

Spotlight on Strategic Research 2019-20

The Scottish Government's Strategic Research Programme (SRP) for environment, land, agriculture, food and rural communities 2016-2022 is delivered by the Scottish Environment, Food and Agriculture Research Institutes (SEFARI). The SRP is the mid to long term research component of the Scottish Government's Strategic Portfolio. In addition to the SRP, this includes the underpinning of SEFARI national capability resources and, in partnership between SEFARI, Scottish Universities and Agencies, the policy facing Centres of Expertise. SEFARI Gateway is the Knowledge Exchange (KE) and Impact Centre for SEFARI. Gateway works to enhance access to the individual and interdisciplinary expertise and innovation within the Strategic Portfolio, strengthening and building new partnerships with policy, agencies, sector organizations and across civic society.

SEFARI research and associated KE delivers to policy and practice, sustainable economic development and building national and international partnerships contributing to <u>Scotland's</u>. <u>National Outcomes</u> and aligned <u>United Nations Sustainable Development Goals (SDGs)</u>. This report provides highlights from the SRP and allied KE for 2019-2020, a period dominated by the <u>response to COVID-19</u> and which has seen the core resources within SEFARI strategically deployed and its research and KE expertise rapidly responding to address the impacts of the pandemic.

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*outputs across the Strategic Portfolio, fully or underpinned by Scottish Government strategic funding **collaborative projects that involve SRP-related work with non-SEFARI organisations

COVID-19 response

- Creation of a new <u>testing node</u> for NHS
- Piloting a study for NHS on enhancing testing capacity
- Provision of <u>equipment</u> to NHS
- Working on sustainable personal protective equipment from agri-waste
- Assessing food habits during lockdown
- Undertaking a COVID-19 food security assessment
- Supporting remote education for families and schools with new online materials
- Examining agricultural production and trade during the pandemic
- Membership on Scot Gov COVID-19 Stakeholder Group for Rural Economy and Communities
- Co-leading expert group on rural economic recovery through the lens of food and drink sector
- Providing voluntary support to local health and wellbeing organisations



Policy and practice



REGIONAL LAND USE PARTNERSHIPS

SEFARI has been working with the Scottish Land Commission to support Scottish Government's commitment to enable Regional Partnerships (RPs) to emerge by 2021, with each partnership creating a Regional Land Use Framework by 2023. Work has focused on the <u>evidence</u> base within land management, land use and environmental governance and on supporting Scottish Land Commission's advice to Ministers on the <u>rollout of RPs in Scotland</u>.

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WADERMAP AS AN ECOLOGICAL TOOL

In Scotland, <u>wading bird numbers</u> have fallen dramatically. SEFARI researchers developed a tool (<u>WaderMap</u>) which will help land managers to combat this decline by identifying locations where these iconic birds have the best chance to thrive. This app will help focus conservation activities to where there are still viable populations, or suitable areas of habitat surrounded by populations of waders.



MEASURING SCOTLAND'S NATURAL CAPITAL ASSESTS

SEFARI researchers have been working closely with NatureScot to develop Scotland's Natural Capital Asset Index (NCAI): an account of Scotland's natural capital stock and its potential to contribute to wellbeing. Methods have been included for estimation and mapping of the benefits of the heritage, and recreational value and aesthetics of the landscape. The register can be used as a robust, credible and useful tool for policy making e.g. biodiversity-based targeting of Scotland's Agri-Environment and Climate Scheme and as <u>indicators of</u> <u>environmental health</u>.





SOCIOECONOMIC & BIODIVERSITY IMPACTS OF DRIVEN GROUSE MOORS

A new <u>report</u> commissioned by the Scottish Government and benefitting extensively from the long term knowledge and expertise from strategic research and data resources within SEFARI, details: identification of the economic and employment impacts of grouse shooting; examination of the employment rights of gamekeepers; an updated and improved Geographic Information System mapping of intensity and grouse butt density; new insights into the extent of land used for driven grouse; the impact on a selection of biodiversity species arising from different intensities of muirburn and examines alternative moorland uses.

TOWARDS INCLUSIVE GROWTH

SEFARI Gateway Responsive Opportunity funded work with Highlands and Islands Enterprise on 'Inclusive Growth' has developed a <u>framework</u> to measure the relationship between prosperity and poverty in delivering an economy that combines fairness and prosperity, and established a better understanding of <u>inclusive growth in the Highlands and Islands</u>.

SUSTAINABLE HEALTH-BASED FOOD SYSTEMS

A SEFARI researcher is part of a review panel supporting Food Standards Scotland in developing 'Dietary Guidance for Scotland', and was a member of an international committee and author that developed the FAO-WHO Guiding Principles for Sustainable Healthy Diets. This brings together guidance for health, environment and food safety, while taking into account social aspects of eating. Its purpose is to be used as a guide for revising national dietary guidelines to include environmental sustainability.



FOOD INNOVATION CLUSTERING

A SEFARI Fellowship in partnership with Highland and Islands Enterprise and convened in consultation with Scottish Government, has provided a unique analysis of food innovation clusters in Scotland's Highlands and Islands. The work is providing options for partnership development under Scotland's Arctic Policy Framework, as well as defining the potential use of food innovation clusters in supporting sustainable economic development and green recovery.



SUPPORTING A JUST TRANSITION TOWARDS NET ZERO

SEFARI has supported the work of Scotland's Just Transition Commission through a Fellowship comparing <u>international perspectives on just transition</u>. The Fellow's report identifies a range of issues for policy consideration including: the need to embed just transition across legislation, regulation and planning; to recognise that while centralised strategic planning, regulation and legislation is necessary, transitions are often context specific; that localities and communities and regions should lead transition responses.

Innovation for industry and sustainable growth



GREEN CHEMISTRIES FOR PPE

Providing value from agri-waste is the focus for the development of new sustainable Personal Protective Equipment (PPE) within an Innovate UK funded project, 'Novel nanocellulosic composites as antivirals and antimicrobials for new PPE materials' (NanocellPPE). The project, building on expertise within SEFARI, is being delivered by a consortium of a SEFARI institute and two Scottish businesses, Cellucomp and Halley Stevensons Ltd., and is using green chemistries, crop wastes and co-products to create novel, absorbent antiviral and antibacterial materials suitable for PPE.





SUPPORT FOR BOVINE VIRAL DIARRHOEA (BVD) VIRUS ERADICATION Bovine viral diarrhoea is a significant endemic disease of UK livestock. Understanding how the BVD virus changes between animals is important for tracing the source of outbreaks. SEFARI scientists have developed new tools for virus identification and informed Scottish Government (via the Strategic Portfolio's Centre for Animal Disease Outbreaks, EPIC) on the range and frequency of BVD virus strains. This provides a unique analytical understanding on outbreaks for Scottish Government and the animal health industry.

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CLIMATE IMPACTS ON SCOTTISH PESTS AND DISEASES

Integrated Pest Management (IPM) practices are key in meeting the major biodiversity and climate challenges faced in arable farming. SEFARI researchers and collaborators have developed a novel metric which allows IPM practices to be quantified, revealing the measures most highly valued by farmers. In collaboration with the <u>Voluntary Initiative</u> and the National Farmers Union, an <u>IPM Plan</u> has been developed which will be an annual requirement for the c.8000 UK crop producers under the <u>Red Tractor</u> quality assurance scheme.



BERRY BENEFITS

SEFARI has an enviable international reputation in soft fruit crop improvement and for strong relationships with breeding and agronomy companies, government agencies and national and international stakeholders. Through such collaborations, founded on long-term Scottish Government strategic funding, SRP research is applying new technologies to identify important benefits from berries, berry extracts or juices. For example, a raspberry component, salidroside, shows beneficial activity in models of Huntington's Disease, and this finding is being used to seek approaches that could be used to breed high-salidroside raspberry varieties.

TACKLING THREAT OF SPOTTED WING DROSOPHILA

SEFARI is instrumental in helping soft fruit growers respond to the potential threat from Spotted Wing Drosophila. Since it arrived in the UK in 2012, SEFARI scientists have monitored populations of this highly destructive pest of soft and stone fruits. This has led to an Integrated Pest Management tool that is used to predict the flight activity with a very high degree of accuracy. Scottish growers have been provided with practical information on how to best monitor and sample for its presence, dispose of affected fruits and control the pest.





DAIRY NEXUS AT FOREFRONT OF INDUSTRY INNOVATION

The long-term Langhill dairy experiment, underpinning SRP dairy research, has been a core component of plans for a Dairy Nexus included in the Borderlands Inclusive Growth Deal. This will provide a flagship facility to drive transformational research and innovation to decarbonise the dairy sector as part of the circular bioeconomy, delivering significant and inclusive regional growth to underpin rural communities crucial to the Borderlands economy and its regional identity. This £34.2M project requires £8.0M of capital investment and will deliver £57.1M in GVA and 739 job years to the Borderlands region.



ANIMAL WELFARE IN LIVESTOCK PRODUCT CHAIN ASSURANCE

Research on the deployment and use of Qualitative Behaviour Assessment (QBA) to understand and support animal welfare has led to QBA being adopted by Waitrose as the designated indicator for animal emotional state. It will be rolled out across Waitrose's 'own brand' cattle, pig, broiler, hen, and duck supply chains, encompassing~640 farms in partnership with a SEFARI organisation.

Scientific excellence



TREE PLANTING AND CARBON SEQUESTRATION

SEFARI researchers have demonstrated that planting trees does not necessarily lead to a net increase in stored carbon over the medium term (12-39 years). Published in <u>Global Change Biology</u>, researchers showed that planting Birch and Scots pine trees on heather moorland resulted in a decline in the carbon stored in the soil, which was greater than or equal to the increased carbon stored in the above ground tree biomass, resulting in no net gain of stored carbon. The results are of direct relevance to current policies, which promote tree planting on the assumption that this will increase net ecosystem carbon storage and contribute to climate change mitigation.



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INSIGHTS FOR FOOD SAFETY

SEFARI research has examined <u>dietary exposure of UK children to mycotoxins</u> from foods, showing that safe levels of intake are frequently exceeded, and how different edible plants and plant extracts impact the growth response of food poisoning organisms, such as *Shigatoxigenic Escherichia coli* and its common O157 (and less common non-O157) types. In recognition of this expertise, a researcher joined the UK Food Standards Agency Register of Specialists: 'Food safety – chemical contaminants & additives'.



NEW DIAGNOSTICS FOR ANIMAL AND HUMAN DISEASE

A SEFARI-developed test for *Babesia* infestans has been added to the list of tickborne pathogens that can now be diagnosed and research has identified that the prevalence of this parasite is probably still relatively low in Scotland.



DIAGNOSING COVID-19

Building on strategic research expertise and SEFARI's national capabilities, SEFARI organisations were able to provide support to NHS Scotland in their COVID-19 testing programme. By November 2020, a milestone of 10,000 tests for SARS-CoV-2 was reached and with additional testing capacity available. The NHS has also selected SEFARI institutions to pilot a study looking at the impact of pooling samples, based on the experience gathered during the Scottish BVD virus eradication campaign. If successful, pooling of samples would not only save money but could increase the testing capacity across the country by 4-5 times.



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NATIONAL RECOGNITION FOR DELIVERY OF DATA INNOVATIONS

A SEFARI scientist has received the Royal Association of British Dairy Farmers Princess Royal Award for outstanding contribution to the UK dairy industry in recognition of the ongoing innovations to understand the genetics of production and fitness in cattle. This research is delivered to farmers through the Edinburgh Genetic Evaluation Service. Evaluations are published for 95% of all dairy bulls marketed for artificial insemination in the UK and for 65% (800,000 million live animals) of the current UK milking herd every month, with a net value of these accelerated rates of genetic gain across the UK national cattle herd estimated to ~£60-80M per annum.

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PRACTICAL ACTIONS FOR DIFFUSE POLLUTION CONTROL

SEFARI research, over progressive SRPs and through collaborations such as with the Irish Environment Projection Agency funded SmarterBufferZ and in developing a bid to NERC-Future of UK Treescapes, has demonstrated (see paper) that more careful vegetation management can capture and retain diffuse agricultural pollutants most effectively. In evaluations, wooded and engineered buffers scored highest and conventional grass buffers lowest for diffuse pollution control, carbon retention and flood management. These 3D buffer concepts align with new ideas in the UK Agriculture Bill, and, in a <u>collaborative report</u> funded from the Environment Agency (UK) and Forestry Commission, SEFARI researchers delivered evidence for improved advice and guidance on buffer design at a field and catchment scale.

Scientific resilience and collaboration



DELIVERING SUSTAINABLE LAND MANAGEMENT

SEFARI researchers have been successful in winning two new EU projects. The projects, FRAMEwork coordinated by a SEFARI institute and IPMWORKS, involve 49 partners from across Europe with a combined value of \in 15M, and are working with farmers and other stakeholders on collective approaches to better land management. The Natural Environment Research Council (NERC UK) has also funded SEFARI researchers (RETINA; £1.08M) to develop novel tools to support policy and land manager decisions. This involves multidisciplinary collaboration, with University of Aberdeen and Centre for Ecology & Hydrology, combining sensing-data with modelling for near real-time decision-making and site-specific decisions to promote soil carbon sequestration and greenhouse gas mitigation.



DECISION SUPPORT TOOL TO TACKLE POTATO BLACKLEG

SRP funding has underpinned a new £2.1M grant from the UK Strategic Priorities Fund with 11 other academic, industry and government partners from the UK. The project will develop a national decision support tool for potato blackleg disease, which remains the main cause of potato seed downgrading and failures in Scotland.





BIODIVERISTY TRENDS ACROSS NORTHERN EUROPE

Europe-wide collaboration, involving SEFARI researchers, analysed over 160 biodiversity time series covering 6,200 marine, terrestrial, and freshwater species from 21 European countries. Published in <u>Nature Communications</u>, this revealed that local trends in biodiversity often deviate significantly from global patterns. For northern Europe, the trend is towards an increase in diversity and species numbers which could be attributed to a combination of climate change (e.g. new species adapted to warmer conditions, the spread of alien species) and recovery from past disturbances and pollution. This work emphasises the need to standardise biodiversity monitoring schemes and to integrate long-term biodiversity and environmental monitoring data, which will allow conservation measures to be better tailored at the local level.



PULSE CONSUMPTION IN SCOTLAND

SEFARI researchers and the Soil Association (Scotland) have secured funding to run a Rural Innovation Support Service (RISS) working-group, 'Processing Pulses for Human Consumption in Scotland'. The RISS group comprises stakeholders from farming to processing, food and drink industries, and consumer organisations. It will identify opportunities and barriers for the further development of a sustainable, local pulse supply chain in Scotland, desirable pulse-based products, associated processing requirements, and market/consumer demands.



AQUACULTURE GREENHOUSE GASES ON PAR WITH SHEEP INDUSTRY

In the first study of its kind, published in <u>Nature</u>, SEFARI researchers collaborating with Food and Agriculture Organisation (UN), Cargill and WorldFish found that, in 2017, the fish farming sector generated 0.49 per cent of anthropogenic GHG emissions, or 263M tonnes of carbon dioxide equivalent. The study quantified the emissions arising from the main cultured fish species (including shellfish) around the world. While the carbon footprints of aquaculture products vary by system, the emissions from feed production generally dominate the emissions. The research raises awareness of how and why GHG emissions arise in aquaculture supply chains.



Knowledge Exchange for Sustainable Development Goals



The impact of strategic research is amplified and extended through Gateway's bespoke knowledge partnerships developed with and across stakeholders, as tailored to their priority needs:



- Clarity on evidence for climate strategies in agriculture
- Delivering practice change on medicated grit use on Scotland's grouse moors
- Connecting management and research needs within the Cairngorms National Park



- Engaging on societal relationships with Scotland's waters
- Reviewing the impact of pharmaceuticals in the environment



- Award-winning protocol for protecting genetic diversity internationally
- Identifying innovative approaches for <u>environmental monitoring</u>
- Supporting land-user engagement for Scotland's Just Transition Commission
- Evaluating frameworks for Nature-Based Solutions in Scotland



- Connecting producers with multiple benefits from under-utilised plant species
- Showcasing innovations for <u>health</u>, <u>welfare and nutrition for pig and poultry</u>
- Mapping agri by-product capacity for the bio-circular economy in NE Scotland

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- Recommendations to enhancing outcomes from The Islands (Scotland) Act 2018
- Supporting <u>Scotland's island resilience</u> leading to <u>Island's Revival Declaration</u>
- Scoping data requirements for land use partnerships in Scotland

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- Mapping Scotland's agritech, animal health and aquaculture capacities
- Assessing natural capital benefits in Scotland's rural small business sector
- Report on technologies for food authentication, provenance and traceability



- Scoping environmental sustainability for Scotland's water industry
- Examining the social capital benefits from farm co-operation



- A new resource for higher biology: <u>The Science behind COVID-19</u>
- Creation of a SEFARI online educational resources hub



- A heathier and sustainable food choices tool for retailers and consumers
- On line approaches <u>encouraging engagement with nature</u> for wellbeing

The interconnecting of projects, their researchers and partners is maximising knowledge flow for evidence use across policy and practice agendas in delivering to the Sustainable Development Goals.