



2022-2027 Environment, Natural Resources and Agriculture (ENRA) Research Programme

Mid-programme Review Report

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ENRA Chief Scientific Advisor Forward

The ENRA Research Programme supports a broad array of research related to land use and the environment in Scotland. The programme is tasked to deliver a rigorous evidence base to support the needs of policy and practitioners. The research for 2022-27 has been focused particularly to guide societal responses to the environmental challenges posed by the Nature and Climate Crises. The research themes cover plant and animal health, sustainable food systems, human impacts on the environment, natural resources, and rural futures. The policy impacts are dependent on building close interactions with the Directorates for Environment and Forestry, and Agriculture and Rural Affairs. Practical impacts are driven by knowledge exchange activities with a varied set of land managers.

The Research Programme depends on key institutions (SEFARI institutes) for delivery and on their staff for creativity in research, for scientific credibility, and for clear communication. Scotland benefits from its long history of supporting these world-class scientific institutions, for instance through the National Soil Archive that has existed for 90 years, or through research farm platforms spread across the country. Institutions' local roots provide geographical context for research, and for knowledge exchange with practitioners.

It is vital that the research produced by the Programme is both excellent and delivering impact. To ensure these requirements are met, an independent Science Advisory Board (SAB), chaired by myself and Professor Sarah Gurr, has reviewed the Programme by themes. The reporting by the SAB has helped to identify the most impactful research, opportunities to be taken, and gaps to be filled. The SAB's work has provided assurance that the programme is delivering at the highest level overall, but also highlighted potential areas for improvement. The SAB identified world-class researchers, dedicated to delivering high quality outputs, and driven to communicate their learnings and evidence more broadly. A key next step recommended by the SAB is for Scottish Government, institutions, and researchers to catalyse stronger linkages across themes, and so to build more connected solutions to the challenges we face.

Prof. Mathew Williams

Chief Scientific Advisor, Environment, Natural Resources and Agriculture



1. Introduction

The 2022-2027 Environment, Natural Resources and Agriculture (ENRA) Research Programme funds a large number of multi-year research projects and underpinning services. The total annual budget for the ENRA research programme is approximately £47m. Further detail on the programme structure can be found in Annex B.

The Scottish Government's vision for the strategic research programme is: *“to support research that is relevant, respected and responsive to Scotland's environment, communities, its people and to the rural economy”* as set out in the Strategy for ENRA research¹.

The science delivered within the strategic research programme and underpinning services falls within the following research themes:

- Theme A: Plant and Animal Health (23 ongoing projects)
- Theme B: Sustainable Food System and Supply (51 ongoing projects)
- Theme C: Human Impacts on the Environment (11 ongoing projects)
- Theme D: Natural Resources (22 ongoing projects)
- Theme E: Rural Futures (6 ongoing projects)
- Theme F: Cross-cutting modelling activities (3 ongoing projects)

One aspect of Quality Assurance within programme delivery undertaken by Scottish Government is to complete a mid-programme review to ensure deliverability, efficacy and direction of the programme. Completing a mid-programme review provides an opportunity to influence decisions and help ensure the programme can realise its intended benefits. Due to ongoing internal financial challenge, a commitment was made to bring forward the mid-programme review to 2023-24. The mid-programme review will assess both the Strategic Research Programme (SRP) investing circa £28m in 23-24 and the Underpinning National Capacity Programme (UNC) investing circa £8.5m in 23-24.

The mid-programme review looks to achieve the following outcomes:

- **We can assure Ministers that individual elements of the programme are meeting objectives, that these objectives are aligned to policy priorities and on track to achieving value for money**
- **We have a basis for portfolio wide decisions**

¹ [Strategy for Environment, Natural Resources and Agriculture Research 2022-2027 \(www.gov.scot\)](http://www.gov.scot)

2. Methodology

The Mid-programme Review (MPR) was delivered by the Rural & Environmental Science and Analytical Services (RESAS) Division within Scottish Government. The review team consists of officials from the RESAS Programme Management Office (PMO) and the RESAS Scientific Advisory Unit (SAU).

Within the MPR, the Chief Scientific Advisory (CSA) ENRA led on the Scientific Evaluation of the programme. This aligns to the CSA's responsibility for providing assurance on the quality of the scientific research undertaken in the areas covered by the programme. It also reflects the fact that the CSA ENRA co-chairs the Scientific Advisory Board (SAB) which provides ongoing scrutiny of the ENRA programme as part of the existing governance structures. Overall responsibility for delivering the review, and its conclusions sits with civil servants in RESAS.

The mid-programme review evaluates the programme through three Work Packages:

Programme Delivery	Science Evaluation	Alignment to Policy Priorities
A desktop assessment on the deliverability risk of the projects and programme functions utilising available delivery datasets	An independent evaluation of Theme A-F provided by the Scientific Advisory Board (SAB) to assess Science Excellence, Reach and Impact	Theme workshops with Senior Policy Sponsors to assess the research against the current policy priorities to provide understanding of priority gaps and opportunities

The findings from the mid-programme review are presented in this report as follows:

- Science Evaluation presented by Theme
- Policy Priorities presented by Theme
- Strategic Research Programme Delivery
- Underpinning National Capacity

Programme Delivery (Led by RESAS PMO)

This work package identifies potential delivery risk based on available datasets such as Researchfish and finance reporting. This work package looks at the research projects in the Strategic Research Programme. Delivery risk is identified if a project meets either of the delivery triggers outlined below:

- Trigger 1: Key project milestones missed, without an agreed mitigation plan and project re-baselining.
- Trigger 2: Two or more substantial changes to a project. This may indicate significant change in project scope/direction.

Science Evaluation (Led by CSA ENRA & RESAS SAU)

This work package uses the research programme’s existing governance structure, specifically the SAB to independently evaluate the research in the Strategic Research Programme, at a Theme Level.

The SAB are asked to evaluate the research based on the evidence presented to them via Theme Level Scientific Delivery Group reports and interviews between SAB and Theme Leaders at Board Meetings. A series of questions were put to SAB members, which in turn provided an evaluation of the research. This science evaluation output centres around ‘Science Excellence and Reach’ and ‘Research Impact’.

The following questions were answered by SAB members for each Theme:

Evaluation Framework	Questions to SAB members
Science Excellence and Reach	<ol style="list-style-type: none"> 1. Has evidence been provided that demonstrates that the research is i) internationally competitive and ii) unique and innovative. 2. Are components of this Theme duplicating past research? 3. Has evidence been provided to demonstrate how the outputs of projects are being [will be] connected across the SRP Themes? 4. Are there any key research gaps identified across the Theme?
Research Impact	<ol style="list-style-type: none"> 5. Has evidence been provided that demonstrates that the research is delivering outputs with impact or demonstrating good progress toward impact in support of key policy and broader end user needs within this theme? 6. Do the outputs delivered have significance and reach? 7. Are there opportunities to enhance research impact? 8. Are there significant risks highlighted that could affect the impact of key elements of this theme?

The SAB did not evaluate the UNC programme but will examine it in 2024-25.

Policy Priorities (Led by RESAS PMO)

This work package undertook engagement with policy officials, via a workshop, to prioritise the policy evidence needs delivered through the research projects in the Strategic Research Programme. Other stakeholder priorities, such as industry, have not been reflected in the workshop assessment but are considered key to a projects overall impact/importance. Project-project dependencies across the programme were also considered in the evaluation, as such projects were not evaluated on their own where key known connections existed.

All research being delivered via the Strategic Research Programme is considered valuable; the following categorisation was used to assist in prioritisation:

Priority Categorisation	Description
Critical	Critical priorities are the most pressing. These are projects that absolutely must be accomplished by a given due date. Failure to do so would mean the Scottish Government being unable to deliver on a key policy commitment. In these scenarios, the project input to policy and timing are fixed. It is possible to have multiple critical priorities of equal importance at a given time.
Important	Important priorities are subordinate to critical priorities. These are projects that can provide significant improvements to policy decisions but where there may be more flexibility on timing, composition or delivery of outputs, without major damage to policy or reputations.
Desirable	Desirable priorities are projects which are useful to have, they may inform long-term thinking or help to broaden the evidence base on a given topic. However, they are not central to delivering key immediate policy priorities, nor are they relied upon by other parts of the programme, or key SG stakeholders. Their delivery is also not time critical for policy or stakeholders.

3. Key Findings

Summary of key programme wide observations is provided below.

Research Delivery:

- Upon commencing the mid-programme review the research programme was only a quarter (15 months) of the way through the five-year delivery duration. Assessing the programme so early in its delivery means we cannot fully communicate the value for money achieved through the research investment.
- To determine the value for money from an investment we would quantify the economic impact of the programme in its entirety. To do this we will look to assess a number of future impacts such as gross value added from jobs, spin out companies and intellectual property licences. We would also look to monetise the avoided carbon emissions, social benefits from employment and return to general public from research. All of which cannot be wholly done at this moment in the programme.
- We know from evaluation of the previous programme² that the research delivered within this portfolio achieves substantial economic impact. The economic impact of the 2016-2022 Research Programme was estimated as £470 million to £680 million (£2022). Overall the mid-programme review provides assurance that the **programme is on track to deliver research of value to Scotland** and significant wider economic impact.
- Overall, most **projects are delivering at an acceptable risk level**, however some projects (12, 10%) have met the delivery risk trigger points and must be monitored to ensure risk does not grow to an unacceptable level. The delivery risk triggers include looking at project changes. Changes to a project can be suggested for positive reasons such as to better align project scope and/or seek efficiencies. As such the triggers are only an indication of significant movement in a project and provide a warning for potential future impact to a project's success.

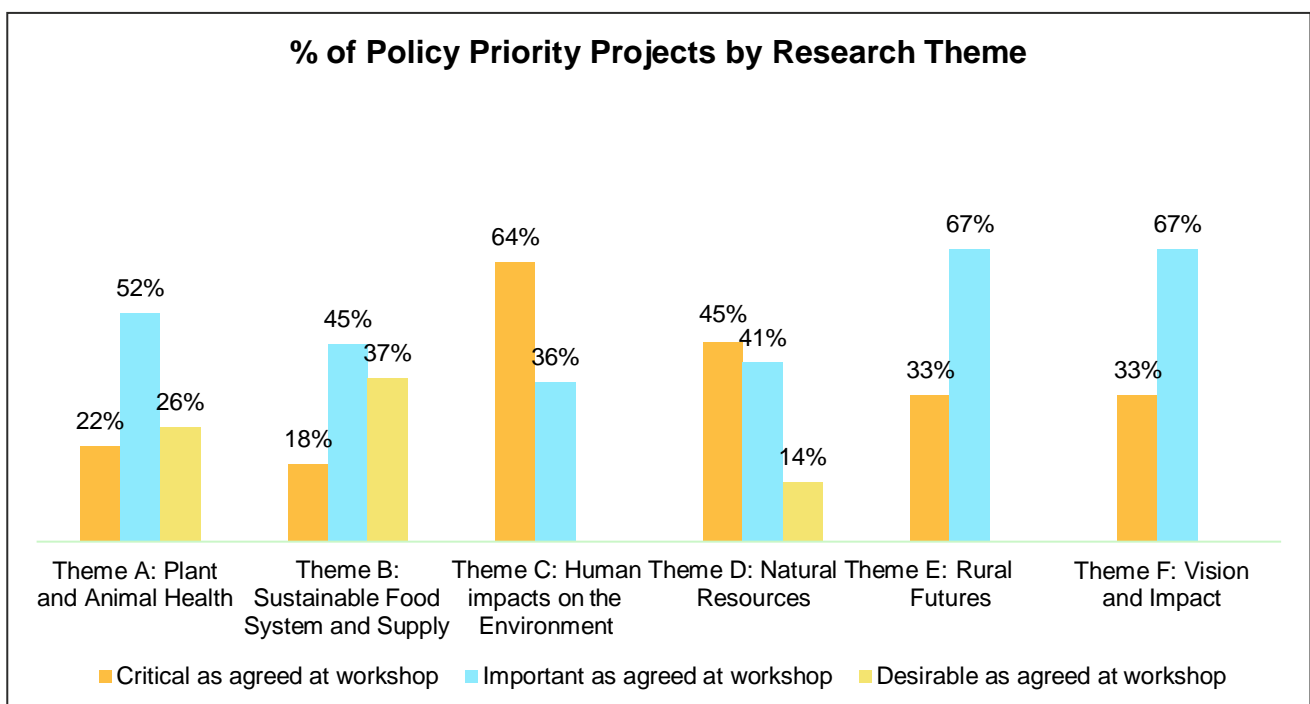
Research Policy Alignment:

- Overall the policy prioritisation workshops indicated that **all the research undertaken within the SRP is aligning to policy needs** and no research projects should be stopped or significantly changed. In some cases research was seen to feed into wider policy spaces than those engaged for example Education or Human Health policy portfolios.
- The policy prioritisation workshops found that the SRP is delivering **34 (29%) Critical** projects. These projects provide evidence that is essential to the success of immediate policy development/decisions.
- The workshops found that the SRP is delivering **54 (47%) Important** projects. These projects provide significant improvements to policy decisions but are more flexible on timing, composition or delivery of outputs, without major damage to Scottish Government.

² [Rural affairs, food and environment research programme 2016 to 2022: evaluation highlights - gov.scot \(www.gov.scot\)](https://www.gov.scot/rural-affairs-food-and-environment-research-programme-2016-to-2022-evaluation-highlights)

- Finally the workshops found the SRP is delivering **28 (24%) Desirable** projects. These research projects are considered valuable and can inform long-term thinking or help to broaden the evidence base on a given topic. However, they are not central to delivering key immediate policy priorities. Projects in this space may be of high priority to other stakeholders such as industry or the wider research landscape, and this should be highlighted in future review/decisions.

Research Theme	Critical Nr of Projects	Critical Year 2 (2023- 24) £k	Important Nr of Projects	Important Year 2 (2023-24) £k	Desirable Nr of Projects	Desirable Year 2 (2023-24) £k
Theme A: Plant and Animal Health	5	£2,054	12	£2,115	6	£973
Theme B: Sustainable Food System and Supply	9	£1,995	23	£4,608	19	£3,616
Theme C: Human impacts on the Environment	7	£2,329	4	£1,090	0	£-
Theme D: Natural Resources	10	£3,900	9	£2,688	3	£221
Theme E: Rural Futures	2	£388	4	£1,087	0	£-
Theme F: Vision and Impact	1	£238	2	£516	0	£-
TOTAL	34	£10,904	54	£12,105	28	£4,811



SAB Evaluation:

- SAB agreed the programme research presented was unique and novel, internationally competitive, innovative and in line with best practice internationally. Many projects are attracting/leveraging additional outside funding. Even though it is early in the programme cycle there was much to celebrate with many internationally competitive projects demonstrating good outputs, innovation and relevance to Scotland.
- SAB confirmed evidence had been provided which demonstrates good progress toward impact in addressing key policy challenges for Scotland. Both academic publications and interactions with stakeholders were extensive and ongoing, and the connections to relevant agencies and authorities were clear.
- SAB members agreed the Themes are innovative and not duplicating past research. While there are similar research questions being addressed currently in the UK and internationally, the research undertaken across the SRP is providing unique Scottish insights into the topic areas where there is a need for nationally focussed understanding and policy advice.
- SAB suggested however that while impacts were emerging across the programme, they need careful tracking, and options for extending and building on them need exploring, including policy engagement over both the short and long term. Across all themes it is important to identify the policy join-up with research projects more clearly and uniformly, and to highlight research links and engagement with practitioners more fully.
- It was noted the Strategic Research Programme has no clear impact strategy. SAB suggested that increased impact and reach could be achieved by further integration and increased connectivity across the themes and into policy.
- Themes appeared to be operating in silos and cohesion across the Themes was not clear. This disconnect made it harder to ascertain research gaps. SAB suggested it would be helpful to understand how these cross-theme connections occur operationally.
- SAB highlighted opportunities to raise awareness of the leading research being undertaken across the SRP to a more diverse range of stakeholders and practitioners.
- SAB identified research gaps across the SRP. Members identified that the demonstration and future implementation of the research outputs was a gap at programme level (i.e. suggesting a need for deep demonstrators).
- SAB agreed key risks to the SRP were resource limitations, including the loss of experienced staff and the need to be responsive to new policy demands over short time frames which can potentially impede the longer term sustained work.

Other Findings:

- The Strategy of ENRA Research called out the need for responsive and flexible research to reflect changing needs and priorities. In 2023-24 responsive research mechanisms have been reduced due to the ongoing challenging public financial landscape. Discussions with stakeholders throughout the assessment have shown an appetite to increase responsive funding options.

- Furthermore feedback from policy stakeholders stated the projects within the Strategic Research Programme should be more flexible to align with changing policy direction if appropriate.
- During project workshops it was understood that projects often had critical elements of scope, and specific elements of scope could be classified as less critical and/or desirable.
- Feedback from policy stakeholders also noted two-way knowledge exchange should be enhanced between RESAS and policy teams to ensure policy colleagues are aware of ongoing research projects, and in turn the research projects can be greater directed by policy needs.

3.1 Recommendations

The programme wide recommendations, and priority of these, are shown below:

SAB Recommendations

Must Do

- SAB recommended more formal mechanisms are adopted to support cross-programme working, particularly when addressing key policy challenges such as climate change, sustainable food production, and biodiversity loss. Further, all SRP Themes should meet together to discuss commonalities (e.g. in big data handling, AI) and coordination.
- The ENRA Research programme should consider developing a formal Impact Strategy.
- RESAS should identify the policy join-up with research projects more clearly and uniformly, and to highlight research links and engagement with practitioners.

Should Do

- To further enhance flexibility in the research ongoing, engagement should include an opportunity for jointly refining the research questions using available information and expertise, feasibility and time frames so they are suited to rapid investigation and/or synthesis of existing information.
- SAB recommended more use of 'deep demonstrators' across the programme, like the Theme E Living Labs, to link science and policy to practitioners.

Could Do

- SAB recommended more explicit capturing of the impact of short-term policy demands on staff, drawing them away from their long-term research, could be helpful for future resourcing.

RESAS PMO Recommendations

Must Do

- Projects which meet a delivery risk trigger point should be considered an ongoing delivery risk. RESAS Topic Lead and RESAS PMO should undertake further consultation to evaluate project delivery against original research questions, and proposal timescales to ensure the project is still able to meet desired requirements.

Should Do

- Flexibility within ongoing research projects should be maximised to meet the needs of policy and availability of responsive research should be increased, perhaps through the Support to Policy functionality of UNC.
- Where elements of SRP project scope could be classified as less priority RESAS should identify this and consider delivery. Similarly, if research overlaps that being delivered by another funder this should be identified and rationalised.

All the mid-programme review outputs and recommendations are to be used in portfolio management decisions to improve delivery and maximise value for money within the programme.

4. Strategic Research Programme Deliverability

The deliverability assessment of the research projects within the Strategic Research Programme identified the following findings (data on projects can be found in Annex A).

Overall, most projects are delivering at an acceptable risk level, however some projects (12, 10%) have met the delivery risk trigger points and must be monitored to ensure risk does not grow to an unacceptable level.

Three projects met **Trigger 1** and have been identified as “not on track” to deliver key milestones in 2023-24 Quarter 2 reporting period:

- Out of the three projects, one has agreed milestone changes and is considered to be an acceptable delay to delivery.
- However, two have not formally signalled to SG that they are not on track through our regular reporting/change processes. This indicates a risk to deliverability due to lack of transparency.

Nine projects met **Trigger 2** and had two or more substantial changes during the first 18 months of the project:

- Changes to a project can be suggested for positive reasons such as to better align project scope and/or seek efficiencies. As such the triggers are only an indication of significant movement in a project and provide a warning for potential future impact to a project’s success.
- Out of the nine projects, only two are considered to hold a risk to delivery due to the types of changes indicating continued missed milestones.
- Where projects have made substantial changes to milestone delivery, all planned mitigation of potential impact risk has been accepted by the RESAS Topic Lead.

One project falls into **both Trigger 1 & 2** and has been identified as ‘not on track’ in 2023-24 Quarter 2 reporting period and had two substantial changes in the first 18 months of the project:

- This project has two milestone delivery delays which have been approved due to staffing problems. However, this project has not formally signalled to SG it is not on track through our regular reporting processes. This indicates a risk to deliverability due to lack of transparency.

Deliver Risk	Risk RAG	Nr of projects
Delivery Trigger Met	High	2
	Medium	3
	Low	7
No Risk Tigger Identified		104

The project risks can be summarised in the table above. Projects which meet a delivery risk trigger point should be considered an ongoing delivery risk. RESAS Topic Lead and RESAS PMO should undertake further consultation to evaluate project delivery against original research questions, and proposed timescales to ensure the project is still able to meet sought after requirements.

5. Theme A: Plant and Animal Health

The Plant and Animal Health theme covers the topics plant disease, animal disease and animal welfare with a combined total of 18 projects. The grant offer for Theme A projects in 2023-24 was circa £5m.

Impact resulting from previous research programmes continue to arise and be reported through current projects. For example, continuation of research on commercialisation of a vaccine for chlamydial abortion (ovine enzootic abortion) in sheep is currently underway. This important research contributes to improve animal health and welfare and the sustainability of livestock production in Scotland. Both safeguarding public health and sustainably improving livestock production to meet global food security challenges. Research funded through the previous two SRPs demonstrated proof-of-principle and then determined how production could be simplified, making it more commercially viable. Moredun scientists are now working with a commercial company on a vaccine licensing agreement and commercialisation.

5.1 Science Excellence and Reach

The SAB commented that while the projects within Theme A are at an early stage in the cycle of the programme they demonstrated a number of good examples of working at the national levels to advocate internationally competitive research and innovation.

SAB noted there was evidence that research within the theme was internationally competitive, based on outputs such as publications in high prestigious journals delivering real solutions to agriculture. SAB noted however this needs to be quantified. SAB suggested the Themes quantify the outputs in comparison to three competitor international research performing organisations of their choosing.

SAB commented there is no evidence of duplication of past research for A1 (Plant Disease), A2 (Animal Disease), or A3 (Animal Welfare). It was noted the research often builds on research from previous programmes. SAB commented while there may be duplication of technology/methodology from the past research the objectives of current research is clear and focused.

A SAB member noted the work on Integrated Pest Management (IPM) in the context of reducing the use of pesticides (important in the context of Scotland's Biodiversity Strategy) seems particularly relevant and the focus on late potato blight is unlikely to duplicate research elsewhere.

SAB noted it was important to ensure the Greenhouse Gas (GHG) emissions reductions due to improved animal health can be reliably quantified to ensure these can be recognised in the national inventory calculations.

SAB members commented on several gaps, which should be considered including:

- A1 (Plant Disease): The need for ongoing Research and Development (R&D) on IPM has been identified. This would be typically longer-term, strategic work, to address issues regarding loss of effective chemistries due to resistance or legislation. For this, both fundamental (e.g. BBSRC) and applied (e.g. Innovate

UK/Industry) funding sources can be leveraged. Scope to link more closely with Plant Health Centre has been identified. Issues around new disease pressures arising from the use of peat replacements may be an R&D gap.

- A2 (Animal Disease): The need to align research on sheep scab with pilot intervention study has been identified as an immediate gap/opportunity. Further proposals for pilot studies are in preparation (Johne's disease). Fundamental work on Vector Borne Diseases. Scope to link more closely with Centre for Animal Disease (EPIC) and social sciences research (e.g. A3) has been identified.
- A3 (Animal Welfare): Scope to link research/pilot studies on sheep scab (A2) with welfare R&D has been identified. Opportunities for R&D relating to welfare of livestock during transport.
- SAB observed there was a common need for diagnostics and better predictive modelling across Theme A.

5.2 Research Impact

SAB reported Theme A is making clear progress towards impact in many areas. In the case studies presented there was good interactions with either farmers, the food industry or policymakers as appropriate. It was noted that in some cases researchers were able to provide a monetary value of their research findings.

The following was noted on impact by Topic:

- A1 (Plant Disease): Good evidence has been provided to show that outputs are being used to make progress towards impact, including support for a range of industry stakeholders. The work aligns well with overarching Net Zero and Biodiversity policy drivers, to include adapting to the effects of climate change which will include complex changes in pest and disease pressures across different landscapes and sectors. The development of effective IPM strategies across a range of Scottish crop production systems (barley, potato, soft fruit, and other horticultural crops) is critical to address the potential loss of effectiveness of available chemistries, alongside the need to reduce inputs/costs, legislation, etc.
- A2 (Animal Disease): Good evidence of progress towards impact, based on translational funding already secured.
- A3 (Animal Welfare): Clear progress to impact is presented, e.g. links from R&D in the area of Precision Livestock Farming (PLF) to support policies/legislation relating to animal welfare. It would be useful to hear more how planned R&D relates to policies relating to animal transport/export and wider sustainable farming initiatives. Excellent evidence of wider stakeholder engagement activities.

SAB agreed Theme A had demonstrated good examples of research outputs which are delivering and projects were presented that are highly relevant to address the triple challenges of food production, climate and nature however the significance would need to be quantified.

5.3 Scottish Government Policy Priorities

The following highlights the policy priority categorisation and observations noted for research projects within Theme A. Other stakeholder priorities, such as industry, have not been reflected in the categorisation below but are considered key to a projects overall impact/importance.

Critical

5 projects, 2023-24 spend circa £2m

All research projects on the topic of plant health have been classified as critical to policy officials. These projects look at understanding pest and disease incidence and developing improved disease management in practice. This research will help inform the UK National Action Plan on responsible use of pesticides and provide information and evidence needed for farmers to increase uptake of integrated pest management practices.

Research which has associated innovation and impacts beyond the current programme has been identified as Critical, including the development and use of advanced in vitro culture systems to interrogate host-pathogen interactions in livestock species. The importance of the future outputs of this research to animal health and welfare, the sustainability of livestock production in Scotland (including reducing associated GHG emissions), and safeguarding public health are seen as critical to policy officials.

Research providing evidence to inform development and implementation of Scottish legislation to align with EU Animal Health Regulations, in particular the development of legislation for Identification, Registration and Movement (IRM) of camelids and cervids.

Important

12 projects, 2023-24 spend circa £2m

Research identified as important to policy officials includes projects which will provide evidence to; control and prevent of economically-important diseases of livestock, vaccines for diseases in sheep and cattle, improve welfare, promote animal husbandry in sustainable farming systems, the antimicrobial use in livestock and resistance, biosecurity practices and sheep and cattle traceability.

The above research areas importantly feed into key policy delivery such as Agriculture and Rural Communities (Scotland) Bill, Agricultural Reform Programme (ARP), Scottish Government strategies on antimicrobial resistance (AMR) and other individual policies development. Vaccination research enhances animal welfare both safeguarding public health and sustainably improving livestock production to meet global food security challenges.

Desirable

6 projects, 2023-24 spend circa £1m

Research in Theme A has been classified as desirable by policy officials when outputs cannot be directly linked to animal or plant health policy needs. For example, some research focuses on human health concern and could be funded elsewhere on grounds of public health.

A research project has been classified as desirable where key research questions are being answered by other funders, although often the individual projects can provide an additional insight.

5.4 Theme A Conclusion

Overall Theme A has demonstrated the research is delivering relevant outputs to address the triple challenges of food production, climate and nature.

In Plant and Animal Health research there is a need to understand and adapt to the pressures of climate change, including altered pest and disease pressures. There is also a need to reduce inputs to preserve biodiversity. The following recommendations have been noted for Theme A:

- SAB Recommendation: Theme A looks to embed more social sciences Research and Development (R&D) and stakeholder elicitation activities.
- SAB Recommendation: It is recommended that research gaps in Theme A identified by SAB, and discussed above, are reviewed by RESAS and options to address gaps are investigated.

6. Theme B: Sustainable Food System and Supply

The Sustainable Food System and Supply theme covers the topics Crop Improvement, Livestock Improvement, Improving Agricultural Practice, Food Supply and Security, Food and Drink Improvements, Diet and Food Safety and Human Nutrition with a combined total of 51 projects. The grant offer for Theme B projects in 23-24 was circa £10m.

Impact resulting from the previous research programme (and indeed older programmes) continues to arise and be reported through current projects. For example, SRP research on hemp demonstrated that this valuable environmental crop can contribute to meeting climate and biodiversity targets, deliver high-quality alternative protein and fibre sources to diversify the diet, and have potential health benefits. These findings have been widely disseminated.

6.1 Science Excellence and Reach

Across the theme SAB noted there was evidence of an impressive record of academic publications and significant effort on stakeholder engagement including science informing policy. There was evidence of unique and innovative efforts and findings (e.g. on hemp as a new crop) and strong collaboration and ability to leverage additional funding but SAB noted it was not easy to ascertain international competitiveness. SAB commented that the research in Theme B is also providing helpful insights on effective approaches for stakeholder engagement (together across a supply chain rather than separately).

SAB commented there was little information provided to show what level of effort is being put into investigating the impacts on biodiversity and the vulnerability/resilience to climate change of the solutions and approaches being investigated. There is a missed opportunity to link the research more explicitly to these key driving factors and to other themes.

It was not clear with regards to the strategies for sustainability / impact driven strategies. For instance, the outcomes of using genetic selection index and how that addresses the research gaps could have been highlighted.

6.2 Research Impact

SAB reported Theme B provided extensive evidence of interactions with stakeholders and high impact academic publications and flagged other impact related forms of publicising the results, with more on the way.

SAB reported the policy environment for this theme is moving very rapidly, with the new agricultural reform programme, ambitious emissions targets but also growing evidence of climate change impacts, a greater emphasis on food security and insecurity policies and the Good Food Nation. Theme B has great potential to contribute to these policy initiatives but there was evidence of some nervousness in the topic report cards that there could be missed opportunities. SAB reported that while some linkages were made, the impact of these policy changes on the research funded under this theme did not come across as strongly in the presentation as might have been expected.

SAB highlighted several positive examples of outputs such as production of hemp which demonstrated the research was moving novel plant production towards impact. It was also noted that policy briefs on biosecurity are important outputs, and this can deliver impact for Scottish agriculture.

SAB commented that in terms of sustainability, it wasn't clear about the next steps for some of the projects which were completed (such as the study on Scottish seaweeds). i.e., how the evidence generated from these projects will be used for initiating future projects?

SAB commented that some examples of research outputs with significance and reach were given but noted programme is in its infancy and so more time is needed to see if the outputs will have significance and reach but the early signs are positive.

SAB suggested making more effort to integrate/connect explicitly across the themes in other ways would help to increase both reach and impact, as would making more explicit connections between the work and biodiversity loss and climate change. It would be good to see the impacts of, and dependencies on these processes expressed more explicitly. In particular, the work has significant implications for adaptation/climate resilience in the food system and wider society and these are not yet being expressed explicitly; any mention of climate change was in relation to mitigation/emissions reduction.

6.3 Scottish Government Policy Priorities

The following highlights the policy priority categorisation and observations noted for research projects within Theme B. Other stakeholder priorities, such as industry, have not been reflected in the categorisation below but are considered key to a projects overall impact/importance.

Critical

9 projects, 2023-24 spend circa £2m

Research which has been identified as critical to policy officials mainly centres around evidence to support the reduction in carbon emissions in the agriculture sector. For example, research into breeding and management strategies for lower methane sheep in Scotland. Research looking at how we can influence and promote best practice uptake across the agricultural sector has been identified as critical to feeding into the Agricultural Reform Programme (ARP)

Policy critical research also includes tools to help understand the future security and resilience of Scotland's supply chain. This research supports the Good Food Nation policy. Research looking at opportunities for Scotland's food industry has been assessed as critical to supporting the strategy for Scotland food and drink industry; SUSTAINING SCOTLAND. SUPPLYING THE WORLD. Research into mycotoxin contamination has been identified as critical to Food Standards Scotland (FSS). It is also critical we investigate the role of Scottish livestock and their environments in transmission of foodborne pathogens to provide evidence needed by FSS in policy development.

Important

23 projects, 2023-24 spend circa £5m

Research identified as important to policy officials includes projects that will provide evidence including; alternative parasite and pest control, development of low carbon vertical farming, sustainable crop production, livestock productivity, Scottish supply chain resilience, antimicrobial resistance (AMR) in the food chain and sustainable dietary behaviours.

Evidence in these areas importantly feeds into key policy delivery such as Good Food Nation agenda, ARP, FSS Strategy, National Action Plan on AMR, Local Food for Everyone Plan and other individual policies development.

Desirable

19 projects, 2023-24 spend circa £4m

There are various reasons a research project has been classified as desirable. Including projects where the industry is already moving at pace and the research may have limited ability to change practices/approaches. Similarly, where key research questions are being answered by others across the sector the SRP research project has been classified as desirable, although often the project can provide an additional insight.

Some projects identified as desirable are considered to be proof of concept projects, or projects where upscaling application levels are not certain. These are considered lower in priority to policy official decision making right now, but are still desirable projects for enhancing our understanding in the future.

Often projects which are not generating new data have been seen as desirable to policy colleagues, this is due to the fact they could be completed at a later timescale. This type of work can often provide a valuable new outlook on evidence.

6.4 Theme B Conclusion

Overall the research in Theme B is considered valuable and impactful to Scotland by encompassing research to address the global climate and nature crises, sustainable food systems, economic growth and the impact of EU exit. Some specific recommendations are noted below:

1. SAB Recommendation: Project specific focus on how research will eventually lead into future farming practice/ improving agricultural practice seems to be missing. Research in Theme B should seek out demonstration sites where research outputs can be rolled out/demonstrated to visiting farmers. This may look like satellite (replicator) commercial farms willing to take on the outputs from the research programme should be linked to the demonstration farms.
2. SAB Recommendation: SAB see the greatest risk of Theme B research being around the agricultural reform programme, as the direction of travel for climate research and food safety seems more settled. There is a strong responsibility on the policy leads to alert the researchers to issues where science is needed to

provide new evidence – given the short time scales, this may often need to take the form of small scale studies and literature reviews rather than primary data collection and research.

3. RESAS Recommendation: There are three projects on antimicrobial resistance (AMR) within Theme B that have been identified as having potential cross over. This should be further investigated to ensure value for money and minimise inefficiencies.

7. Theme C: Human impacts on the Environment

The Human Impacts on the Environment theme covers the topics agricultural GHGs, land use, circular economy and use of outdoor and green space with a combined total of 11 projects. The grant offer for Theme C projects in 23-24 was circa £3m.

In the previous programme we seen research into improving measures to reduce greenhouse gas emissions such as breeding management. The research is a combination of environmental economic modelling, survey work and monitoring and evaluation tools and approaches. It provided improved understanding and estimates of agricultural greenhouse gas mitigation at national and farm level and developed tools for policy makers, farmers and researchers. Data on the future mitigation potential of GHG emissions potential from agriculture was provided to the economy-wide TIMES model (run by the Scottish Government). Evidence has also been provided on the capacity for the UK GHG inventory to reflect the mitigation activities in Scotland.

7.1 Science Excellence and Reach

SAB members agreed the evidence presented showed the methods used are internationally competitive, innovative and in line with best practice internationally. Research is comprehensive and demonstrates that Theme C is addressing key challenges for Scotland.

The research topics are of both international and national importance. Within C4 (circular economy) research that examined opportunities to reduce both consumption and waste flows was highlighted as an example where the science was internationally competitive.

SAB noted the Theme has a broad scope of work with demonstrated progress, for example: creation of a database of mitigation measures, geospatial datasets, GHG measurement and associated App development, foundation of a spin-off company, wide stakeholder engagement at sub-theme level, quantitative storytelling, land use policy modelling, a wide number of case studies, and designing a typology of behaviours (with reference to circular economy). SAB noted much of the research has resulted in improvements in the knowledge base on these key issues in Scotland.

SAB members all agreed the Quantitative Story Telling (QST) approach in Theme C is novel and innovative and could link well with the other Themes:

- Quantitative story telling is a process designed to help scientists work with stakeholders to prompt reflection on, and potentially reframing of, sustainability problems and to develop shared understanding of the issues even when stakeholder values and trade-offs mean that a consensus outcome cannot be delivered. QST is a cyclical, iterative process that balances both work with stakeholders to understand how issues are framed (what is included and excluded) and how evidence is interpreted and 'formal' phases – work to quantify these issues. QST typically incorporates data and expertise arising from different disciplinary perspectives (e.g., social, and natural sciences) as well as from stakeholders themselves.

- Analysis of Enhanced Conditionality (EC) measures led by the Land Use Transformations project (JHI-C3-1), used a Quantitative Story Telling approach as well as consultation with researchers in Theme D to consider the effectiveness of EC measures, their likely uptake, and the crucial factors from other farm support Tiers. Outputs were used to highlight where decisions would have meaningful impact on policy outcomes and sign posting to the researchers and evidence on which those decision could draw.
- From 2025 at least 50% of existing direct farm support payments (~£536M) will be made conditional on undertaking agri-environmental and climate related land management options - Enhanced Conditionality (EC). EC intends to deliver a step-change in how agricultural systems deliver to net zero, climate adaptation, biodiversity and other environmental objectives.

SAB identified additional opportunities using the Analysis of Enhanced Conditionality Measures study method. SAB suggested that this approach can cut across other themes in land management from mitigation to resilience, and SAB encouraged exploration of these areas.

A further area identified as unique and innovative was (C4) the use of circular economy concepts in remote and rural/island areas. SAB reported that the feed-through from some of the circular economy work to large-scale agent-based modelling, was novel. SAB also noted (i) the novel application to the bovine sector to reduce GHG emissions by reducing parasitic infections and (ii) methods used in developing land use strategies for Scotland in C3.

SAB members reported there are similar research questions being addressed in the UK and internationally but agreed this was not duplication as it was a Scotland specific focused programme. It was also noted some topics build on previous research which was very appropriate.

SAB also identified a need to ensure that carbon/GHG-focused work identifies trade-offs with other objectives, such as biodiversity, pollution, food production, and just transition.

Research gaps identified by SAB included:

- The circular economy research was mainly concentrated on waste. Members further noted that there was perhaps an overfocus on carbon and suggested additional activity on reactive nitrogen.
- Gaps in how science links through to policy and cross-cutting priorities e.g. supporting Net Zero planning and scope three emissions reporting, or supporting carbon sequestration in soils/forest through improved land management practices.
- The need for deep demonstrators, which integrate policy, practice and research, bringing these together with individuals in case studies to develop the integration needed to push research into practice; these should include citizen science and communities.

7.2 Research Impact

SAB reported evidence has been provided which demonstrates the research topics deliver important support to key Scottish government objectives.

There is good evidence of significance and reach. The Land Use topic (C3) has made significant investment in developing techniques – quantitative storytelling – to interact with policymakers. Agriculture, Climate and Carbon Topic (C2) can make an important contribution to improving Scotland's national GHG inventory. Circular Economy (C4) will provide an important knowledge base to design a more effective waste strategy for Scotland as part of developing a more circular economy. The outputs have also generated a spin off company that could deliver scalable impact for farmers.

SAB noted coordination among farmers at catchment scale was highlighted as a challenge which needs to be resolved to ensure impact. Members also suggested it will also be important to follow uptake of the AgreCalc and CarbonExtra apps and to see what actual use is made of them. SAB noted that farm apps are a crowded market, and there are risks for the institutes to manage in engaging with carbon markets.

7.3 Scottish Government Policy Priorities

The following highlights the policy priority categorisation and observations noted for research projects within Theme C. Other stakeholder priorities, such as industry, have not been reflected in the categorisation below but are considered key to a projects overall impact/importance.

Critical

7 projects, 2023-24 spend circa £2.4m

Research which has been identified as critical to policy officials includes a project which will provide evidence into the role in sequestering carbon and mitigating GHGs to meet net zero targets across agriculture sector. Research which will provide new approaches for reducing greenhouse gas emissions from agriculture and land use in Scotland is also seen as critical. These projects are critical to the Climate Change Plan and Agricultural Reform.

Research that was identified as critical to policy teams also includes projects which provide evidence to the Circular Economy Bill. Specifically research into important system thinking approach through casual loop diagram and research into behavioural drivers and receptions around circular economy.

Research classified as Critical in Theme C includes modelling on the future make-up of agriculture in Scotland and how it adapts to climate change. This type of research will inform GHG inventory to ensure that Scotland's GHG emissions are captured accurately and that improvements in herd performance can be counted against Scotland's net zero targets. It is critical for developing the evidence base for the Climate Change Plan and the Agricultural Reform Programme.

Important

4 projects, 2023-24 spend circa £1m

Research identified as important to policy officials includes projects which will provide evidence insights including; land-based financial support mechanisms, landownership diversification, GHG and behavioural impact in land use change and reciprocal nature engagement.

Evidence in these areas importantly feeds into key policy delivery such as Land Use Transformation, Climate Change Adaptation Plan, Agricultural Reform Programme and other individual policies development.

Desirable

0 projects

Theme C contains a diverse range of projects with policy interests across the environment directorate. As such there are less differentiation across the three priority categories and no projects have been classified as desirable.

7.4 Theme C Conclusion

Overall Theme C has demonstrated that the research is delivering highly relevant outputs to meet key policy needs. Some specific recommendations/actions are noted below:

- SAB Recommendation: Link up research on reactive nitrogen aspects across themes C/D and beyond. For example the GHG emissions response to land use change and pollutant swapping, or CH₄ emission effects from slurry storage temperature (where there may be co-benefits for NH₃ release).
- SAB Recommendation: Explore the Quantitative Story Telling approach used in the Analysis of Enhanced Conditionality study method across other themes in land management from mitigation to resilience.
- SAB Recommendation: Close a research gap by bringing together carbon mitigation, resilience questions (e.g. water management, flooding, pollution) and biodiversity enhancement on farms.
- SAB Recommendation: Provide reassurance that Scotland has the appropriate level frameworks in place to allow both transfer and reuse of data for research and policy where appropriate while protecting privacy and farmer ownership of their data. Noting that if trust is lost in how data is stored or used, it will be very difficult to restore.

8. Theme D: Natural Resources

The Natural Resources theme covers the topics air quality, water, soils, biodiversity and natural capital and has a combined total of 22 projects. The grant offer for Theme D projects in 2023-24 was circa £7m.

In the previous programmes we seen research demonstrate how ecosystem functions are regulated by the traits of species present, and how potential limits for the maintenance of ecosystem function can be captured in ecosystem health metrics. Dissemination of research outputs resulted in supported uptake of intercropping by a growing number of farmers and shown how research can be translated into practical use in the Scottish farming community.

8.1 Science Excellence and Reach

SAB reported that the five topics in this theme provide an essential underpinning to Scottish knowledge and policy for air, water, soils, biodiversity and natural capital.

SAB noted the evidence presented demonstrated the research is internationally competitive and innovative. Innovation was most clearly shown for projects D3 (Soils) and D4 (Biodiversity), where detailed evidence relating to outputs, stakeholder engagement and follow-on competitive funding was presented. Innovation evidence was less clearly presented for projects in D1 (Air Quality) and D2 (Water), although members commented in discussion that D1 (Air Quality) was a new topic area and at an early stage. Members noted that the topic was focused on the Cleaner Air for Scotland Strategy. SAB confirmed that the topic areas being addressed within D1 (Air Quality) were the right questions for now, and replicate priorities elsewhere in the UK. SAB noted the local context differs and so it is appropriate this research is RESAS focused.

SAB members agreed there was little evidence of duplication. It was noted that D1- D4 are providing unique Scottish insights into the topic areas where there is a need for nationally-focussed understanding and policy advice.

Members noted that for D5 there may be a consideration of the role of local capability in future climate projects/downscaling vs activity elsewhere (e.g. UK Met Office), and if the optimum positioning is research, or a shift to Scotland-relevant translation to impact/policy. SAB noted that other models may predict different mean temperature/rainfalls and the need to consider variability across the ensemble.

SAB members reported some key research gaps:

- Need greater join up between research related to drought and to flooding – members commented that we are moving to a more variable climate with drier summers on average but punctuated by very heavy localised rainfall causing floods. We can also expect increased high pressure blocking and this will cause increased water scarcity (drought) but then increased high rainfall periods following blocks (like storm Babet). Storms in general may become more slow moving and contain more rainfall and more intense rainfall.

- Future research priorities in the air quality area are likely to include ultrafine particles and (if in scope) indoor air.
- Natural Capital (NC) is a new developing area, with private finance investing into carbon and biodiversity. SAB recommended more research on the value of NC investment for policy targets (Peatland Code, Woodland Code). Members further noted that considering natural capital results from sector-specific perspectives including dependencies and risks (e.g. transport, energy, infrastructure) could also be a priority.
- Discussion identified that there was scope to link the research more explicitly to health outcomes – e.g. from air and water quality, and future climate, but also including links to soils and biodiversity, and across themes, taking a OneHealth approach (including links to animal health). Member suggested stakeholders such as Public Health Scotland would usefully benefit from and value this work.

8.2 Research Impact

Members reported topics within Theme D appeared to be well integrated into their respective policy areas. Scotland's soil information is considered top class and is a very valuable resource. However, links for the air quality work seemed to be limited to the CAFS2 process and could be broader.

Clear evidence had been provided of outputs having significance and reach; further confidence given by the follow-on funding (especially for projects D3-D4).

SAB suggested clear examples included the biodiversity topic (D4) had contributed to major reports on Scotland's State of Nature and to Scotland's revised biodiversity strategy. However, SAB noted the Natural Capital topic D5 had no clear policy 'target' but could feed into thinking in SEPA on water and pollution, and extending the reach of natural capital work.

The soils topic (D3) was noted to feed into improved national inventory estimates. The water scarcity modelling case study was a very impressive example of how research not only feeds into but explicitly informs policy choices.

The potential for differences in climate model outputs / scenarios could lead to misunderstandings in the expected changes – national projections vs those available elsewhere in the community (e.g. UK Met Office/UK Climate Projections).

8.3 Scottish Government Policy Priorities

The following highlights the policy priority categorisation and observations noted for research projects within Theme D. Other stakeholder priorities, such as industry, have not been reflected in the categorisation below but are considered key to a projects overall impact/importance.

Critical

10 projects 2023-24 spend circa £4m

Research which has been identified as critical to policy officials includes modelling water scarcity and how it could impact vulnerable land. This critical evidence will inform the development of Scotland's National Water Scarcity Plan. Also seen as critical is research into Nature Based Solutions to address water challenges, this evidence will support the development of the Flood Resilience Strategy.

Outputs feeding into live policy decisions such as peatland restoration and the Climate Change Plan have been classified as critical. This includes research into soil emission factor and Peatland Monitoring Framework.

Biodiversity research looking at novel ways of measuring and monitoring biodiversity is seen as critical to updating the Scottish Biodiversity Inventory, farm biodiversity audits for the ARP and State of Nature Reporting.

Most of the research into Natural Capital is seen as critical. The impacts of climate change will be felt across Scotland's Natural Capital Assets. Outputs of research will show where in Scotland risks may arise, how the various tools can better inform decision making and synthesise emerging knowledge on natural capital.

Important

9 projects 2023-24 spend circa £3m

Research identified as important to policy officials includes projects that will provide evidence insights including; nitrogen deposition on biodiversity, soil health, marine and terrestrial protected areas, Natural Capital Valuation and protozoan parasites in drinking water.

Evidence in these areas importantly feeds into key policy delivery such as Cleaner Air for Scotland plan, 30x30, Land Use Transformation, Climate Change Adaptation Plan and other individual policies development.

Desirable

3 projects 2023-24 spend circa £0.2m

Research in Theme D has been classified as desirable by policy officials when outputs are seen to provide limited evidence to Scotland in its entirety. For example, when research is only focused on specific to local community and has limited scalability. Research is seen as desirable when policy do not see the benefit of the evidence, for example relevance of research into private water supply in doubt.

8.4 Theme D Conclusion

Overall, research in Theme D provides an essential underpinning to Scottish knowledge and policy for air, water, soils, biodiversity and natural capital. Some specific recommendations/actions are noted below:

- SAB Recommendation: Greater focus on climate change adaptation should be considered within the research undertaken in Theme D.

- SAB Recommendation: The balance of research effort should shift from carbon towards reactive nitrogen, given the associated biogeochemical threats to ecosystem services in Scotland.
- SAB Recommendation: Awareness-raising was particularly recommended for the Soils (D3) topic area, which is undervalued out with Scotland. Potentially linking research more explicitly to human health outcomes e.g. from air and water quality, and future climate, but also including links to soils and biodiversity, and across themes, by incorporating a One Health approach (including links to animal health).
- SAB Recommendation: Biodiversity researchers should seek to ensure that they capture the next step in research (beyond identifying and quantifying) i.e. to the policy relevance and advice, beyond categorising.
- SAB Recommendation: To enhance join up of water scarcity and drought, researchers should explore the opportunity to link up much more with work at UK Met Office, UK Centre for Ecology and Hydrology (UKCEH) and SEPA.
- SAB Recommendation: Natural capital work could link to private sector opportunities (D5). Members further noted that there was scope for a clearer strategy/change in approach to engage with these groups (at pace).
- SAB Recommendation: More focus on the variability in climate forecasts across models should be considered to reduce the potential for differences in climate model outputs / scenarios which could lead to misunderstandings in the expected changes.

9. Theme E: Rural Futures

The Rural Futures theme covers topics rural economy, rural communities and land reform and has a combined total of 6 projects. The grant offer for Theme E projects in 2023-24 was circa £1.5m.

Impact resulting from the previous research programme (and indeed older programmes) continues to arise and be reported through current projects. Previous research has improved understanding of rural industry resilience in Scotland. For example, research insights on business resilience during the Covid pandemic helped inform officials of ongoing issues in industry and analytic capabilities helped deliver rapid assessments for officials.

9.1 Science Excellence and Reach

SAB members reported that the research appears to be internationally relevant and competitive. The focus on rural Living Labs is rare, important, and innovative. No obvious research gaps were identified for Theme E.

Theme E, Rural Futures sits closest to policy and the scientific method is largely data-driven and inductive, drawing lessons from spatial comparisons. This gives rise to a wide set of policy-relevant outputs which are clearly highly valued but raised the question how relevant and competitive this research is in an international context. SAB was reassured however during discussion that the researchers are aware of the need to advance theories and methodologies with respect to spatial and rural economies. The work on identifying local capital in the framework of natural and social capitals as an example of the theory development, and the implementation of living labs as a methodological development. Members reported that the teams involved seem well integrated into both similar UK research and several Horizon EU programmes.

SAB agreed Theme E research does not duplicate past research and the projects in this theme seem to be quite different from those in previous SRPs. Members commented Theme E seems to be very responsive to changing policy demands and requirements, for example, the depth of the cost of living crisis in the past two years could hardly have been foreseen when the research programme was designed and yet the team has contributed valuable insights on this topic for rural communities.

Members commented that a focus on rural and remote areas is unusual and innovative, most research focuses on densely populated urban areas. Noting that agent based modelling is being used to understand behaviour change etc. Living Labs appear to be a unique enterprise and demonstrator of this.

9.2 Research Impact

SAB members agreed the evidence presented demonstrated Theme E has high research impact and there was clear policy relevance for the outputs being delivered. Positive examples noted by members included involvement in the rural island and child poverty study and research to support the Agriculture Reform Bill. Members commented that more so than other themes, the outputs take the form of policy briefs and reports that

are accessible and seem to be well appreciated not only by policy customers but also wider stakeholders.

SAB agreed the significance and reach of Theme E outputs are high. The Theme has developed reach by establishing input and partners across the EU in large Horizon 2020 projects. These examine how policy can learn from better data and how policymakers and communities can use data better.

There is opportunity to have greater impact and reach by building on and diversifying the Living Lab approach into more areas. A member also noted that given the main objective of Theme E is to improve the wellbeing of rural communities, it is important to focus on the diet and lifestyle under rural contexts. In fact, this aim could be implemented through collaborations with theme B, which is on sustainable food systems.

9.3 Scottish Government Policy Priorities

The following highlights the policy priority categorisation and observations noted for research projects within Theme E. Other stakeholder priorities, such as industry, have not been reflected in the categorisation below but are considered key to a projects overall impact/importance.

Critical

2 projects 2023-24 spend circa £0.4m

Research which has been identified as critical to policy officials, centres around providing evidence to support the development of the Rural Delivery Plan, the Just Transition Plan and various Land Use Change policies.

This research includes understanding how future changes to agricultural support may impact on rural and island regions of Scotland, as well as research into the impacts of land-based financial support mechanisms on land values, landownership diversification and land use outcomes.

Important

4 projects 2023-24 spend circa £1m

Research identified as important to policy officials includes projects which will provide insights including; economic scenarios overlapping with community and place based assets, change in remote rural and island communities, social theory on community empowerment and new/re-designed policy interventions to ensure sustainable, inclusive and just futures for rural and island communities.

Evidence in these areas importantly feeds into key policy delivery such as the Rural Delivery Plan, The National Islands Plan, National Strategy for Economic Transformation, Just Transition, Remote Rural and Island Housing Action Plan and Addressing Depopulation Action Plan.

Desirable

0 projects

Theme E has not classified any projects as desirable.

9.4 Theme E Conclusion

Overall Theme E has demonstrated the research is delivering highly impactful and relevant outputs to Scottish policy and rural communities.

10. Theme F: Cross-cutting modelling activities

Theme F covers large scale modelling projects, which is a total of 3 projects. The grant offer for Theme F projects in 2023-24 was circa £0.8m.

10.1 Science Excellence and Reach

SAB reported evidence provided demonstrated the research is internationally competitive.

SAB members commented that material presented in the presentation and report card demonstrated the work in Theme F represents substantial novel R&D, including method developments and applications. SAB noted the research was more incremental than innovative. The work could be more strongly framed with an emphasis on innovation through collaboration.

SAB members reported convincing evidence was provided that the project outputs are being connected across SRP Themes and Centres of Expertise. However it would have been helpful if other Themes could articulate links to the Theme F research.

The potential for AI approaches across the RESAS portfolio was surprisingly limited, as was the potential to contribute to qualitative/mixed-methods approaches e.g. to elicit stakeholder perceptions/ narratives.

10.2 Research Impact

SAB agreed good examples of evidence had been provided which demonstrate the research is delivering impact.

Examples such as in Biodiversity & ecosystem tools (BET) project, new tools developed to enhance monitoring and management of biodiversity and ecosystems, e.g. population genetic modelling addressing local adaptation versus assisted migration challenge for forestry management under climate change is informing work under NERC's Future of UK treescapes programme (e.g., risk of great spruce bark beetle spread).

In Sustainable agriculture tools (SAT), method development for real time monitoring of livestock using monitoring and validation data from challenge studies produced under the Precision Livestock Tools to improve sheep welfare project (MRI-A3-1).

In Large-scale and systems modelling (LSM), new tools to support decision makers by providing projections and enabling exploration of policy options through scenario analysis e.g. uncertainty quantification tools applied in Emerging Water Futures project (JHI D2-1), to improve modelling for flood and drought forecasting for SEPA and Scottish Water.

SAB members commented that evidence had been provided of outputs having significance and reach, although suggested more could be made of opportunities to enhance capacity for delivering ex ante and/or ex post evaluations of the value of outputs through to outcomes/impact.

It was recognised that more interactions will be needed with social scientists, practitioners and other stakeholders in the future. Strong communication is needed on the value of Theme F, including from the other Themes/ Centres if the cross-cutting role is to be understood.

10.3 Scottish Government Priorities

The following highlights the policy priority categorisation and observations noted for research projects within Theme F. Other stakeholder priorities, such as industry, have not been reflected in the categorisation below but are considered key to a projects overall impact/importance.

Critical

1 project Total project cost £0.2m

This project has been classified as Critical as large-scale and systems modelling will provide a powerful set of tools to enhance understanding of complex systems and support decision makers by providing projections and enabling exploration of policy options through scenario analysis and better quantification of uncertainties.

Important

2 projects Total project costs £0.5m

The underpinning modelling projects have been classified as important including projects which are essential for predicting the impacts of climate change, by developing broad use statistical and mathematical tools for modelling natural populations and community dynamics and biodiversity and environmental systems.

Also includes research into bioinformatics, modelling and statistical methods to support the transformation of agriculture data streams into information that can drive forward sustainable agriculture.

These modelling projects inform a number of projects across the SRP and are often seen as important to achieving the value and impact of the projects they underpin.

Desirable

0 projects

No projects have been classified as Desirable in Theme F.

10.4 Theme F Conclusion

Overall Theme F demonstrates value and impact. Through discussions and investigation SAB was able to understand the importance of the underpinning modelling projects being

delivered by Bioss. However, interdependencies and values were not clear at central level. It is recommended:

- SAB & RESAS Recommendation: More effort is made to map the interdependencies of the modelling work with other projects across the SRP. Currently it is not clear how the modelling work is linked to the expected impact of allied projects.
- SAB Recommendation: Need to be more explicit about some of the collaborative work, and to develop a forward look and on new priorities and opportunities (e.g. AI), to avoid appearance of this Theme functioning solely in a service provision mode.
- SAB Recommendation: The policy on open-source/open access vs commercialisation and data ownership needs clarifying – including criteria for such decisions.

11. Underpinning National Capacity

The Underpinning National Capacity programme provides funding for several key research capabilities including services, PhD studentships, post-doctoral appointments, outward-looking strategic links and alliances with universities and other research providers. It also funds a responsive support to policy capability, providing a network of scientists at the research institutions, available to respond to questions from RESAS analysts and SG officials.

The assessment of the services within the Underpinning National Capacity (UNC) programme identified the following findings. The grant offer for UNC in 2023-24 was £8.9m.

Underpinning National Capacity Elements and Key Observations

Support to Policy

Policy Context: Having access to specific expertise in the MRP is seen as critical to supporting policy officials. Feedback from users of the service this year, is that this is a priority service and should be secured or funding increased in portfolio management discussions.

Outcome of review: Although an identified underspend from 2022/23 would indicate that the Support to Policy Services is not delivering value for money. However, data gathered from the current delivery year (2023/24) would indicate that the MRPs are on track to spend the full budget and meet SG commitments.

This is thought to be due to improvement in visibility and management of the service. SG have also reduced alternative responsive funding routes and the Support to Policy service is picking up responsive needs from SG. Stakeholders have verbally indicated that this service is valuable to providing quick priority analysis. For example The JHI call down service was used to undertake a rapid evidence review on the implications of not treating bracken with the pesticide asulam. The review was used as part of a package of evidence to directly inform a Ministerial decision that was eventually taken by Cabinet on whether asulam should be licensed for use. The support to policy service was highly effective for producing such rapid and needed evidence.

This is a priority service and should be secured or funding increased in portfolio management discussions.

Seedcorn

Policy Context: Through the training of PhD students and others, Scottish Government makes a significant contribution to the maintenance and development of a skilled work force in support of Scotland's ambitions as set out in the National Performance Framework. It can also help to build the profile of Scotland as a science destination for early stage and mid-career scientists, expanding links with institutions both here in Scotland and further afield.

Scottish science also needs to be outward looking, building strategic links with key partners, making joint appointments, and to be far sighted – investing in ‘speculative’ science that may be required for future programmes of strategic research, or may lead to increased innovation from the research supported.

Outcome of review: Overall more work could be undertaken to better communicate value and impact to Scotland from this investment. Especially the funding used to explore new areas of science & develop new ideas including writing proposals, and seedcorn projects should be better mapped to leveraged funding. We may want to consider specifying an expected balance across the seedcorn activities delivered to maximise value for money.

Value for money of studentship can be presented qualitatively as developing the future of Scotland’s science base. We are aware from previous programme evaluation that the benefits of the additional skills gained through PhDs can be valued using figures identified by the National Foundation for Educational Research (Lynch et al,2015). This highlighted returns to the Exchequer from change in tax revenues associated with several vocational qualifications and identified a one-off benefit to the Exchequer of £56,000-£81,000 (£2015).

Overall Scottish Government is satisfied with the maintenance and development of key long-term data sets of national significance. It is clear how this service underpins research being delivered within the Strategic Research Programme, for example, the Langhill dairy herd database underpins several projects in Topic B2 Livestock Improvement.

A lot of these data sets are connected to ongoing statutory commitments or international agreements. For example, work in the Centre for Sustainable Cropping (CSC) is linked to the Scottish Government approach to alignment with EU laws including the Soil Monitoring Law, Nature Restoration Law and Farm to Fork strategy. The CSC shows how management interventions can be combined to meet the multiple goals of improving soil health, enhancing biodiversity, reducing losses and maintaining crop yields.

Services

Policy Context: Many statutory commitments and/or international agreements are met through the delivery of our services. For example, Maintenance of the Rubus (raspberry) and Ribes (blackcurrant) high health stock collections contributes to the UK’s responsibilities under the Convention on Biological Diversity and the International Treaty on Plant Genetic Resources for Food and Agriculture.

The services provided in UNC are:

1. Maintenance of potato germplasm collections
2. Maintenance of Rubus (raspberry) and Ribes (blackcurrant) high health stock collections
3. Maintenance and development of the barley collection
4. Provision of biomathematical & statistical services
5. Maintenance of pathogen and pest collections
6. Soils and related environmental data – collection, management, application, dissemination and governance
7. Maintenance of the National Soils Archive
8. Maintenance of a responsive and reactive capacity to develop diagnostic

tests

9. DNA technologies, skills and infrastructure
10. Underpinning Open Science and Open Data

Outcome of review: Overall Scottish Government is satisfied with the delivery of the vital services delivered within the Underpinning National Capacity programme.

Services (annual SG grant of £1.4m) have been able to leverage circa **£11m** funding for the Main Research Providers. However, many services do not fully record the leveraged funding, or are made freely available at no charge, therefore the total leveraged funding should be considered as an approximate but minimum sum. More effort should be made to better map services to leveraged funding.

Platform

Policy Context: The Scottish Government see platform funding as critical to promoting scientific and financial sustainability across the research landscape in Scotland by enabling a research institute, in the absence of access to other funding streams, to accept an offer to provide research activity from a funder at a Full Economic Cost (FEC)-minus price

Outcome of review: MRPs in receipt of this funding (annual SG grant of £4m) have ongoing research projects in 2023/24 worth circa £28m all receiving of platform support.

12. Next Steps

Evidence from the review should be used in portfolio management decisions to improve delivery and maximise value for money within the programme. To do this the theme level recommendations, as discussed in each chapter above, along with the programme wide recommendations should be taken forward by RESAS.

Annex A: SRP Project Review Outputs

See supporting document

Annex B: Programme Structure

The Strategy for ENRA Research 2022-2027³ was published in March 2021 and sets out the Scottish Government's priority scientific research themes and topics. It is suggested that board members read this document to gain a greater understanding of the portfolio.

The Scottish Government invests nearly £50 million in the ENRA portfolio a year. The programme has three overarching objectives.

- It provides the evidence and advice needed to deliver on the government's key priorities.
- It funds applied solutions to real world challenges with direct benefits to industry and wider society.
- It underpins central elements of Scotland's wider bio-tech sector.

The science delivered within the portfolio falls within the following themes:

- Theme A: Plant and Animal Health
 - A1 Plant disease
 - A2 Animal disease
 - A3 Animal welfare
- Theme B: Sustainable Food System and Supply
 - B1 Crop improvement
 - B2 Livestock improvement
 - B3 Agricultural practice
 - B4 Food supply and security
 - B5 Food and drink improvement
 - B6 Diet and food safety
- Theme C: Human Impacts on the Environment
 - C1 Climate change
 - C2 Agricultural GHGs
 - C3 Land use
 - C4 Circular economy and waste
 - C5 Large scale models
 - C6 Use of outdoors and greenspace
- Theme D: Natural Resources
 - D1 Air quality
 - D2 Water
 - D3 Soils
 - D4 Biodiversity
 - D5 Natural Capital
- Theme E: Rural Futures
 - E1 Rural economy
 - E2 Rural communities
 - E3 Land reform
- Theme F: Cross-cutting modelling activities
 - F1 Knowledge exchange
 - F2 Horizon scanning

³ [Strategy for Environment, Natural Resources and Agriculture Research 2022-2027 \(www.gov.scot\)](https://www.gov.scot/publications/strategy-for-environment-natural-resources-and-agriculture-research-2022-2027/pages/1-introduction.aspx)

The programme is designed to produce high quality scientific outputs which are useful, accessible and influential for government and other users. This requires a strong focus on engagement and knowledge exchange to ensure that research outputs fully inform the policymaking process and are accessible and useable by a wide range of external stakeholders. To achieve this, funding is delivered through several routes explained below.

1. Our largest funding line is the **Strategic Research Programme**: This programme delivers long term strategic research through 123 research projects.
2. We also fund the **Underpinning National Capacity Programme**: This programme provides funding for several key research capabilities including services, PhD studentships, post-doctoral appointments, outward-looking strategic links and alliances with universities and other research providers. It also funds a responsive support to policy capability providing a network of scientists at the research institutions available to respond to questions from RESAS analysts and SG officials.
3. There is a **Responsive Research Fund**: This is a small flexible programme that will deliver RESAS priority-led responsive projects.
4. Separately under this budget we fund five **Centres of Expertise** – the Centres are virtual expert teams who draw upon a wide network of researchers at different institutions across the country to meet policy needs. They provide a direct route for policy teams to design and commission research. In 2022-23, the Centres of Expertise spent approximately £6.5m. The five centres are listed below:
 - a) **Centre of Expertise on Animal Disease Outbreaks (EPIC)**: brings together Scottish-based expertise to best prepare Scotland's livestock industry and stakeholders for disease outbreaks.
 - b) **Centre of Expertise on Water (CREW)**: delivers advice and evidence on a wide range of topics including flooding, catchment management, and protecting drinking water.
 - c) **Centre of Expertise on Climate Change (CXC)**: delivers research to support policies on adapting to the changing climate and transitioning to net zero. This centre's remit is wide-ranging, including reducing GHG emissions and adaptation to future climate challenges.
 - d) **Plant Health Centre**: delivers scientific evidence to support decisions about pests and pathogens that threaten Scotland's plants from agriculture and horticulture through to forests.
 - e) **Knowledge Exchange (SEFARI Gateway)**: actively engages across the research providers to promote knowledge exchange, maximise research impact and improve research communication.

Most of the funding is received by five research institutions in Scotland. These are collectively referred to as the Main Research Providers (MRPs). These bodies are independent, but they are significantly dependent on Scottish Government funding. These institutes collectively employ 470 staff to work on our research programme. The annual grant funding received via this programme accounts for between 10% and 70% of their income:

- **The James Hutton Institute (JHI):** provides focused research into crops, soils and land use, food, energy and environmental research. JHI receives the greatest proportion of funding from the ENRA portfolio, in 2022-23 they received around £20m.
- **Biomathematics and Statistics Scotland (BioSS):** is a subsidiary of the James Hutton Institute and specialises in the development and application of the quantitative methods needed to enhance scientific knowledge and impact.
- **Scotland's Rural College (SRUC):** provides a broad spectrum of research activities from animal behaviour, genetics and epidemiology to soils, agricultural systems and environmental factors.
- **Moredun Research Institute:** provides focused research into livestock health and welfare. Moredun undertakes internationally-recognised research into infectious diseases of livestock, and develops new diagnostic tests and vaccines to improve the detection of and prevention of diseases.
- **The Rowett Institute:** provides focused research on food, drink, and human nutrition.



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