Theme C – Human Impacts on the Environment

Lay Summary of Projects

January 2024

Theme C- Human Impacts on the Environment – Overview

Strategic Relevance: The Theme Rationale is that the urgent global Climate and Nature crises, post-EU exit readjustments and Green COVID-19 recovery, means that the next few decades are likely to see substantial changes in society, economies and our relationship with the environment, both in Scotland and internationally. **The Aim** of Theme C is to undertake excellent science that is agile and responsive to emerging needs, to provide evidence to the Scottish Government on the development of policy solutions and support decision making to address the complex challenges we are facing. **The Purpose** is to inform better management and utilisation of land to achieve sustainable multi-functional landscape objectives for society and the environment under rapidly changing economic priorities and environmental conditions. **The Context**, whilst focussed on Scotland, will be global-scale pressures and drivers.

Theme C consists of six Topics and 11 projects, as detailed in Figure 1.

Topic	Topic Name	No of Projects
C2	Agricultural Climate and Carbon	2
C3	Land Use (inc. mapping)	3
C4	Circular Economy (inc. waste)	2
C5	Large Scale Modelling	3
C6	Use of Outdoors and Greenspace	1

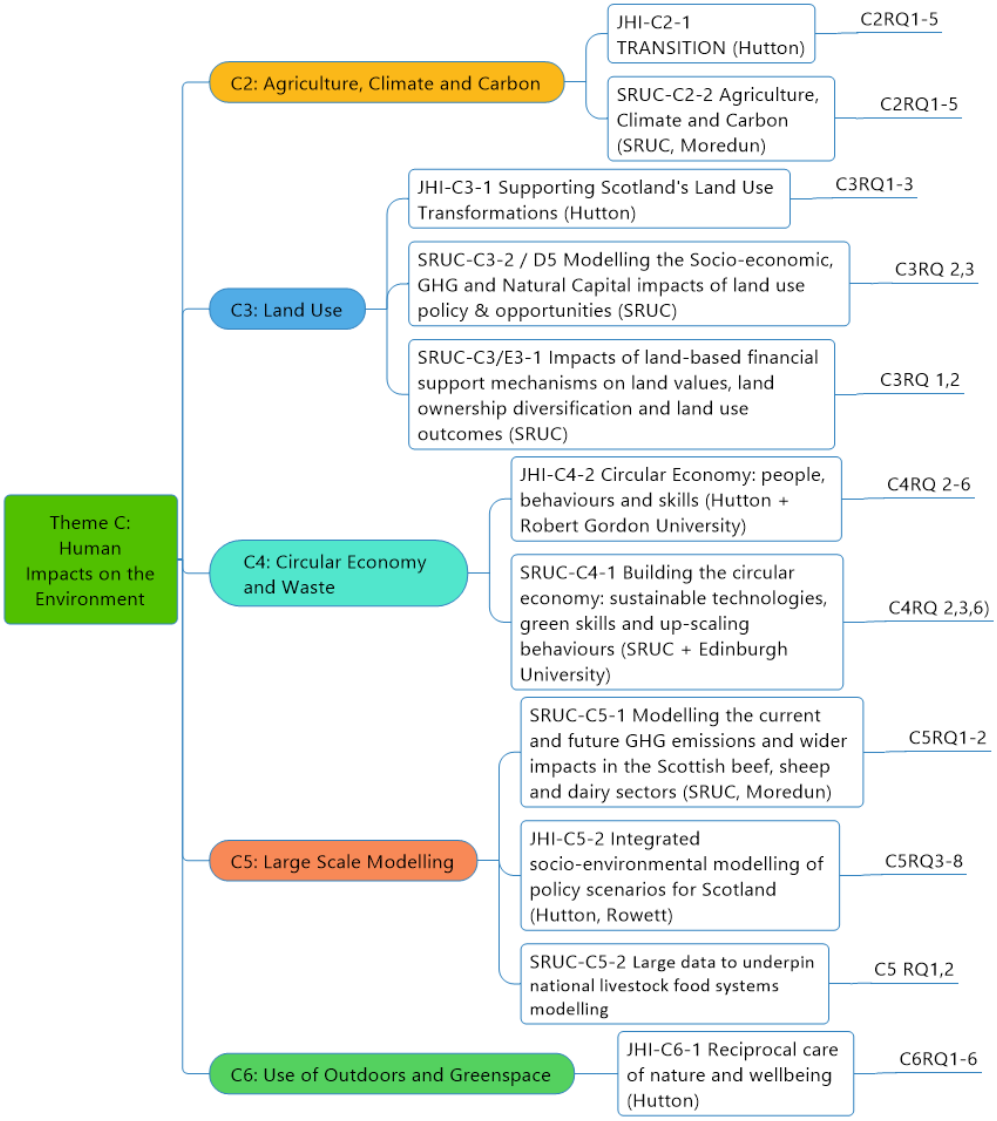

Figure 1. Theme C – Human Impacts on the Environment Topic and Project structure.

Topic C2: Agriculture, Climate and Carbon

This topic addresses agriculture's response to the climate change emergency in two closely linked projects:

JHI-C2-1 TRANSITION - **T**owa**R**ds c**A**rbo**N** po**S**it**I**ve **T**hrough **I**mpr**O**ved farmi**N**g.

PI: Jagadeesh Yuleripati (Jagadeesh.yuleripati@hutton.ac.uk)

Agriculture has a key role in sequestering carbon and mitigating greenhouse gas emissions (GHGs) to meet net zero targets. A lack of cost effective, robust, consistent, transparent and accurate methods limits large-scale use of mitigation measures. The Project aims are to improve assessments of mitigation practices for additionality, permanence, and uncertainty in achieving net zero, and to produce regionally specific options to reduce GHGs and effective monitoring mechanisms. The Project goal is to develop capacity and bridge knowledge gaps to identify best management interventions to balance agricultural production and net GHG emissions. The purpose is to provide

increased capacity and capabilities to Scottish Government to make better informed decisions and policy development based on the best available science.

SRUC-C2-1 Agriculture, Climate and Carbon.

PI: Bob Rees (bob.rees@sruc.ac.uk)

This project provides new approaches for reducing greenhouse gas emissions from agriculture and land use in Scotland and developing approaches to improve emissions inventories. It establishes a database of management activities contributing to the mitigation of greenhouse gas (GHG) emissions, investigates new approaches to GHG mitigation, and assess the potential for land management activities to contribute to carbon sequestration. Engagement with stakeholders will explore barriers to uptake of mitigation measures. It also includes an assessment of the costs required and define wider impacts of mitigation activity on the environment, such as nutrient cycling, soil and water quality, and biodiversity.

Topic C3 – Land Use

The research in the Land Use Topic (C3) responds to the recognition by policy makers and others that how we use Scotland's land is a key part of how we achieve the NetZero greenhouse gas emissions by 2045 and deliver other environmental goals. Scotland's land use systems will also have to cope with climate change that is already in progress from previous GHG emissions. This research is an opportunity to simultaneously consider both climate change mitigation and adaptation in a coherent way that also protects nature.

JHI-C3-1 Supporting Scotland's Land Use Transformations.

PI: Keith Matthews (keith.matthews@hutton.ac.uk)

The purpose of this project is to generate new insights for how land use in Scotland needs to change to meet climate change mitigation, adaptation, and other environmental objectives. The Project considers how policy approaches to land use can be better joined up. This Project studies the macro land-use changes needed to achieve the challenging Scottish Government objectives of delivering NetZero and other environmental objectives. The Project draws on insights from research elsewhere in the Strategic Research Programme to assess how widely technical or behavioural changes can be applied and the factors that may act as barriers to their success. This means reflecting with policy teams on the robustness of policy narratives and looking for opportunities to increase policy coherence.

SRUC-C3-1 Impacts of land-based financial support mechanisms on land values, landownership diversification and land use outcomes.

PIU: Ian Merrell (ian.merrell@sruc.ac.uk)

This project increases our understanding of the impacts of land-based funding mechanisms on land values, and related outcomes for landownership diversification and land use change. The project will incorporate regional case studies and qualitative (interviews with landowners and land agents), quantitative (landowner survey, land sales figures) and spatial analysis (ownership and land use data)

methods. The research will provide recommendations for policy interventions and land-based funding models which are aligned with both land use and land reform policy. It is a joint project with SRUC-E3-1 which sits in the Rural Futures Theme (E) and is concerned with land reform (specifically land ownership concentration).

SRUC-C3-2 Modelling the socio-economic, greenhouse gas and natural capital impacts of land use policy and opportunities.

PI: Alistair McVittie (alistair.mcvittie@sruc.ac.uk)

This project applies different modelling approaches to assess opportunities and impacts of land use in Scotland. Synergies and conflicts in land use policy will be explored to identify how multiple objectives can be achieved. The greenhouse gas inventory for agriculture, land-use and land-use change will be reviewed to improve the emissions factors relevant to Scottish farming and to allow disaggregation to farm business level to identify hotspots for emissions and mitigation potential. Farm business models will be scaled up from farm to regional levels to identify patterns of responses to policy and management change. Also, natural capital will be modelled spatially to explore ecosystem service supply and opportunities from land use change.

Topic C4 – Circular Economy

The Circular Economy is a new Topic in the Strategic Research Programme. In the circular economy, natural resource inputs are reduced; resources are kept in circulation as long as possible; their value maximised; and waste is minimised. Transitioning to a more circular economy is essential to achieving Net Zero carbon emissions. The Hutton-led project JHI-C4-1 focuses on behavioural and cultural dimensions of the circular economy transition in households and organisations. It builds on a portfolio of research on pro-environmental behaviour, drawing on environmental psychology, interdisciplinary social science and complexity science. SRUC-C4-1 focuses on rural and island industries, green technologies and skills. This project extends Hutton research on rural economy, and waste efficiency and behaviours, and draws on systems dynamics, economics, sociology and natural science. The projects incorporate place-based research representing Scotland's urban and rural areas, covering multiple regions.

JHI-C4-1 Circular economy: people, behaviours and skills

PI: Tony Craig (tony.craig@hutton.ac.uk)

This transdisciplinary project develops the evidence base to support policymakers in promoting behaviour change, developing new business models, and understanding workforce skills necessary to accelerate the green recovery through the development of a circular economy (CE) in Scotland. Moving towards a circular economy requires a broad cultural shift in how consumers and businesses think about and act in relation to the consumption and disposal of materials and products. To address this the project investigates how behaviour change at the individual, household and organisational level creates challenges and opportunities for moving to a more circular economy. It explores in depth the portfolio of interventions and broader policy scenarios that would be required to produce required changes in environmental behaviour.

SRUC-C4-1 Building the circular economy: sustainable technologies, green skills, and upscaling behaviours

PI: Luiza Toma (luiza.toma@sruc.ac.uk)

The transition to a more circular economy (CE) necessitates a systemic way of thinking and acting that interconnects people and communities, industries and infrastructure, institutional and policy governance. To be able to assess progress towards the circular economy in these areas, a clear understanding of the capability i.e., willingness and readiness of people and places, infrastructure and institutions, to advance on the CE path is required. This project observes 'living lab' case studies in rural and island Scotland with a focus on dominant industries, analysed through an innovative blend of micro- and macroeconomic concepts and methodologies to map an understanding of circular economy drivers and barriers such as behaviours (willingness) and socio-economic capacity i.e., technologies and green skills (readiness) under alternative scenarios depicting regional CE paths.

Topic C5 – Large Scale Modelling

The Large Scale Modelling Topic is a new one to the Strategic Research programme and develops computer simulation tools to support scenario analysis at the whole-of-Scotland scale. The projects in this Topic Line are designed to adapt as the requirements of the Scottish Government evolve. As the COVID crisis has revealed, the use of computer modelling in policy scenario evaluation can be highly valuable, yet contentious. Hence, the projects in this Topic Line are committed to an Open Science agenda. The models and software will be made available under open-source licences in popularly-used software repositories. Projects will develop tools to support keeping track of how source data and computer simulations have been used to produce diagrams and tables for evaluating scenarios.

JHI-C5-1 Integrated socio-environmental modelling of policy scenarios for Scotland

PI: Gary Polhill (gary.polhill@hutton.ac.uk)

This project develops the science needed to integrate data and models about Scotland's rural social-environmental systems, with the goal of developing the capability to answer policy-led questions quickly. The project makes use of state-of-the-art computer modelling, which has an increasing role to play in helping to navigate the landscapes of complex social-environmental decision-making processes and offer decision-makers integrated, consistent guidance based on formalizations of evidence. The project also develops the science and skills needed to work in an 'agile' way with policymakers and stakeholders on computer modelling at the whole-of-Scotland scale. Research areas covered include developing a framework for monitoring soils; mapping our land capability and how it is affected by climate change; and simulating the effects of agricultural payments, trade, and technology change on rural businesses.

SRUC-C5-1 Modelling the current and future GHG emissions and wider impacts in the Scottish beef, sheep and dairy sectors.

PI: Vera Eory (vera.eory@sruc.ac.uk)

The overall aim of this project is to build capacity towards robust and transparent prediction of greenhouse gas (GHG) emissions and wider impacts of future agricultural production pathways, at the national and regional scale. The project supports the development of better targeted, feasible

and cost-effective greenhouse gas (GHG) emissions policies and industry initiatives, thus contributing to achieving Scotland's net zero goal and reductions in the emissions intensity of Scottish food commodities. The project combines scientific modelling, experimental results, socio-economic information and national scale data to improve the prediction of future greenhouse gas emission (GHG) reduction scenarios, the cost-effectiveness of solutions and their wider environmental impacts. The specific focus of the project is ruminant livestock systems, given their importance in Scottish agriculture, however, the tools and analyses are embedded in Scottish agriculture in general and include the overall Scottish agriculture .

SRUC-C5-2 Large data to underpin national livestock food systems modelling.

PI: Mike Coffey (mike.coffey@sruc.ac.uk)

This Project aims to help the livestock industries to proactively embrace and incorporate sustainability drivers into their systems and take forward improvement plans. The Project explores pilot examples of how animal centric data can drive large-scale modelling, gathering data from disparate sources into a single cohesive dataset that can then be used to inform policy, to demonstrate weaknesses in data (information content) and as input into both phenotypic and genetic analyses. Building on data driven approaches in this and other Themes we will explore how new data analysis approaches can be used to develop new understanding in livestock performance and sustainability of livestock systems. Techniques will include exploring the use of machine learning to help integrate data sources across our livestock food chains.

Topic C6- Use of Outdoors and Greenspace

Recreation is a key ecosystem service provided by Scotland's natural environments. Increasing use of the outdoors (green/blue spaces) is a Scottish Government National Performance Indicator, features across multiple policy domains (e.g. health, education, tourism) and is an important part of Scotland's agenda toward a Greener, Fairer and Healthier country. Recreational use therefore forms an integral part of land management decisions, while how people engage with the outdoors has environmental implications. This Topic consists of one project.

JHI-C6-1 Reciprocal care for nature and wellbeing

PI: Kate Irvine (kate.irvine@hutton.ac.uk)

The Project has an overall goal of building a comprehensive picture of how different population groups engage (or not) with different types and qualities of outdoor environments to derive benefit, to understand the barriers to and capabilities for responsible use of the outdoors, and to develop tools to evaluate quality and assess costs and benefits. The purpose is to gain a comprehensive understanding of the mechanisms through which both diverse and responsible engagement with, and investment in, quality outdoor nature (green/blue) places can be promoted. The rationale is that increasing use of the outdoors is a Scottish Government National Performance Framework indicator. Encouraging, managing and investing in this recreation has cross-sectoral policy significance relating to health, planning, environment, education and tourism. The Project aims are for findings to support and inform decision-making, practice and uptake at multiple scales of policy and practice to encourage or enable more people to responsibly visit, benefit from, and care for nature.