

SEFARI



Royal
Botanic Garden
Edinburgh



The Rowett
Institute



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Hutton
Institute



Scottish Government
Riaghaltas na h-Alba

SPOTLIGHT on Strategic Research 2021-22

Introduction

The Scottish Government's Strategic Research Programme (SRP) for environment land use, agriculture, food and rural communities is delivered by the [Scottish Environment, Food and Agriculture Research Institutions \(SEFARI\)](#). 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 national resources and, in partnership between SEFARI, Scottish Universities and Agencies, the policy facing Centres of Expertise.

This report provides selected highlights from the year 2021-22 of the SRP. This was an extension to the 2016-2021 Programme, reflecting the practicalities of developing a successor SRP under the restrictions associated with the COVID-19 Pandemic and within which SEFARI institutes contributed [capacity and expertise](#). The SRP and its underpinning of SEFARI is delivering integrated, interdisciplinary research that is creating significant innovation and practice change, while the SRP also underpins expertise available for policy advice. Central to this success are SEFARI's enduring relationships with policy, agency, business and civic sectors across Scotland, UK and globally.

SEFARI, through the SRP and its wider research, is recognised as delivering independent peer-reviewed research, underpinning support to priority policy agendas and creating innovation and new practices contributing to Scotland's National Outcomes and aligned United Nations Sustainable Development Goals (SDGs), as enshrined by SEFARI's ethos of "leading ideas for better lives".



**SUSTAINABLE
DEVELOPMENT GOALS**

Contact us



Charles Bestwick
Director SEFARI Gateway

c.bestwick@abdn.ac.uk



Lorna Dawson
SEFARI Advisor

lorna.dawson@hutton.ac.uk



 <https://sefari.scot/>

 [sefariscot](https://twitter.com/sefariscot)

A year in numbers:



196 policy briefings from the Portfolio*
(129 from Strategic Research)



193 international projects



268 PhD students being trained by SEFARI



107 trade publications



337 peer reviewed Portfolio publications



368 expert advisory groups benefit from portfolio expertise



£12.5 million income from industry



£18.5 million additional academic research funding



375 external collaborative projects**



226 scientific outputs: book chapters, software, databases, apps

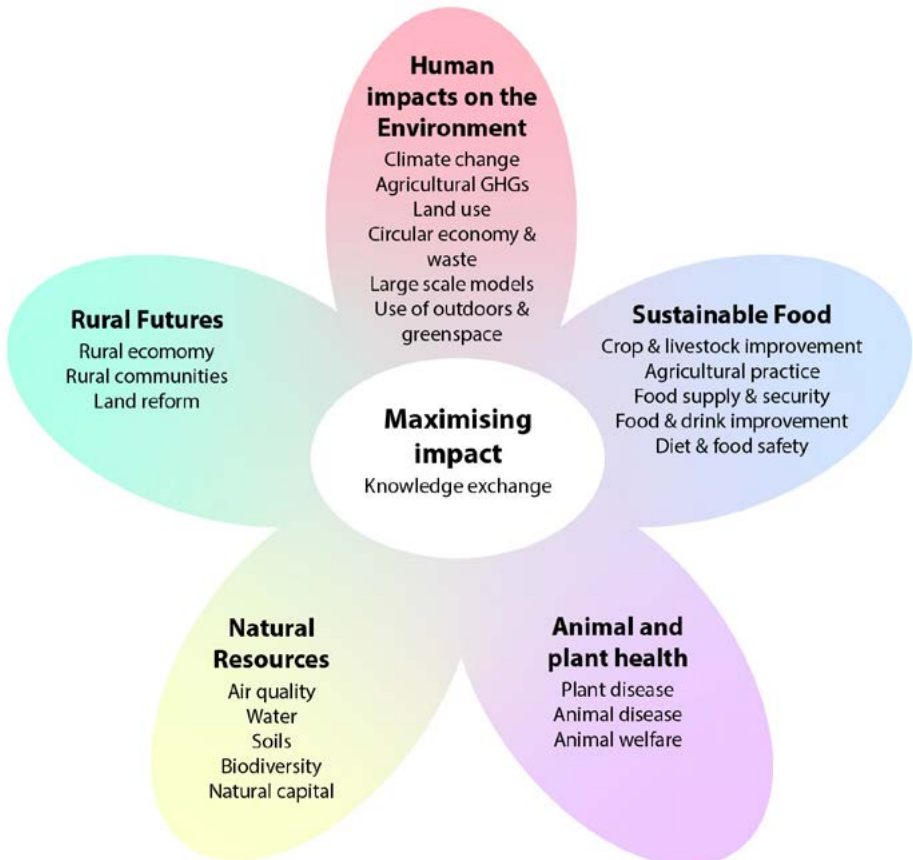
* Outputs from across strategic portfolio fully or underpinned by strategic funding

** Collaborative projects that involve SRP related research with non-Portfolio organisations

The Strategic Programme 2022-2027

This report preceded commencement of the latest Scottish Government funded Strategic Portfolio. The new Portfolio has been constructed to answer key needs across the Environment, Natural Resources and Agriculture policy agenda. Accordingly, the Portfolio addresses challenges across climate emergency, biodiversity crisis, food security and sustainable food systems, effective-sustainable land use, supporting rural community development with over 100 projects being undertaken within the SRP.

The research is grouped under five themes, highly interdisciplinary and linked to and integrated with its stakeholders through an adaptive and bespoke knowledge exchange system within which SEFARI Gateway, the Portfolio's Centre of Expertise for Knowledge Exchange and Innovation, is a key component.



Scientific Excellence

The SRP delivers national and internationally important research



Significant benefits from early action on peatland restoration: SEFARI [research](#) has shown that restoring Scotland's peatlands by 2027 rather than between 2039 and 2050 would provide an additional £191 million in societal benefits.



Impacts of pharmaceuticals in the environment: SEFARI researchers identified the occurrence of waterborne pharmaceuticals in Scottish rivers (e.g., River Dee and River Ugie) with human activities and medication use as the main source of contaminants. The [research](#) suggests that additional catchment monitoring is warranted to safeguard water quality.



Accelerating better barley breeding: SEFARI researchers have identified a [barley gene](#) that doubles the rate at which genetic material is mixed during traditional breeding. This has the potential to speed up plant breeding and to help address economic and environmental pressures of production through breeding new environmentally adapted plant varieties.



Potato Cyst Nematode (PCN) a manipulative pest: A protein has been [identified](#), produced by the potato cyst nematode, that targets a key part of the potato's biology, providing insights by which PCN manipulates the potato plant for its own benefit. This knowledge will help develop new control strategies to combat this devastating infection for the potato industry.



Finding a "light" alternative to plant disease immunity?: SEFARI researchers and collaborators have shown that a [pathogen protein](#) delivered into plants manipulates blue light signalling to promote infection. Understanding of light perception in regulating plant immunity holds open the prospect of new approaches, including as an alternative to pesticides, for the sustainable management of pests and diseases.





Imaging to advance soft fruit breeding: A SEFARI institute has developed a [hyperspectral imaging approach](#) to help the speed and accuracy within which breeding can be improved for raspberry plantations.



Folic acid fortification policy: Drawing on expertise developed over several Scottish Government funded SRPs, in collaboration with Food Standards Scotland, SEFARI expertise has contributed to plans for the UK to introduce [folic acid fortification](#) of flour to prevent neural tube defects. This is one of the most important nutritional interventions in the UK in recent decades, with the potential to protect generations of mothers and babies.



Priorities for digital technology supporting agriculture: Drawing on the SRP, SEFARI researchers contributed to a [paper](#) with UK researchers on emerging issues for the digitalisation of agricultural production. Findings identified key interconnected themes on data needs and identified how new collaborative arrangements can help policy makers in implementing agriculture reform and support.



Advice to Policy

The SRP provides research, as well as responsive and proactive expert advice, to support key areas of policy and improved best practice across the Scottish Government and its agencies.



Tree and Woodland Science Advisory Group: Collaborative work by SEFARI and Forest Research is contributing evidence to Defra through its Tree and [Woodland Science Advisory Group](#). Research has emphasised that the loss of trees from woodlands risks a far more extensive loss than just those associated with either tree host alone. Defra noted “It confirms the importance of intelligent woodland management plans to support resilience”.



Digital Soil Mapping of Scottish peatlands: A process of Digital Soil Mapping was used to produce maps of peat depth and [soil carbon stock of Scotland](#). NatureScot have used the data to identify the areas of peatland for potential restoration through Peatland Action and to inform climate action plans of local authorities (e.g., Perth and Kinross).



Future of rural youth: A SEFARI researcher was invited by the Current Affairs Committee of the Council of Europe Congress of Regional and Local Authorities to [report](#) on the future of youth. This provided a framework for local and regional authorities on how to provide better support for young people to be able to live and work in rural areas, informing recommendations adopted by the Committee in March 2022.



Proof of concept in prenatal flavour programming: SEFARI researchers have shown that inclusion of bitter vegetables in the mother's diet during late pregnancy increases exposure to these flavours in the womb and the subsequent liking of a bitter vegetable, namely spinach, by the child at weaning. The [findings](#) point to ways by which healthy eating could be influenced and are under consideration with Scottish Government Maternal and Infant Nutrition teams and Food Standards Scotland.



Sustainable diets, climate change and human health: A SEFARI researcher led a committee of the Academy of Medical Sciences and The Royal Society to [report](#) on how climate change mitigation could promote human health. They were also invited to participate on a review panel advising Food Standards Scotland on developing their 'Dietary Guidance for Scotland' and website [Eat Well, Your Way](#) launched in February 2022.



Evidence to agriculture and rural development stakeholder group:

An analysis of changes [in farm payments between 2014 and 2019](#) was developed in collaboration with Scottish Government analysts. Outputs to help inform policy development included estimates of changes in support payments by agricultural region and farm type payments under the Forestry Grant Scheme (2015 to 2019) and Agri-Environment Climate Scheme.



UK and Scottish Parliament Committees and Cross-Party Groups:

SEFARI researchers are regularly invited to provide evidence to UK and Scottish Parliament Committees eg: i). Scottish Parliament Rural Affairs, Islands and Natural Environment Committee [evidence sessions](#) on The National Islands Plan Survey, and on the [Good Food Nation](#) (Scotland) Bill. ii). House of Lords [Inquiry into Nature-based Solutions for Climate Change](#).



Membership of Scottish Government and UK stakeholder groups:

SEFARI researchers were invited members of groups set-up by the Scottish and UK Governments including: the [Scottish Government Academic Advisory Panel](#) (5 members), one task of which is the provision of robust evidence to support the work of the Scottish Government and the [Agriculture Reform Implementation Oversight Board](#); ii) [Scottish Animal Welfare Commission](#) (Chair); iii) [UK Government Expert Committee on Forest Science](#), providing independent, expert advice and assurance on the quality of science and evidence from research providers.

Innovation and Improved Practices for Sustainable Economic Development

A major goal of the SRP is to develop new practices and bring forward innovation that will help sustain the economic and social development of the environmental, agriculture and food industries, and communities in Scotland.



Mapping Scotland's natural assets: The [Natural Asset Register Data Portal](#) (NAR), created in the SRP provides individuals, businesses and organisations ready access to spatial data relating to the natural and socio-economic resources of Scotland.



Citizen dialogue about land uses: A "[Bioregional Mapper](#)" online tool has been developed to facilitate citizen participation in the debate on current and future land uses in Scotland.



Reducing risks from blue-green algae: Blooms of blue-green algae in water bodies present a serious risk to human and animal health. In collaboration with SEPA, Scottish local authorities and Scottish Water, SEFARI research created an improved version of an [app to identify locations of algal blooms](#).



Reintroduction of hemp: [Research on hemp](#) demonstrated that this crop can contribute to meeting climate and biodiversity targets, provide a high-quality alternative protein and fibre sources to diversify diets, and with human health benefits. This work has been crucial in supporting the re-emergence of this crop and its market potential, with the [first Scottish commercial hemp oil](#) now produced.



Ovine pulmonary adenocarcinoma (OPA) and disease control strategies: OPA is a viral lung disease of sheep which is difficult to diagnose, and for which there is no cure. With support from the Universities Innovation Fund, SEFARI researchers worked with "OPTimisation of industry Awareness and Networks" to improve uptake of disease control strategies via [webinars](#) and podcasts to improve awareness of clinical signs, diagnosis and available methods for disease control.



Roll-out of Qualitative Behaviour Assessment (QBA): On-farm roll-out of QBA across 12 supply chains of UK retailer Waitrose was consolidated through a collaborative programme of training and on-farm data collection, facilitated by the [QBA mobile app](#). Waitrose submitted the project to the 2021 BBC Food and Farming Awards in which it won It the '[Farming for the Future](#)' category award at the BBC Food and Farming Awards, 2022.



Rural communities and Covid-19: SEFARI researchers [reported](#) on the impacts of, and responses to, the COVID-19 pandemic on rural Scotland and the findings for a rural recovery. Impacts were place and person dependent, and identified ways to help rural communities and island communities to thrive under a rural recovery, including encouraging and supporting young people to move to rural and island communities.

Research Partnerships

Research quality and capability within SEFARI attracts extensive national and international collaborations which are supported through competitively won funding, adding significant value to Scottish Government investment in strategic research.



Natural alternatives to using antibiotics: SEFARI researchers in a consortium of 18 partners in 8 countries secured funding from EU Horizon 2020 ([NeoGiANT](#); 2021-25; total value £8M; SEFARI value £1.125M) to develop new treatment products based on the known potential of natural antimicrobial and antioxidant features of grape extracts, reducing the use of synthetic chemical compounds.



New solution to crop protection: SEFARI researchers secured funding from Innovate UK, in a project led by APS Biocontrol Ltd., to develop [a new solution to crop protection](#) (2021-23; total value £546K; SEFARI value £158K) in a project to investigate the biocontrol against the potato blackleg pathogen *Pectobacterium*.



Greenhouse gas monitoring and modelling: SEFARI researchers, with University partners and UKCEH, secured a NERC grant to improve modelling for assessing climate change-related thresholds and ecological shifts in peatland ecosystems ([MOTHERSHIP](#); £3.7M; SEFARI value £0.9M). Related funding was levered from the new EU Horizon Europe Programme to produce a register of “hotspots” where minimal investment will result in maximum ecological benefit (‘Wet Horizons’; 2022-26; total value c.£5.1M; SEFARI value £1.1M).



Food inequalities and obesity: SEFARI researchers secured funding from the BBSRC Transforming UK Food Systems, Strategic Priorities Fund (FIO FOOD, BB/W018020/1; 2022-25; value to SEFARI £1.6M) to investigate the role of food inequalities and obesity, with an emphasis on the retail food environment.



Vertical and controlled environment agriculture: SEFARI researchers have secured funding from Innovate UK (2021-23; total value £352K; value to SEFARI £90K) to develop sensors to [further advance vertical farming](#) by the accurate, non-invasive measurement of crop stresses and their relationship to food nutritional content. The consortium comprises sensor experts, Gardin Ltd. and Intelligent Growth Solutions.





Funding for the next generation of SRP researchers: [Two UKRI-BBSRC Collaborative Training Partnership Awards](#) have been secured, including an industry-wide programme for Sustainable Agricultural Innovation to provide a £3.6 million postgraduate training programme in sustainable agricultural innovation, funding an expected 30 PhD studentships. The programme is led by G's Growers Limited, co-developed by SEFARI researchers in collaboration with the University of Cambridge, the Crop Science Centre, NIAB and leading UK universities.



City and Region Growth Deals: Investment from the Aberdeen City Region Deal has been made for a centre of excellence for manufacturing and production in north east Scotland ([SeedPod](#)) which will be located on a SEFARI site in Aberdeen. It continues a series of successful regional innovation infrastructure proposals involving SEFARI organisations and their sites. Total funding for SeedPod is £21M, to be opened in 2023.



EU Research infrastructures: SEFARI researchers contributed to one of the first new research infrastructures funded by EU Horizon Europe ([Integrated Services for Infectious Disease Outbreak Research, ISIDORE](#); total value €21M) comprising 154 partners in 32 countries. The infrastructure supports research on epidemic- and pandemic-prone pathogens, with the aim of increasing resilience in the face of epidemics.



SEFARI Gateway

SEFARI Gateway is the Centre of Expertise for Knowledge Exchange and Innovation for the Scottish Government Strategic Portfolio. It provides access to the individual and interdisciplinary expertise within the Portfolio and can source expertise from across the UK to work with the Portfolio, strengthening and building new partnerships with policy, agencies, industry, public sector organizations and sector organisations and civic society.

Gateway provides a range of bespoke Fellowships, Advisory Groups and Knowledge Exchange projects, all developed in partnership with stakeholders to deliver to National Outcomes and UN Sustainable Development Goals.

Knowledge exchange, partnership building and driving change

Benefits and impacts from SEFARI Gateway's latest projects conducted in partnership with stakeholders include:



Leading a Specialist Advisory Group for the Scottish Land Commission that identified how supporting land-based policy and decision-making in Scotland through [recommendations](#) for an integrated approach to environmental and land use data.



Establishing [priorities and identifying commonalities and gaps](#) across current Scottish strategies to assist Environmental Standards Scotland's strategy towards environmental law compliance, monitoring and regulation.



With Scottish Government teams (for Natural Capital, Land Management, RPID, Regional Land Use Partnerships) and public agencies (SEPA, NatureScot, Forestry and Land Scotland) to deliver a [report](#) and recommendations on how spatial data can support the establishment of Regional Land Use Partnerships in Scotland.



Providing an evidence review on land use for [carbon sequestration](#), informing part of the proposed Land Reform in a Net Zero Nation. The review convened more than sixty experts from policy, investment, third sector, research, land management and rural communities.



Working with farming industry, land users, vets and policy in identifying [priority health conditions \(diseases and syndromes\) and practical intervention strategies](#) that would have a demonstrable impact on greenhouse gas emissions across the beef, dairy, and sheep sectors in Scotland.



Defining [Scotland's Agritech, Animal Health, Aquaculture \(AAA\) innovation landscape](#) for the Industry Life Sciences Leadership Group for AAA and Highland's & Islands Enterprise. The report identified Scotland's AAA resources as a means of supporting inward investment and collaboration with this economically important sector for Scotland.



Demonstrating the agricultural-related [bioarising \(wastes and coproducts from agriculture production\), in North East Scotland](#) can provide significant opportunities as feedstocks, ingredients and products in global markets for both economic return and in helping to achieve Net Zero emissions.



Working with NatureScot, to provide an assessment of Nature Based Solutions (NBS) [Frameworks](#) to create recommendations and a route map for applying NBS to land management in Scotland.



Enhancing public accessibility to the strategic programme's climate research via new on line virtual [tours](#). These tours take the viewer to the peatlands of Forsinard, the Climate Positive farming initiative at Glensaugh, the Green Cow facility, the urban raingarden and much more.



Extensive [engagement](#) before, during and after COP26 to inform research and forge partnerships for delivering climate action across agriculture, food-systems and for just transitions towards net zero within rural communities.