Carol-Anne Duthie
Beef & Sheep Research Centre
Scotland's Rural College

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Research interests

I have been based with SRUC's R&D division for >20 years and am currently leading SRUC's Beef and Sheep Research Centre. My research interests focus predominantly on understanding and optimising the productive efficiency of ruminant production systems (mainly beef and sheep, but also dairy).
My key interests include:

- Optimising feed efficiency
- Characterising/mitigating greenhouse gas outputs from ruminant production systems
- Reducing the environmental impact of beef production systems (improved efficiency, mitigation strategies)
- Development and application of Precision Livestock Farming solutions for continuous, automated and real-time monitoring of individual animal productivity, health, welfare and their environment. I am also interested in combining technologies and integrated datastreams to develop appropriate decision support platforms. A large proportion of my work involves collaborating with industry to deliver innovative solutions.
- Optimising supply chain chain efficiency from farm to fork through the use of data and digital innovations.
- Optimising the final product, from a carcass and meat quality perspective (sensory quality and nutritional value).

I have extensive experience of collaborating and leading multidisciplinary programmes of work engaging across both industry and academia. I have a publication history of over 60 peer-reviewed publications. I am former chair of the British Society of Animal Science (BSAS) Strategy and Innovation Committee, former member of BSAS Awards committee, current director of the Scottish Accreditation Board, current member of British and Irish Society of Animal Science annual conference (2027) organising committee, current member of Innovate UK Business Connect Agriculture Sector advisory board and review editor for Frontiers in Animal Science (Precision Livestock Farming).

Supervision

I have responsibility for delivery of undergraduate teaching and supervision/co-supervision of undergraduate, MSc and PhD students:
•Actively involved in design and development of Agriculture degree programme.
•Lecturer (all years) and module leader (4th year) for BSc Agriculture.
•Regular supervisor for BSc dissertation projects.
•Mentor for MSc modules in Integrated Agricultural Management.
•Guest lecturer (various programmes UK and internationally).
•PhD Student 2020-2025: "Improving the efficiency of beef production through the use of precision farming technologies and machine learning techniques". EastBIO CASE, Agriculture and Horticulture Development Board. Joint with University of Edinburgh.
•PhD Student 2020-2025: "Novel approaches to improving calf health: new technology and data analytics". EastBIO; Agriculture and Horticulture Development Board. Joint with University of Edinburgh.
•PhD Student 2009-2013: "Reduction of Energy Usage and Nitrogen Losses in Pork production – Genetics and Growth Models". Joint with Wageningen University.
•Internal assessor for University of Edinburgh PhD students.
•External advisor, PhD, 2019-2021, SRUC/University of Edinburgh.
•External advisor 2024-current, PhD, SRUC.

Projects

2025-2026. Commercial contract - Volta GreenTech. (SRUC: £135,408). Co-I with Gemma Miller.
2024-2026. InnovateUK. IR Laser based agricultural emissions monitoring system (IREMS). Total= £346,556 (SRUC: £61,279). PI.
2024-2025. BBSRC. UltraGreenCow: Comprehensive greenhouse gas and ammonia emissions measurement capacity for large ruminant production. (SRUC: £696,056). Co-I with Rainer Roehe/Gemma Miller.
2023-2025. Innovate UK. Digital Dairy Chain. CEVEC: Cost Effective Ventilated Environment for Calves. Total £349, 662 (SRUC: £84,735). PI.
2024-2025. Innovate UK. Opti-Beef – Commercialisation Launch Readiness. Total: £299,988 (SRUC: £ 89,783). PI.
2024-2025. Innovate UK. WELL-CALF: optimising accuracy for commercial adoption. Total: £ 195,572 (SRUC: £ 58,604). PI.
2023-2025 Innovate UK. CHERI: Calf Health Evaluation and Remote Inspection. Total: £480,271 (SRUC: £239,732). PI.
2023-2026. Innovate UK. DETECT: A Non-Invasive and Automated Real-Time Disease Detection Tool for Cattle. Total: £936,907 (SRUC: £ 195,898). PI.
2024. Commercial contract – Phileo by Lesaffre. (SRUC: £113k) PI.
2023-2024 DEFRA. Transformed cattle systems. (SRUC:£49k) PI.
2023-2024 DEFRA. Reducing Age at Slaughter review. (SRUC:£45k). CoI.

2022-2027 Horizon Europe. AGROSERV: Research Infrastructures services for a sustainable and resilient agriculture and agro-ecological transitions (SRUC: £200k). Co-I with Prof. Richard Dewhurst.
2022-2027 Rural and Environmental Science and Analytical Services Division (RESAS) Strategic Programme. SRUC-B2-4: Data driven innovations for improved sustainability of ruminant production systems (SRUC: £566k). PI.
2022-2027 Rural and Environmental Science and Analytical Services Division (RESAS) Strategic Programme. SRUC-C2-1: Agriculture, Climate and Carbon (SRUC: £1.8M). Co-I with Prof. Bob Rees and Prof. John Newbold.
2022-2027 Rural and Environmental Science and Analytical Services Division (RESAS) Strategic Programme. SRUC-D1-1: Air Quality: Livestock Farming and Ammonia (SRUC: £510k). Co-I with Dr Gemma Miller.
2022-2027 Rural and Environmental Science and Analytical Services Division (RESAS) Strategic Programme. MRI-B2-2: Monitoring Veterinary Medicine Usage to Improve Animal Performance and Efficiency (Total: £231k; SRUC: £71k). Co-I with Dr Adam Hayward (Moredun Research Institute).
2022-2025 BEIS SBRI Direct Air Capture (DAC) and Greenhouse Gas Removals (GGR). GreenShed Phase 2 (Total: £2.9M; SRUC: £1.2M). PI.
2022-2023 Innovate UK. D-FLOWS: Data for Livestock Optimisations for Wiser Supply Chains (Total: £250k; SRUC: £94k). PI.
2021-2023 DEFRA. Animal health and welfare, productivity and sustainability impacts of housed cattle (SRUC: £31k). Co-I with Dr Laura Shewbridge Carter and Dr Jenna Bowen.
2022-2022 WWF-Tesco 2022. Review and evaluation of existing (or near-to-market) methane reducing feed additives and technologies, with associated (business and government) recommendations to deliver ‘best practice’, well-governed markets; AND WWF-Algae-UK 2022: Literature Review of seaweed reducing methane emissions from UK ruminants (SRUC: £45,000) Co-I with Dr Gemma Miller.
2022 AHDB/BBSRC Catalysing Partnerships. Optimising health and productivity outcomes of dairy-bred calves: use of integrated data and alternative management (SRUC: £46k). Co-I with Dr David Bell.
2021-2023 Bulgarian Government. GREENANIMO: strengthening research and innovation capacity for grazing livestock meat production in Bulgaria through advanced knowledge transfer (SRUC: £60k). Co-I with Prof. Marie Haskell.
2021-2022 Scottish Government. Reducing emissions from agriculture – the role of new technologies (SRUC: £30k). Researcher with Prof. Andrew Barnes.
2021-2021 BEIS SBRI Direct Air Capture (DAC) and Greenhouse Gas Removals (GGR). Green-Shed Phase 1 (SRUC: £210k). PI.
2021-2021 DEFRA.Methane-inhibiting livestock feed supplements: review of net impacts, barriers to success and consumer acceptance(SRUC: £71k).PI.
2020-2025 Novo Nordisk Foundation. SuPA(cow): Sustainable production of animals by optimising the feed-microbiome-host axis (SRUC: 264k). Researcher with Prof. Rainer Roehe.
2020-2021 Zoetis Ltd. CalfQuol: Developing a Health-related Quality of Life Tools for bovine respiratory disease (£142K). Co-I with Marie Haskell.
2020 Scottish Government. ClimateXChange Scotland's Centre of Expertise connecting climate change research and policy: Methane-reducing feed additives. A rapid evidence assessment of two feed additives – Bovaer and Agolin Ruminant for reducing enteric methane emissions (£25k). Co-I with Prof. John Newbold.
2019-2022 Scottish Government. "Green-shed": precision technology solution to mitigate methane emissions from ruminant systems (SRUC: £203k). Co-I with Rebecca Audsley.
2019-2023 DEFRA; ERA-GAS, FACCE, SusAn, ICT-AGRI 2. Precision Livestock Farming (PLF) Technologies to reduce greenhouse gas (GHG) emissions intensity of pasture-based cattle systems (Total: £250k; SRUC: £125k). Co-I with Prof. Richard Dewhurst.
2019-2023 Innovate UK. OPTI-BEEF: Precision agricultural solution to monitor lifetime productivity and product quality (Total: £1.8M; SRUC: £434k). PI.
2019-2022 Innovate UK. WELL-CALF: Improving health and welfare of dairy calves (Total: £1.1M; SRUC: £317k). PI.
2019-2021 Scottish Government KTIF. Beef Marbling in a High Value Supply Chain (Total: £49k; SRUC: £24k). Co-I with Dr Nicola Lambe.
2018-2019. Agri-EPI: Service Level Agreement (SLA) - to deliver project management services on behalf of Agri-EPI in relation to Massey University (New Zealand) projects (SRUC: £12k). PI.
2019 Commercial Contract for Simpsons Malt. An assessment of the effect of feeding an enhanced malt residual pellet (EMRP) on suckler beef steer performance (SRUC: £33k). PI.
2018-2022EU Horizon 2020(INFRAIA-2017-01).SMARTCOW: An integrated infrastructure for increased research capability and innovation in the European cattle sector(SRUC: £365k) Co-I with Prof. Richard Dewhurst.
2018. Commercial Contract with Agolin SA. Studies of growth rates, feed efficiency and methane emissions from finisher beef steers offered diets containing 'Agolin ruminant' essential oils (SRUC: £49k). PI.
2017-2019 SARIC NERC.Novel animal-mounted sensor technology to improve efficiency and sustainability(SRUC: 252k). PI.
2016-2020 Rural and Environmental Science and Analytical Services Division (RESAS) Strategic Programme Theme 2, Sustainable Land Management and Rural Economies. RD2.2.9, 2.3.1, 2.3.6, 2.3.9. Co-I with various.
2016-2020 AHDB Beef and Lamb. Enhanced monitoring systems for improved health management of dairy-bred beef youngstock (Total: £340k, SRUC: £253k). PI.
2016-2017 Innovate UK. Geolocation tracking of extensive livestock systems (Total: £200k; SRUC: £72k). PI.
2015-2018 Innovate UK. Precision Beef (Total: £1.3M; SRUC: £431k). PI.
2014-2018 Innovate UK. Beef Monitor (Total: £1.3M; SRUC: £399k). PI.
2013-2016 English Beef and Lamb Executive (EBLEX). Lifetime growth pattern and beef eating quality (“Growth Path”) (SRUC: £164k). Co-I with Dr Jimmy Hyslop.

2012-2015 English Beef and Lamb Executive (EBLEX). Nutritional improvements using diets and novel feed additives to enhance overall efficiency of beef production including meat quality and mitigation of greenhouse gas emissions as identified by characterisation of the rumen microbial population (“NUTRI-BEEF”) (SRUC: £247k). Co-I with Prof. Rainer Roehe.
2011-2014 Technology Strategy Board (TSB). AnimaL Electronic Recording, Transmission and Synthesis (“ALERTS”) (Total: £968k; SRUC: £470k). Researcher with Mr Dave Ross/Prof. Malcolm Mitchell.
2011-2015 Scottish Government and QMS. Research towards an integrated measurement of meat eating quality (IMEQ) (SRUC: £950k). Researcher with Mr Dave Ross/Prof. Rainer Roehe.
2010-2014 DEFRA. Improvement to the National Inventory – Methane (Total: £2.6M; SRUC: £734k). Researcher with Dr Tony Waterhouse.
2009-2010 DEFRA. Determining strategies for delivering environmentally sustainable production in the UK ruminant industry through genetic improvement (“Ruminant GIN”) (SRUC: £274k). Researcher with Prof. Geoff Simm.

Recent research outputs

Martinez Alvaro, MM, Mattock, J, Auffret, MD, Weng, Z, Duthie, C-A, Dewhurst, RJ, Cleveland, MA, Watson, M & Roehe, R 2022, 'Microbiome-driven breeding strategy potentially improves beef fatty acid profile benefiting human health and reduces methane emissions', *Microbiome*, vol. 10, no. 1, 166. https://doi.org/10.1186/s40168-022-01352-6

Cantalapiedra-Hijar, G, Morel, I, Sepchat, B, Chanteleuze, C, Miller, GA, Duthie, C-A, Ortigues-Marty, I & Dewhurst, RJ 2022, 'Identifying cattle with superior growth feed efficiency through their natural 15N abundance and plasma urea concentration: A meta-analysis', *Peer Community Journal*, vol. 2, e31. https://doi.org/10.24072/pcjournal.130

Martinez Alvaro, MM, Auffret, M, Duthie, C-A, Dewhurst, RJ, Cleveland, MA, Watson, M & Roehe, R 2022, 'Bovine host genome acts on rumen microbiome function linked to methane emissions', *Communications Biology*, vol. 5, 350. https://doi.org/10.1038/s42003-022-03293-0

Langford, B, Cash, J, Beel, G, Di Marco, CF, Duthie, C-A, Haskell, M, Miller, G, Nicoll, L, Roberts, CS & Nemitz, E 2022, ' Passive breath monitoring of livestock: Using factor analysis to deconvolve the cattle shed', *Journal of Breath Research*, vol. 16, no. 2, 026005. https://doi.org/10.1088/1752-7163/ac4d08

Memberships

KTN's Animal Sector Advisory Board (External organisation)
Duthie, C.-A. (Member)
25 Feb 2021 → 2025

Awards Committee, British Society of Animal Science (External organisation)
Duthie, C.-A. (Member)
2018 → 2023

Scottish Accreditation Board (External organisation)
Duthie, C.-A. (Director)
18 Dec 2016 → …

Strategy and innovation committee, British Society of Animal Science (External organisation)
Duthie, C.-A. (Chair)
2015 → 2018

Strategy and innovation committee, British Society of Animal Science (External organisation)
Duthie, C.-A. (Member)
2014 → 2018