

Impact evaluation of research undertaken to deliver the Forestry Commission's Science and Innovation Strategy for Forestry in Great Britain



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EXECUTIVE SUMMARY

Background

The Forestry Commission has developed a fourth iteration of its *Science and Innovation Strategy for Forestry in Great Britain* (2014)¹. This strategy describes how the Forestry Commission (FC):

'will apply its financial, scientific and technical capability through research into forestry and woodland matters to support the development of policy and the delivery of its objectives'.

The Strategy details four strategic outcomes: three relating to specific research to provide an evidence base, and one that details how the research will change policy and practice. Along with description of mission and key values, the strategy also includes specific sections, and a wider context, related to how research is commissioned, communicated and evaluated. The strategic outcomes translate into seven core programmes of work at Forest Research (FR), and a smaller programme of external work representing 10% of the budget, against a set of 32 key Research Challenges in the FC's *Research Brief for Forest Research* (September 2014)². This Strategy took a different approach to its predecessors in its outcome-based emphasis. Although this required an early period of transition in designing new research programmes, it is aimed at providing dividends in the longer term. As further context, immediately prior to this Strategy a wider restructuring of Forest Research took place, with a 25% loss of staff.

Given the Forestry Commission's commitment to evidence-based policy and practice, as well as to recurring assessment of its success in generating impacts through the Strategy and the research it funds, it commissioned this impact evaluation of its Science and Innovation Strategy to provide:

'An assessment of the extent to which the research is making an impact on policy formulation at devolved and GB levels, and on operational practice within the wider forestry sector'.

Following a framework of core questions, analytical methods included: close content analysis of key documents; nearly thirty semi-structured interviews of individuals with diverse perspectives, including varied stakeholders; two illustrative case studies; a set of vignettes on knowledge exchange mechanisms. The evaluation team also drew on background knowledge of impact evaluation and of forestry research.

Key Findings

Learning organisation

The Forestry Commission has exhibited commendable good practice by behaving as a 'learning organisation': commissioning and publishing an evaluation³ of its earlier Science and Innovation Strategy in 2012 in advance of work on a new strategy; publishing its response to the evaluation's recommendations; and then in many ways shaping its subsequent actions in developing the next Strategy accordingly, as well as then commissioning this follow-up evaluation. Key findings of this current evaluation, in effect a mid-term review, are captured in our view of progression against the original 2012

¹Available at: [http://www.forestry.gov.uk/pdf/FCFC002.pdf/\\$FILE/FCFC002.pdf](http://www.forestry.gov.uk/pdf/FCFC002.pdf/$FILE/FCFC002.pdf)

² Available at: [https://www.forestry.gov.uk/pdf/SIS_research_brief_for_FR_2015.pdf/\\$FILE/SIS_research_brief_for_FR_2015.pdf](https://www.forestry.gov.uk/pdf/SIS_research_brief_for_FR_2015.pdf/$FILE/SIS_research_brief_for_FR_2015.pdf)

³ Available at: [https://forestry.gov.uk/pdf/Impact-Evaluation-of-Research_2013.pdf/\\$FILE/Impact-Evaluation-of-Research_2013.pdf](https://forestry.gov.uk/pdf/Impact-Evaluation-of-Research_2013.pdf/$FILE/Impact-Evaluation-of-Research_2013.pdf)

recommendations. (Table 1 at the report's end summarises progress and updates recommendations.)

Summary of progress against recommendations in the 2012 evaluation

In general, we found that progress has occurred against the seven recommendations of the 2012 evaluation. More detail regarding progress against each of the recommendations is provided in the concluding section of the report. Progress highlights include increases in stakeholder engagement in the form of Forestry Commission consultation early in the development of the current Strategy, along with some co-designed/joint strategies such as a National Tree Breeding Strategy led by the wider sector. Another significant enhancement in the current Strategy was the launch of FR's Programme 7 with an explicit mandate to increase understanding of knowledge exchange processes and impacts on policy and practice. Programme 7 is also charged with facilitating interdisciplinarity, including socio-economic dimensions, and there is some evidence of FR involvement in new interdisciplinary projects. There is also evidence that the Strategy entailed some improved alignment with wider strategic agendas. Commitment to communication continues, with a communications plan having been developed and the website improved. Not surprisingly, there is need for increased momentum and clarity against the various recommendations. For example, whilst a range of organisations, groups and individuals play knowledge intermediary roles, further identification and deliberate leverage of that role are not apparent, nor is increased transparency as to the nature of the 25% commitment to Knowledge Exchange.

Updated and New Recommendations

Our view is that the Recommendations in the 2012 evaluation are still relevant. However, in light of our findings we have expanded and updated them. In addition, we now make two new recommendations relating to co-investment and appropriate governance. This refreshed set of recommendations should help deliver the needs of a range of end-users and achieve best value from limited resources.

Recommendation 1: Transparent co-design and prioritisation of research

Build upon enhanced engagement of stakeholders to involve diverse stakeholders in co-design and transparent prioritisation: at the level of the Strategy itself, in a light-touch but responsive refreshing, as well as (especially) at the programme and project (work packages and work areas) levels to ensure the right research questions are identified, prioritised and then addressed on an ongoing and adaptive basis (using capability within and outside of FR, within the funds available). Continue interactions between researchers and diverse stakeholders as research is being conducted throughout the lifetime of the Strategy, to maintain engagement and co-ownership, with feedback loops.

Recommendation 2: Increased focus on generating and capturing impacts

Improve awareness not only of 'knowledge exchange' mechanisms but also of 'impacts' (of different types, including instrumental impacts, conceptual impacts, capacity-building, attitude/culture change and enduring connectivity) as they unfold over developmental stages. Take advantage of FR's Programme 7 learning in this regard. Utilise 'critical reflection' and identify 'impact champions' who can disseminate/model best practice and help researchers move towards and capture progress towards impacts (for example via impact templates or plans). In defining beginning-to-end 'knowledge exchange' plans (beyond 'communications plans' that may focus more on dissemination of outputs), shift the emphasis to a shared and on-going dialogue with stakeholders about 'impact-generation' processes that could enhance the likelihood of research having non-academic impacts among end-users. In this way, improve reporting against the Strategy to include 'stakeholder agreed' success criteria and improve reviewing (with stakeholders) on the effectiveness of knowledge exchange processes. Reporting against the Strategy by both FC and FR should also focus more on (a range of) impacts derived from the research and not just

conventionally quantifiable metrics such as publications or financial leverage, although these are also important. Consider introducing approaches to tracking impacts and their developmental stages to enable FR staff (at project and/or programme level) to collect evidence pertaining to impact throughout the research cycle.

Recommendation 3: Pro-active use of knowledge intermediaries

Consider ways to identify and involve Knowledge Intermediaries at Strategy, programme and project (work package/work area) levels. Encourage individuals such as appropriate external stakeholder representatives on steering groups, alongside FC end-users, to take on the role of wider Knowledge Intermediaries in pro-active ways. Furthermore, make effective use of existing stakeholder groups and fora where possible, making explicit the important role of knowledge intermediaries.

Recommendation 4: Planning for end-to-end knowledge exchange and impact generation

Expand objectives of a 'Communications Plans' such that they become 'Knowledge Exchange and Impact Plans' (at both Strategy and Programme/Sub-programme levels), embracing two-way, on-going dialogues as well as dissemination. Take advice from stakeholders and when possible involve them in the co-design and delivery of research and also in knowledge exchange/forms of communication, with 'impact generation' as an explicit goal.

Recommendation 5: Partnership working for capability building and delivery

Continue to take a strategic view as to how FR research fits into a wider - and changing - research landscape. When possible align with relevant current and emerging research agendas of key bodies. Co-design with other funders to ensure full coverage of key issues across the whole 'strategic to applied' span, and call attention to the distinctive capabilities within FR. While retaining important agility to leverage strategic opportunities that arise, review the scope, purpose and implementation of the External Programme funding to optimise collaborations with co-funders in order to support the development of strategic partnerships between FR and external researchers and access or consolidate external capability complementary to FR. Consider a more strategic and, where possible, co-funded PhD programme in light of upcoming needs.

Recommendation 6: Supporting interdisciplinary working and innovation

Pursue, facilitate and support genuine interdisciplinary research and innovation when appropriate to address multi-faceted problems. Include exploration of socio-economic dimensions when sensible to do so. Accepting that interdisciplinarity is not always necessary but when appropriate it can be a powerful source of innovation, continue to build interdisciplinary capacity in training across FR, facilitating the exchange of methodological expertise, ideas and approaches between staff in different areas. Consider naming 'interdisciplinary champions' in steering groups and/or programme leadership and consider a specific fund to specifically encourage interdisciplinary efforts to gel and to support seed-corn-related research innovation in general at FR.

Recommendation 7: Resourcing knowledge exchange for impact

Be transparent and indeed explicit as to funding for knowledge exchange/impact generation as an investment adding value to achievements under the Strategy. Produce knowledge exchange/impact-generation plans at project level (e.g. envisioned pathways or simple logic model templates) as well as at programme level (e.g. a theory of change for a portfolio of projects) and, with the help of Programme 7, share critical learning about relevant processes and capture impacts/early indicators of impacts-in-progress. Consider having some specific, ring-fenced funding available, perhaps in Programme 7, which could be accessed competitively as a top-up when projects identify new opportunities for activities that would enhance the likelihood of impacts, for example facilitating early co-design with end-users or translating research understanding into policy or practice).

New Recommendation 8: Approaches, processes and tools for co-ownership and co-investment

Expand current pursuit of co-investment from a range of partners, appropriate to research questions identified as priorities for the various stakeholders. Learn about coalitions from previous models or experiences (such as the Sitka Co-op, National Tree Improvement Strategy, the Future Proofing Plant Health programme and ERA-nets). Aim to shape decisions through co-design with stakeholders, identifying gaps and including additional collaborators and/or co-investors as needed. Encourage all involved to take ownership and responsibility for the journey from transparent research design through research delivery to embedded use of research findings (impacts). Where possible, engage with existing groups/fora to benefit from their networks and avoid 'stakeholder fatigue'.

New Recommendation 9: Principles for governance and research management

Consider what is needed to achieve added value and synergy, rather than duplication or gaps, in research (whatever the future of the funding landscape). Recognise clearly the challenges inherent in identifying, balancing and prioritising research to deliver to the needs of a range of often quite different stakeholders - while achieving best value in the context of limited resources. So, for example, whatever the future holds, address the need for (in some form) the knowledge brokerage role currently performed by FC-CFS. Implementation of aims (such as, perhaps, those captured in recommendations here) should be tracked and considered in an on-going way by an appropriate higher-level governance body (currently, this might be the Research Strategy Management Board or the Expert Committee for Forest Science).

1. INTRODUCTION

1a. Background and Objectives for the Evaluation

The fourth iteration of the Forestry Commission's Science and Innovation Strategy for forestry in Great Britain (2014)

[http://www.forestry.gov.uk/pdf/FCFC002.pdf/\\$FILE/FCFC002.pdf](http://www.forestry.gov.uk/pdf/FCFC002.pdf/$FILE/FCFC002.pdf)

describes how the Forestry Commission:

'will apply its financial, scientific and technical capability through research into forestry and woodland matters to support the development of policy and the delivery of its objectives'.

The strategy details four strategic outcomes that translate into core programmes of work, three relating to specific research to provide an evidence base, and one that details how the research will change policy and practice. Along with description of mission and key values, the strategy also includes specific sections, and a wider but relevant context related to how research is commissioned, communicated and evaluated.

Given the Forestry Commission's commitment to evidence-based policy and practice, as well as to recurring assessment of its success in generating impacts through the research it funds, it commissioned this impact evaluation to provide:

'An assessment of the extent to which the research is making an impact on policy formulation at devolved and GB levels, and on operational practice within the wider forestry sector'.

This evaluation considered context and aims and paid particular attention to analysis of diverse ways in which research commissioned under the Strategy has contributed to such impacts as 'collection of evidence, translation of evidence to policy, and exchange of knowledge to the wider industry sector'. Because research commissioned under the Strategy runs from 2015-2019/20, this could only be essentially a mid-term review in terms of capturing impacts from new research. However, by examining processes (as well as the development of the Strategy itself), the evaluation also looked to the future, capturing insights into how the Strategy can further contribute to increasing the net value of benefits that forestry can deliver.

1b. Approach

We are committed to the premise that evaluations should be *helpful*. They should not simply look to the past; they should contribute to the future. In order to do so, we sought not only evidence of impacts but also insights that could contribute to strategic decision-making regarding research. Specifically, the methodology matches that which two of us employed when we conducted the previous evaluation of the third iteration of the Strategy,⁴ thus enabling comparisons as well as analysis of progress against the Forestry Commission's response to the recommendations of the earlier evaluation⁵.

We have drawn upon our own extensive experience in evaluation of non-academic impacts from research and scientific outputs, and also a growing body of understanding among others in the impact evaluation field. This evaluation was grounded in a conceptual model which considers research impact to be a function of the interaction between: the content of the research; the context for its application and the processes of user engagement. We

⁴ Meagher, Laura, Hunter, Stephen. 2012. Impact Evaluation of Research undertaken to deliver the Forestry Commission's Science and Innovation Strategy for British forestry. [http://www.forestry.gov.uk/pdf/Impact-Evaluation-of-Research_2013.pdf/\\$FILE/Impact-Evaluation-of-Research_2013.pdf](http://www.forestry.gov.uk/pdf/Impact-Evaluation-of-Research_2013.pdf/$FILE/Impact-Evaluation-of-Research_2013.pdf)

⁵ Forestry Commission. 15/11/2013. Impact evaluation of research: Forestry Commission response. [http://www.forestry.gov.uk/pdf/Research-Evaluation-Response_2013.pdf/\\$FILE/Research-Evaluation-Response_2013.pdf](http://www.forestry.gov.uk/pdf/Research-Evaluation-Response_2013.pdf/$FILE/Research-Evaluation-Response_2013.pdf)

made use of our own 'flows of knowledge' conceptual model (Meagher et al 2008). These processes involve multidirectional flows of knowledge, expertise and influence across a web of networks and relationships. Many have in general observed heterogeneity among research users (e.g. PA Consulting/SQW 2007; Abreu et al., 2009); the range of stakeholders potentially reached by the Forestry Commission is certainly wide. We therefore sought out multiple perspectives and stayed alert to impacts that are diverse in nature and scope, aware that many if not most impacts are often subtle and 'textured' rather than obvious (e.g. Nutley et al 2007). We sought indications of five types of impacts⁶ and developing 'impacts-in-progress'. This is consistent with the approach taken in the previous evaluation (and others) and adds value by broadening the net beyond a conventional focus on mainly instrumental impacts.

Tracing or attributing what are often diffuse and long-term impacts of research is widely recognised as difficult. Triangulation across multiple interviews of informed individuals, as well as document analysis, helped us to capture linkages and contributions, and to illustrate them in case studies and vignettes. Furthermore, we investigated knowledge exchange processes, with which we have significant experience (e.g. Reed et al. 2014, Reed 2016, Meagher et al. 2008, Meagher and Lyall 2013) in order to identify and highlight key factors (such as roles of knowledge intermediaries) and/or mechanisms (such as types of engagement) and/or issues such as barriers to uptake.

We took a close look at ways in which the development and delivery of the Strategy might have addressed the last evaluation's suggestions for improvement, such as those features highlighted in Section 4 of the Strategy: stakeholder involvement in the setting of research priorities and the way in which research knowledge is exchanged; interdisciplinary and collaborative/partnering approaches; and a focus on outcomes and impacts, balancing availability of findings to practitioners with the need for top quality journal papers.

We are grateful for the willingness of diverse individuals to share their insights and lessons learned as to obstacles and effective approaches, as this also contributed to our own concluding recommendations for future impact generation.

1c. Methods

Framework of Core Questions

A Framework of Core Questions agreed with FC acted as a common "spine" across methods and diverse perspectives to help us achieve an objective triangulated, integrated analysis. Key methods included: close analysis of relevant documents; semi-structured interviews; and illustrative case studies and vignettes. (Annex A)

Document Analysis

Key documents were examined closely in relation to the core questions; these included but were not limited to: the 2010 Strategy and the 2014 Strategy; the 'FR' and 'External' Research Plan Briefs; the FR Research Programmes⁷; key relevant publications, reports or internal documents of the Forestry Commission and Forest Research; our 2012/13 evaluation of the impacts of research commissioned under the last Strategy and the Forestry Commission's response; and website information available on the two bodies and various programmes and projects.

Semi-structured Interviews

A set of 28 semi-structured interviews were conducted, including those for case studies and vignettes, using a template (Annex B) based upon the Framework of Core Questions. Interviewees were selected as thoughtful individuals having diverse perspectives, allowing

⁶(Nutley et al. 2007, p.36) defined instrumental, conceptual and capacity-building impacts; Meagher and Lyall (2013) introduced attitude/culture change and enduring connectivity as impacts.

⁷ Available at: <https://www.forestry.gov.uk/forestry/bee9zpd7v>

for triangulation across views regarding impacts and impact-generating processes in both policymaking and innovation in the forestry sector. They included:

- FC policy makers and practitioners
- Wider governmental stakeholders
- Industry and third sector stakeholders
- Senior FR researchers.

Case studies and Vignettes

Through interviews combined with document analysis, we developed two case studies as narratives illustrating examining ways in which research funded under the Forestry Commission's strategy has led to various sorts of impacts (and impacts-in-progress). One is a longitudinal expansion upon the earlier evaluation's case study on carbon accounting; the other explores a longer-term and practitioner-relevant aspect within the Strategy's central theme of resilience and focused on 'silvicultural systems'. We also developed a set of shorter 'vignettes' highlighting diverse mechanisms of knowledge exchange, toward impacts, ranging from FR-produced tools through to collaborative ways of working.

2. SUMMARY OF FINDINGS

2a. Overview of Strategy and Its Impacts

Features of the Strategy itself

In contrast to our evaluation of the 2010-2013 strategy, this time we were able to pick up more of an awareness of the Strategy itself, along with predictably greater awareness of research conducted under it. The new awareness seems likely to have stemmed primarily from the early developmental stage of the Strategy, in which consultation workshops were held explicitly to seek views on priority directions. This initial engagement with the Strategy *per se* was widely welcomed by stakeholders and others, who, it would be fair to say, felt some sense of 'buy-in'.

However, expectations raised in this way were often left unmet later in the process. Stakeholders frequently described the invisibility of the steps through which 'their' priorities were transformed first into the call for programmes to be supported under the Strategy and then into actual research activities which might or might not seem aligned with the original input. Subsequently awareness of the Strategy seems to have decreased and awareness of individual research efforts varied, depending in particular upon the nature of engagement or communication efforts related to particular research efforts.

In turn, this evaluation - like the preceding evaluation - has considered impacts and engagement processes primarily with a focus on specific research commissioned by the Strategy itself. However, in considering knowledge exchange or impact-generating processes, it should be noted that some relevant features of the Strategy itself do emerge. Two features are particularly important in this regard, one intangible and one easily documented. When asked about differences between this Strategy and preceding iterations, interviewees frequently commented in an approving way upon the new 'tone' of the current Strategy; it was described as 'open', 'accessible' and understandable by a layperson, as well as more 'outward-looking'. Intangible though this may be, the tone apparently conveyed that the Strategy genuinely cared about audiences even beyond researchers - thus helping to encourage engagement. More tangibly, the current Strategy added a different sort of programme to its portfolio: Programme 7, 'Integrating research for policy and practice', with aims explicitly including to 'help Forest Research understand and improve the processes and outcomes of interdisciplinary working and knowledge exchange, and its impact on policy and practice'. Finally, there are various elements within the Strategy that align with (a) wider agendas related to impact generation, such as the Evidence Strategy for Defra and its Network and various country drivers, and (b) links through ERA-Nets (European level), the LWEC partnership (UK level) and CAMERAS (Scotland) to other funders' agendas.

In short, as captured under Key Findings, we saw this Strategy as responding to several of the previous evaluation's recommendations, particularly Recommendations 1, 2, 5 and 6:

- *Increase stakeholder engagement* (e.g. consultation workshops in Strategy development)
- *Improve awareness of Knowledge Exchange processes, publish FR proposals and reports, and capture and impacts* (for the first and last points: e.g. establishment of Programme 7)
- *Take a strategic view and fit with the wider research landscape* (e.g. points of alignment with other agendas)
- *Encourage interdisciplinary collaboration, in particular exploring socio-economic dimensions of issues* (e.g. establishment of Programme 7).

Furthermore, in practical terms, there was a response to Recommendation 4, '*produce a communications plan, as advised by stakeholders*' in that a communications plan was developed and a Strategic Publications Group established, along with effective improvement

of the website. Previously existing commitment to dissemination (e.g. through various FC/FR outputs and knowledge exchange activities) is not new, but its continuance is of course positive. Somewhat similarly, interactions with 'knowledge intermediaries', including organisations such as the Institute of Chartered Foresters or Confor, do continue, although there has not been highly visible tactical change along the lines of Recommendation 3, to *'identify, engage and leverage the knowledge exchange potential of diverse knowledge intermediaries', especially on early engagement in co-design of research*. The Strategy did continue the commitment of 25% going to knowledge exchange, compared to research itself. While this exhortation is of course positive in relation to impacts, it is not necessarily the case that the earlier Recommendation 7 to *'increase transparency of funding meant for knowledge exchange'* turned out to be the case, as different programmes and projects interpret this 25% levy differently - often, for example, emphasising academic publications.

Indications of Impacts from Research supported by the Strategy

As discussed at more length in a later section, even in our non-exhaustive and effectively interim study we were able to uncover impacts of various types on both policy and innovative practice; we see this as a healthy portfolio.

2b. Evidence Base and Capability

Because this evaluation focused on the use of evidence and impact generation, rather than the evidence base itself, it did not assess quality of the evidence base in any detail. Nonetheless, achievement of quality is clear from widespread publication of Forest Research work in peer-reviewed publications.

A concern widely expressed - by stakeholders as well as by FR/FC interviewees - was the decrease in capacity brought about by serious funding cuts. Stakeholders were sympathetic but still at times frustrated when decreases in personnel translated to less work in areas of concern to them. Reduction in numbers and breadth of scientific personnel has multiple effects on impact generation, including: necessity to 'adapt' stakeholder priorities to feasibility when planning programmes/projects; decreased agility in moving capacity to suddenly emerging issues; presence of 'gaps' in the scope of research covered; and severe time pressures limiting the ability of remaining staff to interact significantly over time with stakeholders - a key knowledge exchange process.

This situation raises the challenge of achieving a balance between funding research at FR to maintain capability and to deliver usable outputs. It also highlights the role that joint initiatives and leveraged research funding can play as routes for FC to access wider capability and build or strengthen productive partnerships between FR and others. (One aspect of this, the role of FC's External Programme of funding, is discussed later in this report.)

2c. Interdisciplinarity and flexibility

Interdisciplinarity

The Strategy made an explicit commitment to interdisciplinary working in its establishment of Programme 7. This is in line with other funders (e.g. LWEC, Research Councils) moving to support interdisciplinary tackling of complex real-world problems, in recognition that the world outside research does not come neatly compartmentalised into disciplines. Studies of interdisciplinarity (e.g. Lyall et al., 2011), however, indicate that interdisciplinary research takes time and effort; and that it often requires a change in mindset of individuals and culture of organisations. The explicit placement of value upon interdisciplinarity by including Programme 7 in the Strategy is an important step toward culture change, and Programme 7 is itself working toward encouragement of individuals and teams (e.g. through master-classes). Although intangible, a process of change appears to be going on, as, for example, two interviewees observed:

'I see an impact in terms of the way science is now organised across FR, across the two sites. I can see a difference in terms of the focus of research and the way people are working, in terms of interdisciplinarity.'

'I like the tone; it was not that anyone here was against social science, or interdisciplinarity, but no one really understood it or that (sometimes) they were doing it. I can see there has been a sea change in how we work.'

Flexibility

Interviewees were generally positive when asked about the degree to which the Strategy offered sufficient scope and/or flexibility to deal with opportunities or issues arising, new developments or emerging stakeholder needs. The Strategy was designed to offer enough scope for flexibility, perhaps particularly in some areas, such as plant health which has to deal with unpredictable incursions. The general sense is that the Strategy itself serves as a reasonable framework, within which new issues or problems could be fit with a bit of tweaking, making it possible to think about them within the Strategy's context:

'It is a framework with various strands and strategic elements. Overall, because it is about improved Forestry generally, if there is a new pest or disease, that becomes something we need to think about within the context of what we are doing.'

Now that the Strategy exists as a document, however, the locus of flexibility actually lies within the programmes. Each programme's table of outputs is reviewed periodically with the programme's steering group which includes representatives from the three FC countries; officially the commissioning officer signs off on permission to make requested 'sensible' changes, normally having checked with the steering group. Realistically, 'the flexibility really hinges around being able to substitute some deliverables for others; that is part of the process'. Of course, if new money becomes available, new work can be done. For instance, the countries have the option to put additional money in, or to contribute seed money toward external applications such as those to Innovate UK.

Given that FR's attempt to maintain enough flexibility to respond to changing circumstances is recognised as 'an unenviable task', there is a sense that 'they do it as best they can'. However, cuts in FR staff, and in areas of research pursued, can act to limit flexibility, in terms of speed of response or indeed scope of coverage, when new problems or stakeholder needs (or indeed opportunities) arise. While it is recognised that FR is not set up as akin to one of the Centres of Expertise providing quick advice to the Scottish Government, nonetheless stakeholders sometimes feel a need for more rapid responsiveness. Limitations on ability to respond to particular stakeholder needs as they arise might be exacerbated by FR researchers' need to find funding from sources outside the FC. Some 45% of FR's income in 2014/15 (£6.42M of £14.30M⁸) came from outside the Strategy, as FC funding declined (to £7.87M in 2014/15 from £11.28M in 2000).

2d. Impacts

General points

We were able to capture a number of indications of impacts arising from FR research under the Strategy. We cannot paint an exhaustive picture, in part because impacts are infamously difficult to identify and attribute to research causes, but also because capturing impacts is not an automatic process within FR or FC (nor, indeed, is the connecting of research to impacts automatic for stakeholders). For the future, it is useful that some of Programme 7's work in gathering examples of impacts and providing workshops is intended to raise awareness of impacts and impacts-in-progress, so that researchers and stakeholders become more able and more likely to develop their own impact 'stories'. Indeed, we would

⁸ See: Science and Innovation Strategy for British Forestry: Annual Report 2015.

suggest that critical reflection of the sort required could also act to improve processes of knowledge exchange, thereby enhancing the likelihood of future impacts.

Nonetheless, we were able to pick up from interviews a number of examples of impacts upon policy and practice/innovation in the sector. Many of these are fairly general. We will highlight some general examples in discussion of policy and practice and then, below, we will provide examples of different types of impacts, to convey a sense of the breadth of the 'portfolio' of impacts generated by research under the Strategy. The two Case Studies will illustrate in more detail impacts on policy and practice, and how they came to be. Of course, generation of impacts from research can take a long time. For instance, an example provided of an 'impact in progress' is collaborative working between economic modellers in Programme 4 and stakeholders, to develop ways of building corporate social responsibility into hard-nosed economic realities. This is certainly a tough challenge but could, over time, become an important impact.

Policy formulation (country and GB)

Policy related to tree health and disease continues to be informed by research, with FR being the home of the greatest number of UK tree health researchers (although other institutions/fields are increasingly researching related issues). Interviewees often referred to the role of research in dealing with emerging tree health problems in both policy and practice terms. In another dimension, policy priorities for climate mitigation have been to some extent 'operationalised' by the Woodland Carbon Code (described in a Climate Mitigation Case Study). More generally, social science researchers under the Strategy are helping policymakers as they think through how to address stakeholder needs and problems, and engage with stakeholders, with one example being organisation of pest management programmes. Importantly, at the 'big picture' level, as an external stakeholder observed:

'The Strategy has helped ensure that the Forestry Commission is now much better connected into other policy areas which involve trees or wood, timber procurement, the supply chain from seed to chair'.

Innovative forest management practices

Tree health is an area in which need - and impact - are evident in practice. Stakeholders are keenly aware that management of outbreaks of new pests and diseases has been informed by research. Research findings can also have an influence on planting decisions. For example, related to the Strategy's core theme of resilience, selection of tree species and methods for planting is an area directly influenced by FR research, as illustrated in the 'silvicultural systems' Case Study. A further example is the Ecological Site Classification Decision Support System, an FR tool based on research and co-designed with planners for use in guiding selection of species. FR research also identifies implications of climate change for these crucial long-term decisions. FR research related to forests' roles in water quality and flood mitigation has helped lead to new planting schemes, including the use of 'opportunity mapping', which shows best places to plant trees to reduce flooding (see Vignette). More broadly, research has contributed to a new concept or view of flood management being incorporated into forest function. In general, FR's continuing focus synthesising research into practical and readily available decision-support tools and operational guides, updated through new research and user experiences, is a key approach to generating impact from the research. The use of 'user groups' in the development and testing of decision support tools is an example of good practice and engagement with end-users.

Types of Impacts

During interviews, we opened up discussion of impacts by mentioning five different types of impacts⁹; many interviewees provided examples of the less tangible - but still significant -

⁹ See Nutley et al., 2007 and Meagher and Lyall, 2013.

types of impacts. In our view, a healthy portfolio includes all of these impact types and we have found examples of each type arising from research under the Strategy (including ongoing research begun before this Strategy). A brief (non-exhaustive) illustrative list of diversity of impacts from forestry research follows; these have been offered by interviewees.

1. Instrumental impacts refer to those that have 'a direct impact of research on policy or practice decisions. It identifies the influence of a specific piece of research in making a specific decision or in defining the solution to a specific problem, and represents a widely held view of what research use means'. Whilst instrumental impacts on policy or practice are most often sought by funders, they tend to be relatively infrequent. Nonetheless, interviewees came up with a number of examples, which included:

- The Parliamentary passage of new plant health statutory instrument in January 2017 which established a notification scheme for firewood imports (very much based on concerns over Emerald Ash Borer), drawing upon an evidence base developed on Emerald Ash Borer by FR researchers and their colleagues abroad.
- Research into flood and water management has helped to drive one of the targeted grants schemes in England to enhance flood management.
- A new forestry grant scheme in England to address carbon fixation is an example of a policy instrument informed by research.
- FR modelling research has led to various practical tools being developed and used by the sector on a regular basis.
- A strong sense that information coming out of resilience studies has been picked up and reflected in a significant change in the species being planted in our woodlands during the last four to five years.
- More generally, research relating to climate change and resilience is of interest to an increasingly aware private sector, 'as it will have a material impact on the future of not just their jobs but the very existence of the trees and forests we grow and manage'.
- Government procurement of UK grown supply chains is being informed by research regarding pests and disease and that is likely to be turned into policy recommendations for industry.
- The Woodland Grants scheme has been informed by research understanding to act as a delivery mechanism for change. For instance, improvements can include such management steps as removing rhododendron to protect larch from *Phytophthora*.
- As an 'impact in progress', scientists, primarily in FR, are developing guidance and practice notes related to the UK Forestry Standard, which sets out standards to forestry operators if they are to qualify for government funding. This is bound to influence practice, as an instrumental impact.

2. Conceptual impacts refer to those that involve 'a much more wide-ranging definition of research use, comprising the complex and often indirect ways in which research can have an impact on the knowledge, understanding and attitudes of policy makers and practitioners. It happens where research changes ways of thinking, alerting policy makers and practitioners to an issue or playing a more general consciousness-raising role. Such uses of research may be less demonstrable but are not less important than more instrumental forms of use'. Conceptual impacts can be hard to pin down and attribute solely to one piece of work or even a body of research. Yet, new ways of looking at problems inevitably shape how they are framed and addressed. Interviewees did manage to provide some examples, elusive as conceptual impacts can seem:

- The new way of looking at forests and trees as playing an active role in flood mitigation, a role which can be deliberately shaped by scientific understanding, is 'now beginning to become mainstream'. FR research is seen as having played a key role in this conceptual shift.

- Even more generally, FR research has contributed to a wider awareness, amongst a number of audiences, of the range of ecosystem services benefiting society that forests can provide. As one stakeholder said: 'the conceptual impact that is really interesting is around natural capital, where FC and FR were early adopters and early thinkers long before it was called that, valuing what forests can deliver. at least we are talking about it. We have been doing valuation techniques for some years; that has been a real impact of FR'.
- An example of a greater awareness of added value provided by forests, contributed to by FR and others, is that 'the whole area of outdoor access and health has exploded' ... while the change can't be attributed completely to FR research in the area, 'that kind of backlog of work and groundwork has generated knock-on projects and people taking an interest ... these things do happen over a long period of time'.
- Especially in the light of climate change, 'people are talking much more now about resilient woodlands than they were before'. The 'idea of a resilient forest' is taking root.
- A general conceptual change in relation to pests and disease, due in part to the Strategy and its commissioned research, has been an increase in attention paid to the provenance of trees in commercial trade, in contrast to an earlier lack of awareness of supply chains and sources of materials.
- The forestry trade press talks about research work on genetics and properties of wood and trees; research into genetics is seen as being connected to sector decisions.

3. Capacity-building impacts cover a range of impacts, often involving training, for example. Capacity-building has taken place on several levels, from formal education to continuing professional development to useful guidance and assistance with use of tools. Examples include:

- PhD students are supported/co-funded under the Strategy to foster the 'next generation' of researchers in relevant areas. The FC External Programme Funds are often used for this. This allows current FR staff to help shape the next generation of scientists. There remains concern (despite spread of interest among disciplines and institutions thanks in part to targeted tree health funding) that R&D capacity is vulnerable, looking ahead.
- FR delivers workshops, and responds to invitations to do so, in order to reach and build capacity among stakeholders, for example in improved mechanisms for diagnoses.
- Decision-support tools and practice guides contribute significantly to building skills within the forestry sector.

4. Enduring Connectivity impacts result from researchers and research users staying in touch, visiting and perhaps even seeking to work together subsequent to a funded piece of work, enhancing the likelihood of internalisation of research findings and thus impact. Enduring connectivity matters because, if researchers and stakeholders keep communicating with each other, research questions are likely to be framed in useful ways and stakeholders are more likely to internalise research findings, so that they are used and have impact. In a sense, this process-based impact can be a 'proxy indicator' that there is a heightened probability of future impact:

- Some argue that 'FR has always been a very practically-based organisation; many in the sector have no qualms about picking up the phone to talk with a researcher'. This tradition of interaction faces tighter resources, a challenge when the building and maintaining of relationships takes time and effort.
- Although this evaluation could not focus in on the work package level, there are clearly a number of individual FR researchers who maintain good, ongoing relationships with 'their' stakeholders.

- Some ongoing relationships have been formalised and involve external co-funding (as illustrated in several of the Vignettes).
- FR researchers participate in a wide range of networks and collaborations involving stakeholders as well as researchers from other organisations; one example is the Nornex consortium on ash dieback.
- Knowledge intermediary groups large and small encourage connectivity with FR research; just one example is the Wessex Silvicultural Group's invitation of experts to give three to four seminars a year.
- The FC's External Programme also supports: FR participation in key long-standing networks, such as the International Union of Forest Research Organisations (IUFRO); FR participation in co-funded UK and EU research initiatives, enabling them to build their own expertise and establish partnerships with other researchers; FC's access and use of a wider contractor base.

5. Attitudinal/Cultural Change impacts are where researchers or stakeholders (or both) change their views of Knowledge Exchange. Positive attitudes are conducive to continued collaboration and indeed impact. This process-based impact is certainly intangible. Nonetheless interviewees offered some thoughts:

- There has been an increased awareness in the sector as to the importance of biosecurity, which aligns with appreciation of improved understanding of tree pests and diseases.
- There has been 'a massive change in public, stakeholders, policymakers and the science base in awareness of risks to trees', leading to wider efforts 'helping to deliver essentially the Strategy', by protecting trees and their resilience for the future. Citizen science projects like ObservaTree, local wildlife groups and a range of organisations are now viewing themselves as having roles to play.

2e. Key Factors in Impact Generation

Enabling/facilitating factors

We find it helpful to think of impact generation as a *process*. Doing so has made it possible to step back and look at various dynamics and factors that have contributed to impacts arising from research under the Strategy. Pro-active efforts to engage stakeholders have occurred in the form of events, including the consultation workshops at the start of the Strategy's development. Many other workshops take place with the sector, for example a series of plant health workshops, explaining to practitioners what problems exist and how to deal with them. Direct interaction with professional foresters takes place in talks at annual conferences and/or in training, as another example. There are of course many individual interactions between individual researchers and individual stakeholders/groups or organisations of stakeholders. People vary and some researchers are well-regarded as particularly good at this - thus, they act as 'knowledge intermediaries' themselves. Very often (as observed elsewhere, too) such individuals are sought for their broad portfolio of understanding, not simply for findings of a particular research project. Shared participation in learning can strengthen engagement and thus likelihood of subsequent impacts. One example is the way in which sites are made accessible by both the Forestry Commission and other landowners, for a wide range of individuals to look at how trials of continuous cover forestry are laid out, to increase their understanding of effective management. Other activities are more oriented toward learning through a form of 'citizen science', such as tree health monitoring via ObservaTree - a new approach for FR in utilising the efforts of volunteers. An intangible but important factor is that of credibility, on the part of both Forest Research and the Forestry Commission. A policy stakeholder observed:

'My perception is that the Forestry Commission has good contacts on the ground; it has built a lot of trust. It is very good at getting people together when they do have issues; they speak the same language.'

Knowledge Intermediaries

Increasingly, in impact generation generally, the role of 'knowledge intermediary' is recognised as valuable; this is no less true in knowledge exchange involving forestry, as an interviewee observed:

'That role is absolutely crucial. It is very important to translate the requirements both ways - not to just disseminate it in the ways people need it but also to couch the questions in the correct way'.

In this sense, as an interface between science, policy and practice, the 'Analysts' in the Corporate and Forestry Support team within the Forestry Commission are critical Knowledge Intermediaries and knowledge brokers. With experts in different areas, the team commissions relevant research (as in implementing the Strategy) and promotes knowledge translation out to users (e.g. in publications); it 'has to make sure the knowledge pipeline is fit for purpose'. The Expert Committee on Forest Science has one sector representative on it (although there could perhaps be more). In general terms, the Forestry Commission is regarded as providing intermediaries between evidence-based policy and real-world actions of practitioners, for example:

'They are advising people, because they are on the ground, talking to people in woodlands, talking to decision-makers, giving advice on planting or managing ... the Forestry Commission can actually help to deliver things on the ground.'

Furthermore, Forest Research employs a couple of 'Research Liaison Officers' with a specific remit to pro-actively engage various stakeholders with research, fostering good communications and relationships and FC staff in local/regional offices also act as key knowledge intermediaries linking research to end-users.

Several external organisations (or key individuals within them) act as knowledge intermediaries bringing priority research questions to the Forestry Commission or Forest Research and signposting or taking research findings, in accessible form, to their members. Confor, ICF, UKFPA and the Royal Forestry Society are among these organisational intermediaries, as are various charities including Woodland Trust, the Sylvan Foundation and Woodland Heritage (this last features in a Vignette on AOD).

'By dealing with a forestry confederation, one can achieve an interaction with the sector - it is a good route'.

Forest Research researchers participate in conferences run by knowledge intermediary organisations as useful channels for engagement. A particular example is the regular ICF two-day conference, which brings together FR researchers and foresters, providing Forest Research with very useful opportunities for communication (and for listening).

One interviewee suggested that there is now a much stronger need for a relationship between Forest Research and such organisations in disseminating information:

'Because of the way the Forestry Commission is no longer operating as one whole, and in the past the sector has looked very strongly to the Forestry Commission to show the lead; there is probably a greater need for other organisations to disseminate. (However) there is bit of a lull where (such organisations) have not yet taken the lead in disseminating information.'

Collaborations/Partnerships

It is reasonable, and not surprising, that the Strategy encourages collaborations. The timing of the Strategy's development coincided with a rise in collaborative work, such as LWEC's Tree Health and Plant Biosecurity Initiative, and widely professed regard for interdisciplinarity. Collaborations can also be a sensible tactic in the face of reduced organisational funds in an environment with multiple players. Of course, many of the problems arising in the realm of trees and forests are complex and require multi-faceted

investigation requiring both a biological understanding of tree pests and diseases and a socio-economic understanding of behaviour changes toward their management. Not only funders, but also private sector stakeholders appreciate Forest Research collaborating with other researchers:

'We have been encouraged that there is now much greater networking between FR and other research establishments.'

The Forestry Commission's allocations of 'external funding' have often leveraged Forest Research researchers' ability to participate in large-scale, multi-organisation research initiatives, contributing to building capacity, connectivity and conceptual development of new approaches that can then feed through into future FC research programmes.

The National Tree Improvement Strategy initiative under development is seen as an important step in collaboration. The Institute of Chartered Foresters website describes it this way:

'The tree improvement charity Future Trees Trust are working with Confor, the Forestry Commission and Forest Research to develop a National Tree Improvement Strategy (NTIS) for the whole UK forestry sector. As Forestry Commission's funding for tree improvement – conifer and broadleaf – is likely to diminish in the next five years, the consortium is creating a network of stakeholders involved or interested in tree improvement (nurseries, foresters, scientists, researchers, landowners, saw-millers, ecologists) to develop a national strategy and action plan for all tree-breeding. ... By engaging the whole sector from the start, securing their views, opinions and suggestions, an inclusive strategy will be created that everyone can sign up to and support. By creating collaborative partnerships between stakeholders under the banner of the NTIS, significant new funding for tree-breeding research can be secured from organisations that don't currently support tree-breeding projects (Research Councils, international funders, corporate supporters, etc.).'

<http://www.charteredforesters.org/2017/01/ntis/>

A private sector stakeholder voiced key elements of the consortium's rationale relative to knowledge exchange:

'Everyone realises that is the way we have to do (things); we need to work together. If we can pull together a consortium, it is much more likely to access that money out there ... it can access public money if it has private money ... that plurality of research models and research organisations is the way forward. ... If (a member) invests money, it will pressure research and that is healthy and also needed for the long-term ... and it is more likely to have an impact on a company if it invested in the research.'

External Funding Programme

The FC's external funding programme (£737,000 in 2015/16) represents about 10% of the Forestry Commission's research budget. It is intended as a flexible and responsive fund intended to access external expertise and build additional research capacity. The fund is used in a variety of ways:

- Facilitating membership of key networks
- Facilitating FR participation in UK and EU-level joint initiatives (with co-funded and multi-partner projects resulting). Examples include the LWEC Tree Health and Plant Biosecurity Initiative, EU Framework Programme projects and ERA-NETs.
- Funding post-graduate fellowships (PhDs, either directly or co-funded)
- Funding external research providers to deliver specific research where FR expertise is lacking, either through single tender or competition.

The external programme can thus act as a key enabler of a wide range of impacts, principally through leveraging partnerships and increasing amounts of funding for Forest

Research (FR), helping to sustain that core capability during a time of decreasing FC budgets. These collaborative projects help broaden the research base accessible to FC and further develop expertise at FR through research partnerships. They can reinforce new ways of thinking, such as interdisciplinarity and systems thinking, and stretch conceptualisation of problems, often by involving research collaborators and disciplines new to forestry or trees.

Joint initiatives enable FC to develop shared research agendas and explore different approaches to co-design and co-funding, thus paving the way for an instrumental impact on future research policy, for example FC's potential translation of the Woodwisdom ERA-Net model into a UK-level model for exploring co-design and co-funding with the wider industry and stakeholders. To date, there seems to have been only limited bilateral co-design and co-funding of specific areas of work by FC outside of large joint initiatives. To ensure a coherent research and innovation pipeline, there may well be a need for a range of co-design and co-funding models across funders, disciplines and sectors, - perhaps particularly so given challenges around capitalising on the capability and connectivity from joint initiatives once they finish and given uncertainty about future co-funding potential of these types of large initiatives. For FC and for other funders, co-funding and co-design may well need to become more embedded into routine ways of operating, rather than as exceptional activities.

Governance

Broadly similar governance approaches and structures have been used under both this Strategy and the preceding one, e.g. an overarching Research Strategy Management Board (RSMB) with a supporting 'expert science group' (Advisory Committee on Forest Research, 2010; Expert Committee on Forest Science, 2014). The ECFS has a slightly evolved function, taking more explicit responsibility for peer review of the commissioning briefs and the subsequent FR research programmes; the ECFS has a good mixture of science expertise which includes that drawn from industry, the Forestry Commission, academia and from across different disciplines (natural and social sciences are represented as well as practitioners). Steering Groups continue in the current Strategy, but these are now at the programme level (cf. the project-level operation of previous Project Advisory Groups). The steering groups, overall, are multi-disciplinary and draw expertise from across the social and natural sciences and involve practitioners (Forestry Commission policy representatives from each country) as well as FC Analysts with different operational, social or economic expertise. However, there is no formal interaction between the individual steering groups; hence opportunities for interdisciplinary working across programmes may be being missed. The steering groups are primarily for monitoring progress rather than co-design of future work. Programme Steering Groups have been cited as 'very important' in the breadth of perspectives they bring as programmes evolve, as illustrated in a governance Vignette.

Focusing on generation of impacts

An explicit focus on the generation of impacts as a key goal can bring together efforts so that helpful influences on policy and practice do in fact unfold. In effect this can be seen as a 'journey' onward from a focus on knowledge exchange in and of itself. There appears to be a general sense that the Strategy's high-level overarching Outcomes and underlying Research Challenges are probably about right, and it has taken well over a year to set up and start the new programmes of research against the Strategy. Thus, in an upcoming period of significant change, it might be that Outcomes and Challenges could be reviewed and refreshed rather than developed *de novo*, while the next several years could be an optimal time for focusing on development and implementation of tactics that will enhance the probability of impacts. As an interviewee noted, the current Strategy provides 'a good framework within which to think about how research might be funded in a more mixed model'. At the strategic level, the generation of impacts could be enhanced by attention to governance (both governmental and stakeholder); and co-ownership through co-design and/or co-investment (this last could include continuation of experimentation with novel approaches such as consortia). Including stakeholder-agreed success criteria in this way

could help to deliver programmes of research that genuinely and optimally address policy and practice needs - and at the same time to encourage policy and practice stakeholders to take up and use new research understanding. Working with research projects, Programme 7 has already begun to facilitate both understanding of and focus upon impacts, to which effective knowledge exchange processes can contribute. Projects could even develop impact plans in collaboration with stakeholders, jointly assessing progress. Appreciation of the full range of impacts can help; for example continuing to foster healthy 'Enduring Connectivity' at strategic, programme and project levels can pave the way for more tangible impacts. As a stakeholder interviewee observed:

'The key thing about stakeholders is ongoing relationships with them, to reflect on how things are going and on emerging opportunities.'

Dissemination/Communication

Even though definitions of 'knowledge exchange' rightly emphasis a two-way dialogue that begins as early as the question-framing in research, the need for clear, accessible communication of research-derived understanding is inescapable. As an interviewee said,

'In generating impacts from research in my experience, for forestry issues a lot is about an ability to demonstrate, show people what it is, about communicating in straightforward simple terms - because the sector is very wide-ranging -- understanding the audiences and having a range of ways of telling the story is very important.'

Communication has in many ways improved, in what one interviewee described as 'incremental in the right direction, rather than a sea change'. An FC interviewee commented about FR communication that:

'It's been going in the wrong direction in the last five years but the direction of travel is better now. FR has tried using a knowledge exchange person and I'm not convinced that works; researchers need to connect with people personally and back up publications through events. FR is good at events and connects to key players.'

The website itself has been significantly improved and there is good evidence that it is accessible, widely used and appreciated. More web-based publications have been made available and webinars are offered. Use of social media has increased. There has been a notable downward trend in the numbers of publications (e.g. from 162 in 2010/11 to 88 in 2013/14 and 56 in 2014/15). However, there is a sense that the Forestry Commission is active in communicating:

'The Forestry Commission by and large is never secretive about its work!'

Outputs like the Forestry Commission Research Notes and Reports continue to be well-received and viewed as 'high-quality'. Clear research summary notes and practical guides are appreciated. One stakeholder pushed for even greater utility, asking for what can sometimes be 'timid' publications to come out and offer an informed 'best guess' for practical decision-making. In addition to producing a wide range of reports and reviews for non-academic audiences, Forest Research researchers have also conducted seminars, as well as some communication events (in person) at the local or regional level, reaching individuals like site managers with often quite practical understanding. A stakeholder observed 'everyone loves field visits about research projects'. The 'silviculture systems' Case Study illustrates a range of different communication and dissemination routes including training courses, advisory days in the field, the use of research forests and demonstration sites, and links to key FC and wider stakeholder groups.

Importantly, as far as incentives for researchers, the Strategy is seen as recognising the importance of researchers publishing 'grey literature' (in trade journals and so on) for users, not simply academic publications, and it appears that the upcoming visiting group will be considering both when it reviews Forest Research. Nonetheless there is a challenging

'dynamic tension' in prioritisation of outputs for individual researchers, for whom publishing papers in quality journals is critical for career progression and recognition in the wider scientific community.

2f. Issues/Obstacles for Impact Generation

Issues

A common caveat among those investigating impacts from any body of research is that the timeframe until impact can be long - and, for forestry, some would suggest, the timeframe may be especially long. A private sector stakeholder reflected on development of research impacts, for example:

'Often things take time to filter through, they may manifest themselves as attitude/culture change rather than pure eureka moments - and forestry by its nature is a long-term undertaking, so we shouldn't be surprised that benefits take a long time to work through and are ultimately appreciated, more than eureka moments. ... This will vary by subject and over time by what subject is seen as important (now that is plant health, for example).'

Nonetheless, stakeholders often feel 'a hunger for faster answers', perhaps such as those provided by consultants, in a dynamic tension with the sort of work Forest Research typically does. That said, real respect exists for the long-term research conducted by Forest Research. As one interviewee said, for example:

'FR experiments are a treasured resource set up for different purposes, but questions change and experiments provide evidence for new questions. It's important that there's some funding for long-term experiments and to get a consensus on what's a reasonable proportion to invest for the future to get sensible information.'

In general, capacity for FR to respond quickly to policy and practice research needs has been gradually eroded with reduced funding. Some 45% of FR's research funding now comes (of necessity) from outside the Commission, thus £7.9M is funded from FC and £6.5M from external sources - primarily from the EU and other parts of government, with relatively limited funds currently from industry or charities. However, it is worth noting that in some areas, private funding has driven new research that has responded to the needs of the practitioner community (e.g. species level work, or the foci of some of the knowledge exchange Vignettes). Reductions in funding and in staffing have influenced capacity to participate in knowledge exchange, for example the number of 'roadshows' of researchers into the sector is seen as reduced. As effective as personal contacts can be, the time and effort to create and sustain them is not necessarily 'efficient' for researchers facing multiple demands. Time is a precious commodity for FR researchers, who face conflicting pressures: to conduct excellent research; publish academic articles; find more and more external funding; publish reports and lay articles for stakeholders *and* participate in efforts to engage stakeholders. Researchers are expected to 'try to find as many ways (as possible) to engage with end-users and wider users, but it is difficult when chasing the next funds'. (This can mean that attention inevitably moves on to the next project.) Some researchers do perceive the need to 'get better at communicating at the end of the project and keeping people updated through the project'. In terms of reporting research progress and impacts, we saw no evidence that stakeholders had been consulted on what types of reporting would be most useful to them and the most efficient use of FC/FR limited time and resources.

Communication between FR and FC varies between teams and across individuals with some researchers more likely to share policy-relevant updates and emerging findings than others (in some cases FC colleagues may only see final information notes, research reports). There can be limited direct communication between FR and stakeholders from the policy community during the research process, and demand for new policy-relevant FR research is often self-limited by policy colleagues who are aware of limited resources available for responsive research.

Dynamics: Key inflection points in engagement and impact generation

Because engagement and impact generation are dynamic processes, each 'stage' is important and brings its own challenges that need attention. The last evaluation made a strong recommendation that the Forestry Commission encourage early engagement with stakeholders. Commendably, the Forestry Commission modelled this good behaviour with its own early stakeholder consultation workshops identifying key directions for the Strategy. Stakeholders - those who participated - did feel engaged at this critical early stage.

Satisfaction with engagement at the Strategy level, however, decreased as many stakeholders felt left out of the next stage, the translation of their early input into framing programmes, with negotiations between programme calls and researcher proposals appearing opaque to many. While achieving balances across stakeholder priorities can be delicate (e.g. the relative weight of the 'social benefits' of forestry which appeal to many policymakers versus the practical concerns of forest production), more transparency about that process, perhaps with more feedback loops, could maintain more engagement. Referring to the 'black box' of filtering input, a private sector stakeholder underscored this point:

'I haven't been involved in design of research projects other than at a very broad level and that doesn't allow improvement of uptake of research. I am one of the destinations for uptake of the research, so I am disappointed.'

During the operational or research stage, at least some stakeholders would have welcomed more in the nature of ongoing updates on evolution of the Strategy as it is implemented. Capturing this sense, one stakeholder praised the early engagement but emphasised the importance of sustaining it:

'This time (with this Strategy's development), it was the most satisfying as an external customer in that some iterations ago I had a frustrating experience where I was not alone in feeling not well listened to. With the recent one (Strategy), ... I went to a stakeholder workshop where we talked about themes, so a lot of effort was put into listening, which was welcome. That was the last time I had an interaction with the Strategy. To me that would be an issue, I would have welcomed follow-up - reviewing programmes or thinking about emerging opportunities. The danger would be that it could be seen to be a box-ticking exercise, "we will do these 'stakeholder exercises'" and never be thought about again. It would be important to have it be an ongoing interaction with stakeholders, that would be my criticism - maybe just an annual review where they could tell us as stakeholders how they are doing, and how well they are doing on (aspects of the Strategy), and new things that emerge. ... *The key thing about stakeholders is ongoing relationships with them, to reflect on how things are going and on emerging opportunities.*'

The last sentence of the quotation is italicised as it reflects a key principle of knowledge exchange - challenging as it may be in a time of decreasing budgets and increasing workloads. Development and maintenance of sustained relationships of course requires dedicated effort and yet it is key to eventual impact generation.

With the Strategy implemented through research, dissemination during or towards the end of a research project was variable, in terms of researcher reporting and/or communications coverage. When the Forestry Commission has produced reports or notes, however, they have been well received. Engagement at the research project level, throughout rather than at the end of the research, can help to 'embed the work in reality', for instance by:

'trying to do things in a more open way and doing research more on private sector forests, maybe, and having more open days, really communicating, marketing and selling what they (researchers) do and not waiting to the end of the research project at 3 years, but at 6 months saying what has been done so far and ... getting real world input, getting that engagement'.

Of course, any genuine engagement process has to be 'two-way,' not simply science 'push'. Interviewees including stakeholders noted that not all stakeholders invited took up the opportunity to interact with the Strategy or to attend knowledge exchange events. Furthermore, the thought was expressed that senior leaders/managers among stakeholders need to encourage their own people to take advantage of engagement opportunities and/or research findings.

The main impacts come from effective governance, having senior industry leaders in the public or private sector being engaged with Forest Research researchers and seeing they can influence its direction of travel and if (they can) buy into research as not ephemeral but a day-to-day part of their business/business improvement ... A lot has to start from the top so the flexibility of staff on the ground to apply science is supported (with) a commitment to saying "we've invested in this science', we need to apply it to make our business work".'

Explorations in a new level of reciprocal engagement - stakeholder co-investment in research initiatives - appear to be on the rise. Vignettes on the Sitka Co-op and AOD provide illustrations of this change. The developing National Tree Improvement Strategy, jointly defined by various groups, may well become another such example. In a time of decreasing funds and changing structures, co-investment or mixed funding may emerge as an important new model. (For example, FC Commissioners are considering the exploration of a new 'hub and spoke' model, with the hub as current government funding and spokes being issues such as resilient forests or wood/timber properties, each supported by a mixed set of appropriate co-funders.) While on the one hand, stakeholders might play a heavier role in defining research directions, they might also - in part because they have a financial stake - be more pro-active about using/embedding research findings toward ultimate impacts.

2g. Lessons Learned/Insights from Interviewees for Researchers & Stakeholders

Insights and 'lessons learned', or suggestions, were offered by interviewees. Key points are highlighted here. It should also be noted that one of the roles of the new FR Programme 7 instituted under the Strategy is to assist researchers and others in 'critical reflection', so that they capture and capitalise on learning about knowledge exchange/impact generation processes as they move through their projects and programmes.

For effective knowledge exchange - and potential impact, stakeholder suggestions for researchers included that they reach out in more than one way. As one private sector stakeholder observed:

'Do not forget the importance of communication; the written word (in hard copy or online) is still the principal way people are looking for research outputs ... (but also) support with updating events, getting 30-40 people in a room for a half day update; do that for everyone across the sector.'

To heighten the likelihood that research findings will be spread and actually used, toward impact, a different private-sector stakeholder suggested a wise tactic of encouraging stakeholder advocates:

'If a researcher is working with someone from the private sector, have them come in (to a conference) and say "it was great to work with FR and this is what we learned" - that has much more impact! A practitioner saying that has greater resonance.'

And indeed, stakeholders are encouraged to take enough ownership to share responsibility for impacts. For example, a policy/operational end user commented:

'We need to be a more-intelligent buyer of research and need to be sure we are getting value for money in terms of what we need to manage the public forest estate. We need to know what research we are doing now and what the questions are for the direction of travel of the public forest estate. We need to be better at communicating the work

and asking questions related to outcomes. We need to improve transparency both ways; building bridges between the researchers and the research commissioners is important.'

Researchers are encouraged to make effective and timely use of different sorts of support, including collaborations with the FC communications team. Timing matters in policy; another insight is to provide policy teams with information about planned research and determine together dates at which inputs could usefully be received from the policy community. 'Interactive reflections' between stakeholders and researchers should be ongoing, not just preliminary stakeholder engagement at the beginning and delivery or dissemination at the end.

2h. Lessons Learned/Insights from Interviewees for the Forestry Commission

Interviewees also offered 'big picture' recommendations, as to the Forestry Commission. Their recommendations can be clustered into key principles of action, that may be useful under any organisational structure. The Forestry Commission is recognised as managing research and the strategy that governs it, for example by 'commissioning, coordinating, enabling and communicating as intelligent customers'.

Beyond these important roles, several 'dynamics' were commended as deserving attention in the future. One, that spans the timeline of any Strategy, is the importance of **ongoing dialogue and two-way feedback**, for instance even after what was widely commended under this Strategy as the initial stage of stakeholder consultation. This could take the form of widely desired transparency or increased involvement in the critical stage of translating initial directions into research programme plans; it could also take the widely recommended form of researcher/stakeholder interactions both initially and *throughout*, for example, this comment by a third-sector stakeholder:

'More engagement, regular engagement, please! ... in the framing and the commissioning and the reflection of the Strategy itself.'

Or, as a private-sector interviewee said, similarly:

'The Forestry Commission must be sure to have effective dialogue with those involved in the sector, a chance to develop strategies that are meaningful and useful. We do want to see positive, valuable deliverables ... effective dialogue with stakeholders is vitally important (whatever the political landscape). You would like to think that by good partnership working, dialogue, formal and informal conversations - (that would be) a good way to build up awareness and relationships (for when) people are building up policies and strategies.'

Another dynamic is that of **long-term versus short-term research**. New problems can arise quickly, as has been seen with multiple incursions of new pests and diseases; the current Strategy is seen as offering sufficient flexibility to allow responses to such new issues. A private-sector stakeholder praised this feature:

'The themes are sufficiently broad so if something happens, researchers are able to address it. ... Effective mechanisms are already in place to ensure that if the Strategy needs to be refreshed and ground-truthed, it can be done.'

There can be occasions when rapid turn-around is needed, perhaps even provision for responding to 'call-down requests' by policy stakeholders such as that inherent in the Scottish Government's several Centres of Expertise. In addition to near-application agility, however, there is a widely perceived need for continuation of long-term work.

'FR have amazing long-term projects and everyone wants to see long-term plots continue and be monitored.'

Whether research is short-term or long-term, stakeholders recommend that more **'synthesis'** take place across fields or branches of research, so that busy stakeholders get a

coherent picture. As one said, 'I and others cannot deal with a kaleidoscope of views'. The history of FC and FR in producing research-informed outputs making a great deal of information available online was praised - and the continuance of that archive is a concern, because 'government information, a lot based on FR, is very good and very well-respected'.

Another crucial dynamic is that of **integrating and balancing across demands**, an honest-broker role (played until now by the GB Forestry Commission function) which interviewees cited as important for the future, however it is managed. For example, one policy stakeholder said:

'One of the most important things - we will still require an arbiter in the middle to draw together threads from the countries to get the most out of research. My biggest worry is that countries will go their own way and lose capacity, rather than through a sensibly structured set-up in the centre ... with countries working together.'

And a private sector stakeholder made a strikingly similar comment:

'The last thing we want, given the relative fragility of the forest research sector (despite being) a vitally important resource ... is for the research capacity to suffer because the Forestry Commission is broken up (into) three bodies with different needs there is barely enough money to support what they do, let alone carve up or duplicate. I would hope they would recognise the importance of cross-border research. We need to keep reinforcing the message to politicians to be mindful not to throw the baby out with the bathwater; there is not enough money to do the same thing two or three times.'

Of course, **balancing is required not only across countries but also across sectors**, with some private-sector stakeholders expressing appreciation for the (policymaking) drivers of research into social benefits but still desiring more attention to pragmatic sector concerns. While noting themselves that it can at times be difficult to secure input - or indeed funding - from stakeholders, stakeholder interviewees recommended pro-active engagement efforts at both the project level and at the wider, strategic level. This common message is reflected in these comments by two private-sector stakeholders:

'We are proud in the UK that we have such a high-quality body as FR with an excellent history and that does really good stuff. How do we preserve that for the future in a very different funding environment? It has to have private sector involvement - a big challenge. ... Engage with the private sector and make sure it is effective and that there is some way for the private sector to translate that good stuff into real value so it continues to support it.'

'We need FR to continue doing what they're doing. They are an amazing resource!'

Suggestions were offered for **high-level changes in engagement**, for example increasing the number of 'enterprise' representatives on the hitherto primarily policy-based Research Strategic Management Board. Nonetheless, many commented on the strong history of Forest Research and the interaction of many of its researchers with stakeholders. It was noted that there exist multiple 'knowledge intermediary' organisations related to different dimensions of forestry, and these could be good tactical collaborators themselves and/or act as sources for recommending various individuals to serve on key research management groups as advisors.

The **ubiquitous challenge of funding** was raised many times. There is among many a sense that the future will involve a variety of funding models. Agricultural levy boards or even appeals to the public might offer possible mechanisms, as did the Research Councils' contribution to tree health research funding. The Sitka Co-operative (described here in a Vignette) has been mentioned as 'the beginning of a trend', for example, as was the National Tree Improvement Strategy and the coalition under development. One interviewee even suggested:

'The future is going to be like that. Everyone is aware that is where we need to go, but there is still some of the architecture of the old system. The Strategy of the future might look very different, not owned by the Forestry Commission but by coalitions of the private sector and others, with FR on the committee and one of various delivery agents.'

Whatever the form, **securing wide ownership of future research** was often recommended ('there is a need for everyone to get involved in supporting the strategy'), such that the different FC countries, the sector, relevant charities, and even Research Councils are involved. **Ensuring a next generation of knowledgeable researchers** was often raised as an example of a shared concern.

'We still need to push home the need for capacity and capability, particularly in FR and other partners. We are still very vulnerable with a very small number of individuals; we need to inspire the next generation, resource and support them, to make a critical mass.'

Expanding upon collaborations as appropriate to tackle key themes was also recommended. **Appropriate evaluation** was recommended, related to impacts (as currently being explored by Programme 7) and the degree to which diverse stakeholders are satisfied by the usefulness of research and/or the nature of collaboration. And, in making the most of a changing future, fundamentally important questions will need to be considered on an ongoing basis, such as these offered by a public sector interviewee:

'How does FR respond? What are the scientific imperatives? What do we need to know about to help forestry through a difficult time and respond to opportunities? How do we make the best use of our science? And how as a sector do we come forward to a shared view of where the science needs to be going?'

3. VIGNETTES

To complement the more in-depth pictures captured in the case studies, we have developed a set of 'vignettes' or focused narratives describing particular 'knowledge exchange mechanisms'. As a set, these illustrative examples are not meant to be exhaustive, but rather to provide what we hope will be a stimulating look at the range and diversity of forms that knowledge (and expertise) exchange can take.

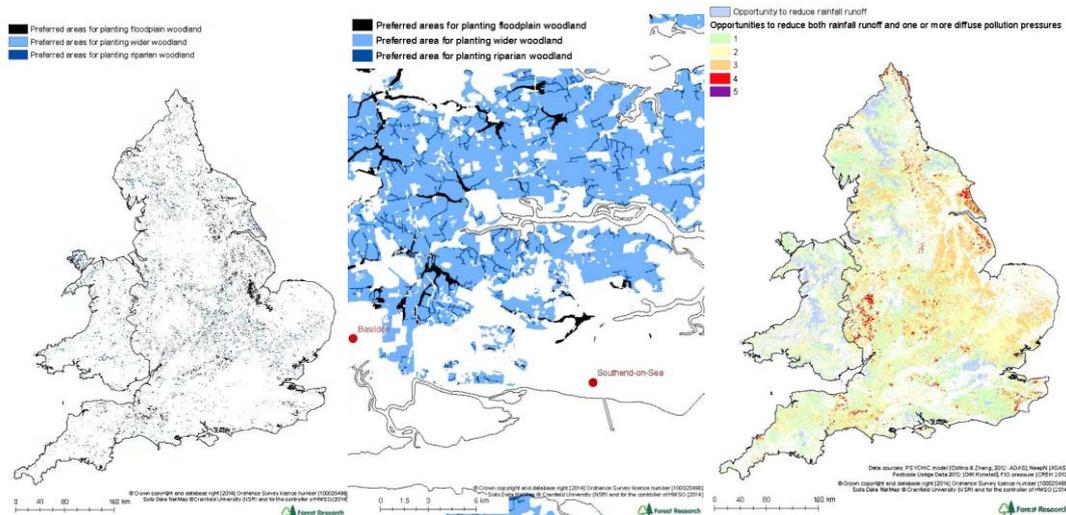
3a. Pro-active Engagement through Opportunity Mapping for Woodland-based Water Services

Opportunity mapping by Forest Research (FR) is helping to shape forestry policy and practice to deliver targeted woodland expansion for water benefits through more informed and engaged stakeholders, work that is contributing to three of the four key outcomes of the Forestry Commission's Science and Innovation Strategy for Great Britain. Specifically, opportunity mapping:

- Spatially targets locations where woodland planting can best contribute to tackling a number of pressing water problems, for example by reducing diffuse pollution from land use activities responsible for waters failing to meet Water Framework Directive targets, or by reducing the volume and speed of water runoff, so reducing damaging flood peaks; and
- Identifies sensitive locations where woodland could have negative trade-offs e.g. where the potentially greater water use by trees could reduce water supplies.

This is done using Geographical Information Systems and so can be applied across a range of scales, from strategic national or regional level down to catchment or farm scales. Opportunities for woodland to address diffuse water pollution are based on modelled data on pollutant loads for phosphate, sediment, nitrate, total pesticides and faecal indicator organisms, combined with local measurements of where these pollutants are having the greatest impact on the water environment. Opportunities to reduce flood risk draw on

topographic and soil data defining the propensity of land to generate rapid runoff and route this downstream. The maps below provide examples of opportunities for woodland creation to reduce downstream flood risk at national (left) and local (middle) scales, as well as where planting could reduce both flood risk and one or more diffuse pollutants across England (right).



Opportunity mapping is being used by country Rural Development Programmes devolved from the EU Common Agricultural Policy, such as Countryside Stewardship (CS) in England, to assist the Forestry Commission and partners with targeting grant aid for woodland creation and related options. The Environment Agency and others are also using the maps to guide woodland planting outside of CS as part of wider catchment management initiatives. In particular, FR has been engaging with a number of local communities in Cumbria that were badly affected by Storm Desmond in 2015 to explore scope with land owners and managers for using woodland creation to reduce future flood risk. The mapping work has been refined to prioritise small to medium sized catchments (<100 km²) draining to communities at risk, where the potential scale of planting is more likely to make a difference.

Opportunity mapping is also being used to inform woodland creation for other forest ecosystem services, including carbon sequestration. For example, the recently launched Woodland Carbon Fund will consider scope to deliver water benefits in addition to contributing to targets under the Climate Change Act. The work is likely to feed into the Government's forthcoming 25 year plan for the environment and help develop a more integrated and sustainable approach to catchment management.

Opportunity mapping thus serves as a conduit for Knowledge Exchange, addressing stakeholder questions at a range of scales by integrating scientific understanding across multiple parameters to provide 'actionable intelligence'.

3b. Collaboration/Partnerships: Co-funding of AOD research

Acute Oak Decline (AOD) is one of a number of diseases emerging and threatening trees in the UK. Indeed, concerns among stakeholders about oak health were a key driver in precipitating the Forestry Commission (FC) and Defra Tree Health and Plant Biosecurity Action Plan (October 2011); those concerns helped lead to oak and AOD featuring explicitly in the subsequent Action Plan and its Research Workstream. From that sprang the Tree Health and Plant Biosecurity Initiative under the Living with Environmental Change Partnership (or LWEC-THAPBI) with funding from Defra/FC/Scottish Government and Research Councils for strategic work that resulted in an AOD-Oak project engaging a wide scientific community (2016-2018). Defra funded an earlier and more applied project (2013-

2016) that complemented the FC-funded work and in which FR scientists worked alongside scientists from universities and other research organisations - as well as with stakeholders; the research into causes, distribution and scale of the disease (in the UK) was intended to generate useful distribution maps, enhance ability to predict risks of spread, and ultimately develop strategies for management and prevention. As part of the joint Action Plan, FC worked with Defra to ensure that the Defra-funded work complemented the parallel FC-funded research, e.g. through collaborative co-design of the AOD tender specification.

Thus, AOD provides a window into the importance of collaboration, across disciplines, organisations and sectors, in bringing research to bear upon urgent real world problems. Importantly, Forest Research (FR) and the FC collaborate with others to achieve a holistic research approach, which, owing to its multidisciplinary nature, is expensive. Funding streams include those from: FC, Defra, LWEC-THAPBI and, interestingly, charities and industry as well. The AOD research model illustrates the value of funders and stakeholders pooling resources and highlights the potential for more coordinated co-investment in the future to optimise financial resources and scientific capability.

Forest Research is 'involved in numerous studies to understand the exact cause and spread of this condition', with work including research into the predisposition to infection, identification, pathogenicity, distribution and epidemiology of the disease and its causal organisms. Details of relevant projects are at: <http://www.forestry.gov.uk/fr/acuteoakdecline> .

In a sense, in terms of rallying wide support to combat the disease, the oak tree is perhaps fortunate. In addition to oak's timber value and its conservation value supporting diverse species and habitats, 'We are in a fortunate position in that oak trees are so iconic in Britain, so it (the oak tree) has got a wide public and general interest ... there is a real embedding of the oak in our cultural fabric, which is a key help' in getting support for investigating and addressing the disease. Even though there is a 'wide net of concern', crucial focus has been brought by the championship of this cause by the charity Woodland Heritage, which was among the first to ring alarm bells, back in the 1990's.

When FC funding for FR research into the disease was cut back, a presentation by the key researcher (Sandra Denman) at a Knowledge Exchange event at a forest health day (2008) turned out to be a pivotal point. A forester recognised the symptoms described in the presentation, and later brought the researcher to other severely affected sites, along with the chair of Woodland Heritage (WH), a membership-based charity. In times of financial austerity, FC funding to investigate was restricted. The problem was considered so serious that the limited funding prompted the Royal Forestry Society and Woodland Heritage to write to the FC Director General to obtain assurance of continuance of the project, and financial commitment to it as well. In 2009 a meeting with stakeholders was held to address the problem of limited funding; the Woodland Trust and the National Trust became involved - and the FR researcher was asked to design and provide a budget for a substantive AOD research programme. In 2010 Woodland Heritage set up an 'AOD' fund as part of its charitable interests, appealing for funding, and a long-term research programme was established along the lines proposed. Together with WH funds, multiple charities have contributed through this 'AOD Fund' to allow continuation of funding for a sustained research programme, cumulatively by this point some £2M has been raised. These charities include but are not limited to: the Rufford Foundation, the J. Paul Getty Jr Trust, the Monument Trust, the Rothschild Foundation, the Duke of Bedford's Woburn Charity and CHK Charities. Ideally, such collaboration in co-funding can lead to a sense of joint 'ownership of' or 'buy-in' to research-derived understanding.

Complementing the 'top-down' funding role of Defra and FC, the 'bottom-up' raising of private funds via FR has, for example, added the strengths of young 'outside scientists' to support of the FR team. Thus, collaborations have occurred with institutions including: Bangor University, University of the West of England, Swansea University, Cranfield University, Harper Adams University, Exeter University, Imperial College, Rothamsted

Research, East Malling Research and Fera, among others.
[https://www.forestry.gov.uk/pdf/FR_AOD_2015.pdf/\\$file/FR_AOD_2015.pdf](https://www.forestry.gov.uk/pdf/FR_AOD_2015.pdf/$file/FR_AOD_2015.pdf)

The fact that this disease is a complex (involving biotic agents that include the *Agilus* beetle and various bacteria, as well as predisposing tree and environmental factors) makes multi-faceted research particularly important. Contributions to understanding draw upon a variety of disciplines. For example, although the FR unit focussing on AOD itself is very small, the AOD newsletter of April 2015 noted efforts by: plant pathology, microbial genetics and transcriptomics, dendrochronology, soil science, epidemiological modelling and entomology, among other fields. Very often, interdisciplinary 'lenses' are needed, for example bringing together dendrochronology studies of tree weakening with soil analysis, pollution and climatic events to identify important environmental stress factors.

The continuity of funding has been underpinned (at roughly a third each) by: 'the courage' of the Forestry Commission to stay with this area of research; Defra support; and by the support of various organisations fostered by the championship of Woodland Heritage ('a shining light, and a source of inspiration and encouragement to forge ahead [through periods of low funding] and show we can do this'). Along with ongoing communication with funders, the key FR researcher observes that 'I feel we have really reached out and locked hands with the universities and other research organisations to work on AOD' and goes on to reflect that 'it is up to us (at FR) to forge relationships with partners and deliver multidisciplinary and multi-organisational working', while at the same time 'reinforcing that FR is the national home base for help, advice and knowledge concerning trees'. Knowledge exchange is two-way: 'I have learned a lot from woodland owners and managers, so in the truest sense it is knowledge exchange: they have told me things that have given me realisations; it has been absolutely beneficial to me'.

Referring to the link-up across diverse funding sources as 'a quite exciting model', as a lesson learned the key FR researcher observes that this all wouldn't have happened without a great deal of effort - 'This is not for the faint-hearted!'

3c. Knowledge Exchange through Co-investment: the Sitka Spruce Breeding Co-operative Limited (SSBC)

The Sitka Spruce Breeding Co-operative <http://www.sitkacoop.co.uk/> (now referred to as the Conifer Cooperative, with an extended scope) is a tree breeding programme in which private sector members invest. When it became clear that public funding would be insufficient for the existing Forest Research tree breeding programme to continue, potentially interested parties were contacted to see if they wanted to help keep the Sitka spruce programme alive and perhaps even expand into new areas. Although this format was new to Forest Research, precedents for public-private consortia exist elsewhere (such as the North Carolina Tree Improvement programme). Intellectual property agreements and articles for the company were developed; the co-operative was established in 2014 and membership has grown to 6 full members and around a dozen associate members, with two recent additions to the membership indicating the ongoing attraction of 'better and quicker access to genetic material'. Associate Members can be forest owners, saw millers, nurseries and forestry companies in fact – 'anyone who has an interest in quality Sitka Spruce'. The co-operative's initial objectives were to:

- Ensure that there is an adequate supply of improved vegetatively propagated Sitka Spruce resource for growers.
- Take forward the breeding programme for Sitka Spruce.

For its investment, the co-operative has exclusive access to FR Sitka spruce Intellectual Property for twenty years; this means access to existing Sitka spruce clone banks as a basis for breeding work, and all data relating to breeding value estimations from field trials. While there may be some controversy over limited access to what was originally publicly-funded research, there is a strong argument that co-investment in this programme has engaged the

very stakeholders who are in a position to bring research findings into practice. 'From the very first meeting, they realised this was a worthwhile thing to be involved in. ... since we started, the engagement from the private sector is great; they realise the value of what they now have access to, and are putting money in, so the programme does not stagnate as it was but we are trying to add to and improve it.' Developments of the programme include consideration of new characteristics and new methods, such as using 'Acoustic Velocity' as an indirect measure of wood stiffness in living trees.

As Chair of the cooperative, Forest Research tree breeding expert Steve Lee acts as a neutral party among the private sector members and provides scientific advice. He has for many years worked with end-users and with nursery owners, learning about their needs as well as communicating what benefits research can bring, so that he is a trusted 'knowledge intermediary'.

With this pathway paved, FR has developed additional non-exclusive intellectual property agreements. Lessons are being learned that may benefit other public-private initiatives in the future. For example, a private sector member of the co-operative, observing that the process of working in cooperation with researchers is 'fascinating on a number of levels', offers this advice:

'When putting commercially driven people together with scientists, we work in different worlds but we need to connect, and this is about understanding each other's needs. ... You have to be able to listen and explain and use different languages. ... Go into it with an open mind and remember what specialisms or knowledge you can bring to the table to help others understand, and listen. Communication comes up again and again!'

3d. Tools to support forest management

Forest Research (FR) hosts a growing number of decision-support tools aimed at helping forest managers use research evidence in their day-to-day practice. Tools are often used in combination and sequence as "delivery vehicles...to aid, influence or inform...outcomes...based on evidence" (Scott et al., 2014). Understood as such, tools are one of FR's main vehicles for getting research into practice. Many of the tools are widely used across the sector and underpin decisions as diverse as tree planting, forest management and timber marketing. By making these tools available as software or online in a single location (www.forestry.gov.uk/fr/decisionsupport), FR is able to increase the uptake of research cost-effectively and at scale.

One of the most widely used of these tools is Forest Yield. The yield tables and other evidence contained in Forest Yield were produced over many years by a team of forest mensuration researchers based at the Alice Holt Research Station. Launched as a piece of software in 2016, Forest Yield aimed to make it simpler and faster for foresters to access the information they need on a daily basis to ensure their management is consistent with the principles of sustainable forestry.

Forest Yield is often used in combination with the Ecological Site Classification tool to work out what tree species to plant where (based on the grid reference of individual planting sites). The latest online version enables users to choose tree species that will be well adapted to future climates, based on climate change scenario research. Users are presented with suitability scores and yield predictions for different tree species under five climate scenarios (baseline, 2050 low/high and 2080 low/high).

The strength of the tool as a knowledge exchange mechanism is its user-friendly presentation of advice (see Figure 1), based on highly complex science whilst accounting for scientific uncertainty through the use of scenarios. The user does not need to understand the science behind the advice, but is quickly empowered to make more informed decisions that are likely to yield more effective long-term outcomes.

Other tools currently available include: the Managing for Timber Quality Decision Support System; Deer Model (a red deer population dynamics model); the Establishment Management Information System to guide upland restocking; ForestGALES, a decision support tool enabling forest managers to estimate the probability of wind damage conifer stands; and Herbicide Advisor.

Species	Baseline			2050 Lo			2050 HI			2080 Lo			2080 HI		
	Lim Factor	Suitability	Yield												
Scots Pine	SMRW		10												
Corsican Pine	AT5		6	SMRW		10	SMRW		10	SMRW		12	SMRW		12
Lodgepole Pine	AT5		14	DAMS		16									
Sitka Spruce	AT5		20	MD		16	MD		12	MD		14	MD		8
Norway Spruce	CT		14	CT		14	CT		14	CT		16	SMRS		12
European Larch	AT5		10	SMRW		8	SMRW		8	SMRW		8	MD		8
Japanese Larch	AT5		12	SMRS		10	MD		8	MD		8	MD		0
Douglas Fir	SMRW		10	SMRW		10	SMRW		8	SMRW		12	SMRW		10
Grand Fir	DAMS		18	SMRS		18	MD		14	MD		16	MD		6
Noble Fir	SMRW		16	SMRS		10	MD		10	MD		10	SMRS		6
Western Hemlock	DAMS		16	DAMS		18	SMRW		16	DAMS		18	MD		10
Red Cedar	DAMS		16	DAMS		18	MD		12	MD		14	MD		6
Silver Birch	AT5		8	SMRS		8									
Downy Birch	AT5		8	SMRS		4									
Sessile oak	AT5		4	SMRS		6	SMRS		6	SMRS		6	MD		6
Pedunculate oak	AT5		2	DAMS		4	DAMS		4	DAMS		4	SMRS		4
Beech	AT5		6	SMRW		4	SMRW		4	SMRW		4	SMRW		6

Figure 1: Future climate analysis output from third generation Ecological Site Classification tool

References

Forest Research Tools to support forest management decisions:
<https://www.forestry.gov.uk/fr/decisionsupport>

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3e. An example of Governance as a mechanism for promoting Knowledge Exchange: Programme-level steering groups resulting in a more holistic overview

Under the new FC Science and Innovation Strategy, steering groups for each of the seven programmes of work at Forest Research have been established. Each steering group is led by an FC Analyst and includes the FR Programme Leader and Policy representatives from each of the GB countries. We explored this area of Governance using one of Programmes as an exemplar. These new steering groups differed from previous steering groups (then termed 'Project Advisory Groups') by taking a programme-level approach rather than a very narrowly-focused 'project-based' approach. This has led to policy representatives on steering groups having a more holistic view of the research and has enabled an increase in 'systems' thinking (thus, a conceptual impact on the ways people think).

For the steering group examined, there was an indication that the increased breadth of work covered through programme-level governance has led to further specific impacts. These include: (a) policy representatives consulting and drawing in wider policy team members, thereby broadening policy engagement with the research; (b) stimulation of several new ways of approaching knowledge exchange to enable policy makers to be better sighted on the research and its outputs and to help translate science into policy (attitudinal/cultural impact, or new ways of thinking about or doing Knowledge Exchange). Examples of the latter include: the creation of a database of programme 'outputs'; establishing specific meetings with policy teams in individual countries to identify what research is emerging and its relevance to specific policy needs ('line of sight'), as well as determining the best formats and channels for communicating emerging and final results to policy teams; the development of a process for translating the many scientific journal publications produced from the programme into a useable format for policy makers (instrumental impact in the form of a change to the way the steering group operates to help 'science into policy'). Although this new steering group structure currently serves to oversee delivery and progress of commissioned work, it may provide opportunities for more inter-disciplinary working, co-design and 'systems thinking' when developing future work.

4. CASE STUDIES

4a. Climate mitigation potential of UK forests

Research summary

Research on the climate mitigation potential of UK forests is helping to deliver woodland expansion and multiple benefits from forestry for sustainable economic growth, two of the outcomes of the Forest Research (FR) Science and Innovation Strategy. Building on a strong track record, research has been broad-ranging, encompassing both social science (for example on “behavioural nudges” to encourage woodland creation for climate change mitigation; Moseley *et al.*, 2014) and natural science (for example on the growth potential of different trees under climate change scenarios; Synes *et al.*, 2015).

Core to the success of this research has been the development of the CARBINE model (originally developed nearly thirty years ago by Thompson and Matthews, and communicated in a Forestry Commission Research Information Note, 1989) to simulate Greenhouse Gas (GHG) emissions and removals from forests. The forest model includes carbon in plant matter, dead organic matter, soil and harvested wood products, and is driven by the area of land newly afforested each year. Changes in soil carbon are based on the University of Aberdeen’s ECOSSE model, which has itself been informed by empirical research by FR re-sampling and re-analysing soil survey samples to investigate changes in soil carbon on sites that were afforested after the original soil survey had been conducted. This part of the model is driven by estimated time series of land use transitions between semi-natural, cultivated (farm), woodland and urban land uses. Building on a long-term research base, more recent FR research has influenced both policy and practice, as described below.

Principal Users/Stakeholders

These include:

- National policy community: Forestry Commission GB and in the devolved administrations, Defra, Natural England, BEIS, devolved administrations and their agencies
- International policy community: European Commission, UN Framework Convention on Climate Change
- Practitioners: forestry management consultants and advisors, private woodland owners, other landowners interested in afforestation
- Others: forest research community in University and research institutes, forest NGO community, developers

Highlighted impacts on policy: research underpinning national legislative targets and international GHG reporting

A number of new impacts have arisen from FR research since this work was last reviewed (in 2013). FR research has supported national and international policy implementation through the deployment of GHG modeling of forests and their soils. This research has been pivotal in enabling the UK Government to set and achieve ambitious national climate change targets.

The Climate Change Act 2008 sets legislatively binding “carbon budget” targets every 5 years to reach the goal of reducing emissions of six GHGs to 80% below 1990 levels by 2050. FR work has delivered evidence to support policy-making in Defra and BEIS to deliver climate mitigation under the Act through new forest planting and the use of forest feedstock for bioenergy. Improved modeling of soil carbon by FR since the start of the current Science and Innovation Strategy has given Government new insights into the magnitude, timing and location of carbon removals, and enabled forestry to be compared with alternative mitigation measures in terms of value for money. This has helped Government set realistic carbon

budget targets under the Climate Change Act, as evidenced through the use of scenarios based on FR modeling in a range of policy documents.

FR research via the National Forest Inventory feeds into the UK's Land Use and Land Use Change reporting under the UK Greenhouse Gas Inventory, providing the basis for BEIS's reporting to the European Union and the UN Framework Convention on Climate Change on the UK's progress towards its Kyoto Protocol target. The inventory considers changes in Land Use, Land Use Change and Forestry in six categories, and the forest category is currently an important carbon sink - a role that FR research has helped to document.

Highlighted impacts on practice: the Woodland Carbon Code

Although the Woodland Carbon Code (WCC) started prior to the current research strategy, a robust programme of research from FR has supported its ongoing development and success. The Code is a voluntary standard, providing good practice guidance to woodland carbon projects and verifiable evidence of climate mitigation benefits to investors in woodland. By the end of 2015, a total of 220 projects were registered, covering 15,800 hectares and projected to sequester 5.8 million tonnes of carbon dioxide. More than 70 companies have bought credits from WCC projects. WCC projects to date have delivered 2.3M tonnes of validated carbon dioxide equivalents, and at least half of this has already been sold, generating over £6M private investment in woodland creation. Carbon benefits from WCC projects can only be traded within the UK, so these benefits can be included in the GHG Inventory towards the UK's national and international climate targets.

The WCC does not explicitly model project-level carbon dynamics, relying instead on look-up tables developed by FR, informed by the CARBINE modeling approach (look up tables available at <https://www.forestry.gov.uk/forestry/inf-d-8jue9t>). These tables provide estimates of annualised sequestration rates at 5-yearly intervals for a range of scenarios. They integrate estimates of soil carbon gains (during the life of a woodland) and losses (e.g. emissions from soil disturbance during planting), based on empirical work by FR. Online tools have been developed to help developers assess market and non-market benefits and research has been conducted into the wider social and environmental benefits of woodland creation arising from WCC projects (woodland benefits tool available at <https://www.forestry.gov.uk/forestry/inf-d-8rclla> and research reports and notes available at <https://www.forestry.gov.uk/forestry/inf-d-8rck8m>). Further work has been done to, and work is ongoing to develop an economic impact model for woodland creation projects based on both timber and carbon returns based on FR modeling. In conjunction with the carbon look-up tables, project developers can use an Ecological Site Classification tool (<http://www.forestry.gov.uk/esc>) developed by FR to assess likely tree growth rates (and factors limiting growth) on a particular site (given soil, slope, elevation, climate, temperature, wind-speeds etc).

In the UK, the WCC has been used as a template for developing the Peatland Code, which is owned and managed by the International Union for the Conservation of Nature's UK Peatland Programme (IUCN-UKPP) and successfully driving peatland restoration towards IUCN-UKPP's target of restoring a million hectares of peatland by 2020. The success of the WCC is also helping shape the natural capital policy agenda, through the work of the Natural Capital Committee and the Committee on Climate Change.

The WCC carbon look-up tables are recommended for use in official Forestry Commission guidance on "Carbon assessment in Environmental Statements relating to deforestation" (Operations Note 032). As a result they are used regularly by consultants and developers in the Environmental Impact Assessment process to calculate the amount of carbon likely to be lost due to removing trees as part of a development (e.g. wind farm). This information is then typically used to propose mitigation options as part of the planning process, and WCC look-up tables are used to calculate compensatory planting requirements.

Finally, new planning guidance in London (London Housing Supplementary Planning Guidance and Energy Planning Guidance, 2016) stipulates that all new homes built in London from November 2016 should be carbon neutral (commercial developments must be 35% below carbon emissions stipulated in 2013 building regulations), and where this is not possible should offset their emissions. WCC are in discussions to become one of a number of official offset options for the scheme. Look-up tables based on FR research are proposed to calculate the number of trees a developer would need to plant to meet the zero carbon target for their development.

Finally, the WCC has been held up as a good practice example of how to develop and run domestic Payments for Ecosystem Services schemes around the world. Much of this interest has been driven by the reputation of the WCC as an evidence-based scheme that is informed by the latest science; a reputation that has only been possible to achieve due to the close working relationship between the WCC and FR. For instance, the German government have been investigating domestic land-based climate mitigation options and have profiled examples of good practice across Europe including the WCC. The WCC team has also actively helped advise on the establishment and running of domestic carbon offset schemes in Turkey, France, Austria and South Korea.

Enabling research with potential for additional impacts

Future research for the WCC will further integrate soil carbon modeling into carbon look-up tables to provide a more robust basis for soil carbon estimates. Further empirical work on soil carbon changes after afforestation is ongoing, and research into the wider benefits (including cultural ecosystem services) is needed. There is demand from BEIS for more strategic and responsive research on climate related issues, as this is a priority area for them.

Routes towards impact

DECC (now BEIS) inputted to the development of the Science and Innovation Strategy via stakeholder workshops. Since then links have been primarily via relationships between key members of staff working in related areas. In particular, there is a close working relationship between staff from Forestry Commission using FR research to inform Government policy via Defra, BEIS and the devolved administrations. A number of FC staff work one or two days per week in Government departments, enabling collaborative working, however this mode of working is not common in FR. Although in general decreased funding has limited capacity for FR to respond quickly to policy and practice research needs, in some areas, private funding has driven new research that has responded to the needs of the practitioner community (e.g. plant, tree, soil and water testing, pest management, and technical advice to woodland managers and land based industries).

Lessons learned

Lessons for researchers

- Continuously expand upon direct links between FR researchers and members of the policy community in order to feed into and shape research priorities and the design and delivery of more policy-relevant research outcomes.

Lessons for stakeholders

- Continuously expand upon direct links with FR researchers to informally feed into and shape research in priority areas.

Lessons for funders and strategy-setters

- Continue to encourage FC staff to work in Government departments and consider how this may be extended to FR research on a wider basis than currently occurs.
- Recognise the value of long-term research as a platform which can be built upon by shorter-term research responding to policy/practice needs.

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4b. Silvicultural systems for resilient forests

Research Summary

Research on *Silvicultural Systems* is delivered as a specific Workarea (2.1) within Workpackage 2 on *Silviculture and Resilient Forests* within FR Programme 3 on *Delivering Resilient Forests*. Overall, Programme 3 aims to provide practical solutions for delivering resilient forests rather than assessing or understanding what resilience is. It contributes directly to two of the three outcomes in the *Science and Innovation Strategy for Forestry in Great Britain*, namely: Outcome 1 – An evidence base for delivering healthy and resilient forests and ecosystems, to enhance benefits to society; Outcome 2 - Providing the Knowledge to deliver woodland management and expansion, as a component of sustainable land use. The workpackage (WP2) on ‘*Silviculture and Resilient Forests*’ also contributes to Outcome 3 – Providing the evidence base to allow the forestry sector to deliver a wide range of benefits from forests and woodlands to support sustainable economic growth in Britain. Workpackage 2 contributes directly to two of the 36 Research Challenges in the overarching scoping document (Research Plan Brief) for the FR programme of work developed under the SIS: (i) *How do we design, cultivate and manage adaptive, resilient, productive forests?*; (ii) *What are the properties of trees that we are likely to grow for increased resilience?*

The Workarea aims to: ‘*Provide the scientific basis and associated technology transfer to ensure that alternative approaches to clear-felling using a range of species, deployed as pure and mixed stands, become part of the mainstream forestry practice in Britain*’. The work is directly integrated with Workpackage 3 (‘*Species and Resilient Forests*’) as it considers the deployment of current and emerging species in a range of silvicultural systems, including mixed-species stands. There are wider two-way links to other Programmes, e.g. to the Ecological Site Classification (ESC) tool (under further development in Programme 1) and to research on growth and yield modelling in Programme 6. The Workarea on *Silvicultural Systems* also supports various specific country level questions. The principle investigator is Gary Kerr at FR.

The workarea builds on previous research and initially focuses on: (a) Research on underplanting and a Practical Guide on ‘*Successful Underplanting*’, which also incorporates work on emerging species, drawing on a review of underplanting experiments and wider literature, plus practical experiences from FC Research Forests at Glentress (Scotland) and Clocaenog (Wales); (b) The Bradford-Hutt system for creating diverse and resilient forests; (c) research on mixed-species stands and collation of new and existing information into a future Practice Guide; (d) long-term transformation studies.

The outputs from this Workarea will underpin the expertise required to deliver sustainable management as outlined in the UK Forest Standard and the UK Woodland Assurance Scheme.

Principle users and stakeholders

Policy users: Forestry Commission GB; FC countries.

Operational end-users: Forest managers (public and private) and forest management consultants; small but growing numbers of community-owned woodlands.

Other stakeholders: Wider governmental and non-governmental stakeholders interested in the economic benefits and wider ecosystem services associated with low-impact silvicultural systems (e.g. supporting policies on climate change, landscape, soil, water, and biodiversity); FR researchers in multi-disciplinary work; and the wider science community.

Highlighted Impacts on policy

The desired impact stated by FC Policy makers is that “*Alternatives approaches to clearfelling become part of mainstream forestry practice*”. The Workarea's policy impacts

therefore related primarily to the implementation of policy and delivery of resilience and associated economic and ecosystem service benefits. The research has contributed to increasing policy-makers' understanding and confidence in the range of alternative silvicultural practices available in place of traditional clear-felling-and-replanting practices, especially low-impact systems with diverse age, species and stand structures. Previous research has instrumentally supported continuous cover forest management being incorporated into the UK Forest Standard, UK Woodland Assurance Standard and some grant systems. This current research provides an evidence base supporting a wider range of alternative silvicultural systems, including the use of mixed-species stands. There is an increased level of confidence in more-complex systems, which policy makers and practitioners may have shied away from previously, reflecting conceptual impacts.

Highlighted impacts on practice

A range of Practice Guides have been instrumental in facilitating transformation of clear-fell-and-replanting woodlands to alternative systems. These Practice Guides can be continually updated with new research and experiences and are a powerful way of collating and consolidating information for practical use, especially when linked to other more-face-to-face knowledge exchange as part of the advisory and technology transfer elements of the current work. The use of two specific Practice Guides was particularly illustrative of instrumental and capability-related impacts, with one external woodland manager commenting:

'The research has been instrumental. We were quite open to the philosophy of continuous cover forestry but were missing key bits of resources. The Forestry Commission information was instrumental to us making that final step to formalise continuous cover on that site combined with our own skills and knowledge on the ground.' (Thinning Practice Guide)

'There is a lot of good practice brought together in the guide and we've taken that advice and followed through. We did an ESC (Ecological Site Classification) assessment and replanted with coast redwood and western red cedar. We followed two bits of advice – the ESC tool to decide what to replant with and the underplanting guide to implement the replanting – so the ESC and underplanting guide worked together. The guide also brings together people's experience from other places and it's a useful piece of work.' (Successful Underplanting Guide)

Although the research is primarily intended to help deliver long-term resilience, there is evidence that it is also contributing 'now' to help adapt to new disease problems in situations where forest managers want to avoid clear-felling, e.g. *Dothistroma* on pine, *Chalara* on ash and *Phytophthora* on larch. The work has therefore had immediate impact beyond the original longer-term aims with different FC staff providing the following feedback on the guide:

'Well authored, usable, relevant and high on the agenda at present.'

'I can see it being an increasingly important document to help deploy resources intelligently to introduce new species into forests. Diseases are a driver that has helped FR focus on real threats. This generation of forest managers needs to step up and do things intelligently and in a measured way without over-reacting. We need to adapt our thinking on how to diversify forests.'

Advisory visits and seminars given by FR researchers have also had conceptual impacts in raising awareness and building confidence in alternative silvicultural systems, such as continuous cover forestry. A specific example was a recently organised seminar with a local Woodland Advisory Group that was also attended by a local company who were an FC contractor specialised in timber forecasting and the use of digital sensing tools. Data were collected using their modern assessment approaches and entered the same day into the FR spread sheets on 'Thinning Complex CCF Stands' to produce thinning targets for transformation of that specific woodland. The external stakeholder who organised the day

reported that this was the first time these had been brought together and demonstrated, stating that:

'We felt like we were pioneering something and were ground breaking. Continuous cover is often deemed to be expensive and for extremists and cranks. But by presenting it as cutting edge we won people over and they became more confident. There's not enough data and evidence, but with tools and survey data techniques it's moved to a sounder knowledge base and there's reliable data now for people to know where they're going with it. It's people's livelihood and they don't want to enter into it without confidence, and that's now happening.'

Overall, the research and its knowledge transfer continues to support capability-building for implementing alternative silviculture systems, including through training, advice and evidence:

'Skills and knowledge in silviculture have diminished over the years and we needed in-house training backed-up by input from research. We drew heavily on the research base.'

Routes towards impact

Impacts from the silvicultural-systems research have occurred through: provision of publicly available tools (e.g. Practice Guides); a range of individual or organisational knowledge intermediaries; key researchers interacting directly with policymakers and practitioners; and capacity-building.

The FC website is a key resource and this forms a central part of FC's communication strategy for this work, resulting in capability-building impacts, especially through distillations of research findings, including those from other research areas, and practitioner experiences in Practice Guides and other Decision Support Tools:

'I knew I could get access to on-line Forestry Commission tools from previous experience with the Ecological Site Classification tool and other tools. I was sure I'd find the information that I needed and I did. The Forestry Commission website is very useful.'

A wide range of knowledge intermediaries were identified as key routes for realising impact from the research. These include:

- A cadre of forest managers responsible for FC Research Forests and demonstration sites who are implementing alternative silvicultural systems and are trusted champions.
- Other private or public woodland owners and managers, such as woodland officers in National Parks, as well as private forestry-management consultants, e.g. through dissemination, training and demonstration activities.
- FC and Forest Enterprise (FE) regional and local staff under various titles, e.g. FC Woodland Officers, Woodland Creation and Resilience Advisers, Partnership and Expertise Managers, Land Managers who facilitate knowledge exchange and are trusted and engaged links between researchers/research (from inside and outside FR) and practitioners.
- External stakeholder groups, large and small, such as: the Continuous Cover Forestry Group (CCF-Group) whose membership includes private woodland owners, managers and consultants as well as FC/FR representatives on GB and country-level committees; the Wessex Silviculture Group (Chaired by FR) deemed by a key stakeholder as being "a brilliant example of how connected FR are and of good two-way interaction".
- The internal State Forest Service Continuous Cover Forestry Group (FSF-CCFG, composed of policy makers and practitioners from the UK and Ireland State Sector and FR researchers), though mainly now used for dissemination and cross-country communication.

- The International Union of Forest Research Organisations (IUFRO), where the FR coordinates the ‘Research Group on Uneven-Aged Silviculture’, is an enduring connection to European and more global research with important reputational and capability impacts.
- A more-specific European linkage to the private sector AFI Research Network and its networks of irregularly-managed stands is facilitated through private sector intermediaries and provides opportunities for exposing researchers and practitioners to wider ideas.

In most cases, knowledge intermediaries were facilitating both outwards and inwards knowledge exchange, but there were some specific examples of inwards knowledge exchange that informed the direction of research or supported its outputs:

- The incorporation of practitioners’ experiences into Practice Guides, facilitated through enduring connectivity between researchers and practitioners over the course of many years.
- The conception of the ‘Bradford-Hutt System’ research via a meeting of the FSF-CCFG’s England sub-group involving an on-site interaction between the FR researchers and FC practitioners/policy makers; such early and on-going interaction is likely to result in increased uptake of the outputs due to the end-users’ sense of ownership.
- The CCF-Group’s 2014 research priorities being loosely reflected within the FR programmes, though limited by financial constraints.

FR researchers were also acting directly as key knowledge intermediaries, e.g. through specific interactions and also by acting as links between the different FC countries and between FC and the wider sector:

“Personal connections are really important for knowledge exchange as well as connecting to the whole sector through events. The sector generally works better through personal contact and having these connections makes the difference. It’s a small sector so researchers can have a big impact through key people and make a big difference.”

A significant proportion of the silvicultural-systems work is dedicated to engagement, advice and knowledge exchange to increase capability for deploying alternative silvicultural systems. Training, advice, visits and teaching took various forms, for example:

- There was widespread demand for, and recognition of the value of, FC/FR training courses by practitioners, alongside that also provided by the private sector.
- There was clear evidence for advisory visits to individuals or groups of public or private sector forest management practitioners by FR staff had a very significant two-way impact, as well as more-direct communication with FC end-users, with one stakeholder commenting:

‘We have now set up 6-monthly meetings between individuals from FR and our [FC] Forest and Land Management functions and the direction of travel is better now.’

- Lectures on silvicultural systems were given by FR to Oxford University forest-management students, positively influencing the next generation of forest managers.

Lessons learned

Lessons for researchers

Continue to invest in direct interactions, relationships and two-way knowledge and expertise exchange with policy makers, practitioners and researchers (inside and outside FR), especially key influencers and knowledge intermediaries, to optimise impact.

Lessons for stakeholders

Consider how to engage more effectively with FC/FR in the co-design of the research, paying particular attention to exploring opportunities for co-funding and adding-value. This could include: increasing the profile and visibility of the CCF-Group's framework of research priorities; increasing use of public (non-FC) and private woods as research and demonstration sites for sharing expertise and knowledge, and for raising public awareness and interest; helping FC identify and access the wider research and expertise base outside FR to help build capability. Consider combining training of 'beat' foresters (improving confidence, knowledge and attitudes to alternative silvicultural systems) along with higher-level culture change by forest managers.

Lessons for funders and strategy-setters

Evidence is still lagging behind policy, which is likely to have an impact on the uptake of alternative silvicultural practices. Consider publishing practical guides more quickly.

Engage more with stakeholders (science, policy, practice and funders) on co-ownership, co-design and co-investment of this specific area of research. Pay particular attention to: opportunities to engage with both small and large stakeholders, and with external scientists, to widen the focus of the research; the need for trusted knowledge brokers (individuals and existing groups); ensuring areas of inter-dependent silviculture, modelling and socio-economic research are better integrated into a more-holistic approach (e.g. through 'question-based frameworks'). Consider more explicit use of the CCF-Group's research priorities as a framework for initiating transparent co-design to encourage co-ownership and co-investment, perhaps through proactive development of a wider and shared strategy for 'Implementing alternative silviculture systems'. Given concerns over lack of data on performance, growth and yield within alternative silvicultural systems acting as a barrier to uptake of new practices, explore ways to build upon the private sector's attempts to generate data and associated models, and also approaches for determining wider economic and ecosystem-service benefits from alternative silvicultural systems.

Consider the balance of funding for long-term research and the value of maintaining long-term experiments as a strategic national resource to meet future challenges and questions.

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5. KEY FINDINGS AND RECOMMENDATIONS

Key Findings

Learning organisation

The Forestry Commission has exhibited commendable good practice by behaving as a 'learning organisation': commissioning and publishing an evaluation¹⁰ of its earlier Science and Innovation Strategy in 2012 in advance of work on a new strategy; publishing its response to the evaluation's recommendations; and then in many ways shaping its subsequent actions in developing the next Strategy accordingly, as well as then commissioning this follow-up evaluation. Key findings of this current evaluation, in effect a mid-term review, are captured in our view of progression against the original 2012 recommendations. (Table 1 summarises progress and updates recommendations.)

2012 Recommendation 1 was to *increase stakeholder engagement*. The Forestry Commission accomplished this in the initial stage of developing the current Strategy, primarily through consultation workshops in which stakeholders were explicitly asked for input into priority directions for science and innovation. These workshops were well-received and the input appears to have been used in the early development of the Strategy, although there is subsequent 'opacity' as to how those early discussions were translated into specific programmes of research. There have been some small areas of co-funding and some engagement in co-designed/joint strategies, such as a National Tree Breeding Strategy led by the wider sector. A commercial-sector representative was placed as a member of the Expert Committee on Forest Science, and many individual projects also worked to engage stakeholders, as part of the ongoing knowledge exchange activities of the established programmes.

2012 Recommendation 2 was to *improve awareness of Knowledge Exchange processes, publish FR proposals and reports, and capture impacts*. A significant enhancement to the Strategy was to launch FR's Programme 7 with an explicit mandate to increase understanding of knowledge exchange and impacts on policy and practice. In addition, FR programmes have been published on a redesigned, more accessible website and the programmes' Descriptions of Work consider impacts, albeit as outputs. There is also a Strategic Publications Group and an identifiable pipeline of outputs.

2012 Recommendation 3 was to *identify, engage and leverage the knowledge exchange potential of diverse knowledge intermediaries*. There is little evidence that knowledge intermediaries have been formally identified. However, there is evidence of continuing/ongoing interaction with a range of organisations, groups and individuals with that role, with examples including the Forestry Commission and Forest Enterprise practitioners (local and District Forest Managers that link to wider public and private sector end-users; local Partnership and Expertise Managers and Woodland Officers) and sector-based groups and fora such as the Continuous Cover Forestry Group). In addition placing Institute of Chartered Foresters members on research governance 'groups' and dissemination of results through private and charity sector groups have all helped tap into a wider pool of knowledge intermediaries.

2012 Recommendation 4 was to *produce a communications plan, with advice from stakeholders*. A communications plan has been developed and a Strategic Publications Group established with a schedule of outputs. Not only has the website been revamped effectively, but also a continuing commitment to dissemination is evident through various FR outputs and knowledge exchange approaches.

2012 Recommendation 5 was to *take a strategic view and fit with the wider research landscape*, considering wider research agendas and creating/extending capability for

¹⁰ Available at: [https://forestry.gov.uk/pdf/Impact-Evaluation-of-Research_2013.pdf/\\$FILE/Impact-Evaluation-of-Research_2013.pdf](https://forestry.gov.uk/pdf/Impact-Evaluation-of-Research_2013.pdf/$FILE/Impact-Evaluation-of-Research_2013.pdf)

delivery. Several examples of actions along these lines have occurred. The stakeholder consultations during the development of the new Strategy helped broaden its strategic context, alongside improved alignment of the Strategy with wider strategic agendas (such as the Evidence Strategy for Defra and its Network, 2014¹¹). There has been achievement of 'line of sight' with country drivers (e.g. the FC 'Desired-Impact Tool' and the FR programmes themselves); and links through to EU ERA-Nets such as Woodwisdom), the LWEC Partnership (UK-level) and CAMERAS (national-level, Scotland) facilitate agenda-sharing with other funders. These develop and broaden access to external capability and leverage joint research efforts through FC's External Programme funding.

2012 Recommendation 6 was to *encourage interdisciplinary collaboration, in particular exploring the socio-economic dimensions* of issues. FR programmes do reference *multi-disciplinary* working and FC have taken a potentially multi-disciplinary approach to Steering Groups in FR Programmes. Two key changes under the new Strategy are beginning to help promote genuine *interdisciplinarity*. Programme 7 is charged with directly encouraging and facilitating interdisciplinary thinking/work and the matrix approach of FR Programme structures encourages some to undertake interdisciplinary or systems approaches/thinking. There is some more limited evidence for interdisciplinary working in future research planning. FC have also continued to support FR access in the 2015/16 round of calls under the interdisciplinary LWEC Tree Health and Plant Biosecurity initiative, resulting in FR involvement in new interdisciplinary projects that deliver more strategic research.

2012 Recommendation 7 was to *increase transparency of funding meant for knowledge exchange*, compared to research. Whilst the (pre-existing) commitment of 25% to knowledge exchange activities continues, it is not ring-fenced within the FR programmes or sub-programme budgets, leaving open the interpretation of what counts as knowledge exchange. For many, it is publication in academic journals; for others it is conventional dissemination to stakeholders; for some it is the building up of informal trusted relationships with individual stakeholders or stakeholder organisations. Communications and Research Liaison staff have dedicated roles. There have been occasions when FC-GB funding has picked up dissemination/knowledge exchange costs when FC countries have funded specific research, hence adding value. The FC Analytical team, funded from outside the research programmes, are also key facilitators and brokers of end-to-end knowledge exchange, helping to link science, policy and practice through that critical intermediary role.

Updated and New Recommendations

Our view is that the Recommendations in the 2012 evaluation are still relevant. However, in light of our findings we have expanded and updated them. In addition, we now make two new recommendations relating to co-investment and appropriate governance. This refreshed set of recommendations should help deliver the needs of a range of end-users and achieve best value from limited resources.

Recommendation 1: Transparent co-design and prioritisation of research

Build upon enhanced engagement of stakeholders to involve diverse stakeholders in co-design and transparent prioritisation: at the level of the Strategy itself, in a light-touch but responsive refreshing, as well as (especially) at the programme and project (work packages and work areas) levels to ensure the right research questions are identified, prioritised and then addressed on an ongoing and adaptive basis (using capability within and outside of FR, within the funds available). Continue interactions between researchers and diverse stakeholders as research is being conducted throughout the lifetime of the Strategy, to maintain engagement and co-ownership, with feedback loops.

¹¹ Available at: <https://www.gov.uk/government/publications/evidence-strategy-for-defra-and-its-network>

2017 Recommendation 2: Increased focus on generating and capturing impacts

Improve awareness not only of 'knowledge exchange' mechanisms but also of 'impacts' (of different types, including instrumental impacts, conceptual impacts, capacity-building, attitude/culture change and enduring connectivity) as they unfold over developmental stages. Take advantage of FR's Programme 7 learning in this regard. Utilise 'critical reflection' and identify 'impact champions' who can disseminate/model best practice and help researchers move towards and capture progress towards impacts (for example via impact templates or plans). In defining beginning-to-end 'knowledge exchange' plans (beyond 'communications plans' that may focus more on dissemination of outputs), shift the emphasis to a shared and on-going dialogue with stakeholders about 'impact-generation' processes that could enhance the likelihood of research having non-academic impacts among end-users. In this way, improve reporting against the Strategy to include 'stakeholder agreed' success criteria and improve reviewing (with stakeholders) on the effectiveness of knowledge exchange processes. Reporting against the Strategy by both FC and FR should also focus more on (a range of) impacts derived from the research and not just conventionally quantifiable metrics such as publications or financial leverage, although these are also important. Consider introducing approaches to tracking impacts and their developmental stages to enable FR staff (at project and/or programme level) to collect evidence pertaining to impact throughout the research cycle.

2017 Recommendation 3: Pro-active use of knowledge intermediaries

Consider ways to identify and involve Knowledge Intermediaries at Strategy, programme and project (work package/work area) levels. Encourage individuals such as appropriate external stakeholder representatives on steering groups, alongside FC end-users, to take on the role of wider Knowledge Intermediaries in pro-active ways. Furthermore, make effective use of existing stakeholder groups and fora where possible, making explicit the important role of knowledge intermediaries.

2017 Recommendation 4: Planning for end-to-end knowledge exchange and impact generation

Expand objectives of a 'Communications Plans' such that they become 'Knowledge Exchange and Impact Plans' (at both Strategy and Programme/Sub-programme levels), embracing two-way, on-going dialogues as well as dissemination. Take advice from stakeholders and when possible involve them in the co-design and delivery of research and also in knowledge exchange/forms of communication, with 'impact generation' as an explicit goal.

2017 Recommendation 5: Partnership working for capability building and delivery

Continue to take a strategic view as to how FR research fits into a wider - and changing - research landscape. When possible align with relevant current and emerging research agendas of key bodies. Co-design with other funders to ensure full coverage of key issues across the whole 'strategic to applied' span, and call attention to the distinctive capabilities within FR. While retaining important agility to leverage strategic opportunities that arise, review the scope, purpose and implementation of the External Programme funding to optimise collaborations with co-funders in order to support the development of strategic partnerships between FR and external researchers and access or consolidate external capability complementary to FR. Consider a more strategic and, where possible, co-funded PhD programme in light of upcoming needs.

2017 Recommendation 6: Supporting interdisciplinary working and innovation

Pursue, facilitate and support genuine interdisciplinary research and innovation when appropriate to address multi-faceted problems. Include exploration of socio-economic dimensions when sensible to do so. Accepting that interdisciplinarity is not always necessary but when appropriate it can be a powerful source of innovation, continue to build

interdisciplinary capacity in training across FR, facilitating the exchange of methodological expertise, ideas and approaches between staff in different areas. Consider naming 'interdisciplinary champions' in steering groups and/or programme leadership and consider a specific fund to specifically encourage interdisciplinary efforts to gel and to support seed-corn-related research innovation in general at FR.

2017 Recommendation 7: Resourcing knowledge exchange for impact

Be transparent and indeed explicit as to funding for knowledge exchange/impact generation as an investment adding value to achievements under the Strategy. Produce knowledge exchange/impact-generation plans at project level (e.g. envisioned pathways or simple logic model templates) as well as at programme level (e.g. a theory of change for a portfolio of projects) and, with the help of Programme 7, share critical learning about relevant processes and capture impacts/early indicators of impacts-in-progress. Consider having some specific, ring-fenced funding available, perhaps in Programme 7, which could be accessed competitively as a top-up when projects identify new opportunities for activities that would enhance the likelihood of impacts, for example facilitating early co-design with end-users or translating research understanding into policy or practice).

2017 New Recommendation 8: Approaches, processes and tools for co-ownership and co-investment

Expand current pursuit of co-investment from a range of partners, appropriate to research questions identified as priorities for the various stakeholders. Learn about coalitions from previous models or experiences (such as the Sitka Co-op, National Tree Improvement Strategy, the Future Proofing Plant Health programme and ERA-nets). Aim to shape decisions through co-design with stakeholders, identifying gaps and including additional collaborators and/or co-investors as needed. Encourage all involved to take ownership and responsibility for the journey from transparent research design through research delivery to embedded use of research findings (impacts). Where possible, engage with existing groups/fora to benefit from their networks and avoid 'stakeholder fatigue'.

2017 New Recommendation 9: Principles for governance and research management

Consider what is needed to achieve added value and synergy, rather than duplication or gaps, in research (whatever the future of the funding landscape). Recognise clearly the challenges inherent in identifying, balancing and prioritising research to deliver to the needs of a range of often quite different stakeholders - while achieving best value in the context of limited resources. So, for example, whatever the future holds, address the need for (in some form) the knowledge brokerage role currently performed by FC-CFS. Implementation of aims (such as, perhaps, those captured in recommendations here) should be tracked and considered in an on-going way by an appropriate higher-level governance body (currently, this might be the Research Strategy Management Board or the Expert Committee for Forest Science).

Table 1. Recommendations: evidence for progress and opportunities for further progress and impact

No.	Recommendation (2012)	FC Response (2013)	Evidence of progress (2017 Evaluation)	Further opportunities for impact (2017)
1	<p>Genuinely involve a range of stakeholders in knowledge exchange:</p> <ul style="list-style-type: none"> - Early in the strategy-setting/problem-framing stage; investigate the impacts they are looking for. - Throughout the research process in ongoing dialogues with greater transparency about progress. - Later in dissemination of findings. 	<ul style="list-style-type: none"> - Stakeholders to be more engaged on SIS development to ensure focus and impact. - Release interim results and consider a range of dissemination media. - <i>“National Expertise Teams.”</i> - <i>“Knowledge Exchange Reference Groups.”</i> - <i>“Forest & Woodland Advisory Committees.”</i> 	<ul style="list-style-type: none"> - Workshops/consultations on SIS. - Some small areas of sector co-funding. - Some co-designed/joint strategies and research priorities such as the National Tree Breeding Strategy. - Commercial sector member placed on Expert Committee on Forest Science and involved in the peer review of FR research brief and programmes. - FR/FC stakeholder engagement via varied routes such as advisory visits, training, events, meetings, user groups, governance structures, stakeholder groups and websites. 	<ul style="list-style-type: none"> - Increase co-design, prioritisation and co-funding activity in any refresh process. - Increase stakeholder involvement during lifetime of SIS, including at programme and project levels.
2	<p>Improve awareness amongst researchers, managers and stakeholders of knowledge exchange processes that can lead to impacts:</p> <ul style="list-style-type: none"> - A more informative annual SIS report. - Better access to research proposals and reports. - Develop a habit of describing and capturing impacts. 	<ul style="list-style-type: none"> - Research proposals will consider impacts. - Proposals published on FC website. - Will produce annual reports and seek stakeholder feedback on improvement. - Regularly assess impacts and translating science into policy/practice. 	<ul style="list-style-type: none"> - FR Programmes published on the FC website. - Websites revamped and information easily accessible and appreciated by users. - <i>Descriptions of Work</i> consider impacts (but as outputs, as does the <i>FC Desired Impact Tool</i>). - FR Programme 7 is a key initiative that is enhancing the translation of science into policy, awareness of impact generation processes and assessment of impacts. 	<ul style="list-style-type: none"> - Use FR Programme 7 to increase further awareness of impacts amongst researchers and stakeholders and help develop Knowledge Exchange Plans. - Increase dialogue with stakeholders about impact generation processes of relevance to end users including the development of some stakeholder-agreed success criteria. - Consider introducing processes to track a range of impacts and their development and realisation. - Report impacts in Annual SIS Reports.
3	<p>Consider who are best placed to act as knowledge intermediaries:</p> <ul style="list-style-type: none"> - in the Forestry Commission (including Forest Research). - in the wider forestry sector (individuals or organisations). - engage with them in order to enhance impacts and leverage contacts with stakeholders. 	<ul style="list-style-type: none"> - FC will consider further how best to deliver. - Need to deliver knowledge consistently to diverse stakeholder community. - Need to achieve balance for key scientists between research and dissemination activities. - Need to ensure knowledge intermediaries have sufficient training and knowledge. - Will explore alternative media to reduce burden on key staff and stakeholders. - <i>“Deer Initiative Partnership” exemplar.</i> 	<ul style="list-style-type: none"> - Little evidence that knowledge intermediaries have been formally identified but evidence of on-going interactions with a range of individuals and organisations (for example using ICF members on research governance groups; dissemination of results through private and charity sector groups as well as FC-CFS Analysts, FC regional staff and forest managers). 	<ul style="list-style-type: none"> - Encourage external stakeholders on steering groups, as appropriate, and a wider range of FC end users to take on knowledge intermediary roles, with a focus on facilitating two-way knowledge and expertise exchange. - Make effective use of existing stakeholder groups and fora as knowledge intermediaries.

No.	Recommendation (2012)	FC Response (2013)	Evidence of progress (2017 Evaluation)	Further opportunities for impact (2017)
4	<p>Develop a communications plan to help disseminate impacts:</p> <ul style="list-style-type: none"> - Take advice from stakeholders on the best approaches and timing to optimise impacts. 	<ul style="list-style-type: none"> - Communications plan under development. - Strategic Publications Group established to ensure publications targeted towards right audiences, media and events for greatest impact. 	<ul style="list-style-type: none"> - Strategic Publications Group has produced a schedule of outputs. - Communications Plan developed. - Effective website revamp. - Commitment to dissemination demonstrated (for example via governance structures, decision support tools/guides, research summaries, excellent website, one-to-one interactions and advisory work). 	<ul style="list-style-type: none"> - Expand objectives of Communications Plans at Strategy and Programme/Sub-programme level so that they become Knowledge Exchange and Impact Plans. - Explore increased opportunities for involving stakeholders in the co-design and delivery of research with impact generation as a specific goal.
5	<p>Take a strategic view of how the SIS fits into the wider research agenda and how to create delivery capability and capacity:</p> <ul style="list-style-type: none"> - Determine the role and critical mass of FR. - Consider how FR can connect with the others in research community to enhance evidence base and impacts. 	<ul style="list-style-type: none"> - SIS consultation makes explicit links to other strategies. - Commitment to partnership working and collaboration to leverage of FC resources and access external expertise. - Role and critical mass of FR will be explored outside of the strategy. - 10% of funds to external providers. - <i>“The SIS will complement the Defra ONE Business Project which looks to co-ordinate robust processes for identifying and meeting evidence needs across the Defra network.”</i> 	<ul style="list-style-type: none"> - SIS consultation with other strategy setters. - SIS alignment to wider strategic agendas such as the Evidence Strategy for Defra and its Network. - Line of sight with Country policy drivers in Impact Tool and FR Programmes. - ERA-Nets, LWEC/CAMERAS link FC to the agendas of other funders facilitating FC access to external capability by leverage through the FC External Programme. - FR participation in networks and collaborative projects and partnerships also facilitated through the FC External Programme. 	<ul style="list-style-type: none"> - Continue to align the SIS with emerging agendas of other research funders. - Look to co-design with other funders to cover span of strategic to applied research and utilise the distinctive capabilities within FR. - Review scope, purpose and implementation of the External Programme funding in order to optimise collaborations with co-funders and further develop strategic partnerships with external researchers. - Consider a more strategic and, where possible, co-funded PhD programme.
6	<p>Consider how interdisciplinary research can be encouraged by SIS:</p> <ul style="list-style-type: none"> - To address complex problems. - To explore socio-economic dimensions of solutions. 	<ul style="list-style-type: none"> - Strong commitment to interdisciplinary research in SIS and extending the reach of social science. - <i>“OPAL & OBSERVATREE exemplars based on interdisciplinary and partnership working.”</i> - <i>“Successful bids into Tree Health & Plant Biosecurity Initiative requiring interdisciplinary working with physical and social scientists.”</i> 	<ul style="list-style-type: none"> - FR Programmes reference multidisciplinary working. - Some evidence for interdisciplinary working in future research planning. - Steering Groups include multidisciplinary expertise. - Programme 7 directly encouraging and facilitating interdisciplinary thinking. - FR Programme-level (matrix) approach encourages interdisciplinary and systems approaches/thinking. 	<ul style="list-style-type: none"> - Continue to build interdisciplinary capacity across training in FR. - Consider naming ‘interdisciplinary champions’ in FR programmes and on steering groups. - Consider specific funding for priming interdisciplinary efforts and innovation more generally.

No.	Recommendation (2012)	FC Response (2013)	Evidence of progress (2017 Evaluation)	Further opportunities for impact (2017)
7	<p>Consider providing greater transparency on funding for knowledge exchange:</p> <p>-How much of the scientific resources goes into research and how much into providing advice to policy makers and the forestry sector at large?</p>	<ul style="list-style-type: none"> - Committed to a 75:25 split between science and knowledge exchange. - Will review to see if balance is right. 	<ul style="list-style-type: none"> - 25% commitment continues, but it is not ring-fenced within programme or WP/WA budgets. - Noticeable downwards trend in number of publications (see SIS Annual Report metrics). - FC-SIS funding of dissemination activities for work funded by countries (for example <i>Hylobius</i> integrated management journal papers, practice note, training, advice and guidance to sector). 	<ul style="list-style-type: none"> - Produce knowledge exchange/impact plans at project and programme levels. - With the help of Programme 7, share learning about processes and how to capture impacts/impacts in progress. - Consider ring-fencing funds, perhaps in Programme 7, for topping up activities that could enhance impact generation (for example facilitating early co-design with end users).
8	<p>Expand current pursuit of co-investment from a range of partners:</p> <p>- Create approaches, processes and tools for co-ownership and co-investment through co-design.</p>	<p>New recommendation</p>	<p>Vignettes and analyses in current evaluation provide insights into models that could be used:</p> <ul style="list-style-type: none"> - Sitka Co-op and National Tree Breeding Strategy. - AOD Collaborative funding. - Analysis of the FC External Programme co-funding approaches such as Woodwisdom ERA-Nets, Future Proofing Plant Health project, joint PhD programmes. 	<ul style="list-style-type: none"> - Learn from varied models and experiences of other collaborative strategies, approaches, processes and tools that can facilitate co-funding. - Co-design projects with stakeholders. - Encourage all involved to take ownership of journey from transparent research design through research delivery to embedded use of findings (impacts).
9	<p>Consider what is needed to achieve value and synergy in research, paying special attention to:</p> <ul style="list-style-type: none"> - Governance. - Knowledge and expertise brokers. - Research base and critical mass. 	<p>New recommendation</p>	<p>Vignettes and analyses in current evaluation provide various insights on:</p> <ul style="list-style-type: none"> - Governance. - Knowledge brokerage role played by FC-CFS Analysts. - Decision Support Tools (GB level development and value). - Silviculture systems research base and connectivity, use of knowledge intermediaries, synergies between work areas and sectors, networks of long-term experiments. -FC External Programme experience in building capability and optimising co-investment opportunities with other funders. 	<ul style="list-style-type: none"> - Recognise challenges inherent in balancing research for diverse stakeholders with limited resources. - Address the need for knowledge brokerage role now done by FC-CFS. - Designate appropriate higher level body to oversee and track on going progress towards aims.

ANNEX A: Framework of core questions

Question
I. OVERVIEW OF STRATEGY & IMPACTS
I.1 Did having this Strategy make a difference? Have policymaking and/or innovation in the forestry sector been influenced? If so, how? If not, why not?
I.2 Does the Strategy offer sufficient scope and/or flexibility to deal with opportunities or issues arising, new developments or emerging stakeholder needs?
II. IMPACTS:
II.1 What are stakeholders doing (or thinking or planning to do) differently as a result of the research undertaken?
II.2 What sorts of impacts did projects have? (Conceptual, Instrumental, Capacity-building, Enduring Connectivity, Attitude/Culture Change)
II.3 Can some “impacts-in-progress” be identified?
II.4 Are there missed opportunities where research has been done but not had sufficient impact?” If not, why not?
III. IMPACT-GENERATING PROCESSES
III.1 Through what sort of process(es) did the Strategy lead via commissioned work/projects to any sorts of impacts?
III.2 What obstacles or enabling/facilitating factors have made/could make a difference?
III.3 Can “Inflection” points be identified that could enhance likelihood of impact generation? (e.g. framing of research needs, commissioning/selecting projects, conduct of research, engagement with stakeholders, interaction with Knowledge Intermediaries, networking, dissemination to various sorts of stakeholders, etc.) What is or isn’t working?
III.4 Adequacy of Communication—are we getting messages across?
III.5 Do stakeholders want to be more involved? If so, what kind of involvement? At what stage/process do stakeholders feel they should have been involved?
III.6 What roles if any have been played by “Knowledge Intermediaries”?
IV. LESSONS LEARNED/INSIGHTS FOR THE FUTURE
IV.1 How can the Forestry Commission refine and/or implement its strategy to make it more likely that impacts will be generated in the future? (What lessons learned are commended to the Forestry Commission?)
IV.2 What lessons learned would benefit future researchers and/or stakeholders in the generation of impacts?
IV.3 What mechanisms would be helpful in picking up impacts (or impacts-in-progress) and/or developing a useful baseline for future evaluations?

ANNEX B: Semi-structured interview template (basic form)

I. Overview

I.A. How have you interacted with the Strategy or its implementation? (Are you aware of the Strategy *per se*, or more specifically one or more component research efforts?) Have you interacted with Forestry Commission supported research for enough years to potentially have seen any differences under this Strategy as opposed to the old one?

I.B. As an overview, in general, do you think having this Strategy has made a difference? - in terms of influencing policymaking and/or innovation in the forestry sector? If so, how? If not, why not? Is there a different tone or coverage or effectiveness of this Strategy compared to the preceding situation? (For example, this Strategy placed a strong emphasis on knowledge exchange, early engagement of stakeholders, etc.)

I.C. Have you seen any either positive or negative examples of the Strategy offering sufficient scope or flexibility to deal with issues arising, whether new problems, new stakeholder needs, new developments or new opportunities?

II. Types of impacts

II.A. More specifically, here are 5 types of impacts; have you seen examples of any of them? (whether fully-developed impacts or 'impacts-in-progress')

1. "Broadly, *instrumental use* refers to the direct impact of research on policy and practice decisions. It identifies the influence of a specific piece of research in making a specific decision or in defining the solution to a specific problem, and represents a widely held view of what research use means."
2. "*Conceptual use* is a much more wide-ranging definition of research use, comprising the complex and often indirect ways in which research can have an impact on the knowledge, understanding and attitudes of policy makers and practitioners. It happens where research changes ways of thinking, alerting policy makers and practitioners to an issue or playing a more general 'consciousness-raising role'. Such uses of research may be less demonstrable but are not less important than more instrumental forms of use".
3. *Capacity-building* covers a range of impacts, often involving training for example.
4. *Enduring Connectivity* between researchers and research users, such that they stay in touch, visit and perhaps even seek to work together subsequent to a funded piece of work.... enhancing the likelihood of internalisation of research findings and thus impact.
5. *Attitudinal/Cultural Change* such that researchers or stakeholders (or both) change their views of Knowledge Exchange. Positive attitudes are conducive to continued collaboration and indeed impact.

II.B. In short, are stakeholders doing, or thinking, or planning to do anything differently as a result of this Strategy?

II.C. Are there examples of missed opportunities where research could have made an impact, but didn't? What could be learned from that?

III. Impact-generating processes

III.A. What sorts of processes or mechanisms connected research commissioned by the Strategy with impacts/impacts-in-progress?

III.B. Have there been enabling factors that have made a difference? (or were missing, but could have made a difference?). Have there been obstacles in the way?

III.C. For example, a role often seen to be important is that of 'Knowledge Intermediary', an individual or entity that facilitates mutual understanding between researchers and stakeholders. Have you seen any examples of that role?

III.D. Is communication adequate? Are messages and understanding getting across? Have you seen changes in the way the Forestry Commission communicates? Are there particular forms of FC communication that you find useful? or not? Recommendations?

III.E. At what stage have you seen stakeholders being involved? Has their involvement had an influence? Do you think that the level of stakeholder engagement is any higher than under the previous Strategy?

III.F. Can "Inflection" points be identified that could enhance likelihood of impact generation? (e.g. framing of research needs, commissioning/selecting projects, conduct of research, engagement with stakeholders, interaction with Knowledge Intermediaries, networking, dissemination to various sorts of stakeholders, etc.) What is or isn't working?

IV. Lessons learned/Insights for the Future

IV.A How can the Forestry Commission refine and/or implement its strategy to make it more likely that impacts will be generated in the future? (What lessons learned would you offer to the Forestry Commission?)

IV.B. Do you have any lessons learned for either researchers or stakeholders, to make it more likely that impacts will be generated in the future?

IV.C. Do you have any suggestions for how impacts/impacts-in-progress can be picked up, tracked and/or evaluated in the future?

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