

Institution: SRUC (Scotland's Rural College)

a) Context and mission

SRUC is unique in Scotland and the UK due to our combined world-leading research, advisory service and teaching excellence, enabling us to address the grand challenges of the 21st Century. Following an institution wide strategic review our context is **anchored locally, impacting globally** with the following vision and mission (Fig. 1).

Vision: Scotland's enterprise university at the heart of our sustainable natural economy.

Mission: Creating and mobilising knowledge and talent. Partnering locally and globally to benefit Scotland's natural economy.

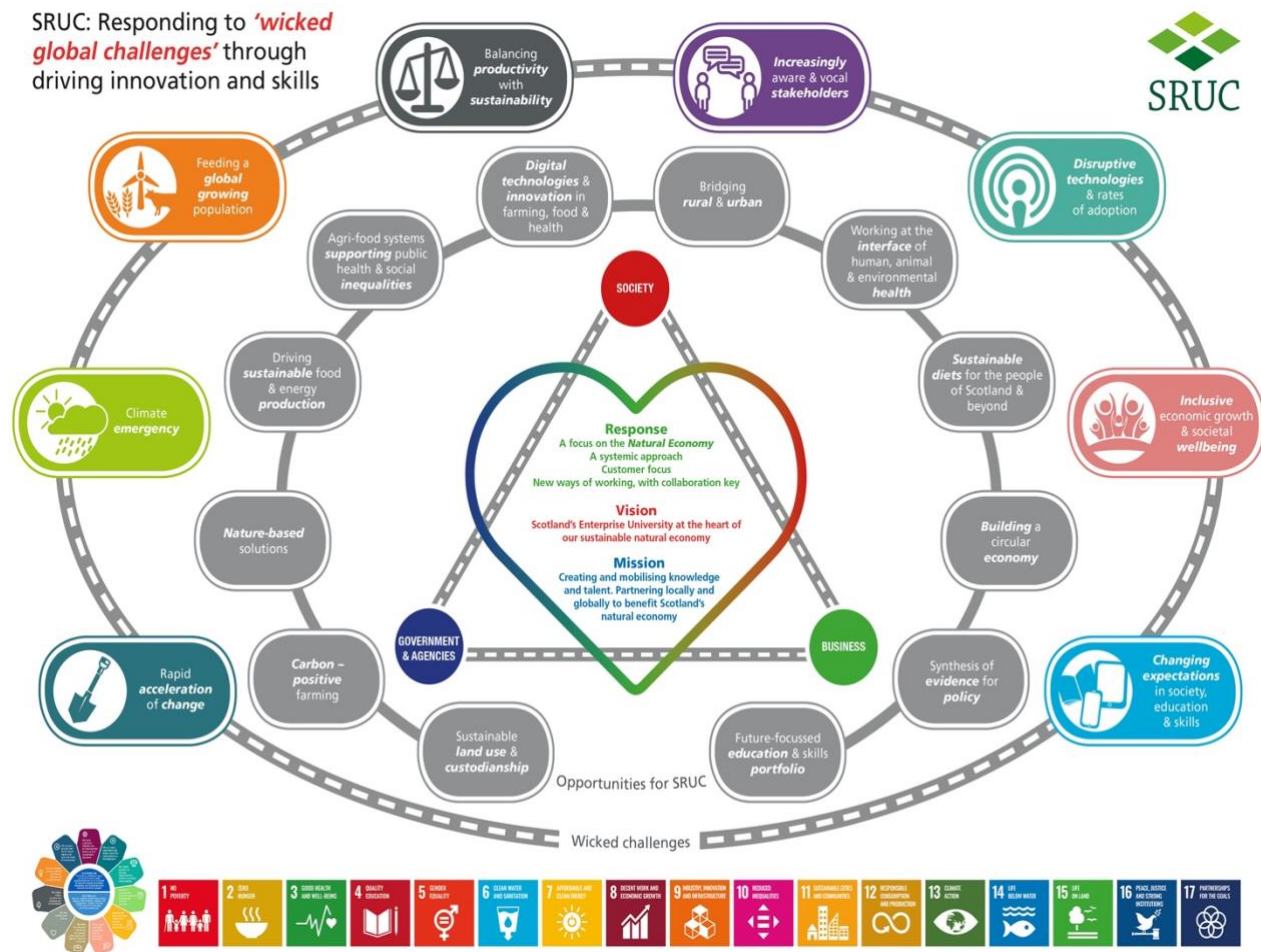


Figure 1. Visual representation of SRUC's vision and mission

A small specialist institution (SSI), SRUC has campuses, consultancy offices, veterinary disease surveillance centres and research farms across Scotland, with three regionally based faculties delivering internationally respected research. We are at the leading edge of a new tertiary model for Scotland in amalgamating further and higher education, resulting in a vertically integrated range of qualifications from access level right up to PhD.

SRUC is on a journey to become Scotland's enterprise university at the heart of our sustainable natural economy. SRUC envisages a natural economy fuelled by responsible use of our natural resources: people, land, energy, water, animals, and plants.

To achieve this, SRUC draws upon longstanding strengths in world-class, sector-leading research, learning and teaching, skills and training, and consultancy. The integration of these complementary 'knowledge exchange' services is of significant value to all with an interest in natural economy - learners, businesses, communities, and policymakers.

b) Strategy

SRUC conducts internationally respected, largely multi- and inter-disciplinary research, seeking to address the major challenges of growing global demand for food and nutrition security, climate change and dwindling natural resources with emphasis on resource use efficiency. Reflecting our ethos of knowledge exchange, we involve our students and our many stakeholders, customers and clients in the rural sector as we continue to grow and develop our research and impact portfolio. The translation of our innovative research outputs, by close interaction with our Consultancy services, helps rural industries through the delivery of up to the minute advice and consultancy to approximately 18,000 clients, in Scotland, the UK and beyond.

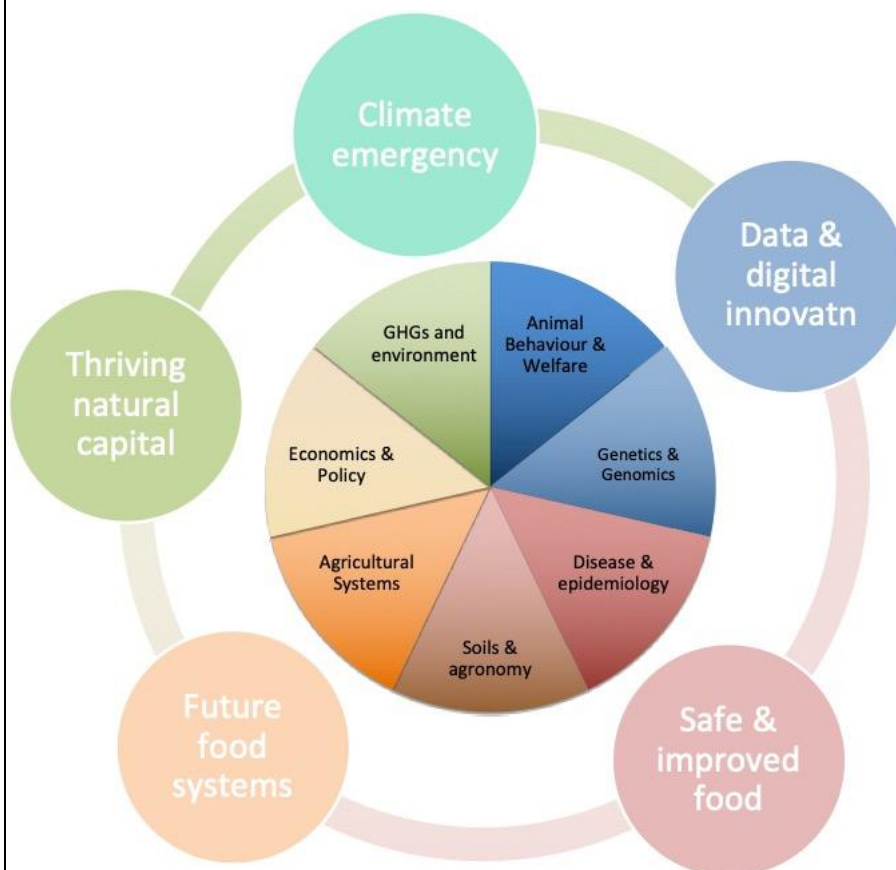


Figure 2. Research disciplinary activities at SRUC and 5 interdisciplinary Challenge Driven Research Centre themes

Our research spans from discovery to applied and industry-led research, and includes collaborative, co-developed research and knowledge exchange (KE) activities with academic, industry, policy, and public stakeholders (**Fig. 2**). Our research is supported by key enabling activities, many providing routes for KE and impact.

- Data and digital tools and infrastructure coupled with rich dataset underpinning food systems
- Experimental facilities ranging from molecule to landscape
- Widespread industry and academic partnerships leveraging world class collaboration

Our linkages to commercial activity, within SRUC and with partners means that our research and innovation activity, and our KE and impact agendas, work hand-in-glove with feedback informing developments in both directions. Examples are given in the following sections and **REF5b**.

Animal behaviour & welfare

Our research aims to understand and interpret the behaviour of managed animals. This includes how expressing positive behaviour may impact on animal health and welfare, the impact of management on animal welfare, developing novel methods to assess animal behaviour and

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emotion, and evaluating the role of sensors to record and understand animal behaviour - on individuals and groups of animals. We also develop approaches to understand the impact of human behaviour in interactions with animals, and methods to bring about behaviour change for a positive impact on animal welfare.

Research Highlights: Our research has led to an increased understanding of, and development of precision farming tools to improve farm animal welfare - e.g., early indicators of tail biting in pigs (**Baxter & D'Eath**, Appl Anim Behav Sc 2018) and spectral entropy of chicken calls as an iceberg welfare indicator (**Sandilands**, J Royal Soc: Interface 2020). Our research in maternal behaviour and offspring experience and fitness has characterised the different types of maternal behaviour shown and factors affecting the quality of maternal care and response in the young animal. This includes understanding sheep maternal care and attention to their young (**Dwyer**, PLoS ONE 2015) and the negative impact of pre-natal stress on pig maternal behaviour (**Rutherford & Lawrence**, Physiol Behav 2014).

Knowledge Exchange and Impact Highlights: Our novel welfare assessment approach, Qualitative Behavioural Assessment has been implemented in a range of animal scenarios. An app based on this method is being deployed by a major UK supermarket to provide an insight into the lives of farmed animals (Impact Case Study (ICS) H). Informed by our early life survival research, Quality Meat Scotland published a "[Ewe Timeline](#)" in 2015 to help farmers maximise lamb survival, which includes lamb vigour as a goal for survival, and stresses the importance of maintaining optimal nutrition in late pregnancy.

Genetics & genomics

The intellectual and practical challenge in sustainable agricultural production is to link genetic variation of traits of interest, including production efficiency, fertility, health, and welfare traits, to the benefit of the production system and food chain. With the advancement of new technologies and theoretical and statistical frameworks, high throughput –omics data, enhanced computer memory, and data-driven biology, we are developing new capabilities for integrating information. We harness these to improve our genetic understanding of traits in agricultural systems and to improve the genetic and genomic tools deployed by industry.

Research Highlights: Our research has developed new methods for genetic and genomic improvement in crops and livestock including origin-specific genomic selection to help manage genetic diversity in crop improvement programmes (**Powell & Mackay** G3-Genes Genom Genet 2020) and improving the accuracy of single-step genomic selection (**Mrode**, Heredity 2018). We have advanced our genetic understanding of novel traits including genomic analyses of international dairy datasets of feed efficiency (**Wall**, J Dairy Sc 2015) and genetics of telomere length as a predictor of animal fitness (**Banos & Coffey**, Front Genet 2019)

Knowledge Exchange and Impact Highlights: Implementation of the outcomes of our research is achieved through multiple strategic partnerships with major breeding companies and other industry partners. With an average research and commercial income to SRUC of over £880k per annum (last five years), key delivery route for our genetics research is via SRUC Commercial is Edinburgh Genetic Evaluation Services (EGENES); providing routine genetic and genomic predictions and breeding programme tools for dairy, beef, sheep, pigs, and goats, in the UK and abroad. Highlights over the REF period include the introduction and/or expansion of genomic prediction in dairy, beef, goats and sheep (ICS C, E) as well as the introduction of [TB Advantage](#) – helping farmers select animals based on their genetic potential for TB resistance.

Disease & epidemiology

Our research aims to provide a detailed understanding of the biology driving disease persistence, prevalence, and spread, and explores how the biology scales up from individuals to populations, in plant, animal and human populations. It explains how this interacts with behaviours, practices, and policies to help determine the patterns of infection seen in host communities and the efficacy of disease control strategies. Much of our research takes a systems approach to frame disease challenges and problem-solve disease risk at a range of

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scales - from farmers, veterinarians and agronomists tackling specific disease challenges to the global grand challenges of disease control, climate change, food security and antimicrobial resistance.

Research Highlights: Our mechanistic work has unravelled the key findings on the genome of *Ramularia*, an emerging barley pathogen (ICS A; **Havis & Burnett**, BMC Genom 2016). Our systems approach to disease dynamics has shown that increased parasite load in sheep increases methane yield demonstrating a direct link between animal health and greenhouse gas (GHG) emissions in livestock (**Smith, Houdijk & others**, Int J Parasitol 2018). Using network analysis, our research has highlighted new risks linking animal haulage to the spread of disease in the pig industry (**Gunn**, Transboundary Emerging Dis 2020).

Knowledge Exchange and Impact Highlights: Our research is enhanced by direct engagement with key disease surveillance activities covering livestock, wildlife, and marine mammals which SRUC Veterinary Services undertake, as well as their health schemes for cattle, sheep, goats, and horses. These are funded primarily by the Scottish Government and provide a key feedback loop between research and practice with examples of research impact including the [BVD Stamp it Out](#) programme in England, [LymeApp](#) – an interactive, spatially accurate Lyme Borreliosis identification and risk management system, and environmental threats to marine mammals (e.g. threat of PCB pollution to killer whale populations, **Brownlow**, Science 2018).

Soils & agronomy

SRUC's soil and agronomy research is centred on developing resilient crop and grassland systems for food, feed, and fibre production. If we are to achieve global food security, it is imperative that we manage our soils and plant genetic resources in a sustainable manner. Looking to the future there is no one simple design for crop production systems, so we work with many different approaches including conventional arable, low input arable, mixed farming, organic and regenerative systems.

Research Highlights: Understanding climate change impacts, we have shown how certain microbial communities are less tolerant to environmental extremes which may become more frequent (**Watson**, Appl Soil Ecol 2020), and developed approaches to modelling future productivity and quality of our pastures (**Wall, Topp & Banos**, Environ Modell Software 2019). Using stakeholder engagement and multi-actor approaches our research has redesigned agronomic systems to improve use of grain legumes in organic systems (**Watson**, Eur J Agron 2020) and potential uptake of precision agricultural technologies by EU crop farmers (**Barnes & Eory**, Land Use Pol 2019).

Knowledge Exchange and Impact Highlights: Through our consulting and commercial activity our [Analytical Service Department](#) and [Crop Clinic](#) offers a wide range of services to help evaluate and monitor soil and plant health and crop and forage quality. Combined with the knowledge of local experts, we help producers interpret and implement improvement strategies for soil, crop, and grass management. For example, [Adopt-a-Crop](#) has monitored Scottish commercial crops for pests, weeds, and diseases since 1983, providing a unique picture of current and historic threats.

GHGs & environment

Our research plays a leading role in developing new approaches to impact, measurement, and mitigation of GHG emissions from agriculture, and rural and coastal landscapes. This understanding of GHG processes at all levels in agricultural systems enables us to inform and improve GHG inventory and reduction methods, which then informs practice and policy. Our environmental and ecological research has also led to new understanding of the wider ecosystem services of our food systems and rural communities at home (e.g., peatland restoration in Scotland - **Glenk**, Ecol Econ 2020) and abroad (e.g. wetlands in Uganda - **Novo**, Ecol Indic 2019).

Research Highlights: Our research has provided new knowledge on system-wide flows and fluxes of GHGs. Work on the nitrogen cycle has identified the role of microbial guild on N₂O soil sink capacity (**Griffiths**, Nat Clim Change 2014), oxygen regulation of N₂O production in agricultural soils (**Rees**, Environ Sc Technol 2019) and estimation of N₂O emission intensity in European crops (**Topp & Rees**, Biogeosci 2019). We have explored the drivers of carbon footprints in agricultural systems (e.g., beef, **Topp & Rees**, J Cleaner Prod 2019) and understanding mechanisms and approaches to reducing GHGs (e.g. livestock feed supplementation, **C Newbold**, EMS Microbiol Ecol 2018).

Knowledge Exchange and Impact Highlights: SRUC has an extensive commercial portfolio supporting climate change mitigation and adaptation in farming and food systems. This is reflected in the [Farming for a Better Climate](#) programme and supported by the development of the carbon footprinting software [Agrecalc](#), used extensively across commercial farm and food chains (ICS F).

Agricultural systems

SRUC aims to understand and engage with farmers and their influencers to bring about beneficial change in farming systems and practices, both nationally and globally. Using our research farms for key demonstration activities linked to our research, we bring together a range of biological and engineering skills and collaborate with leading industry experts as well as academic partners. Our work characterises land management systems for economic, environmental, and social sustainability in the context of international, national and local land use policies.

Research Highlights: Our research has identified routes for alternative protein sources in agriculture including the nutritive value of legumes as an alternative to soya in poultry diets (**Walker & Houdijk**, Poultry Sc 2019) and the importance of sustainable supply of lysine in understanding dietary transitions to plant-based protein sources (**Barnes, Rees & Watson**, Front Sustainable Food Sys 2019). We have demonstrated the value of riparian buffer strips in conserving insect pollinators in intensive grazing systems (**Cole & McCracken**, Agric Ecosys Environ 2015) and the impact of upland grazing strategies on bird species (**Littlewood**, J Appl Ecol 2020).

Knowledge Exchange and Impact Highlights: Established in the 1930s, the [Scottish Farm Business Survey](#) is the most authoritative annual financial analysis of farmers in Scotland. As a key data source for national statistics influencing Government policy, the survey benefits Scottish agriculture, informing farm business decisions and sectoral performance benchmarks.

Economics & policy

SRUC has one of the largest UK groupings of economists and social scientists working in the rural, agricultural, and land-based sectors. We take an integrated approach to complex problems to meet society's grand challenges. We examine how individual elements are connected and interdependent, at farm and ecosystem-level, in food supply chains and in individual farmer and consumer behaviours, to promote innovative and sustainable behaviour change increasing resilience of rural economies and communities. Our researchers, consultants and other professionals work on both domestic and international policy, with a growing portfolio in low to middle income countries, examining such aspects as sustainable intensification, development of food value chains and adoption of innovations by smallholder communities.

Research Highlights: Our research dissects the benefits and trade-offs of different policy actions including understanding the global costs and benefits of expanding marine protected areas (**McVittie**, Mar Pol 2020), economic and ethical analyses of tail docking legislation in pigs (**D'Eath, Rutherford & others** Anim 2016) and impact of landscape value on public water policies in Brazil (**Glenk**, Global Environ Change 2018).

Knowledge Exchange and Impact Highlights: Through our Rural Policy Centre we work in partnership, engage with people ‘on the ground’ nationally and internationally, and ensure, through active knowledge exchange, that our research produces the maximum impact.

Open research

We are fully committed to the principles of the Concordat on Open Research Data. We seek to collaborate and engage with partners to develop approaches that will enable us to address the principles of the concordat and consider solutions that will enable us to develop practical mechanisms at reasonable cost, to make our publicly funded data available to those who wish to access it. We see particular advantages of promoting this in our sector as the use of “big data” is part of the transformative process necessary to facilitate the step changes needed to address the global challenges recognised in our strategy.

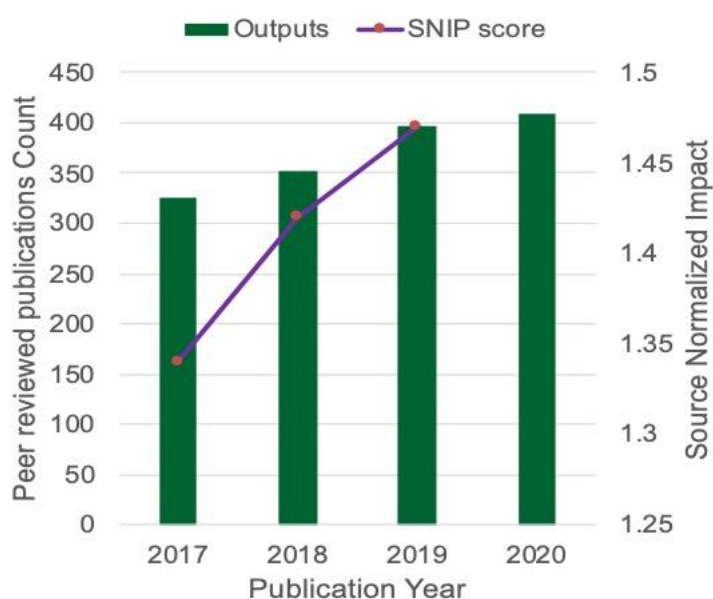


Figure 3. Increase in peer-reviewed publications at SRUC and their impact.

Since 2014, over 65% of our research outputs are open access. Our research outputs have grown year-on-year, as has their impact (**Fig. 3**). Demonstrating our international collaboration, 59% of our papers over the REF2021 period are co-authored with colleagues from 101 countries worldwide.

Forward Research Strategy

As part of our institutional transformation and strategy implementation, SRUC research aims to **Deliver Research for Change**. Working in partnership with industry, policy, and society our staff and students will collaborate to develop and deliver our underpinning strategy of driving real world change to the challenges we face.

Our Challenge Driven Research Centres are both multi- and interdisciplinary drawing on expertise from across SRUC and partners. By aligning our innovation and impact agendas to these Challenge Themes we will begin to imagine, anticipate, and develop new seams of creativity in emerging, cross-cutting areas, allowing us to be a leading force in the development and deployment of innovation to support our natural economy. The Centres will be key foci for KE and the use of research to influence change, enabling them to become key venues for networking, debate and collective influencing with/through key stakeholders.

Driving data and digital innovation: Building on SRUC’s strength in generating, managing, and utilising data across the food chain, this Centre will use data and analytics to develop new

understanding, including efficiencies across agri-food systems, and develop/improve products.

Global climate emergency: Focussing on systems-level solutions to tackle the worsening climate crisis, this centre will identify and implement interventions promoting adaptation to, and mitigation of, climate change impacts. The complexity of this challenge cannot be addressed by direct, short-term research alone but needs a broad, multi-disciplinary and open approach that takes the long view.

Safe & Improved Food: Working with industry and academic partners, this Centre will develop new ways of producing and processing food, to make it safer, healthier, more nutritious and/or tastier. This will be done in the context of ensuring a sustainable yet plentiful food supply to feed a growing global population.

Thriving Natural Capital: This Centre will show how natural capital, underpinned by the interdisciplinary science of ecosystem services, is essential to addressing UN Sustainable Development Goals and informing decision makers on the restoration of natural capital and its sustainable use.

Future Food Systems: Our land-based industries not only produce food and drink but are part of an integrated land use strategy delivering natural capital. In partnership with industry, this centre will generate knowledge to help create safe, sustainable, and new foods chains that deliver sustainable, healthy diets, driving transformation towards sustainable agri-food systems and economic growth.

c) People

Staff and students

Our 1,273 staff (2019/20) include 809 research, education (FE and HE) and veterinary academic staff. Over 36% of HE staff have a research focus in their role. From REF2014 to REF2021 we have increased the total number of staff returned by 82%, with all Category A staff with significant responsibility for research being returned (**Table 1 & REF5b**).

During the REF2021 period 310 PGR students commenced their studies at SRUC. These students are registered with 23 degree-awarding partners from 9 different countries. Over 71% of our PGR students are registered with the University of Edinburgh, including those jointly supervised with UoA6 (**REF5b**). Other major degree awarding partners include the University of Glasgow (9% of our PGR students), University of Aberdeen (5%) and the University of York (4%). 91% of PGR students are in full time study and 52% are non-UK nationals from 48 countries.

Equality and Diversity at SRUC and in REF2021

In line with the Equality Act 2010 and the Public Sector Equality Duty, our Equality, Diversity and Human Rights policies recognise the value and contribution of every individual and seek to enable them to achieve their full potential and aspirations without suffering discrimination of any kind. SRUC has developed a Single Equality Scheme with the express aim of eliminating any form of discrimination, harassment, or victimisation in relation to the identified protected characteristics. We promote equality both across the organisation and in our interactions with our clients and students. We recognise that we both contribute and gain by fully participating with the wider HEI community to better aid our positive promotion of equality and diversity values to all our staff and students. We are preparing for an application for an Athena Swan Bronze award in April 2021.

All staff are required to undertake a compliance module on Diversity in the Workplace. This was introduced in 2018 with 91.7% of research staff completing the module, rising to 97.2% in 2019.

SRUC's underlying principles state that *no individual should receive less favourable treatment on grounds that cannot be legally and reasonably/objectively justified*. We aim to demonstrate a culture of equality, fairness, respect, and common sense as demonstrated by our core values - **Respect** everyone's contributions, **Innovate** for success and **Support** each other to **Excel** in everything we do.

Table 1. Comparison of numbers submitted to REF2014 and REF2021 (gender and early career researcher (ECR) split)

	REF 2014	REF 2021
Headcount total	61	111
FTE total	57.37	105.4
% M	64%	61%
% F	36%	39%
ECR Headcount total	8	17
ECR % M	38%	53%
ECR %F	62%	47%

We have increased the proportion of SRUC's female staff returned (36% of the submitted headcount in REF2014; 39% in REF2021). The proportion of the submitted staff who are ECRs has also increased from 13% to 15%.

Of our total pool of outputs scored as per our Codes of Practice, 32% have female authors while 67% have male authors. Of our submitted outputs, 34% of outputs are attributed to female staff and 65% to male staff. 14% of our submitted pool are attributed to ECR colleagues. Equivalent statistics for our joint submission are given in **REF5b**.

Career support for researchers

As well as induction on starting at SRUC, all staff have, at a minimum, annual performance reviews including training and personal development needs. SRUC's 'People Strategy' launched in 2018 reviewed the Performance Management Framework leading to 'Making Performance Matter' being launched in August 2019. Staff and students are encouraged to participate in a range of development activities to enhance their teaching, learning and assessment skills, and to further their subject specialism - both activities are included within the broad definition of scholarly activity at SRUC.

SRUC has adopted the use of the Vitae Research Development Framework for our research-active staff and PGRs. This allows individual development actions to be evaluated, and tailored programmes for researchers to be developed at all stages of their job progression. More general researcher skills events are run throughout the year, including sessions on grant development, postgraduate (PGR) supervision, and data skills.

Since 2016, 4 female staff have participated in the Aurora leadership development programme. In 2018 the SRUC People Strategy reviewed values and behaviours across the organisation and introduced the employee recognition "Above and Beyond Awards".

SRUC's Leadership Academy (established 2019) is a bespoke development programme designed to develop capability and capacity for the future. The programme, based around the Insights Leading Transformational Change model, has trained 9 new leaders within the Academic Division to date.

PGR Training Environment

We provide our PhD students with support, training, and supervision, as well as meeting the requirements of our degree-awarding partners. We are partners in 3 Doctoral Training Programmes (**REF5b**) and hold an annual PGR conference – the winners of which represent SRUC at the annual SEFARI Postgraduate Student Competition.

During the REF2021 cycle SRUC underwent an Enhancement-led Institutional Review (ELIR) in Spring 2019 and our first Institutional Led Review (ILR) of Research Postgraduate provision was held in September 2018. This process is underpinned by meaningful academic dialogue – through the Academic Governance structure, annual internal monitoring and ILR processes. From this we have developed refreshed policies, procedures and academic governance structures, and reviewed PGR policies and procedures. We are now in the process of further embedding these.

In 2020 we introduced our Doctoral College to enhance our PGR training programme and ensure individual student projects fit into the wider SRUC research and innovation environment. The aims of the new Doctoral College builds on strengths of current policies:

- Supporting the lifecycle of research students
- Supporting academic, personal and professional development of students and supervisors
- Promoting interdisciplinary and entrepreneurial thinking working across SRUC and partners
- Connecting PGR community to network of peers, academics and support staff
- Developing and delivering systems to support PGR progression, from application to alumnus

Our PGR students are an integral part of SRUC research, and this enhanced PGR provision ensures we deliver a cohort of skilled research-trained individuals to support a knowledge-based natural economy.

Institutional level environment template (REF5a)

d) Income, infrastructure, and facilities

SRUC (Fig. 4) was created in 2012 when the Scottish Agricultural College merged with three regional land-based colleges: Barony, Elmwood and Oatridge. It is founded on world class and sector-leading research, education and consultancy extending to more than 50 countries worldwide. The integration of these three complementary areas is at the heart of SRUC's operations and a distinctive strength.



Figure 4. Facilities supporting SRUC research, knowledge exchange and impact activities. Rotating from bottom left, South & West faculty - farming systems on Crichton Royal Campus (with the University of West of Scotland) in Dumfries, Barony Campus in Ayr, Kirkton & Auchtertyre Farms in West Highlands; North faculty – lab, veterinary and marine stranding facilities in An Lochran (with the University of Highlands & Islands) in Inverness, Craibstone Campus and farms in Aberdeen, Elmwood Campus with golf/greenkeeping facilities and food development kitchens in Fife; Central faculty – Oatridge Campus with pig and equestrian facilities in West Lothian, Kings Buildings Campus with lab, data and glasshouse facilities (with the College of Science & Engineering, University of Edinburgh) in Edinburgh, farms, labs, business support and offices in and around Easter Bush campus (with the Royal (Dick) School of Veterinary Studies; REF5b) in Midlothian.

Research Support

SRUC has recently restructured our research support function forming the Research Operations and Strategy (ROS) team (15 posts). ROS remit includes contractual and legal matters, horizon scanning, funder relationship and application management, reporting, post-award management, quality assurance and enhancement, research data and information management, and supporting research ethics and integrity. ROS also houses our Doctoral College, ensuring alignment and efficiencies in researcher training, and is a key interaction hub with professional and commercial services.

In 2020, this new team supported 215 bids submissions with a total value to SRUC of over £33 million. It also delivers management and reporting of our Scottish Government Strategic

Institutional level environment template (REF5a)

Research Portfolio (ca. £6.7 million p.a.) and Scottish Funding Council Research Grants, reporting to main funders (average income > £18 million p.a.; **Fig. 5**) and PGR student administration and management, including doctoral training programmes. ROS also coordinates institutional research-related projects including REF and Athena Swan submissions.

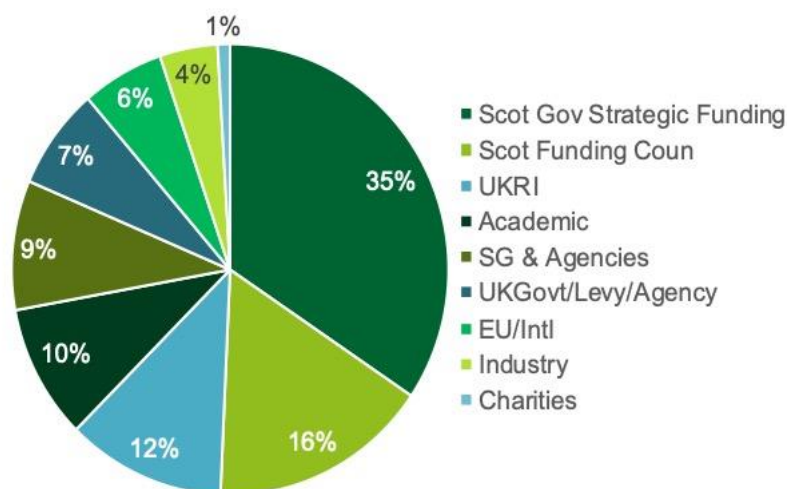


Figure 5. Average annual research income at SRUC by funding type

Research Quality, Ethics, and Integrity

SRUC is fully committed to the principles of the Research Integrity Concordat and ensuring that these principles are embedded in our research culture and actively implemented at SRUC. SRUC are also members of the Scottish Research Integrity Network.

We maintain a fully certified, ISO9001/2015 approved Integrated Management System (certificate number BS 94274) where Standard Operating Procedures for all our research processes and procedures are stored. These are regularly reviewed and internally audited, and subject to periodic independent external audit by the British Standards Institute.

In 2017-2018 we increased our activity on ethical and integrity issues and formed an overarching SRUC Ethics Committee which has now been embedded in our academic governance, which oversees the ongoing activity of our previously established animal experimental and social science committees. The remit of this group is to advise SRUC on the development, implementation and review of institutional procedures and guidelines relating to ethical, legal, and professional frameworks and standards, and integrity issues arising from teaching, research, consulting, KTE and other related institutional activities. The committee is now embedded and proactive in relation to emerging issues of institutional, national, or international significance. In addition, the committee has a role in helping to guide and promote good practice within SRUC to further develop our research culture and underpin existing governance for the ethics and integrity in all our activities.