

May-August 2018

Progress Report on Strategic Research Programme Delivery



SEFARI, the Scottish Environment, Food and Agriculture Research Institutes, are responsible, with HEI partners, for delivering the Scottish Government (Rural and Environment Science and Analytical Services, RESAS) funded Strategic Research Portfolio on environment, food, agriculture, land and communities.*

The Portfolio includes the Strategic Research Programme 2016-2021 (SRP), the Centres of Expertise, Innovation partnerships and underpinning capacity funding for strategically important projects and resources. SEFARI Gateway (herein referred to as the Gateway) exists to improve the flow of research, knowledge and expertise to and from the Scottish Government funded Strategic Research Portfolio to policy, industry & society sector-representative organisations and public audiences – and to improve the impacts of those activities.

Here we provide highlights from the Strategic Research Programme for the period of May 2018 to August 2018, as presented to the Operational Group of the Strategic Advisory Board for RESAS Science for the period of May 2018 to August 2018.

We would be very pleased to receive your thoughts on these highlights, including whether and in what format you might wish to receive them in the future. We will also be happy to expand on any of the research featured and place you in conversation with the appropriate researchers regarding any of the presented highlights, as well as with any of the disciplines across the SRP.

The Gateway provides a range of opportunities through our Fellowships, Think Tanks and Responsive Opportunity programmes to enable experts from the SG Strategic Portfolio to engage and work directly with stakeholders. We are now expanding both the number of and stakeholder-need focus of our Gateway-funded programmes (in particular we seek to build partnerships via co-funding). A key feature for all Gateway schemes and interactions is genuine co-construction with the stakeholder(s) to ensure a priority need is addressed. We want to build strong partnerships for the benefit of environment, food, agriculture, land use and communities.

Contact details for research-specific and Gateway enquiries are provided at the end of these SRP highlights and we look forward to hearing from you.

Very best wishes,



Interim Director-SEFARI Gateway



* You can find more information about the structure of the Strategic Research Portfolio and the partners involved (SEFARI, SEFARI Gateway and CoEs) [here](#).

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Theme 1 - Natural Assets

Work Package 1.1 - Soils

Major Achievements

- **Policy interaction:** Using digital mapping resources for soil hydrological data (developed in the SRP through interaction with CREW and Underpinning Capacity), SEFARI researchers were able to respond to a request from SG Policy (Climate Change and Business Support) to provide evidence in support of a derogation request to the European Commission. The evidence on the impact of the wet spring (2018) and potential damage that would result from farmers being forced to cultivate saturated soils (Crop Diversification under EU CAP Greening), supported a successful approach by SG to the European Commission that prevented thousands of farmers across Scotland facing penalties for breaching an EU regulation.
- **Knowledge accounts:** Information generated (publications and reports) by SEFARI researchers on economic and social aspects of peatland restoration options contributed to SG-produced knowledge accounts of Scotland's natural assets, highlighting the importance of peatlands in provision of ecosystem services, potential risks and knowledge gaps in relation to public and land-manager acceptance of potential peatland restoration options. This information was also used in a current application for funding to investigate barriers to uptake of peatland restoration management, led by the Soil Association.
- **Knowledge exchange:** Research from WP1.1 was presented to a range of science audiences (e.g. [EGU Vienna](#), [ESSC Showcase Imola](#), [BSSS Soils and Sustainable Development Goals](#), and [World Congress of Soil Science](#)) and stakeholders ([Farmers Journal](#), MSPs visiting James Hutton Institute on 28th May, [Glensaugh Open Farm Sunday](#)) and at a SEFARI Showcase event at the Scottish Parliament (highlighted in a SEFARI [blog](#)).

Work Package 1.2 - Water

Major Achievements

- **River restoration studies:** These have been consolidated by completion of ecological surveys and invertebrate sample identification work, installation of hydrological monitoring systems, and hosting of a visit from the river restoration centre for hydromorphological assessment and landowner discussion. Researchers are newly collaborating with Herriot Watt University and Napier University and the work will be presented at the River Restoration Centre [conference](#) in Spring 2019.
- **Presentation on turbidity:** A paper was presented at the [3rd International Workshop](#) on High Temporal Resolution Water Quality Monitoring and Analysis at Clonakilty, Ireland, hosted by Teagasc Agricultural Catchments Programme. The paper was on the application of hidden Markov methods on the estimation of turbidity time series data from the Lunan catchment, Scotland and was a collaboration between researchers at James Hutton Institute and BioSS.
- **Seminar on Phosphorus risk model:** Continuing the development of our Phosphorous risk model, a seminar was given at Teagasc in Ireland in May by a SEFARI scientist, and a small contract undertaking similar work for the Agricultural Catchments Programme was secured. A joint PhD studentship proposal developing these modelling approaches is being submitted to Teagasc for a Walsh Fellowship (with Teagasc, BioSS, Uni of Reading) showing the growing network of our P modelling.
- **Buffer strips seminar:** A presentation was given by a SEFARI scientist at the Chartered Institute of Water and Environmental Managers (CIWEM) diffuse pollution conference, London, 18-19th July entitled 'Rethinking Buffer Strips in 3-Dimensions' including international co-authors, EA and Forest Research.



Considerable attention was gained from the presentation (available [here](#)) including knowledge exchange via emails between James Hutton Institute researchers and practitioners from River Boards in Ireland and Wessex Water towards future practical demonstration.

- **Catchment restoration:** A collective of events developed the impact of SRP-funded catchment restoration work: SRP research contributed to the Building with Nature workshop (Trondheim, Norway, June) working with Norwegian and other European practitioners discussing application of these mitigation techniques. In addition, RESAS research on the same topic was presented in an EU COST Action meeting (Riga, Latvia, June). SRP researchers were invited to the 'Global Water School' launch in the House of Lords (host Lord Stone of Blackheath) and attended to discuss future opportunities.

Work Package 1.3 - Biodiversity

Major Achievements

- **Public engagement for biosecurity:** Research on plant and animal biosecurity from the RBGE, James Hutton Institute, Moredun Research Institute, and SRUC was distilled into an interactive, permanent [public exhibit](#) at the John Hope Gateway. SEFARI work is presented in a series of interactive panels demonstrating how plant and animal diseases move around the world, and actions the public can take to protect Scotland's natural and economic assets. This exhibit is prominently placed in the entrance to the RBGE (694,000 international and local visitors in 2016), with portable panels in construction to further spread the message at public events across Scotland.
- **Oak and ash biodiversity work used by Defra:** Oak and ash are two of the most common British trees but both are under threat from pests and diseases in addition to climate change. If oak and ash decline in abundance then species that use

the trees may also decline, particularly if they are only found on oak or ash trees. In order to conserve the species associated with ash and oak, we need to know which species use these trees and how 'at risk' they are if ash or oak decline. Data, compiled by scientists at the James Hutton Institute, on the number of species found on oak and ash trees was recently used by Defra in its 2018 [Tree health resilience strategy](#) and was presented at the opening meeting of the Plant Health Centre of Expertise. A lay summary of this work was produced and published on the SEFARI [website](#).

- **Major new database on multi-scale plant diversity published:** The James Hutton Institute was the main UK contributor to a new international database of vegetation data - [GrassPlot](#). The difference between this database and others is that all the plot data were collected at multiple scales. The main aim of collecting and publishing these data is to facilitate studies on the scale- and taxon-dependency of biodiversity patterns and drivers along macroecological gradients. For instance, it will allow researchers to analyse how scale dependent relationships such as the species-area curve vary with climate.
- **Importance of crop mixtures research brought to the fore through Parliamentary Reception and new publication:** Research on potential benefits of crop mixtures for sustainable food production was highlighted during a [SEFARI Showcase](#) event at the Scottish Parliament. The event's keynote address was given by the Cabinet Secretary for Rural Economy and Connectivity, Fergus Ewing MSP. In addition, concepts developed through WP1.3 work on crop mixtures contributed to the delivery of a [new research paper](#) in Nature Ecology and Evolution. This shows that some of the effects which might help to deliver benefits from crop mixtures evolve best in species-rich plant communities, indicating benefits for sustainability from conserving species.

Work Package 1.4: Integrated Land Use Systems

Major Achievements

- **Aligning existing and new delivery mechanisms:** A comparative analysis of institutions and processes to deliver soil, water and biodiversity policy goals has reported findings that help to identify opportunities for improving the integration of policy instruments to support delivery of multiple benefits in peatland, forestry and agricultural settings. SEFARI scientists are sharing and disseminating these findings widely through [reports](#), a [lay summary](#), [stakeholder meetings](#), [peer-reviewed publication](#) and several academic meetings including as a session organisers at the [RGS-IBG Annual International Conference](#).
- **Improving the environmental performance of supply chains:** a model of the beef supply chain has been developed that identifies geographical, sectoral and supply chain hotspots in GHG emissions. Analysis of the [model](#) has been used to study the impact of alternative uses for distillery by-products on GHG emissions.
- **Key issues for habitat connectivity:** SEFARI scientists have contributed to the design of actions for enhancing habitat connectivity and resilience reported in a recent [paper](#) in the Journal of Applied Ecology. This has drawn on research (including SRP research) that highlights habitat connectivity as a key issue affecting the resilience of different species and habitats.
- **Climate change modelling:** A new modelling approach has been [published](#) that produces high resolution (100m) spatial climate data by downscaling existing 1km resolution WorldClim data. This approach will have applications in the estimation of soil erosion, species range shift, carbon stocks and the provision of ecosystem services in response to climate change.

Theme 2 - Productive and Sustainable Land Management and Rural Economies

Work Package 2.1: Crop and Grassland Production and Disease Control

Major Achievements

- **Potato Knowledge Exchange:** SEFARI staff presented SRP research findings at Potatoes in Practice (Balruddery Farm, 9th August) including the latest updates on late blight, blackleg, free-living nematodes and stress tolerance. More than 500 participants from industry and science attended. Extensive press coverage included an article on heat tolerance in potato ([The Sunday Times](#), estimated circulation 721,000).
- **Cereals Knowledge Exchange:** A stakeholder workshop was held to develop best practice interventions in cereals and to identify potential barriers to uptake amongst end users, complementing [research](#) on adoption of Integrated Pest Management (IPM) practices amongst arable farmers. Resulting information on improved targeting of fungicides has been incorporated in AHDB barley growth guides and FRAG-UK fungicide stewardship guides.
- **Uptake of Integrated Pest Management:** An online [IPM planning tool](#) developed in the SRP is now a requirement of the [Scottish Quality Crops farm assurance scheme](#) which assures →90% of Scottish combinable crops. Additionally, IPM was promoted through the [Farm Advisory Service](#) and AHDB roadshows and workshops and a [paper](#) on capacity and willingness for uptake.
- **Legume Science and Plant Protein strategy:** A meeting of the Association of Applied Biologists "Advances in Legume Science and Practice" was co-organised, three [invited](#) and three other presentations were given and a [journal volume](#) produced. Leading from this, the European Commission sought [expert opinion](#) from SRP staff to inform the development of the EU Plant Protein strategy to be published in 2018.



- **Insights into host-pathogen interactions:** SRP research has shown how a *Phytophthora infestans* virulence factor exploits a host susceptibility factor to cause late blight. Susceptibility factors are potential novel targets for disease control. Additionally, an effector from Potato Cyst Nematode, which targets the cytoskeleton to suppress host defences, has been [identified](#).

Work Package 2.2: Livestock Production, Health, Welfare and Disease control

Major Achievements

- **Barbervax® licenced for the UK:** Developed by SEFARI scientists, Barbervax® is the first registered subunit vaccine to protect sheep against gut parasite infection (*Haemonchus contortus*). Recent figures from 2017-18 indicate that in Australia alone, Barbervax® sales approximated two million doses for the treatment of more than half a million sheep on more than 150 farms. *H. contortus* infections are being observed more frequently in the UK, possibly as a result of climate change. Barbervax® has recently been granted a special licence for use in the UK. Merlin Vet Export, a company based in the Scottish Borders, has been appointed to handle sales in the UK and has just received its first shipment of vaccine. The vaccine has also been licenced for use in South Africa, widening its global impact.
- **Reducing agriculture's contribution to climate change:** Gastrointestinal helminth worms are globally ubiquitous and represent one of the most pervasive challenges to the health and productivity of grazing livestock. These parasites influence a number of factors affecting methane emissions, including feed efficiency, nutrient use, and production traits. This is the first study that empirically demonstrates [disease-driven increases in methane](#) (CH₄) yield in livestock (g of CH₄ per kg of dry matter intake). We show that parasite infections in lambs can lead to a 33% increase in methane yield (g CH₄/kg DMI). This knowledge will facilitate more accurate calculations of the true environmental costs of parasitism in livestock

and reveals the potential benefits of mitigating emission through controlling parasite burdens.

- **Stakeholder consultation on management and control of ovine pulmonary adenocarcinoma (OPA):** OPA is a complex disease of sheep characterised by tumours and fluid in the lungs. Early diagnosis is a key element of disease control, but this has been problematic. To address this, SEFARI scientists have developed and evaluated ultrasound screening to identify affected sheep. In June 2018 a workshop was organised by SEFARI scientists entitled "OPA control – the Next Steps" to discuss management and control of OPA. This was attended by 42 stakeholders who concluded that individual farms should go ahead with ultrasound screening to control OPA as part of a flock management programme.

Work Package 2.3: Productive and Sustainable Land Management

Major Achievements

- **Uptake of Precision Agricultural Technologies (PATs) in the Arable Sector:** PATs provide a potential route to meet the sustainable intensification of arable farming systems. We assessed the likelihood of uptake of 7 potential PATs with 244 Scottish farmers. We found institutional and trust barriers towards the technologies and recommend the use of demonstration farming to support any increase in support of PATs. Further funding was secured through NERC SARIC to co-create solutions with farmers and a joint workshop was held with innovative farmers to understand the limits to uptake. The 244 farmers (around 30% of the wheat and potato growing population in Scotland) were provided with further information on these technologies and a press article was published identifying the findings.
- **Perception of best practice in animal welfare:** The definition of 'best' practice is not constant across stakeholder groups, due to differing objectives and priorities. This lack of

agreement leads to inconsistent messages and promoters of better practices can overlook key barriers to adoption. As a result, confusions arise and trust is lost with practitioners, detrimentally affecting the uptake of better practices. We have engaged separate communities along the supply chain on the concept of 'positive animal welfare'. Work has been conducted with farmers through the development of an app and website to assess cow welfare management, collect data and provide an assessment of current welfare states. Progress towards uncovering a different societal understanding of best practice in animal welfare is developing from interviews with farmers, consumers and retailers.

- **Informing GHG Policy:** Climate change research in WP2.3 focuses on integrating expertise and knowledge developed across SEFARI to improve our understanding of greenhouse gas emissions and the opportunities that are available for mitigation. Recent examples have highlighted socio-economic approaches to improve our estimates of mitigation costs and provide advice and support for government policy development. These include (1) showing that marginal abatement cost curves can [catalyse changes in policies](#) and inventory accounting and proposed harmonised guidelines for their development, and (2) identifying the sources and types of uncertainties in analysing the [cost effectiveness of different mitigation options](#). Results showed that while most mitigation options appear to be 'win-win' under some scenarios, many have a high probability of switching between being costineffective and cost effective considering uncertainty in the analysis.

Work Package 2.4: Rural Industries

Major Achievements

Brexit Interactions: In this period of unprecedented policy challenges resulting from Brexit, WP staff continue to be heavily engaged in supporting future policy considerations both within Scotland and beyond. WP staff supported the development of a [Future Strategy for Scottish Agriculture: Final Report](#) by the Scottish Government's Agriculture Champions. WP staff were joint authors of the report on [Post-Brexit implications for Agriculture, Crofting & Related Land Use in the Highlands and Islands](#) for the Highlands and Islands Agriculture Steering Group, to which Cabinet Secretary Ewing provided a statement of support during its launch.

WP staff have appeared on BBC television and radio programmes as experts on issues surrounding Brexit (migrant labour, agricultural policy, sheep sector and post-Brexit trade) and have engaged in stakeholder and local authority roundtables, and UK-wide academic workshops as experts on Brexit. Knowledge and insight gained from the current and previous SRPs were at the forefront of institutional responses to both the National Council of Rural Advisers' (NCRA) A Rural Conversation: Together We Can, Together We Will consultation and the Scottish Government's Support for Agriculture and the Rural Economy - Post Brexit Transition consultation.

In addition, staff engaged with NCRA on Exploring Scotland's Rural Economic Strategy and also have engaged with Peers and Members of Parliament and senior policy leads and analysts at Defra (with Scottish Government representation at the later) on post-Brexit issues in Scottish. Whilst these engagements and consultation responses have not drawn on the WP budget, these activities have significantly drawn on the expertise and knowledge base that has been built up during this SRP (and previous iterations of it), thereby demonstrating the added value of both the WP and SRP.

Theme 3 - Food, Health and Wellbeing

Work Package 3.1: Improved Food & Drink Production

Major Achievements

- **Soft fruit health benefits:** Based on sustained SRP, Underpinning Capacity and external leveraged research funding, SEFARI researchers were invited to publish a review on '[Evidence for Health Benefits of Berries](#)' by the high impact journal Annual Plant Reviews highlighting the effects of consuming berries or their phytochemical components on neurodegenerative and noncommunicable diseases and the underlying mechanisms involved.
- **Presentations to the International Association of Agricultural Economists:** SEFARI scientists presented two papers at the meeting (August 2018), (i) "Exploring the effects of increasing underutilized crops on consumers' diets: The case of millet in Uganda," output from a BBSRC GCRF project, but applying methodology used in the SRP to simulate the impact of increasing the amount of fruit and vegetables in the diet, and (ii) "Rate of success of new dairy products in the UK: how important are health and sustainability claims?"
- **Importance Mycotoxin workshop:** Building on SRP and SG-funded research, a workshop to discuss mycotoxin monitoring and potential areas of concern in a Scottish and UK context was jointly organised by Food Standards Scotland and the Rowett Institute (May 2018), bringing together representatives from industry, science and government. Discussion (see [report](#)) focussed on Fusarium mycotoxins - the most relevant toxins in terms of UK primary agricultural production, and the challenge of monitoring imports following Brexit.
- **Reducing waste in the food supply chain:** A briefing on [Horticultural Food Waste in Scotland](#) outlined measures for positive change to ensure that more food from Scottish fruit and vegetable farms makes its way along the food supply chain as intended, without being

wasted. Findings were disseminated to the industry through trade publications ([The Scottish Farmer](#); [Farmers Guardian](#); Fresh Produce Journal) and local newspapers. In addition, a paper was [published](#) on food waste ('The effect of date labels on the willingness to consume dairy products: Implications for food waste reduction').

- **Group Model Building to reduce food waste:** A workshop on Group Model Building with stakeholders including SG, ZWS, WRAP, FDF Scotland, NFUS, SEPA, AHDB, SAOS, and the Soil Association was held in June 2018. Strong interest was expressed in exploring how causes of food waste, e.g. through antibiotic residues in milk, can be mitigated through incentives to farmers and collaboration with others along the dairy supply chain, and in developing stronger links between research and the interests and activities of stakeholders.

Work Package 3.2: Healthy Diets and Dietary Choice

Major Achievements

- **MRC funded project grant:** Building on SRP expertise, SEFARI scientists are collaborators on a grant examining the role of dietary emulsifiers (soya lecithin) on markers of gut health and metabolic health. This is a collaborative multi-disciplinary approach to investigate ingestion of emulsifiers (also known as surfactants or detergents) within the modern 'Western' diet.



- Dietary patterns associated with sustainable, healthy diets:** SEFARI work on the dietary cost implications of moving towards healthier and more sustainable diets in Scotland was chosen for the prestigious 'Public Health Nutrition' Theme Highlight Lecture to over 100 delegates at the Nutrition Society Summer meeting - 'Getting Energy Balance Right' (July 2018).
- Global Food Security (GFS) Programme Chair:** A SEFARI scientist chaired a BBSRC GFS interdisciplinary sandpit (July 2018) for 30 participants from a range of disciplines and backgrounds, 'Resilience of the UK food system in a global context: Transforming the food system for health, sustainability and resilience across production and demand', the 3rd call (£1.8M) in the programme funded by BBSRC, NERC, ESRC, and SG.
- GCRF call:** SEFARI scientists received BBSRC pump priming funding to visit Zimbabwe (May 2018) to develop a bid for the next round of GCRF calls. The visit, exploring opportunities for research collaborations to strengthen agricultural biodiversity towards improved food and nutritional security, included a stakeholder workshop attended by the Zimbabwean Ministry for Agriculture, Agriculture Research Council, Oxfam, World Food Program, NGOs, the Seed Services Institute, Zimbabwe Farmers Union, Zimbabwe Herald, and academics from various Universities in Zimbabwe and at which SEFARI interdisciplinary approach and capacity was highlighted. The meeting report will inform new policy development in the [research area](#) of Neglected and Underutilized Species (NUS) for nutrition security in Zimbabwe.
- Publication on sustainable diets:** [Publication](#) in Global Environmental Change - 'Moving beyond calories and protein: micronutrient assessment of sustainable diets and land use'.
- Knowledge Exchange in food sustainability:** A SEFARI scientist gave invited talks at (i) the Nuffield Council on Bioethics workshop on future horizon scanning - 'The future of food sustainability in the UK' (July 2018), and (ii) The National Academies of Sciences, Engineering & Medicine Food Forum (Washington, DC; August 2018) - 'Sustainable Diets, Food and Nutrition', to 80 government, industry, consumer group, and academic attendees and 300 global online viewers.

Work Package 3.3: Food Security

Major Achievements

- **Impact of Brexit on nutrition:** A SEFARI researcher presented a [paper](#), 'Consumption of fruits and vegetables in the UK and the potential impact of Brexit on nutrition', to 60-70 delegates at the Family Finance Surveys User Conference, Royal Statistical Society, London (June 2018).
- **International trade is vital to global food security:** Using an advanced computer simulation technique ('agent-based modelling'), Theme scientists have modelled global food trade using data from the Food and Agriculture Organization of the United Nations (FAO). Preliminary findings, presented at the [Social Simulation Conference](#) in Stockholm, show that global food insecurity is worsened when countries rely on existing trade relationships and/or prioritize trading with rich countries. Conversely, when countries can initiate new trade relationships and/or prioritize trading with neighbouring countries, more of the countries are food secure.
- **Local Food Growing Strategy:** A SEFARI scientist has been invited to sit on the steering group for the Local Food Growing Strategy in Aberdeen, which will identify land that can be used to grow food, how provision for community growing can be increased, particularly in areas which experience socio-economic disadvantage, allocate funds to growing projects around the city, and offer input into the development of the Strategy based on [SG guidelines](#).

Work Package 3.4: Communities and Wellbeing

Major Achievements

- **Improving Invited presentations:** Supporting the development and debate on SG rural policy development, SEFARI scientists were invited to speak about (i) digitisation in rural areas to the Scottish Parliament Cross Party Committee on Rural Affairs (June 2018), (ii) 'Rural policy in Scotland post-Brexit' to the National Council of Rural Advisors (NCRA; August 2018), based on the submitted report of the same name, and resulting in an invitation to review the NCRA's recommendations prior to their publication, and (iii) '[The Healing Power of Greenspace](#)' discussion session (Jun-18) at the Central Scotland Green Network annual event..
- **Blog post for the National Centre for Resilience (NCR):** SEFARI scientists have been invited to write an inaugural blog for NCR on the conflicts between everyday and emergency resilience
- **Knowledge exchange activity:** Research was presented at the Nordic Ruralities Conference (May 2018), the International Association People-Environment Studies (July 2018), and the Royal Geographical Society (August 2018).
- **Further publicity for the key report:** A link to the WP3.4 [report](#) 'Demographic change in the Sparsely Populated Areas of Scotland (1991-2046)' featured in a [Huffington Post](#) article.

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SEFARI works across six Research Institutes who deliver the Scottish Government funded Strategic Research Programme.

