



Food, Farming
& Countryside
Commission

Scotland Field Guide for the Future





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Foreword

The RSA Food, Farming and Countryside Commission has learned much through our inquiries in Scotland. From the bike tour and our visits to people in their businesses and communities, to the roundtables, workshops and conferences kindly hosted by partners, we have been inspired by the ideas we've heard and seen in action.

Scotland has taken a lead, amongst the UK nations, in approaching some of the most intractable issues we all face. How to design and implement a fairer food system and improve people's health. And how difficult and complex issues of land use and ownership are mediated and tackled. This work has provided rich material on which we have drawn to shape the inquiry and make our recommendations.

Most inspiring are the stories of people already doing extraordinary things. Experimenting, taking risks, learning together, supporting each other – people who are bringing their creativity, passion and commitment to grow a secure, sustainable and fair food system for Scotland, and on the world stage. Scotland's Field Guide for the Future shares a glimpse of some of these stories, from the Highlands to the Borders, and from the grassroots to the high tech.

Our thanks and appreciation go to all those who participated and contributed so generously. Special thanks go to Professors Lorna Dawson and David Miller at the James Hutton Institute, for their excellent and unstinting leadership of the Scotland work, with help from RSA Fellow Ann Packard and RSA Scotland Director, Jamie Cooke. We look forward to continuing to build this rich resource bank to share across the UK and beyond.

Sue Pritchard
Director, RSA Food, Farming and Countryside
Commission

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The devolved inquiry in Scotland

The RSA Food, Farming and Countryside Commission (FFCC) was established to carefully consider how our food is produced and where it will come from in the future; how we can fairly and properly support farming and rural communities; and how the many benefits the countryside provides can be nurtured for the benefit of all. This challenge and vision for the future was set within the context of a multitude of external factors – the most present being the imminent departure of the UK from the European Union, which brings both challenges but also opportunities.

This work is also set within the very real and pressing external challenge of the global climate emergency, where agriculture has to deal with the increasingly unpredictable impacts of climate change as well as the need to reduce greenhouse gas (GHG) emissions. At national and sub-national scales there is greater opportunity to align climate change mitigation aims with both physical and socioeconomic parameters, although any food and climate change policy approach will need to also take account of local contexts. A system change is required which challenges individuals, farmers, growers, consumers, communities and society as a whole. We must engage, understand and learn from those acting or being affected on the ground, something high on our Scotland Inquiry priorities as well as the wider Food, Farming and Countryside Commission's agenda.

However, choices and decisions will have to be made regarding the best course of action to take. To make informed decisions on the local trade-offs between one form of land use or management strategy and another is vital to our future in Scotland. As a developed nation with a

large and highly developed agriculture sector that is also working under ambitious and visionary climate change mitigation targets, Scotland provides an exemplar of the challenges climate change poses to our food systems and how these challenges can be addressed.

The Climate Change (Emissions Reduction) (Scotland) Bill was approved by the Scottish Parliament on 25th September 2019 and is now awaiting Royal Assent. The Government has committed to updating the Climate Change Plan within 6 months of the Bill receiving Royal Assent, so potentially by March 2020. This will raise the ambition of Scotland's domestic emissions reduction targets in line with the UN Paris Agreement.

Over the summer 2019, The Big Climate Conversation public workshop events were held throughout Scotland to hear the public's concerns, priorities and ambition to tackle the global climate emergency. These conversations were where people could discuss their thoughts on climate change and what steps need to be taken to reach the net-zero targets.¹

This will inform the update to the Climate Change Plan which will guide Scottish Government's climate change policy over the next few years.

In May 2018, a new Climate Change Bill was introduced to the Scottish Parliament to raise the ambition of Scotland's domestic emissions reduction targets in line with the UN Paris Agreement. Following the First Minister's declaration of a global climate emergency in April 2019, and receipt of advice from the UK Committee on Climate Change in May, the Scottish Government lodged amendments to the

Climate Change Bill to set a net-zero emissions target for 2045, and to increase the targets for 2030 (to 70 percent reduction) and 2040 (to 90 percent reduction). The independent UK Committee on Climate Change advised that these targets represent a high ambition contribution to the UN Paris Agreement aims, including limiting warming to 1.5°C. Scotland remains the only country to have set statutory annual targets to reduce emissions and was the first to include a fair share of the emissions from international aviation and shipping in its targets. The process of responding to climate change threats and wider sustainability issues, by the Scottish Government led to the creation of the Just Transition Commission which will advise on a carbon neutral economy which is fair for all.

Equitable engagement is also vitally important when the many different views on change in the land use sector are considered. Improving land use practices have been responsible for many of the absolute emissions reductions by the agricultural and related land use sectors since 1990² increasing carbon sinks through land use change and forestry policy alone may not be enough to tackle all the required emission reductions.³

Different sectors will have to work closer together to achieve the challenging targets set in Scotland. Individuals will need to cooperate and collaborate. Knowledge brokers will have to set the scene for safe engagement and provide evidence to help make the best decisions in a very rapidly changing arena. The establishment of a Land Use Strategy for Scotland⁴ and its two different, but equally successful, associated land use pilots have demonstrated effective use of our evidence base and they pave the way as an exemplar of interactive policy drivers for other UK nations to follow.⁵

Agriculture is one of the most important sectors in Scotland: responsible for many of the beautiful and iconic landscapes the country is famed for. It is the largest user of land, with around three quarters of Scotland's land used for agricultural production of some type⁶ with around 85 percent of the agricultural land in Scotland currently designated as 'Less Favoured Area' (LFA) by the EU.⁷

Despite the impacts of past climate, policies, price fluctuations, and market uncertainties, the agriculture industry has grown significantly over time.⁸ For example, the real terms value of total income from farming almost trebled between 1998 and 2013, showing consistent steady growth, though fluctuating every few years.⁹ A future look by the Scottish Agricultural Champions report¹⁰ recommended strategic ambitions for Scottish agriculture: Scotland's form of agriculture will be enviable for its alignment with our land and other assets, in all their biophysical diversity, supported by tailored policies that lead to real commercial results, Scottish farming will take the actions that forearm it for difficult times and justify its support from the public purse and Scottish farming's stewardship of the countryside will protect and enhance our natural assets and will be valued and supported by society.

Agricultural businesses are reducing their GHG emissions by taking a holistic approach to improving and protecting their soils, optimising land use, tackling livestock disease, adopting genetic improvements, using up-to-date technology, maximising input efficiency and by turning wastes into a resource. Such actions will help not only to reduce emissions, but also aim to improve animal health and welfare, provide cleaner water and air, reduce biodiversity loss, increase the financial security of the business, and improve soil quality while increasing the carbon sink. This can already be seen in initiatives such as the Scottish Agricultural Organisation

Society (SAOS) testing the feasibility of nationally rolling out the CarbonPositive programme, which enables Scottish farm businesses to measure the tonnes of CO₂e (carbon dioxide equivalent) impacts and to calculate an accumulated carbon figure for their farm.

Dealing with the climate emergency, the ongoing loss of biodiversity and rural depopulation are just some of the additional concerns for Scotland. A road forward has to be found to support agriculture that benefits the environment outside of the Common Agricultural Policy (CAP), while also retaining our current levels of environmental governance, principles and standards. Innovation and resilience have been at the forefront of Scottish farming and crofting, allowing the many different types of agriculture to continue to play their invaluable roles in food production and care of the land. Scotland is also helping to reduce its GHG emissions through sequestering carbon in woodlands and soil and through generating much of its energy from renewable sources, often at a farm scale.

Based on the farm-gate value of unprocessed food in 2017, the UK supplied just under half of the food consumed in the UK. The leading foreign supplier of food consumed in the UK were countries from the EU (30 percent).¹¹ A resilient food system in Scotland will therefore need to take account of the climate emergency risks to overseas producers and international supply chains, as well as the challenges that are faced at home. With aspirations to double in size to a £30 billion industry by 2030, Scotland's food and drink sector has never been more important. The sector has built success on its recognised high quality, collaboration, cooperation, diversification, and its many compelling stories from the land, some of which are included in this report, with commitment as a 'Good Food Nation'. There has been a renewed interest in food growing in urban areas in Scotland, resulting in an increase

in the demand for allotments and in the number of community garden projects springing up in Scottish towns and cities.¹² The Local Food Growing Strategy and food partnerships are starting to understand the complexity of urban food systems and to tackle the inequalities and waste that such a system can produce, through a reorientation towards more local food and shorter supply chains, as well as addressing health and environmental issues within local communities.

The likely exit of the UK from the European Union poses major challenges and uncertainties for farmers, food supply systems and rural communities. Replacement of the EU's CAP provides an opportunity to better align our land use strategy and support systems with local contexts, such as Scotland's net zero by 2045 target. The UK's Committee on Climate Change (CCC) has highlighted the role that the land use and agriculture sectors in Scotland can play in helping the whole of the UK achieve net zero. A critical element of this transition is improved efficiency of food production in some areas to free up land elsewhere for reduced emissions and carbon enhanced CO₂ sequestration, for example through afforestation.¹³ Scotland's Forestry Strategy 2019–2029 is a keystone of the new statutory and administrative arrangements under the Forestry and Land Management (Scotland) Act 2018. This is building on over 100 years of stewardship and growth in forestry and woodlands. Forests and woodlands now cover around 20 percent of our land and although we plant more trees in Scotland than anywhere else in the UK, and our forests and woodlands deliver a rich mixture of benefits, including rural employment, green health benefits and contributing to our climate targets, more trees need to be planted.¹⁴ Expansion planning in the new Scotland's Forest Strategy 2019-2029, along with the Scottish Government's Programme for Government¹⁵, has increased the annual

planting target of 10,000 ha to 15,000 ha. Careful consideration of the interactions with our evidence base of soils, climate, biodiversity, land capability, catchment management and potential trade-offs will need to be considered to ensure that we plant the right trees in the right place with consideration to other land other use options, including food production, peat restoration and recreation.

Scotland has an ambitious strategy to help protect and restore biodiversity – the Scottish Biodiversity Strategy. The 2020 Challenge for Scotland’s Biodiversity sets out the steps required to improve the state of nature. To help achieve these aims a set of Biodiversity Strategy indicators have been used. Scottish Natural Heritage are leading on delivery of a route map, with a range of working groups concerned with a specific aspect of biodiversity conservation. The *Scotland Field Guide for the Future* report provides examples of where people are working with nature to deal with many of the pressures on biodiversity such as climate breakdown, invasive non-native species and the fragmentation of habitats. The thrust is to connect people with nature, where the benefits are clear, such as the story of how we are increasing biodiversity through peatland restoration, encouraging biodiversity at the margins of arable fields, and many more which are presented in this report. Our natural environment and biodiversity are intertwined with climate change action for mitigation and adaptation. Our physical and mental health depends upon it.

In Scotland, land reform has been a feature of debate since the mid 1990’s, having been driven by diversity, transparency and accountability in ownership. The Land Reform (Scotland) Act 2003 sought to overcome inequality in land ownership and land governance.¹⁶ The Land Reform (Scotland) Act 2016 established the Scottish Land Commission, an executive non-departmental public body, which became fully

operational on 1 April 2017¹⁷ to help create a country where everybody will benefit from the ownership, management and use of Scotland’s land and buildings. It has set out a framework for the relationship between land and people with an aim to deliver greater public benefit from our land. This public body was established to help move land reform from a ‘stop-start’ process, to a continual process of reform that ensures our approach to land ownership and use keeps pace with people’s changing needs and expectations. The Land Commission are concerned primarily with topics such as agricultural tenancy, urban spaces, better use of derelict land, and many more that impact on our community life.

Successfully realising these changes will require deep understanding of local contexts and well-informed, evidence-based policy that integrates the multiple demands on land use and biodiversity, and avoids the unintended consequences that can arise from broad brush approaches, such as the issue of food waste under CAP. In the Programme for Government the Scottish Government announced the creation of ‘regional land use plans for maximising the potential of every part of Scotland’s land to contribute to the fight against climate change’¹⁸ These plans will be very important in identifying support and interventions in the local context and engaging with the key stakeholders and local communities. We are fortunate in Scotland to have a strong and high-resolution spatial evidence base available to help inform any local decision making. The successful integration of the many cross cutting policy issues is critical to the Scottish Government’s National Outcomes.¹⁹

There are many challenges that we face going into the future, but through the process of the Food, Farming and Countryside Commission Scotland Inquiry we are already seeing ideas emerging at grass roots level with true innovation and a real ‘can do’ attitude prevailing. The Scottish Inquiry

focussed on gathering stories from some of the people and organisations making real changes on the ground, presenting examples of how novel solutions have been found, new businesses created, new technologies developed, and new friendships and partnerships formed, despite often adverse conditions. The stories illuminate how agriculture, food production, research, policy, government agencies, community groups, and individuals in Scotland are all working together to help improve the environment and the public's health and wellbeing.

The scale and diversity of Scotland's land and rural communities are frequently misunderstood. That diversity is important. The needs of Highlands and Islands communities, especially the remote areas, are often under-addressed. Members of farming groups expressed a desire to become more included in emerging food policy and members of food and health groups wanted to feel more connected to their farming communities. Community groups and the farming community are willing to work with trusted brokers to help alleviate some of the health issues emerging. The people of Scotland, whether they live in cities, towns, villages or on individual farms, have a real desire to work closely together to develop healthy and sustainable local supply chains. This positive attitude was reinforced again and again during our discussions.

We are demonstrating our willingness to work alongside partners in an international context, e.g. by showing a strong commitment to the UN Global Goals. In 2015, the First Minister pledged that Scotland would lead the way to deliver a more equal, more just world. In signing Scotland up to the Sustainable Development Goals (SDGs) the Scottish Government made a statement of intent not just to the people of Scotland but to the world. Scotland should be a place where people can satisfy their basic needs and enjoy a good quality of life. The SDGs give

us the framework to achieve real change, from eradicating poverty to ensuring a good home for everyone. Meeting these goals for 2030 is a responsibility for us all. Europe wide initiatives such as the Natura 2000 green infrastructure network is a strategically planned network of natural and semi-natural areas set up to help integrate the countryside with urban areas, aiming to ensure the long-term survival of Europe's most valuable and threatened species and habitats.²⁰

We have been striving to improve the quality of the rich and diverse food that we produce and to deliver innovative farming practices, while also playing our role in supporting and revitalising rural communities. Within this report we have included a diversity of examples and stories: individuals, organisations, opinion pieces, interviews, and collective group views. The collective view from all the discussions was that we will 'work with nature to come up with solutions, not work against it', to protect our rich biodiversity that is the very life blood of our countryside.

In Scotland we have led on many of the key global issues of our time and are rising to the challenge of tackling these threats and turning them into opportunities to create better lives for all. This report sets out the context of our inquiry in Scotland with its devolved background, the findings from round tables, individual discussions, interviews, chats in fields and polytunnels, and it hopefully provides some helpful suggestions to help tackle our future challenges. Many Scottish farmers, producers and communities are already showing the way forward to make a real impact, leading by example to improve the lives of all.

Prof. Lorna Dawson CBE
The James Hutton Institute
RSA Food, Farming and Countryside
Commission Scotland Inquiry Lead

October 2019

Evidence gathering

The process of gathering information and evidence was carried out through a series of round table discussions, a conference-style debate, meetings and one-to-one interviews. We involved many key stakeholders including Scottish Government, Scottish Parliament, UK Government representatives, government agencies, charities, arts and crafts businesses, food and drink producers, manufacturers, farmers, land managers, chefs, knowledge exchange professionals, academic researchers and many others.

As part of a cross-border event with RSA North England, initiated by former RSA Trustee Ann Packard, a conference-style debate was organised to discuss issues related to the specific geographical context of the south east Borders region. The 'Borderlands' project and South of Scotland Economic Partnership provided the backcloth to a day of excellent presentations, welcomed by the venue owner, Hugo Burge of Marchmont Farms.

A round table meeting was held in the north east of Scotland, at one of the Scottish Environment, Food and Agriculture Research Institutes (SEFARI), the Rowett Institute, where the topics of food, health, nutrition, urban food, forestry, land use, and land reform were the main issues under discussion. We were shown around the world class human nutrition unit, where volunteers were given the opportunity see the studies investigating the effects of dietary change on human health, measured in a clinical setting. A lunch was served by chef Craig Wilson from the nearby Eat on the Green restaurant, who cooked delicious, nutritious dishes made from locally sourced fresh food – showing us a wide diversity and quality of local Scottish produce.

In Scotland's capital, at the Royal Society of Edinburgh, a broad range of topics were discussed at the round table, including the benefits of farm cooperatives, the role of the Scottish agricultural champions, farming with the environment, livestock systems, education, research and the importance of effective communication.

A round table and farm visit was held at an organic dairy farm in Gatehouse of Fleet, Dumfries and Galloway, in the south west of Scotland, to reflect the green and rolling lands of the west with diverse land use types. Farming, employment, peatland restoration and communities were discussed at the event, with many and varied opinions voiced. Specific topics of importance for Scotland such as fishing, crofting, urban food, and the island communities which were not able to be covered in the formal round tables were subsequently discussed in the format of one-to-one and small group meetings.

During our visits to the many and varied landscapes and communities across Scotland, and through the discussions with a wide range of growers, producers, researchers, community groups, and individuals, we were overwhelmed by the sense of looking forward to the future and the positive attitudes which prevailed. There is deep willingness and technical ability to innovate and to find creative, long term solutions to the issues Scotland faces, often at grass roots level. It is heartening to see that evidence, information and knowledge being gathered from research in the fields and in the labs appear to be feeding directly into the Scottish Government policies on farming and the practice of safe, quality food production for the health of our nation.

Wilma Finlay showing the group of stakeholders at the FFCC roundtable event at Gatehouse of Fleet the family farm, the organic herd and their innovative cheese production system.



Source: Lorna Dawson

This stories in this report showcase the people rising to the challenges, taking up opportunities and making a positive future happen. The future, happening now.

Farming

Farming provides much of the food we eat and shapes the countryside that everyone enjoys. In Scotland over 67,000 people are directly employed in agriculture representing around 8 percent of the rural workforce. After the service and public sectors, agriculture is the third largest employer in rural Scotland. The agri-food sector is now the UK's largest manufacturing sector.

There is a wide diversity of farm types in Scotland, with crofting enterprises also on the west coast and island communities. Many farms in north west Scotland are much smaller in terms of the numbers of livestock and area of crops grown than on farms elsewhere in Scotland. Sheep farming is the predominant type of farming in the north west but there are also sheep farms in the south of the country. The larger cereal, fruit and vegetable farms are concentrated in the east of Scotland. Beef farming takes place throughout Scotland but is most common in the south west. The south west also has the bulk of the dairy industry. Around 85 percent of Scotland is classified as Less Favoured Area. A rich diversity of enterprises.

Farmers are the stewards of much of Scotland's land, with three quarters of our land under their management and care. However, the topic of farming is often at the forefront of an often polarized debate, while also being under pressure from climate, environment and biodiversity concerns. Farming is often hard and never-ending work; farmers manage a range of risks every year, from increasingly unpredictable weather, fluctuating prices, staffing shortages, and now trade uncertainties. It's no wonder that the mental health of farmers is also at risk. Despite these many pressures, there are many farmers already demonstrating resilience and

developing innovative ways in which farming can be a force for change. They are helping accelerate a transition to farming that provides many of the things that people really value – nutritious, affordable food; good, secure and rewarding jobs; clean, fresh water; beautiful landscapes; and green biodiverse space for people to live within nature.

Soil health is now at the top of many farmers' minds. Soil is critical to human, plant and animal health, through the sustained provision of the nutrients it provides; for the microorganisms that provide the foundation of all life on earth; for the provision of clean water for plant growth and drinking water; for buffering and protecting against flood and drought and in the provision of many of our cultural resources. Our many different soils, treated in the right way, could mitigate climate breakdown. Whilst we now understand the importance of soil to the provision of healthy ecosystems, changing practices at the farm level takes time.

The keepers of our land are helping in many ways by increasing carbon sequestration, halting the loss of vital biodiversity, promoting wildlife habitats, restoring soils and planting trees - responding in a positive way with many innovative solutions to the climate emergency and biodiversity loss. Farmers and farming groups are very much part of the solution to, rather than the cause of, climate change and biodiversity loss.

Cooperation, collaboration and innovation in Scottish agriculture

Agricultural co-ops perform an essential role in the supply chain of the Scottish food and farming businesses. They are a vital link in bringing scale and collective access to markets for farmers and other food producers, which they could not attain as individual businesses. Co-ops offer a strategic interface to support fragile rural communities stretching across the key pillars of economic, social and environmental sustainability. Without the capabilities and added value that is strategically and collaboratively delivered by the co-op sector, the success and growth of both Scottish agriculture and the food and drink sectors would undoubtedly be constrained and diminished.

Innovation is key to the sustainable success of the industry. As the farming industry is challenged to produce more food, more efficiently for more people, the industry needs to seek out innovative ways to increase sustainable production, competitiveness and profitability. One of the best ways to innovate is through co-operation – people working together to achieve a common purpose. Co-operation and co-ops are uniquely positioned to drive forward the innovation and supply chain collaboration that is required, enabling shared risk taking and scalability both amongst farmers and in connections with supply chain customers.

“The best way to fast track innovation and change is through co-operation. Co-ops provide the thought leadership, have the management structure, the resources (people & capital), and the appropriate communication channels to push it all out to their family farmer members.”

Jim Booth, Head of Co-op Development, SAOS

Scotland has a vibrant farm and rural co-op sector lead by Scottish Agriculture Organisation Society (SAOS) the umbrella co-op development organisation, owned by some 70 co-ops. SAOS, a co-op itself, are experts in co-operation and supply chain collaboration. All of the SAOS member co-ops are involved in innovation on one way or another. Some examples which illustrate the dynamic and collegiate approach of the co-op sector are:

East of Scotland Growers (ESG) is a progressive vegetable marketing co-op and one of the largest producers of broccoli in the UK. It was one of the first European Union Producer Organisations in the UK and takes great pride in this recognition. ESG helps members innovate through operating at the cutting edge of brassica production, investing heavily into new varieties, innovative production techniques, enhancing the environment and developing new products. One recent example is the launch of an innovative, healthy broccoli crisp snack, Growers Garden, which utilises waste broccoli.

The McDonald farm enterprise, built up over several generations, located on the east coast of Scotland, specialises in the production and packing of vegetables – including broccoli, cauliflower, brussels sprouts and potatoes, producing over 5,000 tonnes of vegetables annually. As a member of ESG, their brassica production is marketed to the major UK retailers. Together as a group, East of Scotland Growers has developed into one of the major growers of broccoli and cauliflower in the United Kingdom and Europe. Alongside the sales to retailers, the business also supplies a growing number of farm shops, farmers markets and the Scottish wholesale trade.

ESG broccoli fields and Growers Garden broccoli crisps which utilise waste



Source: Andrew Faichney

Ensuring the supply of quality produce, the crops are harvested and transported to their purpose built chilling and packing facilities within hours of harvest. In addition, they design, build and customise agricultural equipment; from flatbed, tipper and curtain sided trailers through to fully customised one-off harvesting equipment.

The Skinner family farm near Lazyfold. All the pig units in Scotland are regularly inspected by SSPCA to ensure high standards of animal welfare.



Source: SPP

Scottish Pig Producers (SPP) is a pig marketing co-op owned by 110 pig farmers in Scotland and Northern Ireland. SPP plays a leading role in industry and market developments to maximize value for its farmer members. They operate Wholesome Pigs (Scotland) which drives improvements in pig health and welfare through information analysis and reporting, along with the emergency response facility for any potential disease outbreak. In a major innovation for Scotland's pig farmers, SPP worked closely with co-ops Scotlean and Tulip to re-develop the abattoir at Brechin, creating a modern processing facility for Scottish pork.

"Innovation is critical to what we do at Scottish Pig Producers. This is not just about technical advances affecting the productivity & profitability of our members but also novel collaborations that improve the sustainability of pigmeat supply chains for the benefit of all partners and even initiatives that enhance our own internal operating efficiencies. If we stand still, others will catch up so continual change is essential to our success."

Andy McGowan, CEO, SPP

A personal perspective: A national success story

James Withers, CEO, Scotland Food & Drink

Scotland's food and drink industry has become a national success story. Worth nearly £15 billion a year, the sector is marked by talented businesses across farming, fishing, and food and drink manufacturing. It has become the nation's fastest growing export industry – with international sales topping £6 billion a year – and it is one of the best performing domestic sectors of the economy.

The industry has gone from being something of an economic after-thought a decade ago, to star player today. The recipe for success has had a number of key ingredients. The business base is diverse; boasting both exciting start-ups and long-established global brands. Crucial too, has been the development of a national identity for Scottish produce.

“Brand Scotland” is built upon a reputation for world-class products, responsibly produced and with a strong provenance story underpinning them. This reputation is critical both in the domestic, Scottish and wider UK market but also internationally. Increasingly, it is underpinning our tourism industry too, with visitors drawn to an authentic culinary adventure. Scotland is well placed to be a food tourism destination of choice in future.

However, perhaps more than anything, a culture of collaboration has taken the industry from static performance to new heights. The industry and government in Scotland have found a unique way of working, through the creation of Scotland Food & Drink. The industry sets out its vision and strategy, and Scottish Government and its agencies support the delivery. It is a model other parts of the world are now seeking to emulate.

That is not to say there aren't still real challenges for the sector's development. The success of Scotland's food and drinks reputation and turnover growth has yet to be reflected in a more profitable and confident farming sector. A disconnect remains and bridging that gap is a key measure of success for the Scotland Food & Drink Partnership in the coming years.

So too, Scotland wrestles with the need to improve dietary health and the industry has committed to try and take the same partnership approach that has served the economic growth strategy so well into this arena.

One of the major challenges for the sector also represents a great opportunity. Scotland – like all nations – is trying to chart a course through a climate emergency. We strive to provide leadership in this area and tangible action too. Scottish food and drink has an opportunity to show the way in terms of climate-friendly food and drink production.

This is particularly true for Scotland's red meat sector where our grass-based, extensive systems can offer a sustainable form of protein production. So too, along our shoreline, aquaculture can offer a low input form of protein and nutrition. The ridiculously simplistic “plants versus meat” debate is hardly relevant in a country like Scotland where most of our land mass is only fit for grazing livestock. It would be negligent not to use this asset for sustainable, healthy, red meat production.

Our long-term vision is to create a £30 billion, profitable and responsible industry by 2030. To aide that journey, a rural policy framework will need to be created which incentivises and rewards innovation, skills and supply chain development, as well as strides into new markets both here and overseas.

The benefits of that approach will be measured not only economically, but environmentally too. And the dividend will be felt right across Scotland, from our major cities to our most fragile and peripheral areas.

Farming for a Better Climate: Soil Regenerative Agriculture Group

Farming for a Better Climate (FFBC) provides practical support to benefit the farm and help reduce the impact on the climate. Taking action as a sector, both to reduce greenhouse gas emissions and to adapt to a changing climate, will secure farm viability for future generations. FFBC, run by Scotland's Rural College (SRUC), on behalf of the Scottish Government, combines ideas trialled by the volunteer Climate Change Focus Farms and information from up-to-the-minute scientific research, offering practical advice to help farmers choose the most relevant measures to improve both farm performance and resilience to future climate change effects.

One of their initiatives is the Soil Regenerative Agriculture Group, a collective of five farmers who are working together to establish how best to support, enhance and protect the soils on their farms. They aim to improve production and tailor inputs, maximising profitability, including benefits which can be gained from healthy and resilient soils, ranging from improving water retention and drainage to supporting biodiversity and helping to lock up carbon on the farm.

With support from SAC Consulting, researchers and other industry specialists, the group aims to find out which management techniques, treatments, crops and rotations help to shape and protect a resilient farm soil. This approach gives an excellent opportunity to work with a group of

farmers in Scotland to demonstrate practical measures that could not only benefit the farm, but also help farmers contribute towards mitigating climate change.

“Soil compaction is an issue that myself and my team would like to reduce or eliminate. In 2018 we moved to a no-tillage system to test it out. If successful, this could help to make the farm more resilient whilst also improving farm soils”

Ross Mitchell, farmer, Castleton Farm

The project also involves any interested farmers to learn from the experiences of other working farmers who have tried it out. The group posts regular updates about their findings via a webpage and through their Facebook and Twitter accounts. One farmer in the group, Ross Mitchell, specialises in strawberries, raspberries, cherries and blueberries over 600 ha and supplies Marks & Spencer Plc.

The Soil Regenerative Agriculture Group discussing soil structure. Source: Farming for a Better Climate



The soils group and SAC consultants assessing the root structure of recently direct drilled petit pois peas



Source: Farming for a Better Climate

The home of ethical dairy farming: Cream o' Galloway

The Finlay family have been farming at Rainton since the 1920s and with each generation comes new priorities and innovative approaches to producing food from this beautiful part of Galloway in south west Scotland. In the 1930s and 40s the goal of David Finlay's father, James, was to produce food for a hungry population during the difficult years surrounding the second world war. Milk from the dairy cows was used to create farmhouse cheese, the leftover whey was given to pigs reared for meat and sheep made use of any grassy areas that were less well suited to cattle. This was a systems approach with very little waste.

Through time farming and food production became more industrial and more intensive. Cheese production stopped at Rainton in the 1970s as mass produced cheddar became more widely available, was produced cheaper elsewhere and the farm began to focus more on excellent milk production. In the 1990s Rainton started to diverge from the intensive direction of most of the dairy industry in the UK. The Finlay's recognised the benefits of farming organically and, over the past twenty years, have been exploring new and alternative ways of producing food in a more ethical and sustainable way.

In 2013 a new dairy was built, along with innovative renewable energy technology to generate electricity from farm waste. The new system allows the calves to stay with their mothers, dramatically reducing the stress on the animals and improving their health and welfare. In 2019 the old cheese house was reinvented with a fantastic specialist cheese making facility. The Finlay's new approach to dairy farming is also inclusive of the local and visiting population. Examples include a crowdfunding campaign and in-depth farm tours led by David Finlay to explain

his systems approach to dairying. Testament to their commitment to the visitor experience, they have a gold award as part of the Green Tourism Business Scheme.

They hosted the Ethical Farming Conference on the 16th May 2019 at their farm and discussed the great opportunity for Scotland to take the lead in incentivising ecological farming. The Finlay's are pioneering a pasture-based, regenerative approach that is as sustainable as it is productive. This was the first ever conference on the emerging 'ethical' farming sector, exploring the very real concerns that the public has with current food production systems, and how they might be addressed. Two hundred farmers, researchers, academics, and students from Finland, Sweden, the Netherlands, Ireland, the USA, and from across the UK took part. The 'ethical' claim covers four pillars; fair work for people, high welfare for livestock, regenerative closed-loop production, and economic sustainability. The conference explored examples of sustainable food production that grow value through an ethical proposition, rather than growing volume through intensification. It also provided a platform for sharing research and innovation in practice and, through the bringing together of ethical and sustainable innovators, it encouraged collaboration across supply chains and between researchers and producers. There is also real value involved; raw milk cheese. This collaborative conference was live streamed, which enables the wider international ethical food community to also enjoy the insights.

David and Wilma Finlay with cows and calves



Source: Wilma Finlay

Personal perspective: delivering more sustainable farming in Scotland

Caroline Drummond MBE, Chief Executive, LEAF

Since our early beginnings in 1991, LEAF (Linking Environment And Farming) has been working across the Scottish farming sector to support the development and delivery of more sustainable farming. Ours has always been a very practical, grass roots approach, working collaboratively with some of Scotland's most forward looking, innovative farmers and world leading research centres to bring about real change that delivers both economically, environmentally and socially for Scotland.

Science into practice: driving sustainable farming innovation and uptake

Equipping farmers with the latest skills and know-how to address sustainability challenges through Integrated Farm Management (IFM) is at the core of LEAF's work in Scotland. We support farmers to implement IFM through the provision of training, technical tools, resources and on-farm visits. In addition, our LEAF Network of Innovation Centres and Demonstration Farms play a pivotal role in pushing forward the science and technology behind sustainable farming and ensuring it translates to farmers on the ground. Working with Scotland's world-renowned research institutes – The James Hutton

Institute and the SRUC – both of whom are LEAF Innovation Centres, we are able to tap into their cutting edge IFM research and technological innovations. In turn, our four Demonstration Farms in Scotland put this science into practice to engage, inspire and disseminate it to other farmers through on-farm visits, talks and training. It is this ‘bottom up’ hands-on, science into practice approach that is driving forward lasting change through adoption, experimentation and adaptation leading to improved soil management, more efficient water use, best practice Integrated Pest Management, reducing waste, enhancing on-farm biodiversity and connecting with local communities.

Rewarding sustainable farming in the marketplace

The economics of more sustainable farming have to stack up in the marketplace. Our global environmental assurance system – LEAF Marque – provides a powerful pathway for farmers and crofters in Scotland to demonstrate their environmental achievements and get recognition for them in the marketplace. This may be in the form of a premium or access to higher value supply chains. It also helps farms access other income streams such as through agri-environmental schemes and can often lead to significant cost savings through greater efficiency. We currently have 60 LEAF Marque certified

Sion Williams, Farms Manager, Bowhill Farming Ltd, one of Scotland’s four LEAF Demonstration Farms



Source: LEAF

businesses in Scotland and also work closely with leading retailers and food brands to ensure that commitment to more sustainable farming is recognised and rewarded.

Public engagement with sustainable farming
Building relationships and encouraging genuine exchange and understanding between farmers and the public is a key driver in the delivery of more sustainable farming. Since 2006, we have run LEAF Open Farm Sunday – the farming industry’s annual open day and every year we see a growing number of farms across Scotland taking part. This year, 25 farms opened up, welcoming 11,760 visitors and in the UK, over a quarter of a million people visit a farm on this one day alone. By providing opportunities for people to engage with farming, LEAF Open Farm Sunday is helping to build trust and understanding of what the farming sector delivers, why it matters and its relevance to every aspect of modern life. This in turn encourages a younger generation to connect more closely with farming and become more aware of the exciting career opportunities available in our sector.

There is no magic bullet to optimising sustainable food production. It requires collective efforts of farmers, governments, retailers, NGO’s, scientists, and individuals, but the can-do approach of the many leading Scottish farmers and crofters we work with is an inspiration to drive change in a practical, realistic and achievable way.

Quality Meat Scotland: world leading quality standards

Quality Meat Scotland takes great pride in the work it delivers for the Scottish red meat industry, which supports 50,000 jobs and generates over £2 billion for Scotland’s economy. Their overall strategy is to support the development of a sustainable, professional, resilient, and profitable red meat industry which makes an important contribution to Scotland Food & Drink’s target of £30 billion by 2030.

Its Quality Assurance scheme underpin the world-leading animal welfare standards we all uphold. To carry the Scottish red meat industry’s three premium brands Scotch Beef PGI, Scotch Lamb PGI and Specially Selected Pork, livestock must have been born, reared and slaughtered in Scotland and spent their entire life on QMS Assured holdings.

Whole chain assurance underpins the integrity of these premium brands and provides reassurance to consumers of provenance, highest standards of production, animal welfare and wellbeing, to deliver a quality eating experience.

QMS runs a number of farmer-led industry initiatives to enable farmers and the wider industry to develop solutions for a sustainable farming future. This includes the three-year Monitor Farm Programme²¹ which is a network of nine farms across Scotland reaching more than 6,000 people over the lifespan of the project. This takes a place-based approach to sustainable development and local monitor farm management groups drive the local monitor farm projects to ensure solutions are both farmer-led and locally appropriate. The monitor farms programme is funded by £1.25 million secured from the Scottish Government and European Union’s Knowledge Transfer and Innovation Fund. The objective of the Monitor Farm Scotland programme is to help improve the

productivity, profitability and sustainability of farm businesses through practical demonstrations, the sharing of best practice and the discussion of up-to-date issues.

QMS also runs a series of Better Grazing workshops,²² which focus on enabling farmers to make better use of their most economical feed – grazed grass. Fully utilising grass availability on farm is key to sustaining farming businesses both increasing animal performance and reducing their days to slaughter whilst reducing their use of artificial inputs required to produce animal forage.

“QMS’s grazing workshops have grown increasingly popular to date with 97 percent of participants making a positive change to their business as a result of attending these meetings”.

Sarah Millar, QMS Head of Industry Development

The organisation works closely with Scotland’s pig farmers, with projects specifically focussing on improving pig health across the country. The QMS Pig Health Programme monitors pig health and gives producers the evidence and data to enable them to improve pig health and their productivity.

Interaction at a recent QMS Better Grazing event



Source: Ruth McClean

Innovation in farming: Advanced Plant Growth Centre

Research and innovation is increasingly playing a significant role in supporting the world's most important industry-agriculture and food production. A good example of this research and innovation is the James Hutton Institute's Advanced Plant Growth Centre (APGC) being developed in Invergowrie with both industry and academic partners. The APGC project received investment funding under the Tay Cities Deal development programme. The project is part of an overall investment of £62 million in innovation centre projects at Invergowrie and also includes the International Barley Hub.

APGC will deliver increased commercial, economic and environmental benefits to the agricultural, food and drink sectors in Scotland, the UK and internationally, by the innovative use of precision-controlled environmental technologies. With a return on investment of £13.41 for every £1 invested and £330 million in economic added value, it will bring significant economic impact and an estimated 800 full-time equivalent jobs to the entire UK food and drink supply chain.

The APGC aims to make the Tayside region a global hub for indoor and precision farming technologies building upon innovation in the local agricultural base and by working with local engineering companies to build production capacity. However, the ambitions of the APGC do not stop at the borders of Tayside. The use of advanced controlled environment technologies will allow us to replicate any current and future global climate scenarios. By combining these technologies with high-throughput imaging and sensing technologies, molecular breeding tools, and artificial intelligence that allows us to analyse huge amounts of data, we will be able to massively accelerate crop breeding programmes.

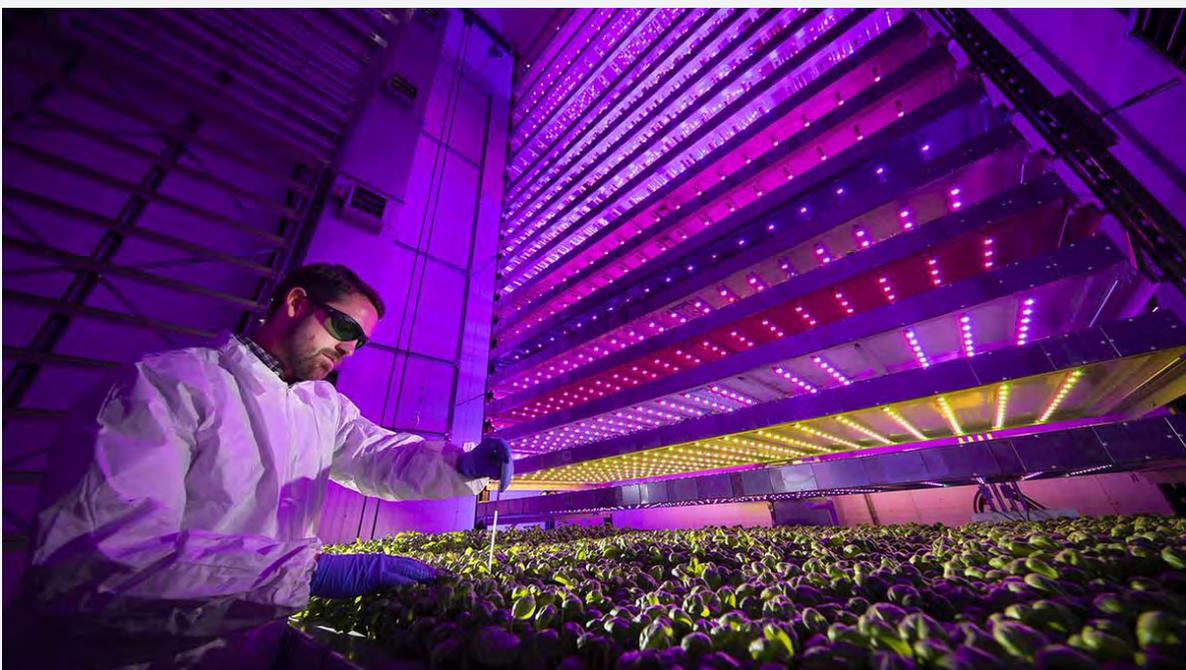
This will give us the capacity to provide farmers and growers with crops that are environmentally resilient not only to environmental factors but also to emerging pests and diseases that will change their geographic distribution in a changing climate.

APGC will drive economic development in agricultural technology as well as mitigating risks to the UK and global food supply chain by accelerating the development of improved crop management systems and varieties. The capacity to grow plants in precisely defined environments is key to understanding the underlying processes and genes that allow crops to thrive under adverse conditions. The technology behind the development of vertical farms provides the opportunity to undertake controlled environment experiments on a previously unprecedented scale and level of technological sophistication based on the Intelligent Growth Solutions commercial demonstrator already in operation at Invergowrie, Tayside.²³ The APGC will offer new and cutting-edge technology to plant and crop sciences at the James Hutton Institute and the University of Dundee, which will provide opportunities to further enhance our global reputation and draw attention to the agricultural, engineering and advanced manufacturing skills of the Tayside region.

"The global horticulture market is crying out for new approaches to enhancing food production in terms of yield, quality and consistency. It is also searching for ways to reduce power consumption and labour costs and our technology has been designed to fundamentally address this".

David Farquhar, CEO, Intelligent Growth Solutions

Vertical Intelligent Growth Solutions Systems



Source: Jonathan Snape

Personal perspective: Innovation in upland livestock systems

Prof. Davy McCracken, Head, SRUC Hill & Mountain Research Centre

SRUC's Hill & Mountain Research Centre is based at Kirkton and Auchtertyre Farms, a 2,200 ha hill farm near Crianlarich in the west Highlands of Scotland. The site, within the Loch Lomond and Trossachs National Park, ranges from high quality and productive grazing to high altitude (over 1,000 metres above sea level) semi-natural habitats of high nature conservation value.

A major focus of our work is in helping drive forward innovation that has the potential to change the economic viability of hill farming and crofting in Scotland and beyond. Until fairly recently, technological innovations have been seen as only relevant to lowground arable and dairy farming systems.

But the use of precision livestock farming, as we call it, is just as relevant in upland areas, if not more so. I can talk for Scotland about what we are doing on the farms and elsewhere, but lack of space means two examples will have to suffice.

At the cutting edge of the Internet of Things We are particularly interested in being able to track our livestock no matter where they are on the farms, but although the use of GPS is now commonplace in many lowland and marine situations it is not an ideal technology to use in mountainous environments. For one thing, it is not possible to get connection to a sufficient number of satellites in order to obtain a precise location fix. Just as importantly, any sensor fitted

to an animal rapidly uses up battery power when connecting regularly to satellites – resulting in a battery life of days or weeks rather than the months or years that would be preferred.

LoRaWAN, or LoRa for short, is a long range, low power communications platform which is now being rolled out in cities worldwide. Providing a range of around five miles in urban, up to eight miles in suburban and over 10 miles in rural areas, LoRa is ideal for the deployment of sensors and battery-powered devices where small amounts of data need to be transmitted regularly.

We have established a LoRa network which covers the majority of the 2,200 ha of the farms. This is the first LoRa network covering a remote, rural location in the UK and it ranges from an altitude of 170 m in our inbye fields to over 1,000 m at the highest point on the hill.

Although we originally established the network to track livestock, we have also extended the value of the system to use sensors that provide real-time, automatic information on everything from water depth to soil temperature, air temperature and humidity. In turn that gives valuable insight to subjects such as identifying potential flooding events and how well our grass is growing at different times of the season.

Using technology to assess individual animal performance

The use of electronic identification (EID) tags on sheep has been mandatory in Scotland since 2010 to aid sheep traceability. On our farms we have assessed whether the electronic monitoring and logging of information on individual sheep and lambs could provide a powerful management tool.

Two management systems were tested to assess ewe weight and condition. One used EID-based technology, linking the tags with an auto-drafting weighing crate, and the other used conventional means. The information gathered by both systems was used to make decisions on flock management, including the allocation of individuals to feeding groups, targeting health treatments, and selecting ewes for culling and lambs for slaughter or sale.

We found that EID-based technology helped greatly when taking decisions on feeding, worming, drawing animals for slaughter and selection for breeding. It also saved time and labour, reduced handling stress on the animals, reduced paperwork and increased the ease and accuracy of performance data recording.

By combining our weigh crate and auto-drafter we can record and automatically sort up to 500 animals per hour. Over the whole year, this can lead to labour savings of 30-40 percent. On our farms, the average differences in net margin between the two systems were found to be around £4/ewe, meaning that for a flock of 900 ewes it would take only 3 years to recover the cost of our EID-based equipment.

We handle our sheep much more often than other hill sheep farmers and so use a high specification auto-drafter and weigh crate. However, there are cheaper pieces of kit on the market that would do the job just as well for smaller flocks or flocks being handled less often. Whatever the cost of

Aerial view – taken from a drone – of part of the farms



Source: Davy McCracken

investment, our research has shown that the use of such equipment is extremely useful when making management decisions to improve the health, welfare and performance of the flock.

The wider picture

The Hill & Mountain Research Centre has a long history of working at an international level, given that conditions in Scotland's uplands are very similar to rangelands elsewhere across the globe. My team are involved in a range of European and international research and knowledge exchange projects and activities. In recent years, this has also involved assessing the wider ecosystem services associated with livestock grazing and other upland land use systems.

Many of the open habitats and species that we put nature conservation value on in Scotland's uplands rely on some form of grazing to maintain the vegetation characteristics that benefits those plants and other wildlife. By showing how the use of innovations can increase the economic viability of hill farming and crofting, we are helping increase the chances that hill farmers and crofters will remain in the uplands and hence be able to continue to manage these habitats sustainably into the future.

Magic Margins: making the edges of the field more useful

In 2010, the James Hutton Institute farm staff were involved in setting up a science project at Balruddery Farm as part of a UK wide study to investigate erosion in the tramlines of arable crops. They developed from this an innovative approach to field margins called 'Magic Margins' that reduces soil erosion and diffuse pollution, including the loss of sediments and nutrients. The issue of erosion is far wider than simply the loss of the important agricultural resources of soil, water and nutrients. It can have detrimental off-site effects on other valuable natural capital and is

linked to on-going concerns about important species, such as the freshwater pearl mussel, along with potential economic implications for salmon farming and retaining a stock of healthy fish for the angling community.

All arable farms in Scotland currently have to commit at least 5 percent of their total arable area to Ecological Focus Areas (EFA). Like many LEAF (Linking Environment And Farming) Innovation Centres and Demonstration Farms, to meet the new obligations they only had to make small adjustments to the habitat and wildlife corridors they had already created around the farms. Magic Margins are created using a combination of potato drill ploughs and a Tied Ridger followed up by sowing the areas with a wild grass / flower seed mix to create an effective and stabilised barrier. The margins are effective, relatively easy to establish, low cost and semi-permanent, forming part of the farm's, arable Ecological Focus Areas. They do not compromise the commercial farming operation, our science or the environment, in fact they add significant value to them.

"As a leading LEAF Innovation Centre, the James Hutton Institute are all about pushing forward the science, knowledge and know-how to deliver more sustainable farming. Magic Margins are a fantastic example of a simple, practical, low-cost solution to a very straightforward question: how do we help safeguard our soil? It is through these kinds of innovations that farmers and crofters are transforming the way we produce food and care for the natural world to deliver multiple environmental benefits for people and the planet".

Caroline Drummond, Chief Executive, LEAF

Once created, the ridges and miniature dams also increase the total surface area which promotes higher rates of evapotranspiration and infiltration, ultimately safeguarding stream and river quality and biodiversity.

Euan Caldwell, who helped create Magic Margins, said that they also provide an excellent refuge and food reservoirs for mammals such as voles and mice. Wild grass seed mixes have been sown which have increased plant diversity which then attracts pollinators such as bees, and other insects, enhancing the visual value to the landscape and improving cover and sustaining food sources for bird and insect life.

Sustainable Livestock Production Systems

Efficient, sustainable and profitable livestock production is very important in Scotland, both from an economic and environmental standpoint. Livestock farming supports local industry and provides employment for many in remote rural areas.

Livestock farming also contributes significantly to Scotland's iconic landscapes, which have been grazed over many years. As around 85 percent of Scotland's land cover is LFA or Area Under Natural Constraint (ANC), it is ideally suited to raising livestock on grass, thereby converting

Farms manager at the James Hutton Institute standing in a biodiverse Magic Margin



Source: Euan Caldwell

something we can't eat into a highly nutritious product on otherwise unproductive land. In addition, conservation grazing can actually contribute to increasing biodiversity on farmed land.

High animal welfare standards and low disease incidence reduces the carbon footprint of livestock farming. Incursions of exotic diseases e.g. Foot and Mouth Disease and Bluetongue can be devastating, but endemic diseases – the diseases we have already – are production limiting by definition and significantly reduce the biological efficiency of livestock production.

Specific examples of where strategic research is underpinning efforts to control endemic disease includes DNA fingerprinting to trace Bovine Viral (BVD) isolates as part of the Scottish Government's BVD Eradication Scheme. Also, the development and deployment of a new sheep scab diagnostic test developed by researchers at Moredun, in support of the Scottish Government's Sheep Scab Order, 2010. This was initially validated as part of a regional control programme on the Isles of Mull & Iona and is now being used as part of a new national control campaign in Wales. Furthermore, targeted selective treatment strategies are being deployed to help optimise anti-parasitic drug treatments, to reduce drug usage and selection for resistance.

The livestock sector contributes an estimated £1.85 billion p.a. to the Scottish Agricultural Output, with some iconic brands such as Scotch Beef. Output from the beef sector alone contributed an estimated £830million in 2018, and livestock products made up 58% of Scotland's agricultural output in 2018**.

Stuart Ashworth, Quality Meat Scotland

Health

Scotland has an international reputation for the quality of both animal and plant derived products that can be grown, harvested, produced, and processed to provide a healthy and sustainable diet. However, the Scottish population has one of the poorest quality diets in the developed world, linked to non-communicable diseases such as obesity, type 2 diabetes and cancer. Dietary related ill-health represents a major public health and economic burden in Scotland. For example, estimates of the total economic costs of obesity to Scotland range from £0.9 billion to £4.6 billion per year in 2015.

Achieving change requires a joined-up approach to food, where Scotland continues to build its strategy as a Good Food Nation, where good (nutritious, safe, tasty), affordable, locally sourced food is at the heart of efforts to ensure everyone in Scotland has a healthy diet. The commitment to being a 'Good Food Nation' stands to make a very substantial contribution to the Scottish Government's ambitions.

However, it's not just what and when we eat that affects our health and wellbeing, but the wider links between food, farming, the environment and the many individual contexts in which individuals buy and consume food. The relationship between food, farming, the countryside, and the public's health and wellbeing is far reaching, beyond food alone. Policy on its own cannot achieve such change. Positive change happens at home and within communities, in the places where we eat, live and work, and through the lives we lead. In all these places we must collectively make it easier to eat well and maintain a healthy weight. For example, access to outdoor greenspace and engaging with nature can have positive physical and mental health benefits for children and adults

alike. It is important to use that knowledge to develop systems to help those people experiencing mental ill health in both our rural and urban communities.

Recent years have seen renewed interest in food growing in urban areas in Scotland which has resulted in an increase in the demand for allotments and in the number of community garden projects springing up in Scottish towns and cities. These food systems are also an important part of the framework for change. They are however complex, involving multiple partners, relationships and processes. They introduce a greater role for locally-grown food through public procurement of local food and could lead to a shift away from agri-intensive food systems towards a more localised food supply chain supporting the local economy, reducing food miles, ensuring access to healthy, affordable food for all, and enhancing the environment.

Often we hear that health is not farmers' business. We sought to find out how farmers and growers felt and how they were incorporating health and wellbeing into their work. It turns out that people across Scotland are bringing the two together – choosing to farm for healthier produce and kickstarting the supply chain to make good food available to customers. Local authorities are ensuring that schools and hospitals serve healthy, nutritious food through public procurement. Farmers are coming together to support each other through the particular challenges of modern rural life being an important part of the solution.

Scotland's Natural Health Service: local green health partnerships

Scotland's natural environment and associated green infrastructure is an important and undervalued asset for improving societal wellbeing and public health. Improvements in public health can be achieved by increasing physical activity through green exercise – outdoor recreation, volunteering, play and learning, gardening, and active travel. Wellbeing benefits can be gained through enhanced contact with good quality natural and green/blue spaces even without physical activity. We know that access to good quality greenspace can help to improve the physical, mental and social health of people living in the more deprived areas of Scotland.²⁴ We also know that more deprived areas are more likely to have lower quality green spaces, and that overall investment in urban greenspaces is in decline.²⁵

Our Natural Health Service (ONHS) action programme is a national initiative led by Scottish Natural Heritage, in partnership with a range of organisations from health, sport, transport, education, and environment sectors.²⁶ This programme is investigating how greater use of the outdoors can contribute to improving public health and tackling health inequalities.

The establishment of four Green Health Partnerships in Dundee, Lanarkshire, North Ayrshire and Highland is the centre piece of the ONHS Action Programme. Each Partnership brings added value by co-ordinating cross-sectoral local action to shine a spotlight on nature as a resource for health and wellbeing and by developing green health services which support people to engage with the natural environment and be more active outdoors in their communities.

"The links between nature, health, and wellbeing are clear. Multiple benefits can be gained by enhancing links between people and the landscapes, green and blue spaces and neighbourhoods they live in. These benefits are increasingly being evidenced. Society, economy and environment can collectively and simultaneously be enhanced through green space initiatives. Successful implementation of these ambitions can only be realised through collaboration. Working across sectors, disciplines, and organisations is essential if we are to apply a 'joined-up' approach where the gains can be realised".

Rebecca Wade, Abertay University

Green prescriptions are now being trialled in three GP surgeries in Dundee. The trial, launched in 2019, has been achieved through close partnership working with NHS Tayside, several voluntary sector organisations, the local authority (Dundee City Council) and has been developed and coordinated by the Local Green Health Partnership. Dundee doctors can now offer their patients a green prescription. The patient can 'fill' the prescription by contacting a dedicated phone line where a volunteer will inform patients of the green health activities appropriate for them (in terms of activity type, location, timing, accessibility etc) and can offer volunteer assistance, if needed, to access the service.

Each prescription has a unique code which allows the uptake of the scheme to be monitored and assessed. The green health partnership will work with the NHS and university researchers to assess the impact of the trial scheme.

“Collectively, the progress being made by the four Green Health Partnerships is beginning to demonstrate how Scotland’s new public health priorities (particularly place, physical activity and mental health) can be translated into practical action on the ground through a co-ordinated whole system approach”.

Alan Macpherson, Policy & Advice Manager,
Scottish Natural Heritage

Food and nutrition: evidence-based solutions

Scotland has an international reputation for the quality of animal and plant derived products that can be grown, harvested, produced, and processed to provide a healthy and sustainable diet. However, the Scottish population has one of the poorest quality diets in the developed world, linked to non-communicable diseases such as obesity and cancer.²⁷ Driven by the ambition to become a ‘Good Food Nation’ (a Scottish Government initiative), this research provides the evidence to embrace dietary health, affordability and sustainability whilst working with the food and drink sectors.²⁸

One approach to help provide nutritious food for all, based on scientific research, carried out by the University of Aberdeen Rowett Institute, is to explore food reformulation, which can be used as an effective strategy to make foods more nutritious by introducing essential nutrients and healthy ingredients in the diet, or by replacing artificial additives, such as preservatives with natural products. This practice can be adopted to increase the daily fruit and vegetable intake of the

general population and may also be a good option to improve the sustainability of our diet by introducing ‘waste’ and underutilised ingredients into the food chain.

“Food reformulation is regarded as a realistic opportunity to provide healthier, nutritious and sustainable food choices to the consumers and likewise improve public health. However, reformulation also poses many technological challenges to food manufacturers. Most, if not all, ingredients are included in processed foods to serve a purpose. By removing an ‘unhealthy’ ingredient and/or new ingredients in the recipe, the safety, structure or taste of the food may be compromised, and this is likely to affect product acceptability. The purpose of our research at Rowett is to develop reformulated products with improved nutritional profile and assess their commercial feasibility by considering important parameters, such as shelf-life and flavour”.

Alexandra Johnstone, University of Aberdeen
Rowett Institute

“The work undertaken at the human nutrition unit offers exciting, highly relevant and innovative research in the area of nutrition and health and enables a large number of studies to be undertaken to help improve nutritional guidelines and establish healthy Scottish food products as well as to investigate ways to implement them into the average person’s diet. Many of the volunteers at the Human Nutrition Unit have been attending for years and love both the knowledge and health outcomes they gain from the diet-controlled studies, as well as the friendly atmosphere and ability to contribute to science. The space offers a wealth of opportunity for ongoing research and translation, with investigators such as Alex, being key leaders in designing and driving the undertaking of robust and novel nutrition based research projects.”

Leonie Ruddick-Collins, University of Aberdeen
Rowett Institute

Why Scotland needs plant protein

Although Scotland is world leader in high quality animal production, research is looking at ways that improvements could be made to other sources of protein. Increases in plant production, inclusion, revalorisation and consumption could leverage benefits throughout the chain from field to feed and food.²⁹

Work being carried out by Wendy Russell and her team includes production and utilisation of better varieties of different protein crops. There is a particular emphasis on sustainable protein-rich crops, which grow, or could grow in Scotland.^{30, 31} These crops include pea, bean, buckwheat and

“The required cooperation between breeders, farmers, the food industry, retailers and consumers has been critical. Within Scotland the SEFARI research institutes have been playing a key role in enabling this dialogue and its translation to policy and non-government organisations”.

Wendy Russell, University of Aberdeen Rowett
Institute

both in agricultural systems and in the diet. Increasing yield is important, as well as a better understanding of cropping systems.

However, nutritional quality is also a primary consideration as is the profitability opportunities for arable farmers.³² Many of these crops are gluten free, meeting the needs of a growing global market in this area (\$32.39 billion by 2025³³). In addition to being high in protein, these crops also contain dietary fibre and are a rich source of a range of vitamins, minerals and bioactive plant metabolites (phytochemicals). Some of the phytochemicals from buckwheat are being explored in a human dietary intervention study at the University of Aberdeen Rowett Institute for their ability to reduce blood sugar, which has potential to benefit people at risk of or currently living with diabetes (more than 228,000 people in Scotland³⁴).

These crops also provide fractions that can be used as functional food ingredients and SEFARI scientists are working closely with the food industry to identify and develop these products. Increasing production of protein rich crops will however have consequences on agricultural land use, so SEFARI researchers are also exploring the value of crops that could be grown on marginal lands and the opportunities for revalorisation of underutilised plant species and/or agricultural

SEFARI and SEFARI Gateway

The Scottish Environment, Food and Agriculture Research Institutes (SEFARI) is a collective of six research institutes, each with their own global capability, expertise and reputation. The six institutes are: Biomathematics and Statistics Scotland, the James Hutton Institute, the Moredun Research Institute, the Rowett Institute, Royal Botanic Garden Edinburgh and Scotland's Rural College

Through fully collaborative multi- and interdisciplinary research, SEFARI are responsible, with Higher Education Institute partners, for delivering the Scottish Government (Rural and Environment Science and Analytical Services, RESAS) funded Strategic Research Portfolio on environment, agriculture, land, food, and rural communities (2016-2021). The Portfolio includes the Strategic Research Programme, Centres of Expertise, Innovation Partnerships and Underpinning Capacity funding of national resources within SEFARI.

The SEFARI Gateway is the knowledge exchange and impact hub for SEFARI. The Gateway works to improve the flow of research-knowledge and expertise to and from the Portfolio to policy, industry-sector representative and public audiences and to improve the impacts of those activities by ensuring research findings, evidence and expertise gets to the right people, at the right time, in the right format. A key role is also to ensure that SEFARI research is actively informed by stakeholders and knowledge networks across Scotland, UK and internationally.

waste as protein sources. As global initiatives rise to address protein crops for profitable and sustainable farming, research will ensure that Scotland is in a strong position to contribute with evidence-based information.

Urban food systems

Recent years have seen renewed interest in food growing in urban areas in Scotland. This has resulted in an increase in the demand for allotments and in the number of community garden projects springing up in Scottish towns and cities.³⁵ Allotments usually consist of several plots each managed by an individual while community gardens can take many different forms and can include individual plots as well as shared and/or communal areas. While many community gardens are created for food growing there are also community gardens for health, sensory restoration, art or remembrance with no food-growing areas. Reasons for the

increase in food growing in urban areas are varied and include social, economic, health and environmental elements. The benefits of growing include community cohesion, improved mental and physical health and well-being, access to a wide range of local and fresh produce, increased biodiversity and improved local greenspaces.³⁶

While increases in food growing in urban areas have been noted, and their benefits for individual and community wellbeing documented³⁷, less is understood about the impact such activities have on urban food systems. To date much food growing activity has been carried out by non-commercial growers, mainly as a hobby or for health or community regeneration reasons (for example Granton Community Gardeners) or for a particular market sector (such as organic). There are several reasons for this. In policy terms, local food growing is framed through spatial planning and development, not economic strategy, meaning that food growing in urban areas usually falls

under the remit of environmental services rather than economic development. Research biases may favour urban food projects that focus on welfare and social issues, rather than impact on urban food systems, because the latter is harder to evaluate and many projects are about the social dimensions that accrue from food growing, rather than food production itself. Local food activists and advocates face market biases which mean to compete in the food retail sector they are forced to focus on high-end, niche products for the well-off, rather than staple foods at affordable prices for everyone.

In Scotland there are currently two strategic developments that could help to enhance the potential of urban food growing to change urban food systems from agri-intensive to more local and help to address inequalities around access to healthy affordable food for all. In 2015, the Scottish government passed legislation making it obligatory for every local authority to develop a Local Food Growing Strategy, to identify potential food growing sites and to encourage local food growing activities, including increasing the number of available allotments. This has the effect of making the provision of food growing spaces a consideration in local authority planning.

Secondly, there has been a move towards the creation of cross-sector food policy partnerships, with Scotland's three largest cities (Edinburgh, Glasgow and Aberdeen) becoming members of the Sustainable Food Cities Network.³⁸ While it is still some way from creating a local food policy (as has happened in Bristol) many see food partnerships as a first step to addressing a wide range of food-related issues including health, food security and waste. There are also increasing calls for local food to be included in procurement budgets, (e.g. Soil Association's Food for Life Campaign).

Together the Local Food Growing Strategy and the food partnerships could start to understand the complexity of urban food systems and tackle the inequalities and waste that such a system produces, through a reorientation towards more local food and shorter supply chains, as well as addressing health and environmental issues within local communities.

"Urban food systems are complex, involving multiple partners, relationships and processes. Introducing a greater role for locally-grown food through, for example, public procurement of local food, could trigger a more systemic shift away from agri-intensive food systems towards a more localised food supply chain that supports the local economy, reduces food miles, ensures access to healthy, affordable food for all, and enhances the environment".

Liz Dinnie, James Hutton Institute

Mental health initiatives: valuing lived experience to make change together

While researching rural community empowerment in 2016, Sarah Skerratt from Scotland's Rural College (SRUC) became concerned that very little was known about those people experiencing mental ill health in our rural communities – particularly the extent to which they could become involved in Scotland's national empowerment policies and programmes. Coupled with information that one in four people experience mental ill health at some point in their lives, and that high suicide rates occur in rural occupations, particularly amongst farmers

The 87th Craigmmond Scout Group using the community garden. Source: 87th Craigmmond Scout Group



Source: Paul Gunderson

and vets³⁹, Sarah started to work with the national mental health charity Support in Mind Scotland (SIMS) – who provide help to 1,500 people per week, 80 percent of whom live in rural areas.

Together, SRUC and SIMS ran scoping workshops with service users and rural stakeholders, to assess whether there is a rural aspect to living with mental ill health. From this they concluded that without a doubt there are specific rural dimensions. They carried out an online and offline survey running for two months, targeted specifically at those experiencing mental health problems in rural Scotland. The main finding from this work was that people living in the rural environment wanted to connect. They wanted to connect in ways that are low-level, non-clinical, local to them and pre-crisis. They don't want such

opportunities to be labelled as 'mental health' due to the stigma and associated late or non-disclosure that happens in many rural communities where everything about you is known.

"One key statement from a respondent (and there are many!) that's stuck with me is, "Don't tell me that cos I have a great view I should feel fine!" This research is all about seeing with others' eyes, thinking with others' minds, hearing with others' ears, and ultimately building lived-experience evidence that saves lives. It's a total privilege to work together to do so".

Sarah Skerratt, Scotland's Rural College with Support in Mind Scotland

Sarah and her team listened to hundreds of people telling their stories and produced the first national report of lived-experience data, which was presented in the Scottish Parliament in March 2017.⁴⁰ By working closely with the Scottish Government, a rural element was included in the ten-year national Mental Health Strategy. The compelling evidence led to the establishment of the National Rural Mental Health Forum, an action within the strategy, funded by the Scottish Government. In the past two years, forum membership has grown from 16 to 116 organisations – testament to the cause and need for its purposes of reducing stigma; raising awareness; sharing and creating changed practice; and producing evidence to inform and shape policy.

The team are building on the original research, working with people in communities to find out how to create what is truly needed in the nooks and crannies of rural Scotland. Further research partnerships have formed off the back of the work, including a new focus on those who are caring for people experiencing mental ill health across Scotland’s rural areas – more voices that need to be heard in order to create change through shared understanding.

Tobermory, Isle of Mull



Helping hidden hardship

Farming is a wonderful occupation – the great outdoors, working with the land, crops and livestock to produce food for the world can be really satisfying. However, it is not always the case. Farming is often a 24-hour occupation. At times it can be difficult to create a healthy work-life balance, there is always one more job to do. Misfortune such as an illness, accident, bad weather or a financial crisis can suddenly result in hardship. Extreme tiredness and a build-up of stress can result in low mood and can lead to depression.

Decision making can become difficult and one problem can lead to another. Business, home and family is often closely linked on farms, so issues of concern can affect not just the farmer but the whole family. Relationships get strained when support is most needed and those relationships can break down completely. It is reported that one farmer a week takes their own life.⁴¹ This is one of the highest rates for any occupation.

The Royal Scottish Agricultural Benevolent Institution (RSABI) supports people from Scottish agriculture in many ways – emotionally, practically and financially in times of need. The service is available to those involved (or previously involved) in farming and crofting and is a comprehensive service to clients who are experiencing difficult times, to enable them to move forward.

Emotional support is available through the RSABI helpline, case officers and volunteers, all of whom are mental health first aid trained. The trained professionals listen, keep people safe and access professional confidential support when required. Their helpline is open from 7am to 11pm, 365 days of the year, and offers a call out service for the lonely and vulnerable.

“RSABI has never been busier with on average 20-30 new clients a month receiving support, many of whom are working farmers and their families.

Together, the emotional, practical and financial support can be really powerful and people can move out of their problems. I can only see RSABI and the other Farming Help charities getting busier. There are huge challenges for people in the industry going forward”.

Nina Clancy, CEO, RSABI

RSABI can access practical support including, but not limited to, welfare benefits, business reviews, debt signposting, counselling and mediation services. They are also happy to liaise with statutory agencies when required. Financial support from RSABI can be monthly payments and/or single grants for essential items including food, heating, counselling, disability aids, funerals, retraining and items for the home. Business costs will be considered to help overcome a short-term crisis. All requests are considered, with the main aim being to help alleviate hidden hardship amongst people in Scottish agriculture in times of need.

Countryside

The Scottish countryside is varied in its many different uses. The many industries it supports produce many of our essential products. In addition to food, the production of timber, clothing and raw materials allow many rural industries to thrive. However, these industries also fundamentally affect how our land is shaped, what species and habitats survive and grow, and how people can interact with and enjoy our land.

Our land is diverse and, in that diversity, it is central to local and national identities. From the remote montane habitats of the Munros through upland heath, West Atlantic oakwoods, Caledonian pine forests and the blanket bogs of Caithness, it provides a home for many. Our image of the countryside often brings reassurance and comfort for those living in cities and brings many health benefits to those who visit. It attracts visitors from home and abroad, with the iconic landscapes and associated produce attracting many. However, our landscape of green fields, rolling hills, grazing animals, integrated woodlands and atmospheric uplands can often mask a very different reality: eroding soils and degraded peatlands, excessive greenhouse gas emissions and the disappearance of wildlife. The beauty of these places can also mask some of the human realities of living in the countryside, including underinvestment, low wages, unaffordable housing, limited access to amenities and an ageing population. With this backdrop, people in their communities are thinking carefully about how we best use the land, how we re-energise rural communities, reinvest in affordable housing, build essential infrastructure and create the jobs we need for the regenerative economy to thrive.

Land in Scotland is one of our biggest assets. It provides us with food and water, shelter and open space. However, it is not inexhaustible: soil is being lost around cities to building (termed soil sealing) at an alarming rate. It needs much care to be able to meet so many different demands in a sustainable and fair way. Scotland already has a suite of integrated policies and a Land Use Strategy with tested pilots which sets a backdrop for evidence-based decision making for potential change.

From the earth beneath our feet, to the environment around us, it has also become the ground on which people's different hopes and fears are being played out, raising some difficult questions about what our land is for, and who decides. Across Scotland people are thinking strategically and practically (with the available evidence) about how best to use land and ensure that it is passed on to the next generation in a fair and equitable way and in a good shape to sustain future generations. Education, co-operation and collaboration is vitally important to ensure that there is access to the right information at the right time so that the right decisions are made to create a flourishing rural economy in Scotland.

A personal perspective: rethinking how we use land

Hamish Trench, CEO, Scottish Land Commission

Land reform is rising up the policy agenda across the UK. In Scotland it is mainstream government policy, with two Land Reform Acts passed by the Scottish Parliament over the last 20 years. Land reform recognises that the questions about how we make the most of our land and tackle big public policy questions about land use are not only about management choices and technical knowledge. They also raise fundamental issues of rights and responsibilities, the dynamics of power and participation and the balance of public and private interests. Land is at the heart of Scotland's identity, economies and communities – it matters to people in so many ways. Scotland's Land Rights and Responsibilities Statement now sets out a framework for the relationship between land and people.

In 2017 the Scottish Government established the Scottish Land Commission, a new public body to help move land reform from a 'stop-start' process, to a continual process of reform that ensures our approach to land ownership and use keeps pace with people's changing needs and expectations.

Urban and rural: Land reform in Scotland is now as much about urban as rural land. We are opening up questions and ideas about the ways in which land is allocated and released for housing and development, including the influence land values play. We have established a taskforce to challenge and transform Scotland's approach to bringing vacant and derelict land back into productive use. Over a third of people in Scotland live within 500m of a vacant or derelict site: think of the impact this has on local pride, quality of life and environment. And then think of the

impact of transforming this into community use, greenspace, growing spaces, business opportunities, housing, climate adaptation. We can't afford not to.

Releasing opportunity and regeneration: Community land ownership is well established in Scotland, empowering communities to buy land and buildings. Its track record shows community ownership is an effective way of delivering regeneration, responding to the risks of rural depopulation, creating jobs, housing and service delivery. To take just one example, since taking ownership the West Harris Trust has reversed a depopulation trend to increase its population by 20 percent, with more new homes currently being built. We think it should be normal for communities across Scotland to own the land and buildings they need to meet their ambitions.

As well as a thriving community ownership sector, we need a diverse and dynamic private sector of ownership. We published a report in 2019 looking at concentration of land ownership in Scotland and the risks of localised monopoly positions which can constrain opportunities. The Scottish Government has asked us to progress our recommendations which aim to tackle these risks. We are also working with land owners and communities across Scotland to support more effective engagement in land use decisions, to help ensure more people are able to influence and benefit from land use.

Fresh thinking: The establishment of the Scottish Land Commission, together with the depth of experience in civic Scotland in shaping land reform to date, brings an exciting opportunity for fresh thinking about the systems that shape the way we own and use land. Now more than ever, the big public policy challenges in tackling climate change, inclusive growth and wellbeing demand a proactive public interest-led framework for the way we own and use land.

The Isle of Raasay and surrounding islands



Education: Royal Highland Education Trust

Twenty years ago, the Royal Highland Education Trust (RHET) was formed to help the Scottish population to be ‘amongst the best informed’ in Europe about farming, food and the working countryside.

The Scottish Government is keen for communities to be involved with land management decisions, both in an urban and a rural context. But for communities and individuals to make sound and knowledgeable contributions to these decisions, there has to be a good level of understanding of the situations relevant to that land, whether in the town or country.

Even in the rural context, only a small percentage of people actually make their livelihood from the land and many rural dwellers have little or no understanding of why farmers and estate owners work in the ways they do. Scotland is a hugely diverse nation and there is no ‘one size fits all’ when it comes to land management.

HET is a volunteer run charity, covering the whole of mainland Scotland. Its aim is for every school child in Scotland to have contact with a farm or farmer during their school career, and preferably at least three times.

There are twelve countryside initiatives in Scotland under the RHET ‘umbrella’, each covering a different geographic area, with different farming methods and different local

authority education departments. Each authority offers farm visits, farmer speaker visits to schools, estate days, food and farming days, growing projects, and teacher information events.

Farm visits by school pupils of any age provide hugely informative events. Many children have never been to a farm or walked in the countryside. The fact that potatoes grow under the soil, milk comes from cows and plants flower, then produce seeds is often greeted with astonishment. However, the positive news is that there is a growing desire within the community to understand where food comes from, who produces it and how. This fits with much of the Curriculum for Excellence in Scotland, which focuses on encouraging children of all ages to learn in 'a classroom without walls'. By encouraging knowledge about how food is

produced, a knowledgeable public will make healthier choices for themselves, but will also be more understanding of how the countryside works and lives.

"RHET is unique to Scotland. It is recognised as being able to provide independent and unbiased teaching materials to support the education of young people aged 3 to 18, and beyond".

Gill Lawrie, Farmer, Trustee and Board Member,
RHET

A classroom without walls



Source: Carol Littlewood

Sustainable rural community systems: identifying opportunities to recycle phosphorus

Rural communities face considerable challenges in accessing affordable energy, drinking water and treatment and disposal of waste. The Sustainable Rural Community concept envisions a paradigm shift in delivery of these services by moving towards a closed loop system that would be carbon and energy neutral, cost-effective and resilient.

The Centre of Expertise for Waters (CREW) is a Scottish Government funded partnership between the James Hutton Institute and Scottish Universities. Their project on phosphorus flow mapping is of particular relevance to the food and farming sector.

Phosphorus (P) is crucial to food security through its use in fertilisers. However, there are a limited number of years left of economically viable reserves of the mineral – rock P is increasingly contaminated with heavy metals and many global reserves are politically non-secure. As raw mineral P in accessible mining areas diminishes, the need to look for other more local sources, such as recycling phosphorus present in waste, becomes increasingly important. Increasing the P-cycle efficiency has the potential to decrease cost, increase sustainability, reduce pollution, and improve local and worldwide food security through long-term access to phosphorus sources.

The project seeks to build on the outputs of a previous study to pilot spatial P flow maps for Scottish catchments with contrasting land use. Ultimately, the approach will be upscaled to create a regional scale map of Scotland's P flows. This work will allow the identification of opportunities for innovation in capture and reuse of phosphorus. Currently untapped sources of recoverable phosphorus (e.g. wastewater treatment) could be linked to users of phosphorus

(e.g. agriculture) and any negative impacts of diffuse pollution managed. The outputs and results of this work will inform basin management decisions about phosphorus waste streams and work towards a long-term increase in sustainability of rural communities through identification of potential local sources of phosphorus for recycling.

“The P Flow project is an excellent example of an initiative approach to understanding current spatial patterns of P flows in Scotland that will help identify actions for encouraging closer coupling of resource and reuse. Once complete, the outcomes will inform policy makers on enhancements to the circular economy policy and value of better P management”.

Rachel Helliwell, CREW Manager

Peatland restoration: research, policy and support on the ground

Peatlands are spectacular landscapes that account for nearly a quarter of Scotland's land.⁴² Historically, these landscapes were considered unproductive and of poor societal value. Various efforts have been made to reclaim and make them more productive (for example through draining, burning and afforestation), which means that over 80 percent of the Scottish peatlands are now no longer in their natural state.⁴³

Our understanding of the societal value of peatlands has vastly increased over the last few decades. Peatlands store a huge amount of carbon (25 times more than any other plant life), are important habitats for wildlife and soil organisms, provide us with clean drinking water and are iconic and culturally significant Scottish landscapes.⁴⁴ These landscapes are net

sinks for carbon in their natural state but, if they are degraded to some degree, can release large amounts of carbon back into the atmosphere, which will compound the effects of climate change.⁴⁵ This is a vicious cycle as peatlands are also sensitive to the anticipated effects of climate change. The current climate projections are for higher temperatures and changes in rainfall patterns, leading to peat drying out in the summer and being eroded by heavy rainfall in autumn and winter.

Active restoration is needed to reverse these losses. The Scottish Government is now investing heavily in peatland restoration to help deliver their Climate Change Plan and ambitious greenhouse gas emission targets. SEFARI research, led by Dr Rebekka Artz, has demonstrated the wide-ranging benefits of peatland restoration on biodiversity and water quality, its carbon storage potential and

other societal uses.⁴⁶ The research has played an important role in helping Scotland assess progress towards the statutory greenhouse gas emission reduction targets. It has also informed how to better incorporate peatlands, and the effects of peatland restoration, into calculations for the UK GHG inventory, and is being used in the energy modelling system⁴⁷ to inform the development of the next Draft Climate Change Plan.⁴⁸ Research is also targeting how to monitor peatland condition, and greenhouse gas emissions, remotely, using satellite data sources, in order to support both national peatland condition monitoring and site-specific assessments of the effectiveness of peatland restoration efforts.

Support for the benefit of peatland restoration



Source: Emily Taylor

This work is designed to inform management decisions with the most up to date scientific evidence, to ensure that restoration efforts continue to take place in the right place, at the right time, and with the best possible practice, in order to provide the maximum societal and ecological benefits.

Those working on the ground are vital if we are to deliver large-scale change. The Crichton Carbon Centre (CCC) is an environmental charity based in the south west of Scotland, helping people and government learn about and adapt to climate change. CCC has developed carbon metrics that underpin the Peatland Code, which markets the climate benefit of peatland restoration and now helps deliver peatland restoration through the Scottish Government's Peatland ACTION project.⁴⁹ As of March 2019, 19,000 ha of peatland are now on the road to recovery across Scotland thanks to Peatland ACTION funding.

Financial support however is only part of the story; sustainable land management and ecological restoration starts with people. It is by supporting those that can bring people together to recognise opportunities and design effective management and restoration plans that deliver

multiple-benefits for those that manage our land, which ultimately has underpinned this scale of restoration. The CCC has helped to develop and deliver restoration projects by supporting land managers at every stage of project design and delivery. CCC now also extends support to machine operators through Peatland ACTION's National Training Programme to help those already working in our countryside to hone their skills and understanding of peatland hydrology, ecology and restoration techniques.

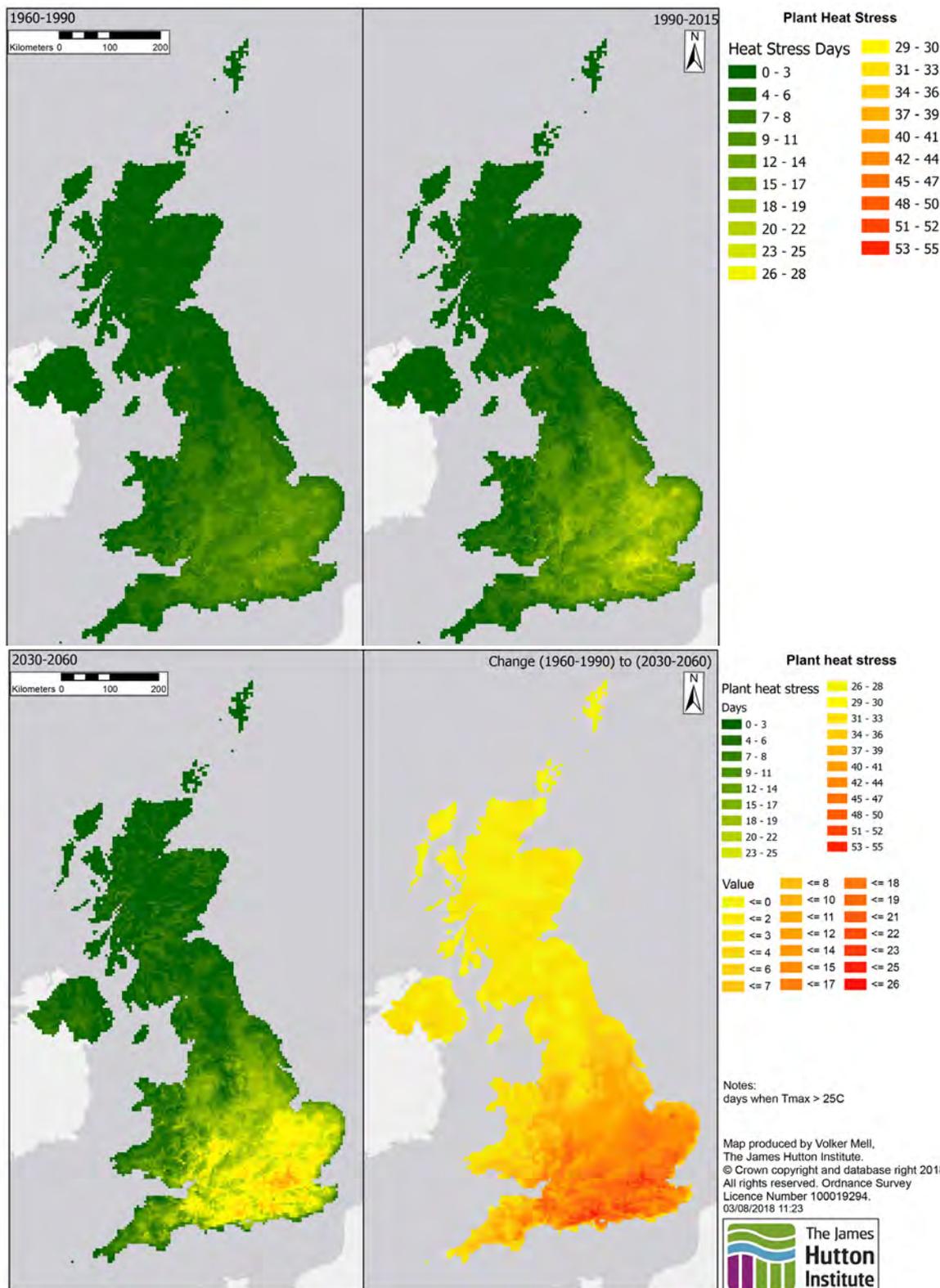
The science of foresight: innovation in climate change impact research

A current major area of innovation in research into the impacts of climate change is the 'science of foresight'. Using data integration and computer modelling approaches to simulate future biophysical conditions spatially for the whole of Scotland, it predicts how crops may respond under potentially different climates in the future. By estimating future impacts we can be better prepared in developing appropriate adaptation and mitigation strategies.

"I am the very fortunate owner of a fairly large area of peatbog...I have been very aware that this peatbog is drying out and friends of mine have commented that it would be good to re-wet the bog. I have been in agreement with that, but as far as I am aware there hadn't been any encouragement or any funding towards that and it would be an expensive operation to do. I've been managing it myself as sensitively as I can from the natural history point of view, but I've actually learnt that what I've been doing, in some ways is not the best way of managing a bog. I've not been re-wetting it, a considerable amount of scrub has developed and I've not been grazing it. Partly because I thought by having scrub there I was increasing the biodiversity of the site. Looking back now that was probably a mistake and I should have been grazing it heavier than I had been. That is one of the reasons why I came on the course which I have found very useful particularly the practical aspects particularly today's trip out onto Moin Mor and seeing the digger work being done, I'm aware that this needs to be done I've read about it but it's quite different seeing the job done on site".

Max Bonniwell, Landowner

Average count of the number of plant heat stress days (days when maximum temperature is above 25°C) per year for the periods: 1960-1990, 1990-2015 and 2030-2060, and difference between 1960-1990 and 2030-2060.



Examples include the spatial simulation of spring barley and spatial agrometeorological indicators, developed by Mike Rivington at the James Hutton Institute. The spatial simulation estimates crop yield, phenology, nitrogen uptake and soil water balance, using soil properties data alongside bias-corrected Regional Climate Model projections of future climates. These estimates provide information on likely overall trends, temporal (seasonal and inter-annual) and spatial variability and the type of genetic traits crop breeders need to develop in order to reduce risks and build on opportunities. They also identify potentially vulnerable areas, such as where soils are at risk of drying.

The simulation also provides many agrometeorological indicators (estimated for the whole of the UK) which are important for land management decision makers. These include: growing season start and end dates and length, dates of first autumn and last spring frosts, number of plant heat stress days and access periods. Analysis of the range of indicators creates a more comprehensive overall picture of possible futures. Predicted impacts (such as plant heat stress days) are greatest in the South East of England.

A personal perspective: the future of agriculture

Diarmid Hearn, Head of Policy, National Trust Scotland

Farming is the single largest land use in Scotland, with some 77 percent of Scotland under agricultural management, and a further 18 percent under forestry. These industries produce many of our essential products – food, clothing, materials – but they also fundamentally affect how our land is shaped, what species and habitats prosper, and how people can enjoy our land. Farming and forestry are in turn strongly

influenced by public regulation and subsidy, which for 45 years has been overseen by the European Union’s Common Agricultural Policy (CAP).

Place, products, people

One feature of the CAP throughout its history has been its essential disconnect from the wider environment in which it takes place. This is noticeable in the relatively low – or no – priority given to issues such as public access to good quality food, the care of our landscapes, or the conservation of natural heritage.

With the UK expected to exit the EU, and the CAP, there is currently the opportunity to rethink our agricultural and forestry systems from the ground up and identify what public benefits we want to secure. One approach would be to recognise that the qualities of place, of food, and of human experience are intimately linked. Our farmed landscapes support not only farmers but can be the foundation for promoting good quality food associated with well-managed, and attractive landscapes. Italy has taken this approach in its own agricultural policy, where in 2012 it introduced a ‘National Register of Rural Landscape, Agricultural Practices and Traditional Knowledge’, identifying the practices that shaped regional landscapes and local food specialties, and which could then become eligible for support.

Putting a landscape approach into practice

The National Trust for Scotland cares for some of Scotland’s finest landscapes and recognises how human use has shaped many of these. One example of this is the estate of Balmacara, close to the Skye Bridge. Here, traditional crofting practices have created a diverse and distinctive landscape – a blend of built, farmed and natural environments. Around the small settlements

Duirnish Township, Balmacara



Source: National Trust Scotland

are a mosaic of arable inbye fields and outlying common grazings, characterised by lochs and lochans, open moorland and semi-natural woodland.

Currently, Scottish agricultural policy does not recognise the importance of landscape or landscape management, and there is no specific support for this. At Balmacara, the Trust has stepped in with its Traditional Crofting Management Scheme to encourage better landscape management.⁵⁰ The scheme provides crofters in the participating townships with small payments to prompt particular land management practices – for example the timing of cattle returning to the inbye land, which in turn encourages greater wildflower growth, boosting both biodiversity and the attractiveness of the local area.

The Traditional Crofting Management Scheme points to how we can improve farming support in the future, by giving greater priority to landscapes, and encouraging community-level activities. Ultimately, the quality of place will underpin the quality of product, and its market appeal.

Scotland's Land Use Strategy: innovative approaches to land use decision making

An overview: by Chris Spray, Andy Tharme, Derek Robeson, Luke Comins, Irina Birnie, James Davidson and Sally Thomas

The scale and complexity of the issues that surround land use are challenging and rapidly changing. When produced in 2011, Scotland's Land Use Strategy (LUS)⁵¹ represented an innovative approach, unique in Europe for tackling these challenges. A key commitment of Section 57 of the Climate Change (Scotland) Act 2009, it set out a long-term Vision towards 2050, which was reconfirmed in the second LUS (2016-2021). It is for:

'A Scotland where we fully recognise, understand and value the importance of our land resources, and where our plans and decisions about land use deliver improved and enduring benefits, enhancing the wellbeing of our nation'.

This vision is supported by three objectives relating to economic prosperity, environmental quality and communities:

- Land based businesses working with nature to contribute more to Scotland's prosperity
- Responsible stewardship of Scotland's natural resources delivering more benefits to Scotland's people
- Urban and rural communities better connected to the land, with more people enjoying the land and positively influencing land use

The objectives are accompanied by ten principles for sustainable land use for guiding policy and decision making, as well as indicators for measuring progress towards achieving these objectives. Amongst 13 proposals for its implementation were commitments to:

- Use demonstration projects to determine the best means by which land use and land management practice can contribute to climate change objectives
- Demonstrate how the ecosystem approach could be taken into account in relevant decisions made by public bodies to deliver wider benefits, and provide practical guidance
- Investigate the relationship between land management changes and ecosystem processes to identify adaptation priorities
- Identify and publicise effective ways for communities to contribute to land-use debates and decision-making

In furtherance of these, Scottish Government commissioned and funded two regional LUS pilots, led respectively by Aberdeenshire Council and Scottish Borders Council, in partnership with local organisations and stakeholders.

Their aims were to:

- Pilot a mechanism which considers existing and future land uses in a collective and integrated way, and to establish a means to prioritise or guide decisions about possible competing or conflicting uses

and the objective was to:

- Produce a regional land use framework in each pilot area which will facilitate the delivery of policies, strategies and objectives in relation to integrated land use

These were to be produced using an Ecosystem Approach, thus ensuring they are prepared in partnership with all locally relevant land use sectors, and fully consulted upon.

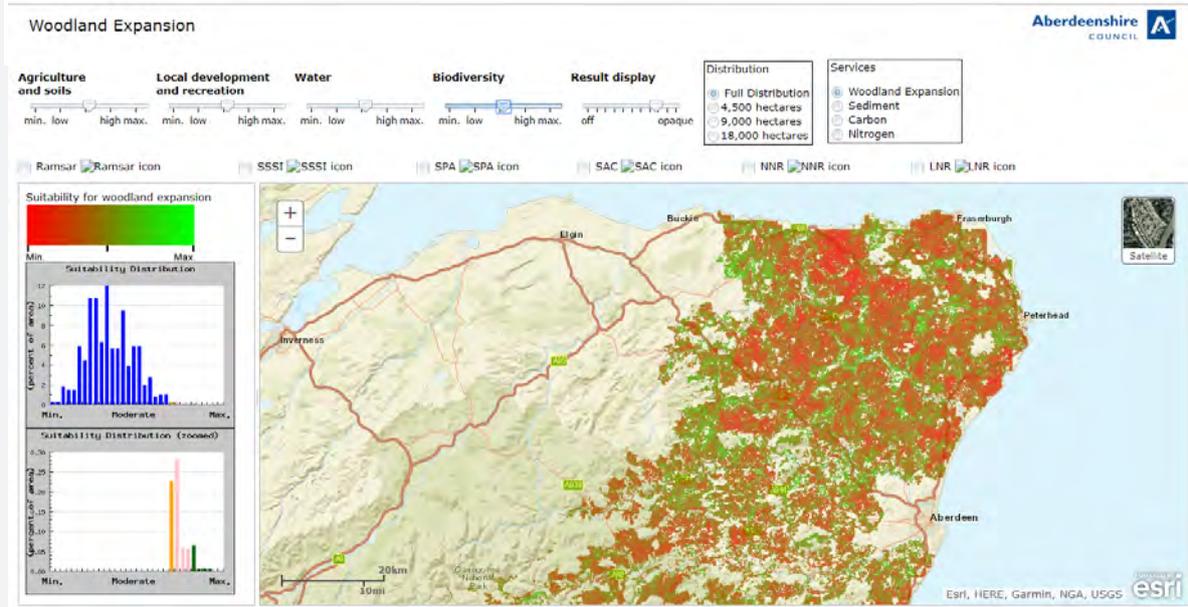
The pilots worked to exactly the same specification but independently developed two innovative approaches to local land use decision-making. The land use framework for each locality both reflects Scottish Government policies relevant to land use and expresses regional priorities as well. They aimed to provide clarity about the opportunities and constraints, taking account of changing circumstances and cumulative impacts of potential land use change, while covering the major land uses in each area. The final product was a tool to guide decisions about land management, land use change and funding; developed at a sufficiently detailed scale to enable grant funding decisions to be made (for example Scottish Rural Development Programme funding) and able to interact in a meaningful way with the statutory planning system.

Land Use Strategy 2016 to 2021 then builds on the experience of these two Regional LUS pilots:

The Aberdeenshire pilot built its approach around an interactive web tool, developed with an expert advisory group which was designed to aid discussion about land use change, to better deliver policy objectives and highlight trade-offs.⁵² The key aim was to create a framework which summarises policy and the environmental information for users and indicates where particular types of land use change might be beneficial or detrimental in line with policy goals and climate change mitigation/adaption. This was achieved by enabling the exploration of options for land use change and assessments of their consequences. Policy areas considered in the Aberdeenshire pilot were Prime Land Protection, Enhancing biodiversity, Reducing Flood Risk, Improving Water Quality, Landscape Character and aspects of Public Access.

One land use change on which the Aberdeenshire Pilot focused was afforestation and its interactions with three ecosystem services: nutrient retention, soil/sediment retention and carbon storage. Using the web tool, the user could explore the effect of altering the weighting of related groups of criteria on the suitability for woodland expansion and identify where other benefits (such as recreation opportunities) or problems (such as poor water quality) may be identified. Results were then discussed with a range of land managers in a series of interactive workshops which were held across the region.

The Aberdeenshire Regional Land Use Pilot



Source: James Hutton Institute

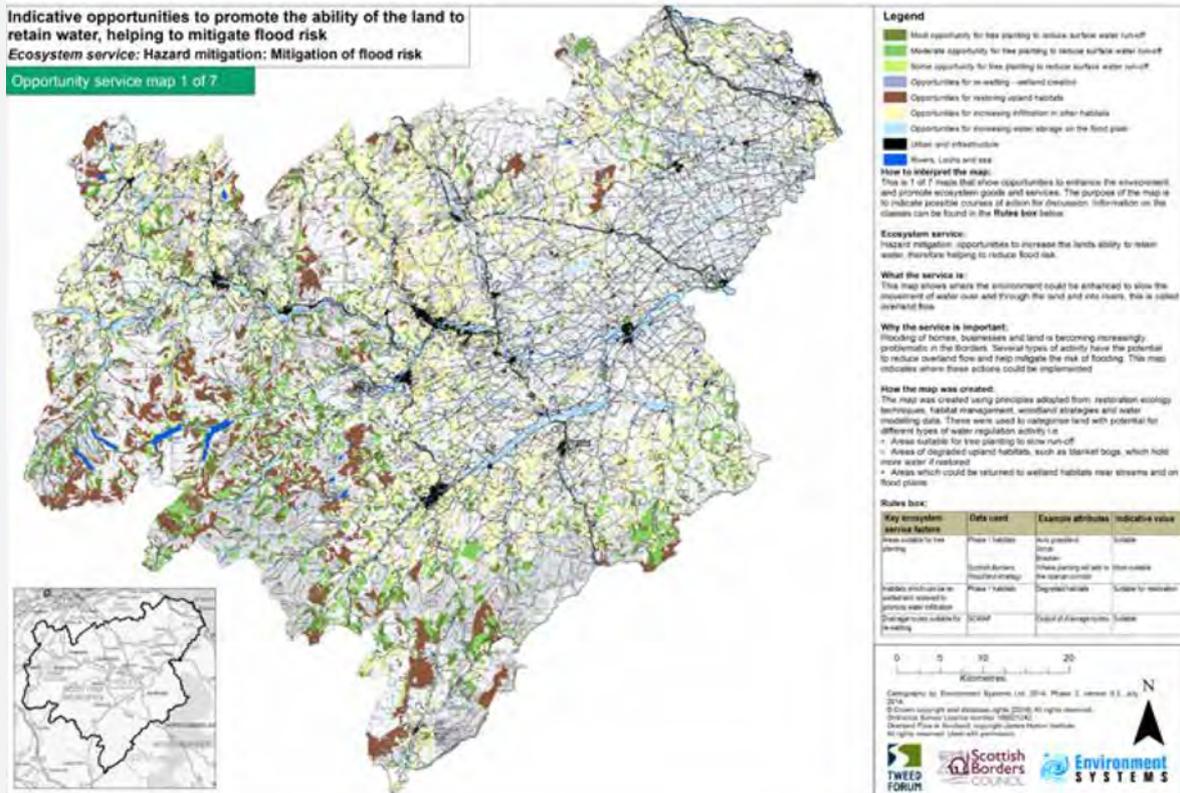
The Scottish Borders pilot undertook detailed mapping of key ecosystem services across the region, supported by a targeted engagement strategy with local communities.⁵³ Using a wide range of accessible data sources combined with state-of-the-art assessment methodologies, a set of maps were produced to communicate:

- The extent of existing Natural Capital
- Opportunities for enhancement/expansion of target Ecosystem Services
- Potential constraints or conflicts between services
- Where an expansion of Ecosystem Services could lead to co-delivery of multiple benefits

This helped identify what and where potential opportunities and potential constraints might arise if a particular policy direction was adopted to favour the expansion of one specific land use type – potentially as a response to climate change.

The Ecosystem Services approach has been demonstrated to work well at the landscape scale, and fits with the Integrated Catchment Management approach developed by the Tweed Forum. Working with the charity, the Scottish Borders pilot was able to hold over 40 stakeholder meetings across 7 sub-catchments of the Tweed chosen to reflect the range of current and future land management challenges. These meetings were used to inform the prioritisation of mapping of ecosystem services, for validation of methods, and as fora for discussing emerging results. The Scottish Borders Land Use Strategy framework maps, can be viewed as part of the Scottish Borders Council interactive mapping tool.⁵⁴

The Scottish Borders Land Use Pilot. Example Ecosystem service Opportunity Map, showing areas where land management could be targeted to slow the flow of surface water after heavy rainfall events



Source: Tweed Forum

Although both pilots ended in 2015, Scottish Borders Council and Tweed Forum continue to promote the LUS approach working with University of Dundee and Environment Systems Ltd. Together they are assisting Scottish Government, Scottish Forestry, Scottish Environment Protection Agency and others through, for example opportunity target mapping within conservation projects, and through mapping woodland planting opportunities to deliver multiple benefits, including Natural Flood Management and Diffuse Pollution control.

The Council has applied the map-based tool to target delivery of its biodiversity offset projects, has applied the LUS framework to update and revise the Local Biodiversity Action Plan and is seeking to apply the Ecosystem Approach, based on the LUS pilot framework, to a new Scottish Government pilot for woodland expansion. Elsewhere, other partnership initiatives on a smaller scale have also explored the LUS Ecosystem Approach, notably in the Carse of Stirling and the Strathard Project in the Loch Lomond and the Trossachs National Park.

The activities and findings from the two regional land use pilots have shown how complex the task is, but also the potential benefits to be achieved from developing the LUS so as to get the best from our finite land resource. A local approach devolving decision-making to the lowest, appropriate level is clearly the right scale for decision-making about land use. We have seen the development of technical solutions to assist with assessment and mapping of ecosystem services, making full use of all forms of knowledge. The importance of the Ecosystem Approach and the full engagement of stakeholders from the outset is paramount, not least the contribution of local public to the debate. This directs us to focus on key ecosystem services and highlights the opportunities and challenges that arise when considering changes, including how to take account of different ecosystem services and what methodologies to use for resolving conflicting priorities for their delivery.

The Scottish Government Land Use Strategy has provided leadership on the purposes for which land should be used. Its approach and the principles that lie behind it have been adopted in other countries (e.g. A Land Strategy for Northern Ireland by Northern Ireland Environment).⁵⁵ In turn, when the Scottish Land Use Strategy post 2021 is next reviewed (under the Climate Change (Scotland) Act 2009), it can be informed by lessons learnt from other approaches to achieving similar aims, such as that of the Welsh Government Statutory Guidance on the Well-being of Future Generations (Wales) Act 2015.⁵⁶

Looking to the future, the Scottish Government has identified that land plays a critical role in our response to the global climate emergency, and in its Programme for Government (Sept 2019) commits to ‘make regional land use plans for maximising the potential of every part of Scotland’s land to contribute to the fight

against climate change.’ This aim is strengthened by a commitment to develop proposals for implementing regional partnerships and frameworks and, based on these proposals, to ‘work to enable regional land use partnerships to emerge locally by 2021.’ Each partnership will be tasked with creating a regional land use framework by 2023 that identifies where resources can have the biggest climate impact.

Scotland’s Biodiversity Strategy: helping to improve the state of nature

Scotland’s biodiversity strategy Scotland’s Biodiversity: It’s in Your Hands was published in 2004.⁵⁷ It aims ‘to conserve biodiversity for the health, enjoyment and wellbeing of the people of Scotland, now and in the future.’ It sets out a vision for 2030 and articulates the objectives and desired outcomes which will enable Scotland to realise that vision.

In response to the Aichi international biodiversity targets agreed in 2010, the 2004 document was supplemented by the 2020 Challenge for Scotland’s Biodiversity, published in 2013 to provide a focus for the desired outcomes for Scotland to 2020.⁵⁸ Scotland’s 2020 Challenge aims to protect and restore biodiversity on land and in our seas; to support healthy ecosystems; connect people with the natural world, for their health and well-being, and to involve them more in decision making; and maximise the benefits for Scotland of a diverse natural environment and the services it provides, contributing to sustainable economic growth.

Scotland’s Biodiversity: A Route Map to 2020 was launched in 2015 to help direct priorities for action.⁵⁹ It sets out six Big Steps for Nature, plus the various priority projects needed to achieve

each big step. Scottish Natural Heritage is tasked by the Scottish Government with leading the delivery of the Route Map and the Scottish Biodiversity Strategy working groups.

The Route Map to 2020 identifies seven key pressures on biodiversity; pollution, land use intensification and modification, the spread of invasive species and wildlife diseases, lack of recognition of the value of nature, disconnection from nature experienced by many people, climate change and marine exploitation. The value of adopting an ecosystem approach to address these pressures is recognised, along with the need for partnership and collaborative working to secure the many benefits provided by ecosystem services for future generations.

Scotland supports a wide variety of wildlife including the Wild Cat, Capercaillie and the endemic Scottish Primrose, Northern February Red Stonefly and the Scottish Crossbill. It was noted however in the State of Nature, 2019 report that the pressure on Scotland's landscapes has resulted in both losses and gains in biodiversity. They note that Agri-environment schemes (AES) represent one of the main policy mechanisms to reverse declining farmland wildlife. AES have been shown to benefit some wildlife groups, particularly when targeted to specific species such as the Corncrake, with benefit also to wider biodiversity.

Learnings and Recommendations

There are many challenges that we face in Scotland – including climate change, biodiversity loss, trade uncertainty and rural depopulation. As mentioned in the ‘Our Future in the Land’, our future very much depends on the land and the people who live and work there. The linkages between policy, practice and food systems are complicated, and some of the connections are broken. Biodiversity loss, soil erosion, diet related ill-health, GHG emissions and mental health issues all need to be tackled but as part of an overall system.

However, presented in this report are many examples of leadership, innovation, cooperation, collaboration, sharing and caring. Future policies should be designed for the long term and should be based on sound evidence with information and knowledge firmly integrated into practice on the ground. This is important as we are to transition into a nation that values health and equality as paramount. The health of our environment, biodiversity, soils, crops, trees, water, livestock and of our people, are intrinsically linked to the health of our economy.

We must look after our wide range of natural assets, whether that be our soils and rivers, the insects that pollinate our crops, or the very people that farm and manage our land and who produce the diverse and high quality food and drink that make our nation productive and beautiful in both the countryside and the cities.

The people of Scotland have risen to the climate emergency and biodiversity loss challenges, driven by a desire to lead by example - through setting and working towards achieving ambitious targets.

There is evidence emerging that forward-looking individuals and groups are taking considered and safe action against the biggest challenges facing Scotland and the world.

We all want to see positive change happening in Scotland’s rural sector. Custodians of our land are seeing opportunities as well as challenges, and demonstrating willingness to collaborate, cooperate and innovate working towards transformative environmental change at a farm and at a landscape scale.

We are experiencing the effects of climate change in Scotland. However, there has never been a greater need for effective land management and use that provides environmental, economic and social benefits, to help build a more resilient rural sector for the people who live and work in Scotland and for the many visitors who enjoy and gain benefits from our land and its many and diverse landscapes.

Recommendations for Scotland are to:

- Form a ‘transition for change’ plan involving all key stakeholders
- Involve the young in formulating the plan for change
- Re-invigorate the Land Use Strategy and integrate with existing and developing related policies
- Apply and further develop regional land use plans
- Encourage and reward further innovation in food and farming
- Encourage and reward cooperation and collaboration
- Encourage and reward working with nature and delivery of public goods
- Ensure the right support is available to the right people at the right time
- Ensure that the required evidence base is available
- Encourage appropriate learning and skill development
- Ensure that the appropriate communication and knowledge exchange systems are established
- Build on the findings of the UK RSA Food Farming and Countryside Commission and Devolved Inquiry findings to form an integrated UK based sustainable approach

Scotland is rising to the environmental challenges that we face and is in the process of transitioning to a more sustainable and climate friendly food and farming system - putting healthy food at its very core, involving everybody, while farming will be the driving force for change, and that the countryside will be healthy and vibrant to nurture those who live, work, or visit our beautiful countryside.

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