The Scottish Parliament
Pàrlamaid na h-Alba

Scotland's Futures Forum
Fòram Alba air Thoiseach

SCOTLAND 2030

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HOW RESILIENT AND WELL-FUNCTIONING WILL SCOTLAND'S ENVIRONMENT BE?

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Introduction

As part of the Scotland's Futures Forum [1] Scotland 2030 Programme exploring our culture, society and aspirations for 2030 and beyond, and working on a fellowship funded by SEFARI [2], I was asked to consider what Scotland might look like in 2030. This report gives a personal perspective, and is designed to trigger discussion. It does not represent the views of SEFARI or constituent institutes, but it does draw on some of their research and expertise.

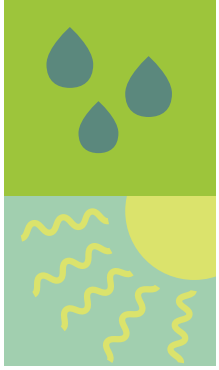
Despite the fact that society, economy and the environment will be inextricably interwoven into the fabric of Scotland in 2030, I will focus on to what extent Scotland's environment will be resilient and well-functioning at this time – this is based on the theory that society and economy, as human constructs, cannot function without a resilient and well-functioning environment. I will primarily focus on climate and land use and – whilst there are a plethora of other environmental impacts not mentioned here – the purpose is to set the context for wider debate.

As I considered what Scotland would look like in 2030 I had to think about the lenses through which I would view it. I noted first that they had to be bifocal. When life on earth is represented in an hour, the emergence of modern humans is mere seconds before midnight, but our impact in that brief period of time has been significant. As such, there is a need to consider what has come before, what is happening currently and what is projected to occur in the future and how this aligns with our planet's biological limits.

Secondly, I noted that the lenses are extremely blurry, and this means that it is hard to see beyond 2020 and, in particular, how the vote to leave the European Union will affect Scotland in relation to the rest of the United Kingdom, the European Union and globally.

Lastly, context is everything – everyone wears a different set of lenses, and it is important to remember this.

Our climate



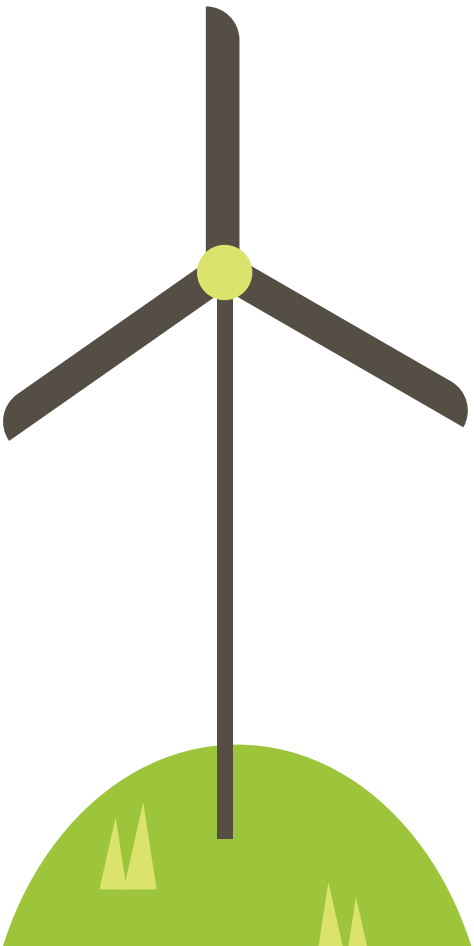
Let's start with a favourite topic for us all: the weather. More specifically, the climate. Weather reflects short-term conditions of the atmosphere while climate is the average daily weather for an extended period of time, at a certain location. Scottish average temperatures are predicted to increase by between 0.9°C and 4.5°C by 2050 (compared to the 1961–1990 record[3]) and the amount of precipitation (rain, snow and hail) is predicted to change by between -2% and +31%[4]. Warming temperatures also leads to thermal expansion of water and melting ice caps; at a UK scale, a best estimate of sea level suggests a rise of 1.4mm (+/- 0.2mm) per year compared to 1901[5].

On one hand, this may have short-term benefits for crop production by extending the growing season, and ultimately it means access to water will be continue to be less of an issue in Scotland than elsewhere, providing a competitive advantage over other countries with regards to irrigation[6]. On the other hand, warmer, wetter conditions are favourable for known disease-causing organisms such as the liver fluke in livestock[7, 8] and 'red band needle blight' in Caledonian pinewoods[6] and, potentially, as yet unknown exotic food- and water-borne parasites or their carriers[6]. Additionally, damaging river-side floods such as those of January 2016[9] and sudden flash floods are likely to become more common, with need for mitigation measures (e.g. woodland planting, wetland creation, maintenance of raised bogs[10]). Within the next 30 years, the number of Scottish residential homes at risk of flooding is predicted to rise from 180,000 by between 10% and 21%, and a 53% to 160% increase in flood risk to railways is predicted by 2080[6]. This has promoted some local flood protection schemes such as in Selkirk[11], Galashiels, Forres and Elgin[12], guided by the Flood Risk Management (Scotland) Act 2009. Change in temperature will also impact human health: the number of heat-related deaths in Scotland is estimated to increase from 38 per year to between 70 and 281 by 2050 and, whilst there is set to be an associated 2% decline in cold-related deaths in the UK, an ageing population continues to put more people at risk[6].

The main driver of climate change is greenhouse gas emissions caused by human activity. Scotland has ambitious targets to reduce greenhouse gas emissions across all sectors of industry (42% by 2020 and 80% reduction by 2050), but not all sectors are equal in their ability to decarbonise. For example, while there are targets to create a carbon neutral electricity sector by 2020[13], agriculture still contributes substantially to national greenhouse gas emissions through methane emissions from grazing livestock as part of their digestion process – although there are still 12% reduction targets for agriculture (2017 – 2032)[14] suggesting efficiency gains can be made. Further, manure storage and its decomposition on pasture contribute to nitrous oxide emissions and methane[15, 16] whilst the ability of our soils to capture and retain carbon has decreased due to over-exploitation[17]. Further, in Scotland, 33% of agricultural land is within 5km of the coast, with predictions suggesting that damage from coastal flooding could increase 450% by 2050[6].

There are practical ways forward in the agricultural sector for mitigation. These include improving animal health by targeting disease, thereby reducing the number of animals producing emissions who never make it to market or whose production is disrupted by infection[15]. Feed and production efficiency can also be achieved through genetic improvement[18]. Surveillance, improved diagnosis and targeted use of vaccines will be fundamental in tackling disease, while, put simply, selective breeding could produce cows which produce more milk and beef per kilogram of food they eat and produce lower emissions[16]. Further, on-farm digestion of animal waste by special micro-organisms can generate biogas fuel and potentially save farmers money on energy bills[13].

In terms of the energy sector (of which electricity is only 20%), the UK is currently a net energy importer and, therefore, trade arrangements and regulations remain of paramount importance[19]. Current commitments to EU targets on the use of renewables and fuel quality may no longer be valid after 2019, but the UK is bound by obligations to the United National Framework Convention on Climate Change (UNFCCC) and the legally-binding UK Climate Change Act 2008 and the Climate Change (Scotland) Act 2009. Ultimately, the cost of energy in the UK will be shaped, at least in part, by the value of the pound and trends in the price of one of our main commodities – crude oil[20] – plus the role of pricing and trading carbon. In the EU demand for biofuels is due to increase towards 2020, but it is likely to be increasingly sourced from waste oils and non-feed crops and securing these sources could affect biofuel production[20].



With regards to the transport sector, another of the high energy sectors, I wonder if meeting Scotland's current targets to decarbonise the transport sector by 2050 will be achieved by increased ownership of the latest Tesla Model X or Toyota Mirai or (the most likely wheels I will be on) the common bicycle[21]? In the UK, between 6 million and 9 million people currently suffer chronic respiratory conditions[6], and their future vulnerability to emissions will be shaped by the number of diesel-fuelled vehicles on the road and by future fuel quality and emissions regulations. Increasing temperatures could also lead to travel disruptions due to swollen railway tracks, cause power lines to droop and reduce the efficiency of underground cables[6], affecting the security of electricity supply.

> Land use for livestock, crops, tourism, sport, energy, transport and biodiversity will also have to accommodate the 15,800 new homes projected to be built annually in Scotland between 2012 and 2037.

Using Scotland's land

The history of land use in Scotland is complex. The future of land use in Scotland could be shaped by post-Brexit alternatives to Common Agricultural Policy support, continued land reform, the redistribution of funding, and trade agreements for agricultural products. Currently 79% of Scotland's land is designated as agricultural. The current political situation offers the chance for wider conversation of what we want our land to do for us. The shape that incentive-driven land use drivers take over the next 15 years will help determine land use and its relationship with public goods, the nature and diversity of crops grown, the forestry planted, the pastures available, the livestock grazed, the size and structure of farms and crofts, and the development of potentially complementary land uses (e.g. agro-forestry, urban green spaces).

Land use for livestock will depend on global and national demand, but will also be subject to policy decisions on support. EU market trends suggests beef production will continue to increase (to meet the global per capita demand for red meat, which has increased from 23kg to 42kg per person in the last 50 years[22]) but not as fast as the demand for pig meat and poultry[21]. In national campaigns to address diet-related disease in Scotland, the latest advice is to reduce consumption of red meat[23] and other greenhouse gas-intensive livestock products. Societal and cultural habits, together with politics, will continue to have an effect on how we use the natural biological and physical limits of our land.

EU market trends suggest land use for crops will increase in response to the demand for animal feed for the livestock sector[20], namely cereals, oilseed crops and protein crops which could also be seen in Scotland[20]. The future legislative and support environment in Scotland could help determine the production of ecologically-focused crops (e.g. those which can convert nitrogen in the atmosphere to atoms which it can use for growth) and could also guide the use and extent of fertiliser and pesticide application. This is particularly important in the context of land which may have largely reached its 'biophysical ceiling'[20] – effectively the maximum yield the land can physically produce.

Options for post-Brexit legislation could also test the flexibility of Scotland's food and drink sector, especially as 39% of overseas exports are to the EU. This sector is currently worth £14.4 billion to the Scottish economy and employs c.116,000 people [24] whilst targets are in place to double this to a value of £30 billion by 2030.

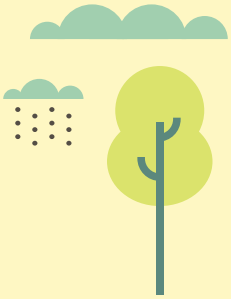
Meeting our greenhouse gas emissions targets not only means the reduced use of fossil fuels but also encouragement of land use which facilitates long-term storage (called 'sequestration') of atmospheric carbon. Soil, peatland and forestry restoration can maximise sequestration and buffer against flooding and pollution, and yet Scotland has one of the lowest levels of woodland cover in Europe [25]. Currently, there are ambitions to replant 10,000 ha of forestry a year [26, 27]. The success of that target will be affected, at least in part, by control of grazers such as red deer.

Land use for livestock, crops, tourism, sport, energy, transport and biodiversity will also have to accommodate the 15,800 new homes projected to be built annually in Scotland between 2012 and 2037 [28]. New housing and affordable means of insulating and cooling residences could reduce the number of homes currently suffering penetrable damp (2.8%) and condensation (9.3%) [29], while tackling fuel poverty in Scotland over the next 15 years could see health benefits.

All the various demands for land use have implications for biodiversity in Scotland, which is currently ranked 182nd out of 218 countries for the Biodiversity Intactness Index (a internationally recognized measure of the loss of nature due to human activities) [30]. Distributions of cold-loving species are likely to move their ranges north (if they can through 'biodiversity corridors' – areas of suitable land connecting habitats), and new potentially invasive, warmer-loving species could widen their distributions [30].

Climate change will likely impact the growth and behaviour of plants and animals, potentially in ways as yet unknown. For example, flooding in rivers may damage salmon spawning grounds, predator – prey and plant – pollinator cycles may be affected, and species may be impacted by drought [31]. The loss of 98% of the UK's flower rich meadows has been linked with a massive decline in bumble bees and other pollinators [32]. Maurice Maeterlinck, author of the "Life of the Bee" suggested that "If the bee disappeared off the face of the earth, man would only have four years left to live". The integration of biodiversity in amongst housing, farming, forestry, infrastructure and energy (even wind farms can be detrimental if planted on blanket bog [30] or in major migration routes) will help to determine the stability and enhancement of Scotland's biodiversity over the next 10 to 15 years.

> Decisions today can impact how prepared we will be for climate change in 15 years' time



Conclusions and implications for Scotland?

Overall, almost all major climate predictions come with caveats of uncertainty and include estimates, with substantial ranges determined by models based on the lowest (maximum of 2.9°C) to the highest (6.4°C) increases in global surface temperatures by the end of the 21st century[33]. Of course we have already observed changes in climate, such as an increase of 0.9°C of the average UK land temperature in 2005-2014 compared to 1961-1990[34] and increases in rainfall in Scotland of 7% in 1981-2010 compared to 1961-1990[6].

Some things are easier to predict – increases in precipitation, sea levels and flooding risks, for example – and some are far more difficult to predict: the occurrence of extreme climatic events and emergence of novel and invasive pathogens.

Will such climatic changes be equally felt across Scotland? Initially, not at all. Scotland itself is largely regionally diverse in terms of geology, soils, land use, distribution of livestock, concentration of vehicle emissions and air quality, access to transport or the grid, dependency on weather conditions, fuel poverty, flood and erosion risk, and the level of precipitation. However, our similar requirements for food, water and shelter mean that we will all feel some effects of the changing climate, though that may vary depending on where we live, and how we live. For example, whilst rural areas may experience more obvious changes to the landscape, island areas may encounter more travel disruption due to wind and those living in urban areas may experience higher cases of respiratory problems.

Decisions today can impact how prepared we will be for climate change in 15 years' time. For example, river-side planting for flood mitigation, the diversity of tree seeds planted in afforestation, soil conservation for future use and implementing sustainable drainage systems (relieving pressure on public sewer systems with increased surface water) could all have an effect[6].

In conclusion, from the perspective of my own lenses, Scotland 2030 looks warmer and wetter, more exposed to extreme weather and flooding, home to more invasive species and changes in the distributions of some of our native biodiversity as it adapts to climate change. However, I also observed three main determinants likely to influence the trajectory to Scotland 2030 with regards to the resilience and functioning of its environment.

First is the legislation put in place following Brexit, the future trade arrangements, our market position and the reallocation of budgets – and the duration across which all of these become manifest.

The second determinant is our valuation of 'natural capital' in economic decisions (for example, Scotland's Natural Capital Index[35]). This has historically not been accounted for compared with other types of capital, but could have an effect in relation to protecting the resilience of soil quality, buffers to flooding, species diversity and natural functioning carbon storage.

Thirdly, the resilience and functioning of Scotland's environment depends on human behaviour and our willingness to adopt new and advanced technologies and approaches. Genetics can allow approaches tailored to climate resilience in agricultural products, targeted vaccination can maximise production efficiency, and better understanding of the biophysical capabilities of different land types (such as the land use capability classification system and guidelines) can optimize its use.

> **The resilience and functioning of Scotland's environment depends on human behaviour**

Acknowledgements

I would like to thank SEFARI for funding this fellowship and the opportunity to conduct such research and to Graeme Cook, the Director of SEFARI Gateway, for his support. I would also like to thank Scotland's Futures Forum, in particular Rob Littlejohn, for allowing me to work on the Scotland 2030 Programme.

Within my organisation (SRUC) I would like to thank my line manager, Eileen Wall, for affording me the time and flexibility to complete this work and Steven Thomson (SRUC), Philip Skuce (Moredun Research Institute) and Lorna Dawson (James Hutton Institute), in their roles as SEFARI KE Sectorial Leads for 'Communities', 'Livestock' and 'Soil and environment' respectively, for their unwavering support, feedback and encouragement.

Lastly I would like to thank all those who provided feedback to my questions, which includes key staff from across all six research institutes, researchers from the Scottish Parliament Information Centre (SPICe), a brief discussion with SEPA, and colleagues and friends.

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