with improved production efficiency and product quality into practical breeding.



Livestock health and Greenhouse Gas (GHG) emissions

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Endemic, production-limiting disease is a significant constraint on efficient livestock production and animal welfare, both here and globally. Dealing effectively with disease represents an opportunity to reduce GHG emissions from the livestock sector, without compromising productivity or farm economics. SEFARI scientists have been working with industry and government policy teams to better understand the impact of disease on GHG emissions from livestock and to help prioritise control strategies.

Researchers have:

- Produced an evidence assessment of the key endemic diseases in Scotland, their GHG abatement potential, cost-effectiveness and feasibility for control/eradication
- Experimentally shown that sustainable control of gastrointestinal nematode infections in sheep can reduce GHG emissions intensity by up to 30%
- Used modelling to estimate that treating trypanosomiasis (the equivalent of sleeping sickness) in African cattle could reduce their carbon footprint by up to 8%

We are currently investigating the impact of liver fluke and Bovine Viral Diarrhoea (BVD) on cattle productivity and associated GHG emissions using abattoir data from large numbers of animals. This will provide evidence on which of the endemic diseases has the greatest impact on GHG emissions and which would be most amenable to control/eradication, as a contribution to reducing GHGs.