TAPIO

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Tools for improving science-policy interaction in forestry –

Approaches in Leveraging Forest Research in Northern and Central European Countries

Risto Päivinen and Liisa Käär (editors)

Tools for improving science-policy interaction in forestry -

Approaches in Leveraging Forest Research in

Northern and Central European Countries

PROCEEDINGS

of

SNS-EFINORD Network meeting and international workshop

Tools for improving science-policy interaction in forestry

May 15-16, 2018

Hosted by NIBIO and Skogkurs (Forestry Extension Institute), Biri, Norway

Edited by
Risto Päivinen and Liisa Käär

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NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH
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Foreword

Research results contribute to policy-making through different processes and organizations in different countries. The importance of streamlining processes that bring science to policy support is increasing at the international and national levels. However, international cooperation and awareness of concepts in neighboring countries has so far been limited.

This network aims to speed up the process of turning research results into effective practical forestry applications and support for policy making in the participating countries, by:

- Creating a Northern European network for exchanging experiences on, and developing instruments for, bringing research results to policy support
- Organizing an international workshop to carry out benchmarking
- Developing applications for further Nordic and European projects that can identify best practices for transferring forest science to practical applications and policy support

In these proceedings, presentations of the SNS-EFINORD Network international workshop *"Tools for improving science-policy interaction in forestry* "in Biri, Norway in May 15-16, 2018 are gathered. Country reports on interaction between forest research and forest policy include Estonia, Finland, France, Germany, Iceland, Norway, Poland and UK.

The concluding remarks from the presentations and discussions at the end of the meeting (by professor Maria Brockhaus) included the following:

- "Very rich and diverse country-context specific examples allowed for deep insights in interactions and active interfaces, different roles and different perspectives were presented.
- Countries faced many similar issues with regard to science and policy interactions, among both policy makers and scientists
    - For scientists, e.g. the risk of ignorance of science input, delay of funding and research processes, pressures to fit the dominant discourse, etc.
    - For policy makers and administration, e.g. challenges related to often ad hoc emerging policy processes and resulting needs for evidence, as well as lack of incentive structures to ensure quality of received information, etc.
- Country case discussions highlighted an often absent theory of change regarding sciene-policy interactions. To which changes in which ways the science policy-interaction can contribute, and how?
- Also highlighted was the problem of lack of information over the actors in science-policy interaction: what are the underlying interests, funding sources, agendas of those involved in the interfaces?
- A major gap identified during the workshop: limited discussion on *impact,* evaluation of what are the aims and intended changes these interfaces were set up to achieve, linking back to the earlier point on theories of change."

We would like to thank SNS and EFINORD for making resources available for the network activities, all participants of the workshop and other authors of the proceedings for their valuable contributions. Special thanks to the NIBIO and Skogkurs (Forestry Extension Institute) for providing facilities and staff for organizing the workshop.

Risto Päivinen Liisa Käär

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Examples of international cooperation on science-policy interaction in the field of Forest and Environment

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1. Introduction

The concept of Evidence Based Policy (EBP) was introduced in 1990´s as an extension of Evidence Based Medicine (Cochrane *et al.* 1979) to all areas of public policy. The EBP refers to situations whereby scientific evidence is used as a basis for policy making rather than the other way around - when politicians pick certain research results to support their own agenda.

One of the first organisations promoting EBP was Campbell Collaboration (2018). It conducts reviews on the evidence regarding educational and social practices and policies. The organisation describes itself as a "nonprofit organization that aims to help people make well-informed decisions about the effects of interventions in the social, behavioral, and educational arenas".

At general level, the EU has declared its efforts to make sure that Commission proposals and activities are based on sound scientific evidence (European Commission 2015). In the field of forest and environmental policies, there are a number of approaches towards Evidence Based Policy making.

The EU forest strategy includes the following orientations: “The Commission will also assist Member States and stakeholders in transferring technological and scientific knowledge to forest practice and the market.” (European Commission, 2013). The Commission has expressed the need for science-policy interaction, particularly in the field of environmental policy: “Especially in the area of the environment, it is important for researchers to communicate scientific findings in an appropriate and accessible way to policy makers in order for them to make the right choices in drawing up policies aiming at sustainable solutions to environmental problems. An improved dialogue between the scientific and policy making communities is necessary to improve linkages between policy needs and research programmes as well as to enhance the accessibility of scientific knowledge to policy makers.” (European Commission, 2018)

In the European forest policy process – Forest Europe (2015) – already in the 2003 Vienna conference, the Signatory Countries committed themselves to more than only supporting research; their aim was to: “Make forest-related decisions based on science, take measures that support, and strengthen research and increase interdisciplinary research.” Four years later, the Warsaw conference resolutions highlighted the importance of the “effective measures to improve understanding between policy makers, practitioners and the scientific community in order to better use scientific knowledge and research results relevant to forests and the forest sector as a sound basis for decision making”. The most recent conference in Madrid in 2015 considered science - policy integration necessary to enhance competitiveness within the whole forest sector (Forest Europe, 2015).

At global level, United Nations Environment Programme has analysed the gap in collaboration between scientists and policy makers, and concluded that closing it would be necessary to protect the globe and its people (UNEP 2017). They identify two trends: First, researchers are re-aligning their work to be more useful for policy-making by looking for solutions having implications to citizens in the countries. Secondly,

stakeholder groups have become more aware of the fact that lack of knowledge is hampering their ability to influence policy development. UNEP report suggests that non-governmental actors should be more involved in the policy making, and scientific information should be more easily available. There is a need to reform the decision-making processes by placing greater emphasis on research and quality data in informing policy development, and to introduce the term ´Evidence Informed Decision Making (EIDM)´ describing this process.

2. Scope for the science-policy interface

The science-policy interface includes "many ways in which scientists, policy makers and others link up to communicate, exchange ideas and jointly develop knowledge for enriching policy, decision-making processes and research." (Hove et. al., 2014). The concept has often been expanded to the science-policy-practice interface (Weichselgartner and Kasperson 2010, Stewart et.al., 2014).
In order to increase the use of the science in policy making and practice, donors have required the involvement of users of research results in the research projects, through steering committees or other forms of panels. In addition, today's research reports more often include policy recommendations or suggestions for the practical use of the results. Policy questions are, however, often broad and complex, and cannot be solved using knowledge gained within a single research project or program. Young et al. (2014), express the view that transforming scientific evidence into a usable knowledge "is neither automatic or straightforward". Moreover, Vogel et. al. (2007) conclude that the scientific output is often not what practitioners or policy makers need or its timing and format is not suitable for their use. There may also be communication problems between the producers and users of the results.

A very common case is that researchers feel obliged to report all reservations and preconditions for implementing their results. Practitioners are then confused to see too many reservations and have difficulties to understand how to utilize the research findings. Researchers may also be concerned that too close collaboration with practitioners decrease their credibility as scientists, if not otherwise, at least by limiting the time used for their main products – peer reviewed publications. Consequently, stakeholders may consider that their legitimate concerns are not addressed in the research (Vogel et. al., 2007).

Many of the problems related to the low impact of the research results can be traced back to the so-called 'linear' model of communication, in which the scientific facts are transmitted to policy makers to be used in solving policy problems. Several authors demand for a shift from a puzzle-solving linear model towards a more integrated non-linear interaction of science for policy (Koetz et. al., 2011, Young et.al., 2014).

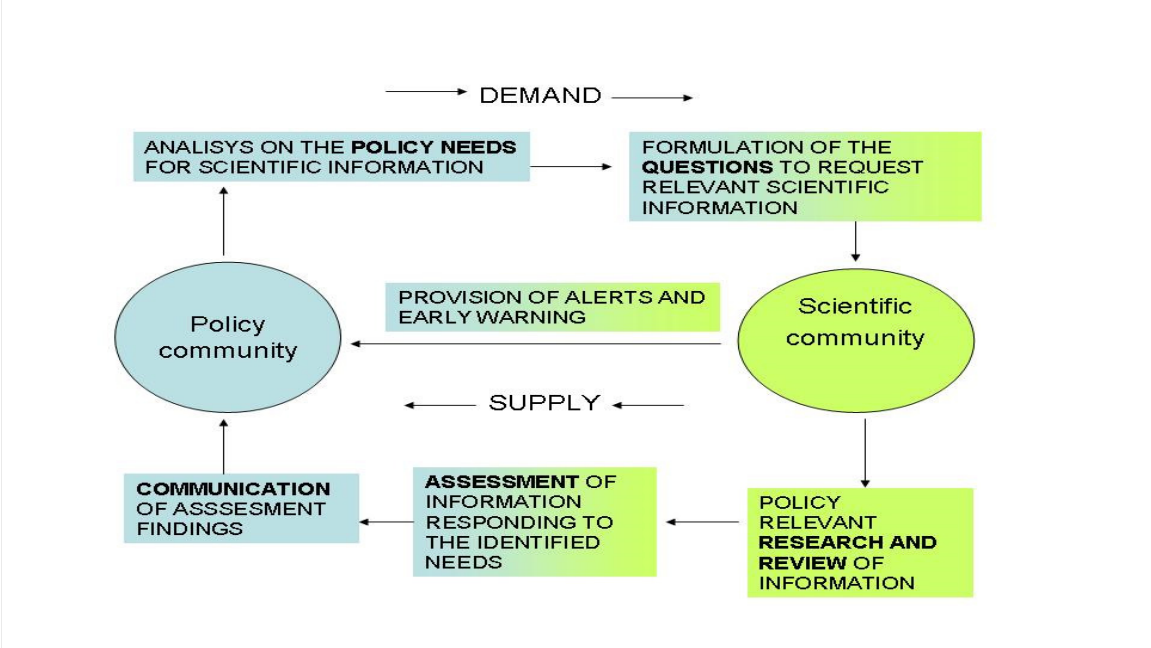


Figure 1. The cycle of the science-policy interface (IUCN 2010).

Figure 1 describes the policy-science interface where policy and science communities interact and meet to discuss three main issues: the formulation of the research questions, the provision of alerts, and the assessment of the information responding to the policy needs (IUCN 2010). In this approach, the linear, one-way communication is replaced by an interactive system with feedback from the policy side.

The figure also describes policy and science communities as being separate, which may reflect the reality in most countries. This type of 'silo effect' can occur within both science and policy communities. Individuals in different policy sectors or disciplines may have different motives for producing and using knowledge. Young et.al. (2014) argue that in order to avoid the silo effects, "it seems critical that any recommendations to improve science-policy communication also promote interdisciplinary integration on the science side and cross-sectoral integration on the policy side."

The most important attributes of effective science-policy interphase cited in the literature are as follows (Cash et. al. 2003, IUCN 2010):

1. Relevance, reflecting the ability to link the issues on which decision makers focus.
2. Credibility, reflecting the believability of knowledge to a user of scientific results and facts, models, scenarios and options behind them.
3. Legitimacy, referring to political acceptability, transparency and trust of the process in the science-policy interface.

3. Examples of initiatives towards evidence-based forest and environmental policies

In the following, we concentrate in three examples:

3.1. The Intergovernmental Science- Policy Platform on Biodiversity and Ecosystem Services (IPBES)
3.2. Global Forest Expert Panel, GFEP by IUFRO, and
3.3. ThinkForest, the policy support facility within the European Forest Institute.

3.1. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

Probably the best-known example on the science-policy interaction at the global level is the International Panel on Climate Change (IPCC), established under United Nations in 1988. Its main activity is to synthetise scientific findings on the elements of climate change and bring the results to the political processes in a demonstrative and easily digestible manner.

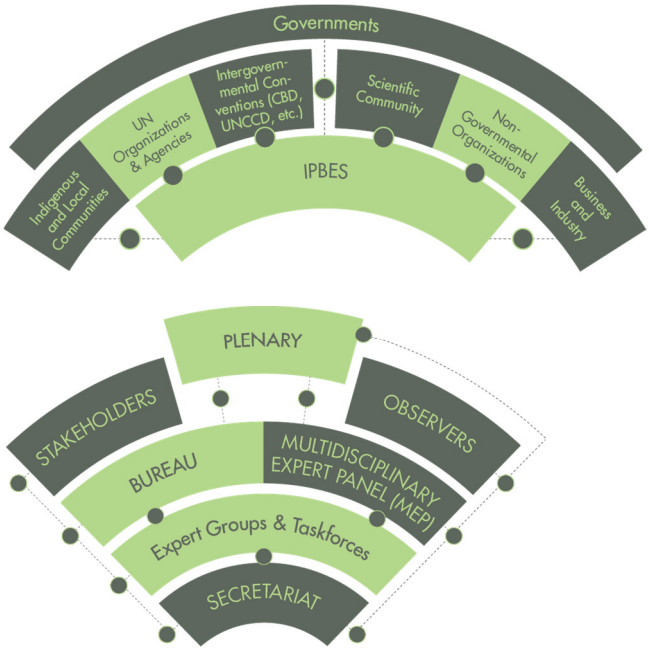
To some extent, Biodiversity and Ecosystem Services (IPBES 2015) does for biodiversity what the IPCC does for climate change. IPBES provides a mechanism to assess and synthetise relevant information on biodiversity generated by the scientific community. It was established in 2012 as an independent international organization open to all United Nations member countries.

IPBES mission is to strengthen knowledge foundations for better policy through science, for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development. The European initiatives, the European Platform for Biodiversity Research Strategy (EPBRS 2015) and The Science for EU Environment Policy Interface (SEPI 2015) launched in 2010, work today under auspices of IPBES.

The main outcomes of the IPBES are assessments, policy support, capacity building and outreach.

Assessments may concern specific themes and methodological issues at both the regional and global levels. Policy support includes identifying policy-relevant tools to solve environmental problems, facilitating their use, and catalyzing their further development. Capacity and knowledge building consists of identifying the

priority capacity, knowledge and data needs of the IPBES member States, experts and stakeholders. Communications and outreach aims at ensuring the widest reach and impact for the work.



- 128 member states
- Budget 2018 8,5 Mill USD

Selected scientists and knowledgeholders carrying out the IPBES and other assessments and other deliverables.

Figure 2. The organization of IPBES.

The first IPBES thematic assessment on pollinators, pollination and food production, was completed in 2016 – the result of two years of intensive work by 77 experts from all over the world. The assessment cites about 3,000 scientific papers and includes information about practices based on indigenous and local knowledge from more than 60 locations around the world. Its summary for policy makers was approved word-by-word by the IPBES Plenary.

Some findings and key messages of the first IPBES thematic assessment (IPBES 2016):

- Up to $577 billion worth of annual global food production relies on direct contributions by pollinators.
- Agricultural production dependent on animal pollination has increased by 300% over the past 50 years, but pollinator dependent crops show lower growth and stability in yield than crops that do not depend on pollinators.
- Nearly 90% of all wild flowering plants depend to some extent on animal pollination.
- 16% of vertebrate pollinators are threatened with global extinction - increasing to 30 per cent for island species - with a trend towards more extinctions.

3.2. Global Forest Expert Panel - GFEP

The Global Forest Expert Panel (GFEP) initiative was established within the framework of the Collaborative Partnership on Forests (CPF), and it is led and coordinated by the International Union of Forest Research Organizations (IUFRO). It builds on the political recognition provided by the United Nations Forum on Forests and the Convention on Biological Diversity (IUFRO 2018).

GFEP provides a mechanism for effectively linking the information requirements of governments and intergovernmental processes related to forests and trees with existing scientific expertise. Rather than

conducting new research, the initiative is designed to consolidate available information and expertise in relevant fields.

GFEP produces assessment reports on key issues that reflect state-of-the-art understanding of the subject matter and are written so that they are comprehensible to policy makers and stakeholders. The reports are prepared by thematic Expert Panels consisting of internationally recognized scientific experts. All reports undergo rigorous peer reviews. The number and frequency of reports is determined by the information needs and requests coming from the intergovernmental processes.

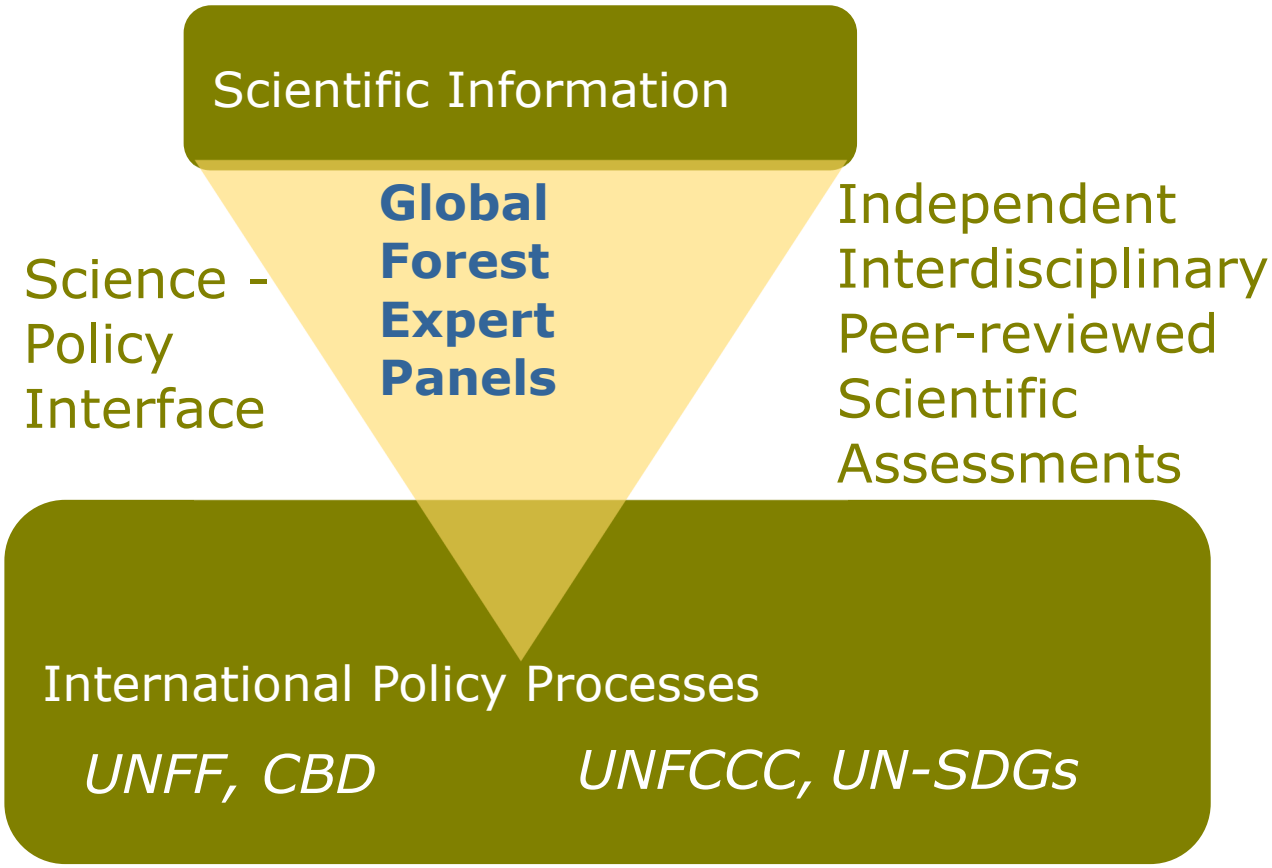


Figure 3. The main elements of GFEP.

Thematic reports include the Adaptation of Forests and People to Climate Change, the International Forest Governance, Biodiversity, Forest Management and REDD+, Forests and Food Security, Illegal Logging and Related Timber Trade and the latest, Forests and Water in 2018. Tens of researchers around the world have collaborated on the publications under the coordination of the International Union of Forest Research (IUFRO 2018).

Assessments are undertaken by thematic Expert Panels – groups of internationally recognized scientific experts selected by the GFEP team, keeping in mind the scientific, regional and gender balance. Panel members include scientists serving as Coordinating Lead Authors (CLAs) and Lead Authors (LAs) of chapters; Contributing Authors may be involved as needed. Scientific experts participate in their personal capacity and do not represent any organization or institution, the Panels meet physically at least 2-3 times during the assessment. The basic idea is not to carry out new research but assessment of existing scientific literature and information on a given topic. Publication of results is done through comprehensive peer reviewed assessment reports and 'policy briefs' for decision and policymakers.

Reports have been launched and study results have been disseminated within the framework of global policy processes (UNFCCC, CBD, UNFF). The publications have received considerable international media uptake worldwide (e.g. by BBC Online, Conversation, Mongabay, Voice of America, UN News Centre, Reuters, Science Daily, Deutsche Welle).

3.3. ThinkForest

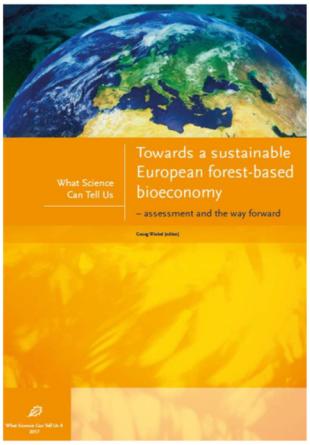
ThinkForest is a European high-level forum on the future of forests. It aims to provide a unique science-policy interface and an inspiring and dynamic platform for science-policy dialogue (EFI 2018). ThinkForest works to identify information needs related to forest policy questions and build a common understanding of the problems at hand. By helping policy makers navigate through the wealth of information on offer and providing them with the best available expertise and the latest research-based information from the scientific community, it enables informed decision making on strategic forest issues.

ThinkForest is chaired by the former Swedish Prime Minister Mr. Göran Persson. Since 2012, 17 events have been held, attended by over 1000 people. Modus operandi for policy support work within the ThinkForest is often as follows: A report on scientific evidence on the topic is prepared by the secretariat at the European Forest Institute and a research group selected for the topic. The recent topics include forest fires, forests and water, governance issues, bioeconomy and Natura 2000.

Second element is a ThinkForest science-policy seminar in Brussels or in some of the participating countries. Typically 2-4 ThinkForest events are organised annually. The participants include Members of the European Parliament, commissioners, ministers, EC civil servants, stakeholders, scientists and media.

A request for an activity can come from the Steering Committee, consisting of representatives from ThinkForest donor countries or from EFI bodies. Study timetable varies from 4 months to 1.5 year. Sometimes an open call is launched, which takes time and is more costly, but allows larger participation.

Science-Policy Report + Executive Summary:



ThinkForest science-policy seminar in Brussels and MDTF countries

- Typically 2-4 TF events/year
- Participants: *MEPs, commissioners, ministers, EC civil servants, stakeholders scientists, media,*
- ThinkForest President: Göran Persson

Figure 4. Typical *modus operandi* for Policy Support work.

The following principles are applied:

- Studies should be neutral, and based on scientific publications
- Analytical work is carried out by individuals or organizations who have no conflict of interest in the study subject

- It is based on already existing research (Think Forest organizes the collection, coordination, and synthesis of the scientific work)
- EFI capitalizes on its own and member organizations' research and networks, and also on global scientific knowledge from other organizations and other disciplines.

Regarding the pending activities, there are 6 proposals for 2018-2019:
1. Bark beetle disturbances: Causes, impacts and adaptation strategies
2. Europe post 2020 - New perspectives on forest policy and governance
3. Improving Pan-European awareness and skills against forest fires
4. Afforestation and plantation forests: Potential and impacts in Europe
5. China-Europe Bioeconomy
6. Forest and Water

EFI's policy support activities, including ThinkForest, are funded by a Multi-Donor Trust Fund, which was first established by EFI member countries for the period of 2015-2017. In 2017, the funding was decided to be continued for another 3-year period. The current donors are: Austria, Czech Republic, Finland, France, Germany, Ireland, Italy, Norway, Spain & Sweden (Poland considering to join in 2019).

The added value of the foresight and policy support activities financed by the Multi Donor Trust Fund is generated through the professional policy work based on scientific excellence. The well-known research platform ensures the independence of assessments. Opposing views and different research outcomes can be considered in the synthesis reviews. Outcomes of the assessments will be communicated to target groups in a concise way. A timely recognition of upcoming topics ensures impact on policy discussions. Likewise, the topics should be relevant for the ongoing or coming policy discussions. Different target groups can be consulted in selecting the topics and places of the events.

4. Discussion

The following recommendations regarding good practices and approaches in the field of science-policy interaction can be found in the literature:

In order to be able to handle complex issues related to climate change, protection of biodiversity, forest products trade and trade-offs between various aspects of sustainability, among others, the experts involved must be interdisciplinary on the science side and cross-sectoral on the side of policy making and practice (Young et. al. 2014).

The scientists, policy makers and practitioners participating in various roles on the panels should be aware of processes in fields other than their own. Scientists should be willing to engage themselves to a policy arena and bear the associated risks (Guldin 2003). Policy makers and practitioners should bring questions relevant for their work to the process, but at the same time understand what types of questions can be answered by a scientific approach.

In order to protect the credibility of any science-policy-practice interface, scientific independence cannot be compromised in any way. However, the ways of communication should not be dictated only by scientific traditions, they should also be complemented by the needs of the users of science. For this reason, it is necessary to find incentives for scientists to devote time for activities that do not directly support the writing of peer-reviewed publications (Sarkki et. al. 2014).

The UN report (UNEP 2017) concludes that science-policy activities should aim at more than the synthesis of scientific research only. To influence policy where the existing availability of evidence alone has not influenced outcomes, there are two special hurdles to science-policy activities being effective in this mission: 1) Working with divergent viewpoints: Improved outcomes come from engaging policy makers who hold significantly divergent viewpoints on the importance of the environment, but whose decisions influence environmental outcomes, for example, officials in economy or agriculture-related ministries.

2) Dealing with complexity: Policy processes are also complex – with interactions of multiple parties producing uncertain outcomes. Achieving the Sustainable Development Goals requires scientific advice on the complex interactions between goals achievement, which are dynamic, non-linear and uncertain.

A relevant question is, what communication tools are the most cost-effective: face-to-face, telephone, email, meetings with interest groups, written reports, websites and social media. Research on science-policy activities shows that personal communication is the most frequent way to introduce scientific evidence to the decision makers (UN 2017, Janse 2007).

There are also warnings regarding the approaches used in evidence-based policies. Critical voices (Cairney 2016) argue that supporters of the idea underestimate the complexity of policy- making and misunderstand the way of making policy decisions. Saltelli and Giampietro (2017) bring up the risks that using statistical indicators and mathematical modelling as a basis for policies can generate only partial solutions which may even be outside the context of the subject matter. They suggest ´quantitative storytelling´, taking the ambiguous political environment into account, as a less controversial, more socially robust alternative to the presently used quantitative analysis in evidence-based policy.

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The science-policy interface in an international context – circumboreal cooperation

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Abstract: The circumboreal cooperation initiative

The *Circumboreal Cooperation* initiative aims at strengthening cooperation on forest matters in the boreal region and is built around the themes of (a) boreal forests and climate change; (b) boreal forest and the bioeconomy; and the cross-cutting theme (c) science-policy interface.

The involved countries are Canada, the United States, Norway, Sweden, Finland and the Russian Federation. The International Boreal Forest Research Association (IBFRA) – a cooperative effort between forest scientists to promote and coordinate research related to boreal forests – is also part of the cooperation. The UNECE and the FAO participate as observers.

The cooperation was established in 2012 at the initiative of the Canadian and Swedish ministers responsible for forests. The work is led by a high-level group comprised of directors-general for the countries' forest authorities/ministries. A working group (the *Circumboreal Working Group, or CWG)* functions as the secretariat and is responsible for implementing the work program and have the mandate to decide on actions within the framework of the work programme. The President of IBFRA is a member of the working group.

Meetings of the high-level group are usually held in conjunction with an IBFRA conference or UNECE and FAO meetings, in order to maximize the participation potential of both scientists and policy-makers.

1. Introduction

Boreal forests grow in high-latitude environments consisting of cold-tolerant tree species such as spruce, larch, fir, pine, poplar and birch. Analogous conditions can be found in mountainous regions at high elevations. The boreal domain represents about 30 percent of global forest area and has large tracts with little or no human influence. Boreal forests are found mainly in six countries (Canada, Finland, Norway, the Russian Federation, Sweden, and the United States of America), all in the northern hemisphere where they surround the increasingly important Arctic Ocean watershed (see Figure 1).

[1] *Based on the work by the Circumboreal Working Group, for further information: Dr. Gerben Janse, Swedish Forest Agency, Vallgatan 8, 55183 Jönköping, Sweden. E-mail: Gerben.janse@skogsstyrelsen.se*

Brandt et al.
Figure 1

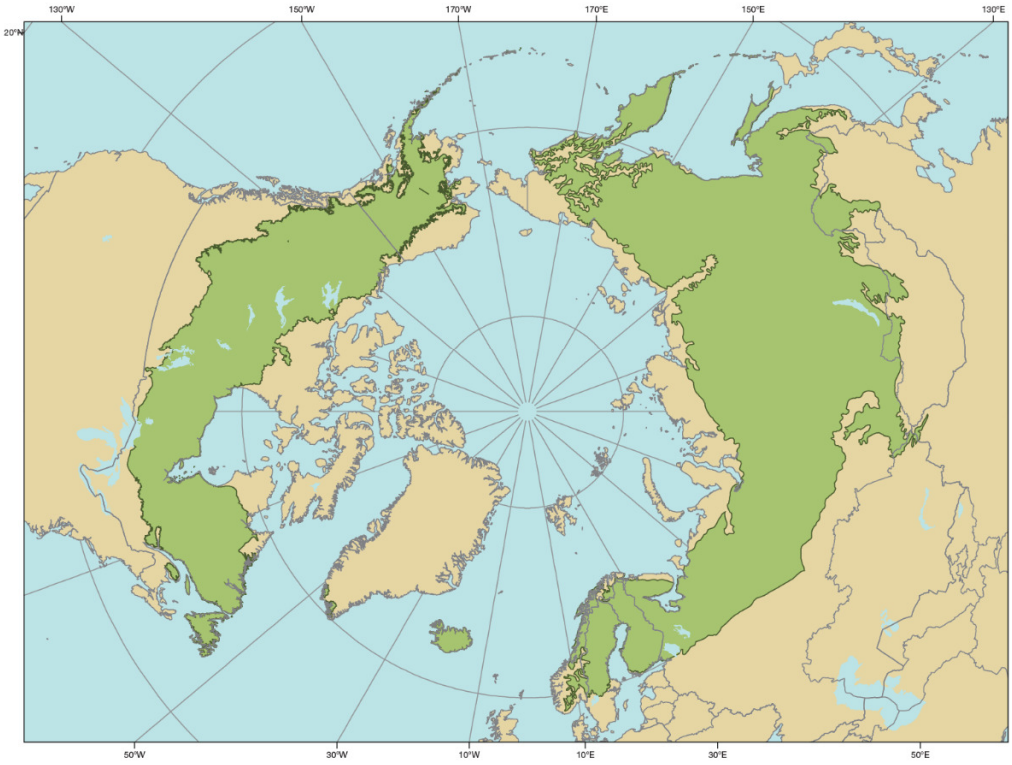

Figure 1. Distribution of the circumboreal zone (Eurasia based on Lavrenko and Sochava 1954, Ahti et al. 1968, Denisov 1970, and Kurnaev 1990; North America is that of Brandt 2009).

The Russian Federation has both the largest forest area in the world (815 million ha) and the largest boreal forest. The Russian boreal forest is estimated to account for 88% of all Russian forest land (717 million ha), and about 60% of the world's boreal forests. Canada has the next largest area of boreal forest, about 270 million ha of forest, which is more than three quarters of Canada's forest land. The United States of America has approximately 40-50 million ha of boreal forest, accounting for 13-16% of its total forest area (310 million ha). Norway's, Sweden's and Finland's forests (12 million ha, 28 million ha, 22 million ha, respectively) fall mainly within the boreal zone.

The boreal biome contains more surface freshwater than any other biome in the world, and about one-third of the biome is underlain by permafrost. Boreal trees, soils and peatlands constitute the largest terrestrial carbon pool with 559 Gt C (mostly stored in soils and permafrost), and thus play a key role in regulating the global climate.[2] While currently a carbon sink globally, boreal forests could turn into a carbon source due to increased incidences of disturbance by insects and fire, and to the increased decomposition of organic deposits following soil warming and the thawing of permafrost. The boreal forest offers opportunities to reduce greenhouse gas emissions and to increase carbon removals from the atmosphere, thereby contributing to the aim of the Paris Agreement to achieve a balance between anthropogenic emissions and removals by the second half of this century. Implementation of long-term management and wood use strategies would be necessary to realize these opportunities.

2. Policy background

At the global level, the overarching policy context for all is provided by Agenda 2030 and the Sustainable Development Goals. Questions pertaining to the role forests (can) play in achieving the SDGs permeate many

[2] *Enhancing work on boreal forests. COFO/2014/7.3a.*

of the sectorial policy discussions. An additional policy context can be found in the UNFCCC's Paris Agreement.

As two of the six cooperating countries are EU member states – i.e. Finland and Sweden – and Norway is a member of the EEA (European Economic Area) the EU policy context plays a role as well.

When it comes to national policy development there are some governance-related differences. For example, Canada, the Russian Federation and the United States are federal states – e.g. forest policies may to varying extent be decided at the state/territory level – whereas Finland, Norway and Sweden are unitary states with a more centralized form of forest governance. In general, however, forest governance in the boreal region is well developed and stable. Forest land tenure is generally clear and secure, and governance models for different types of ownership are well established and based on longstanding legal traditions.

Patterns of forest ownership vary across the countries containing boreal forests. All of Russia's forests are federally owned. Most of Canada's forest (90%) is owned and managed on behalf of Canadians by provincial and territorial governments as public land; Of the remaining 10% of Canada's forest land, 2% is federally controlled, 2% is owned by indigenous peoples, and 6% is under private ownership. More than one-half of all U.S. forest land is privately owned. However, the vast majority of boreal forest in the USA is found in Alaska, where it is primarily in federal ownership. Forest land in Norway, Sweden and Finland is mostly in private ownership: about 80% in Norway, 75% in Sweden and 70% in Finland.

Looking at the interplay between policy-making and the scientific community there are some differences as well. Whereas the forest authorities in the US and Canada have their own research branch internalized within their organizations, the other four countries have a system where forest authority and forest research are separate entities.

3. Rationale for science-policy interface focus

Since the start of the circumboreal cooperation process it was clear that a focus on the science-policy interface would have to permeate the work done in the cooperation. In general, most would agree that policy development logically needs a firm basis in scientific evidence. However, that most likely holds true even more for forest policy as it deals with a natural resource of large ecological variety, manifold biotic and abiotic effects and influences and complicated interlinkages between economic, social and ecological functions. Forest authorities in the boreal countries either directly or indirectly have forest research as a part of their day to day work – either with forest research being a part of the mandate of the authority or through close cooperation with forest research (governmental) organisations.

In spite of these tightly interwoven relationships between forest authorities and forest research in the respective boreal countries some gaps were identified. Researchers often cooperate with colleagues internationally. However, it was deemed very difficult to get a clear overview of all the cooperative efforts and – most importantly – scientific output with relevance to the whole circumboreal region. In addition, due to the complexity surrounding the challenges faced by boreal forests, policy-makers and scientists needed to be able to discuss issues such as: what are currently the most pressing policy concerns? What information is needed to strengthen policy development? What are the most relevant research questions?
By discussing this an attempt can be made to align the policy and research agenda somewhat and enable a stronger science-policy interface, with policy being able to indicate to scientists which questions they face and scientists being able to inform policy-makers of the current state-of-the-art, possible future directions of research. With greater mutual understanding opportunities arise such as e.g. increased or specific research funding; tailored scientific briefings to policy-makers.

4. Recent developments

On the 26th of June 2018 a Boreal Ministerial Summit was held in Haparanda, Sweden. Ministers adopted the Haparanda Ministerial Declaration on Circumboreal Cooperation on Forests, which emphasized the need to

continue enhancing science-policy linkages and knowledge exchange on circumboreal forests and invited IBFRA to continue its collaboration with the Circumboreal Working Group. The major topics for science-policy cooperation identified were: boreal forests and climate change, and boreal forests and the bioeconomy.

Ministers welcomed continued support by UNECE and FAO to the circumboreal cooperation and invited IBFRA to continue to enhance the science-policy interface, amongst others through its cooperation with the CWG.

In order to further formalize circumboreal cooperation and maximize possibilities for synergies ministers encouraged exploring the establishment of a UNECE/FAO Team of Specialists on boreal forests.

The day before the Boreal Ministerial Summit IBFRA hosted a science-policy dialogue in which IBFRA scientists and policy-makers from the participating countries, as well as UNECE and FAO participated. At the dialogue IBFRA proposed to establish an *insight process* with the purpose to compile state-of-the-art scientific knowledge on specific boreal forest issues and to transfer that information in an accessible way to policy-makers. Policy-makers and scientists discussed current challenges and opportunities in order to come to a list of the most relevant research questions to inform policy-making.

Sweden has offered to provide funding for kicking-off the first insight process.

5. The IBFRA insight process

Based on the discussions between policy-makers and scientists at the IBFRA science-policy dialogue before the Boreal Ministerial Summit, a core team of IBFRA scientists from the six cooperating countries summarized the major political and research questions and challenges (see Kurtz, 2018).

The premise of the questions and challenges is that the circumboreal forest is a vast region with considerable diversity in forest ecosystem types, drivers of carbon dynamics, vulnerability to climate change, and types and intensity of forest management. Both the discussions as well as the available scientific literature emphasized that the impacts of global environmental changes are already affecting the boreal forest. A, or perhaps the, major concern expressed is that, at present, large scientific uncertainties remain about the magnitude and direction of the future contribution of boreal forests to the global greenhouse gas balance. This uncertainty has major policy implications for the level of mitigation efforts that will be required in other sectors, if future atmospheric CO_2 concentration targets are to be achieved.

Presentations by participating scientists and the ensuing discussions with policy-makers showed that many opportunities exist to enhance the contribution of the boreal forest to domestic greenhouse gas emission reduction targets, largely through enhancement of forest productivity and reducing natural disturbances, through the use of wood products to store carbon, and by substituting harvested wood products for fossil-based products, steel and concrete to reduce emissions in other sectors. The most appropriate mitigation actions will depend on the current forest conditions, climate change impacts, and the socio-economic and institutional context for mitigation actions. Therefore, mitigation strategies need to be regionally-differentiated portfolios of activities designed to meet society's targets for carbon emission reductions as well as other forest management objectives. Impacts of climate change on the forests need to be considered so that mitigation actions can be designed to also yield benefits for enhancement of forest resilience to climate change impacts and for other adaptation objectives.

Following the IBFRA science-policy dialogue ahead of the Boreal Ministerial Summit, the IBFRA conference in Laxenburg, Austria in September 2018 decided on the following topic for the first insight process: *Sustainable intensification of boreal forest management.* The insight process will address climate change impacts, role of forests in mitigating climate change and the ways in which the forest sector can contribute to net negative emissions.

The final concept note for the insight process was approved by the CWG at its meeting in the margins of the UNECE Committee on Forests and Forest Industry in Vancouver on the 8th of November.

The IBFRA steering group decided to establish a smaller steering committee with one representative from each of the participating countries. The group will monitor and guide the insight process. The practical implementation of the insight process will be led by Sweden – the Future Forests platform at the Swedish University of Agricultural Sciences. The insight process will involve scientists from the cooperating countries.

In order to maximize policy relevance, the insight process will last for one year after which the results will be presented to and discussed with policy-makers. IBFRA also intends to continue using the science-policy dialogue concept during and after the insight process. About half-way the running time of the current insight process IBFRA and the CWG will decide on the next insight process, focusing on other policy relevant research questions.

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Science-policy interaction in Estonian forestry

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1. Forest-relevant policy documents with links to international agreements

The most essential national forestry-related policy documents are the Estonian Forest Policy (adopted by the Parliament in 1997) and The Forestry Development Plan (hereinafter FDP) 2011-2020 which was approved by the Parliament on 15th of February 2011.

The principles and rules of forest management, the rights and obligations of forest owners, the management of state forests are prescribed by the Forest Act (2006). This Act applies to forest land and the flora and fauna, regulates the directing of forestry, forest survey and management, the administration and support to private forestry, regulates the forest use and determines the obligations of forest owners in forest management. The Act also states that a forestry development plan for the directing of forestry is prepared for every ten years. The forestry development plan sets out the objectives of forestry development and describes the measures and means necessary for the achievement of the objectives.

As Estonia has joined with most of the international processes and agreements related to sustainable forest management, these agreements are important when formulating and implementing of the national forest policy. For example, the Estonian Forestry Development Plan until 2020 is consistent with the EU Forest Strategy and EU Forest Action Plan. The strategy promotes a coherent, holistic view of forest management, covers the multiple benefits of forests, integrates internal and external forest-policy issues, and addresses the whole forest value-chain.

Achieving the objectives of the Forestry Development Plan is supported by the Rural Development Plan for 2014–2020 being enforced by the Ministry of Agriculture, through which most of the private forestry support measures are co-financed.

Preparations for the new Forestry Development Plan until 2030 were started in spring 2018. The binding and non-binding international agreements are taken as a basis where to build up a set of national targets and actions.

The national forest policy is in a very large extent influenced by the decisions and declarations of Ministerial Conference on the Protection of Forests in Europe, known by the brand name Forest Europe. The political decisions and resolutions made in the framework of Forest Europe are voluntary, and by endorsing these commitments, countries show their willingness and interest to protect and sustainably manage their forests.

Sustainable Development Goals, formulated by the United Nations (2015) have been considered in the formulation and elaboration of forest policy. The goal No 15 „Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss" deals with the sustainable management of terrestrial ecosystems, including forests and the maintaining of biological diversity.

Aichi Biodiversity Targets are important for Estonia for the period 2011-2020. The goal is achieved considering the area (volume) of protected ecosystems, according to which at least 17% terrestrial ecosystems should be located in an ecologically representative and well-connected network of protected areas. Paris agreement and the United Nations Framework Convention on Climate Change (UNFCCC) have also had an impact to forestry, mainly through the forest management reference level (FMRL). Forestry will be significantly affected in the near future by "The Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF) into the 2030 climate and energy framework ". LULUCF role as a sink or source of GHGs in the future will be determined by the intensity of forest felling. The potential of maintaining felling rates on today's level or even decreasing them would result in increasing or maintaining forest carbon stock for the period of 2013-2020. However, Estonia needs to look further into the future and plan forestry activities according to current situation.

Nature protection also has a remarkable impact on forest management practice and forest policy. One of the documents linking nature protection and forestry is the Nature Conservation Development *Plan* which is a strategic base document for the development of sectors related to the conservation and use of nature until 2020. Some of the strategic goals of the development plan are tightly related to forests and forest management, e.g.:

- ✓ the favourable conservation status of species and habitats and diversity of landscapes is ensured and habitats are functioning as a coherent ecological network;
- ✓ long-term sustainability of natural resources is ensured and the principles of the ecosystem approach are followed in the use of natural resources.

The National Renewable Energy Action Plan until year 2020 is a comprehensive document summarizing the national renewable energy policies, forecasting final energy consumption and setting out renewable energy targets and forecast trajectories until 2020. In Estonia, wood is the biofuel with the greatest economic potential for producing both heat energy and electricity.

2. Science-policy interface

The role of research in forestry and in forest policy development has been formulated in all fundamental policy documents which indicates high expectation and also the trust into the research.

In the Estonian Forest Policy (1997) the task of research was shortly described: "The objective of forest related research is to provide scientific background information in support of practical decision-making in forest management, conservation and multiple use of forests. Forest research will also support the formulation and evaluation of forest-related policies by conducting scientific analyses on key issues. "

In the Estonian Forestry Development Plan until 2020 (2010) the international collaboration of researchers was emphasized: "Due to limited resources for R&D, the participation of researchers in international programmes, networks, doctoral schools etc. is essential. The number of researchers is rather small in different research areas, therefore there is a lack of visible opinion leaders. The participation of scientists in policy formulation is modest. "

The process of preparation of the new FDP until 2030 started in March 2018. Side by side with other stakeholders, researchers are involved in the work group formed by the Minister of the Environment for the mapping of problems and launching of the program. One of the first steps in the preparatory phase is a background study, which is related to acute and disputable topics. Scientists with different expertise have to report the current knowledge and suggest potential solutions. Whether recommendations are considered and will be implemented in the future plan, depends on the interest groups and political decision makers. The study is financed by the Ministry of the Environment and the results of this should provide support to stakeholders when they are working out the next development plan.

In Estonia, the forest research is carried out mostly by universities. On the second half of 1990ies the research institutes, including The Forestry and Nature Protection Research Institute, were merged with

universities. Forestry related research groups work currently at the Estonian University of Life Sciences (forest science), University of Tartu (ecology, biosciences) and Tallinn University (ecology).

Different ministries are responsible for forestry issues: Ministry of the Environment, Ministry of Rural Affairs, Ministry of Economic Affairs and Communication. The main responsibility lies on the Ministry of the Environment, in addition to forestry, the ministry is leading the activities related to climate issues, environmental monitoring, hunting, management of the environment, nature protection, sustainable development etc. All these focus-areas are strictly linked to forestry and have remarkable influence on forest policy.

Fundamental research is financed by the Estonian Research Council, but they have also programmes offering funding for applied research. The aim is to find solutions to practical problems within a relatively short period of time. The support aims to contribute to growth in the research-intensity of the Estonian economy, supporting collaboration between R&D institutions and companies. Furthermore, the support will help to raise the capabilities of R&D institutions to carry out applied research needed for business in smart specialisation growth areas.

The programme RITA supports the pursuit of socio-economical applied research, guided by the needs of the Estonian state in order to increase the role of the state in the strategic steering of research and the capabilities of R&D institutions in carrying out socially relevant research (Estonian Research Council 2018). Ministries select the topics for applied research according to sectoral needs. Research and development institutions carry out research as planned. RITA aims to strengthen the capabilities of the Ministries in commissioning applied research needed by the state. Moreover, the programme will improve the capabilities of R&D institutions to conduct such research, thereby further strengthening the collaboration between state and R&D institutions.

In the call “Analysis of the economic situation and perspective of the Estonia`s bioeconomy and its sectors. Formulating business models in selected fields of bioeconomy” the project “Maximising added value and efficient use of raw materials in bioeconomy and its sectors in Estonia” was proposed and initiated by the consortia of universities. Use of wood resources and its provision to bioeconomy will be analysed in this project.

The Forestry Council at the Ministry of Environment should work as the main basis for science-policy interaction (Põllumäe and Korjus 2017). The Council includes different representatives from the public (public administration, Parliament, ministries) and private sector (industry, nature protection, forest owners). In addition, representatives from universities are present. In the council, they act as representatives of research organizations as one stakeholder group. The Council meets on an irregular basis.

Participatory approach was adopted in forest policy in the middle of 1990ies within the Estonian Forestry Development Program. The approach was novel for governance culture prevailing in Estonia at that time (Sootla, 2004). The stakeholders and their involvement were slightly different compared to the present situation. Representatives of research and educational institutes are considered as stakeholders equally to other interest groups (forest owners, wood processing enterprises, environmental NGOs etc.). Considering that a new Forestry Development Plan period is approaching, debates over the content of the new FDP have been started (Ministry of the Environment 2018). This also means a wider participation of different stakeholders and scientists also in the different working groups.

3. Challenges and development needs

Different new legislative initiatives, launching of new programmes and changes in the national forest policy documents are examples of the co-operation of policy makers and researchers. There is a general perception that science should provide support to decisions before these are implemented into legislation.

An obstacle for the successful collaboration lies in different expectations and approaches: policy-makers and ministerial officers expect from researchers a quick and definite response to topical questions. Researchers

are used to present scientifically proved arguments, but such an in-depth analysis takes a time. In practice, short-term demand for topical studies prevails on mid- and long-term studies and research programs. While most of the researchers are engaged with teaching at the universities, then it is difficult to expect them to be very open for “express-missions“ with duration of one or two months.

Indicators of research performance do not support the participation of academic staff in policy processes as well. The number of peer-reviewed scientific papers in highly ranked journals, the number of citations to these papers and h-index determine the recognition and position of a researcher in academic community. Although, these activities like doing professional expertise, participating in decision-making bodies and work groups are taken into account when accrediting and evaluating academic staff, but the weight of these activities is marginal compared to the above-mentioned indicators. In many ways, researchers work together to solve practical problems due to intrinsic motivation and sometimes the only compensation one can get is the expert’s reputation and respect of practitioners.

Researchers expect more long-term planning from contracting authorities, but the authorities are affected by the length of the budget period. The ministries' budget is planned for one year; therefore, contractual research can be scheduled after the state budget has been approved, but contract work has to be completed by the end of the year. Enhancing the flexibility of funding would improve the effectiveness of cooperation between science and policy.

Teder and Kaimre (2017) studied the opinion of stakeholders about the behaviour of other stakeholder groups in the policy processes. While the policymaking discussions are not academic in their nature, scientists act more like observers, just monitoring the struggles of other stakeholders. Scientists are sometimes expected to take a more authoritative attitude in challenging discussions, rather than being compliant.

Unlike politicians, people trust scientists, and also on forestry issues. It is therefore wise to involve researchers in order to provide adequate support to forestry policy. The precondition for improving the effectiveness of research and policy co-operation is the willingness of the parties to act together and pro-activeness.

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Forest science-policy interaction in Finland

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1. Introduction

Forests are an important element in the Finnish national economy and social and cultural life. Growing stock of 2,3 billion m3 and its annual increment of 107 million m3 provides annual harvest of 72 million m3. This wood volume generates stumpage earnings worth 2 billion Euros for 630000 forest owners. The value of forest industry production is about 20 billion euros and the share of forest sector of the GDP is 4,1%.

In this paper, we introduce three relevant cases where science is utilised as a basis for policy formulation, implementation, follow up and for policy recommendations. They are: 1) the National Forest Policy, 2) the Forest Policy Forum and 3) the National Forest Inventory.

2. Forestry related policy documents in Finland

Finnish forest policy formulation is under the jurisdiction of the Government, within the frame of international agreements relevant for forests and the Finnish forest law of 2014. The forest policy is described in the National Forest Strategy, adopted by the Government in February 2015. The strategy formulates the main objectives for forest-based business and other activities until 2025 (Ministry of agriculture and forestry, 2015). The strategy is largely founded on the Government report on Forest Policy and the parliamentary views related to it. Other important background documents are e.g. the Finnish

Figure 1. Elements of National Forest policy in Finland.

Bioeconomy Strategy (Ministry of employment and economy 2014) and the National Biodiversity Strategy (Ministry of Environment 2012).

The National Forest Strategy aims at growth, investments and employment. The vision is that the sustainable forest management is a source of growing welfare. The three strategic objectives to make the vision come true are:

1) Finland is a competitive operating environment for forest-based business,
2) Forest-based business and other activities are renewed and become more diverse, and
3) Forests are in active use defined by all three dimensions: economic, ecological, and social.

The implementation of the National Forest Strategy is followed up by Forest Council. It consists of a great variety of stakeholders, Government ministries, forest administration, research and education, forest owners, forest industry, energy sector, environmental bodies, trade and labour market organisations as well as youth and leisure-time organisations.

The Forest council has approved the development of a total of eleven strategic projects. These key projects, also called "spearhead projects", include the development of electronic information and customer services for private forest owners and creating new incentive schemes for promoting entry of timber to the market. The spearhead projects include also development of nature management in commercial forests. The National Forest Strategy is implemented through the Regional Forest Programmes, where also the specific regional characteristics can duly be considered.

The update process of the strategy will be completed by the end of 2018. The project portfolio will be prepared in cooperation with the Ministry of Agriculture and Forestry, researchers and forestry stakeholders.

The role of science is visible in all phases of the National Forest Strategy: in planning, implementation and in the follow up. In the planning phase, researchers of the Natural Resource Institute conduct an analysis of the operating environment and create alternative scenarios regarding the expected futures. In the implementation phase, the research results are utilised in actions embedded in the strategy, i.e. through legislation and various funding programmes.

Statistics of the forest sector play an important role in the follow up of the success of the strategy implementation. Economic indicators include e.g. income of forest owners and the share of forest-based production of the GDP. National forest inventory provides continuously updated information on the state of Finnish forests, including indicators describing both wood production and biological diversity.

Researchers have also presence in the various governance bodies such as the National and Regional Forest Councils which generate input for the National Forest Strategy.

3. The Finnish Forest Policy Forum

The background for establishing the Forest Policy Forum lies in the lively national discussions on the governmental policies regarding better use of research results in policy-making and practice. In the field of forestry, an assessment of the Finnish forest research was carried out recently. It was concluded that science is utilised in practice and policy-making in various ways. However, the main problem is in the slow and low level of the implementation of the research results (Seppälä 2014).

To tackle this problem, the foundation Metsämiesten säätiö funded a pilot project, carried out by Tapio Ltd (Päivinen and Toivonen, 2015). The objective of the project was to promote evidence-based forest and environmental policy-making in Finland by:
1. synthesizing research results on selected themes
2. creating policy options and
3. revealing research gaps.

In the following table, the *modus operandi* of The Forest Policy Forum is described. It typically takes 8-10 months to process a selected theme. The project is conducted by a small secretariat in Tapio, consisting of 2-3 experts. The steering committee of the Forum - up to 12 members - represents various stakeholders: forest administration, research, forest industries, forest owners and environmental expertise. The main tasks of the steering committee are in selecting the policy-relevant themes and in approving the policy recommendations. As members of the steering committee often also represent their organisations in various policy processes and other bodies (such as the National Forest Council), they also play an important role in the dissemination of the results from the forum to the policy-making.

Table 1. The process of Finnish Forest Policy Forum.

Month	1	2-4	4-5	5-6	6-7	8	8 -
Activity	Selecting a relevant theme to process in the forum	Tentative review of research	Research panel : Synthesis of research, research recommen-dations	Expert panel: Tentative policy and research recommendations	Finalising the results of the panels: Policy and recommendations for future research	Final seminar – publishing the report	Bringing results to media and various policy processes
By whom	Steering committee 12 members	Secretariat	15-25 researchers	15-25 Stakeholders	Steering committee, Secretariat	Open to all	Secretariat, Steering Committee

After a tentative review of the available research results carried out by the secretariat, a panel of researchers is invited to synthesize the research results and suggest recommendations for further research. The research panel together with the secretariat - under the guidance of the steering committee- formulates the policy recommendations. These will be discussed in the stakeholder panel, consisting of 20-30 experts from relevant fields. The final seminar is open to all and is a part of the dissemination of the Forum's results.

There are a few requirements regarding the themes that can be selected for this process:

1. They should be relevant for coming policy decisions
2. There should be research results available regarding these themes
3. The analysis should be feasible, considering the available resources of the forum
4. Processing and discussing these themes within the Forest Policy Forum add value for the forest sector.

When it comes to the policy recommendations, they should be based on sound scientific evidence and have a potential to impact policy-making.

The themes of the past, present and decided upcoming Forest Policy Fora are as follows:

2016: Wood supply from private forests
2017: Sustainable growth from the forests
2018: Balancing the various ecosystem services from the forests
2019: Diversity of the forests
2020: Role of peatland forests in the future

The reports are in Finnish and available in http://tapio.fi/metsatietoa/julkaisut-ja-raportit/
After the pilot period 2015-2017, the main donor of the forum has been Finnish Ministry of Agriculture and Forestry.

It has been learned that the concept itself has been considered useful in general – both among the researchers as well as the policy-side actors. Some participants have expressed the opinion that the process itself is as useful as the results achieved and recommendations made. It has been observed that constructive conclusions have been easier to make, as the discussions both in the steering committee and in the panels are focused in the scientific evidence, and not so much on the political standpoints of the participants.

The impacts of the forum observed so far include some re-orientation of the national forest policy priorities. The first forum concluded that since many measures aimed at attracting forest owners to increase their harvests have proven to be unsuccessful, even if the annual increment exceeds clearly the harvest. It was recommended to focus on various actions targeted at increasing the growth in the Finnish forests – as all theoretically available wood is not coming to market anyway. This principle will be included in the updated version of the National Forest Strategy.

Another impact has been the Forum's recommendation to invest in research on the evolution of forest owner´s values and their behavioral profiles. Such a research project received funding recently.

An overall challenge for the Forum has been the limited availability of researchers from research institutes and universities to participate in the Forum's activities and also in the expert panels. The financial landscape of forest research has significantly changed in recent years and scientific staff are forced to use more and more time in project work and in writing proposals to attract outside funding. This also creates pressure for the Forum to find resources to compensate the researchers for their contributions.

4. National Forest Inventory (NFI)

In the following, we present few cases where NFI results (Luke 2018a) are used to support the National Forest Strategy 2025:

In the strategy, objective 3.3 states that "*Forests are in active, economically, ecologically and socially sustainable and diverse use. ….Of the indicators to be monitored… Level of activity and forward planning in forestry can be gauged by monitoring the early management of seedling stands and the tending of young stands." The strategy also describes the goal for management of young stands in 2025:"Management needs as indicated in the National Forest Inventory*" (see pages 25-26 of the strategy).

In Fig.2. NFI results are showing decrease since 2009-2011 of the quality of young (20-40 years) forests in Southern Finland.

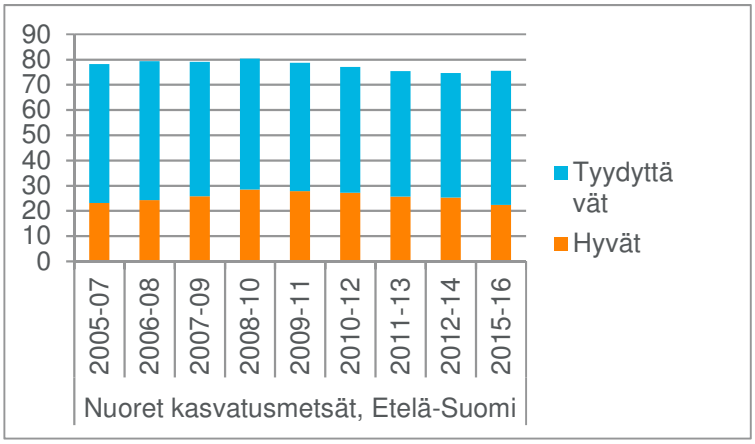

Figure 2. State of the young stands in Southern Finland. Share (%) of satisfactory (blue) and good (orange) stands.

Similarly, NFI results are also used to identify other urgent activities needed in forest management (planting, re-draining, etc.)

Under the strategic goal "Forest biodiversity and ecological and social sustainability are reinforced" it is stated that the "*forests are a primary habitat for more than a third of all the threatened species in Finland, and many structural features of habitats have changed as a result of forest management. Lack of deadwood is the most important structural feature of the forest that results in species becoming threatened. By increasing the volume of deadwood we can influence both the halting of forest biodiversity impoverishment*

and the ecological status of forest habitats. Over the long term, the volume of deadwood must be increased in excess of the target level set for 2025." (see pages 28-29 of the strategy).

The quantitative goal in the strategy is to increase the average amount of dead wood by 30%, to 5m3/ha in the Southern Finland and to 10-11 m3/ha in the Northern Finland. Fig.3. shows the NFI results and the increasing trend in dead wood development in the whole country.

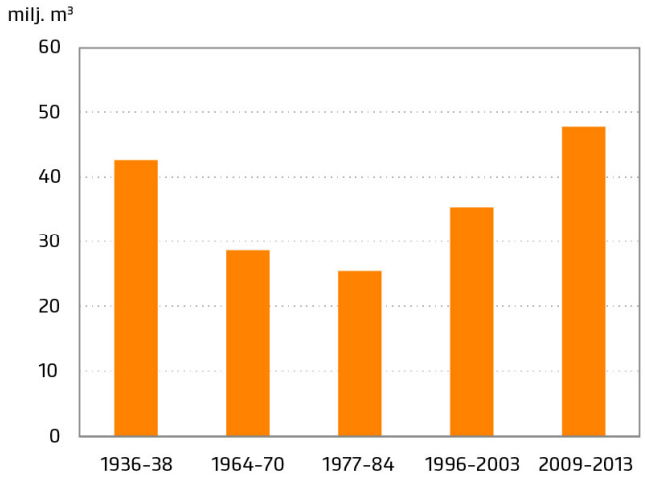

Figure 3. Dead wood in Finnish forests from 1930´s (Larger than 10 cm diameter, usable for firewood).

As an example of NFI as basis for scenario modelling, the strategy states:" *Forests as a carbon sink have been a significant means of mitigating climate change in Finland. Whereas the international benchmark level agreed upon for 2020 is 17–18 million tons in carbon dioxide equivalent, the carbon sink has been larger than this as harvesting volumes have been lower than those indicated in the National Forest Programme 2015. As wood consumption increases, forests will lose their significance as carbon sinks, and emphasis in climate change mitigation will shift to replacing fossil raw materials by renewable ones, including wood*." (pages 27-28.)

Scenario modeling is an efficient way to demonstrate impacts of selected forest policies in terms of
- Economic impacts (wood harvest, stumpage, income from other ecosystem services, etc.)
- Ecological impacts (biodiversity, soil protection, water quality, etc.)
- Social impacts (employment, recreation, etc.)

In these applications the NFI data is used as a starting point. Simulating the development of forest resources using growth models and alternative forest management regimes gives a clear picture on the possible futures. Scenario modeling package MELA has served forest experts since decades (Luke 2018b), but also other initiatives exist. In Fig 4., S40 – S100 refer to policies aiming at harvest levels of 40-100 mill m3 wood from forests of Finland. The cumulative carbon sink increases when harvest levels decrease. Similarly, consequences of various harvest levels have been derived for economic indicators, such as stumpage paid for forest owners, social indicators such as employment, or environmental indicators such as amount of old growth forest.

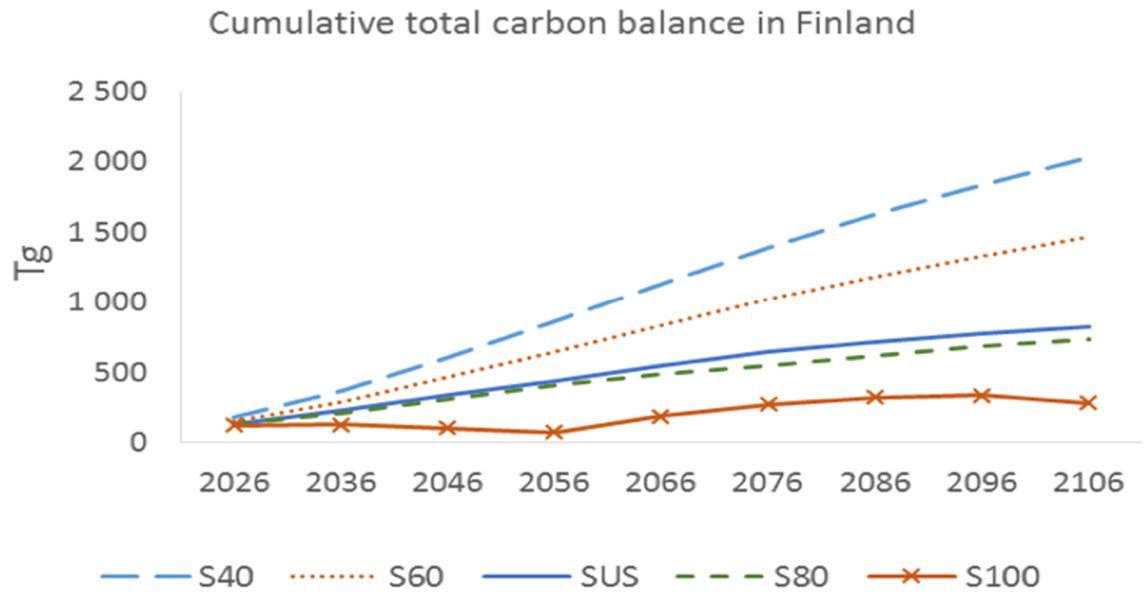

Figure 4. Impact of various harvest levels to cumulative total carbon balance in Finland (Heinonen et.al. 2017).

5. Challenges and development needs

Finland has set the goals for a low-carbon and resource efficient society and sustainable economy, where bioeconomy and forests have an important role. Environmentally friendly and climate smart wood production must be in balance with the needs of maintaining all ecosystem services that are provided by forests.

Science aims at providing neutral and objective elements to the discussion, including environmental, social and economic aspects. The principle of evidence-based policy making is widely agreed, but there are choices how to implement it. The complexity of policy-making and the different ways of making policy decisions must be understood. The risks of using statistical indicators and mathematical modeling as a basis for policies leading to partial solutions must be kept in mind. It is important to keep the focus on *science-based evidence* and be aware of problems introduced if using *policy-based evidence,* where suitable or purposefully chosen research results are used to support pre-selected policies.

Dialogue between scientists and different stakeholders should be encouraged and carried out continuously. Science-based evidence will help in finding consensus in contradictory issues often encountered in case of forest and environmental policies. If the discussion would focus more on ~~to~~ the strength of the evidence, it might help the participants to overcome the problem of staying in their standard political standpoints. For better policies and improved impact of research, systematic approaches and instruments for enhancing the interaction between scientists and policy makers should be further developed.

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SNS-EFINORD network meeting and international workshop
Tools for improving science-policy interaction in forestry
Biri, Norway, May 15-16, 2018

Science-policy interaction in France

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1. Introduction

With about 9 million hectares in mainly tropical overseas territories and 17 million hectares in four different biogeographical regions of Europe, French forests are characterized by a huge biodiversity and a large biomass. The latter increases much in metropolitan France where only half of the biological net increment is harvested. Such low felling rate is partly due to the youth of recent forests (the wooded area doubled during the last two centuries). But there is also a large diversity of species, a multiplicity of owners, some difficulties to access forests, the management of which is rather extensive (MAAF, IGN, 2016). As a result, there is a great potential for bioeconomy based on increased roundwood harvesting, substitution of fossil intensive materials and energies for wood, and a reduction of vulnerability to extreme events such as storms, droughts, fires and biotic damages that are expected to be more frequent with climate warming.

A major challenge of the French forest policy is thus to increase the harvest of roundwood and, in the same time, to preserve the biodiversity and the overall carbon balance of the forest-based sector. In the same time, forests and forestry are included in many other strategies and policies dealing with more general issues such as biodiversity, resilience, energy and bioeconomy, research and sustainable development. Their management deals thus with trade-offs between different objectives. This situation makes it necessary to implement sound policies, based on relevant knowledge, and to rely on strong science-policy interfaces.

This chapter first describes the main forestry-relevant policy documents that may be encountered in France. It then identifies and lists interfaces between science and policy, of which it develops some examples before discussing the main challenges and needs for the future.

2. Forest-relevant policy documents in France

The main strategies and policies that exist or are developing at different scales, from the World level to the French regional level, are grouped in table 1 in five thematic categories:

- biodiversity,
- climate, energy and bioeconomy,
- research,
- sustainable development,
- forestry and timber.

The **French biodiversity strategy** is the embodiment of the French commitment under the United Nations Convention on Biological Diversity adopted during the Earth Summit in Rio de Janeiro (1992) and ratified by France in 1994. It derives also from the European Community Biodiversity strategy that was presented in 1998 by the Commission to the Parliament, was preceded by the Council Directive on the conservation of natural habitats and of wild fauna and flora (1992, just days before the Earth Summit), was followed by action plans in 2001 (Verschuuren, 2002) and 2006, and finally renewed for the period 2011-2020. A first French biodiversity

strategy ran from 2004 to 2010 on the basis of sectoral plans including a forest action plan. The second phase (2011-2020) of the French biodiversity strategy aims at a greater commitment of actors in all sectors at all territorial scales, in metropolis and overseas. It is about achieving 20 cross-sectoral objectives set to preserve, restore, strengthen, enhance biodiversity and ensure sustainable and equitable use.

The forest implications of the Biodiversity strategy in France derive thus from three main documents:

- a forest action plan has been developed for both the previous National Biodiversity Strategy (2004-2010) and the National Forest Program (2006-2016) through joint reflections involving all stakeholders (MAP, 2006, updated in 2009); the forest action plan was divided into about 40 measures grouped into seven major actions: knowledge about biodiversity and the pressures exerted on it; improvement of biodiversity considerations in forest management; towards a consistent network of protected areas; strengthening of coordination and governance; information and training of forest managers; public awareness; financing of biodiversity (maintenance, restoration);
- the European Biodiversity Strategy to 2020 (European Commission, 2011a) is organised into 20 actions among which two actions aim to encourage forest owners to protect and enhance forest biodiversity, and to integrate biodiversity measures into forest management plans;
- the National programme on Forest and Wood 2016-2026 (MAAF, 2017a) contains a section that is dedicated to the knowledge, preservation and enhancement of biodiversity, and clearly embedded in the Biodiversity strategy; it creates a Forest Platform for Biodiversity (PBF); its members are scientists, managers of protected areas, environmental non-governmental organizations, economic actors; it is responsible for reflecting on the coordination of objectives and means of R & D around the challenges of forest biodiversity.

The National Biodiversity Strategy is associated with the implementation in France of the European Habitats Directive and the monitoring of a "favourable conservation status" of ecosystems, and particularly forest ecosystems (European Council, 1992). It is also complemented by a National Strategy for the Creation of Protected Areas (Coste *et al*., 2010). The latter aims at having at least 2% of the terrestrial metropolitan land under a strong protection in 2019. In 2016, a strong protection was covering 1.35% of the total land and 1.7% of the forest land. However, the creation in 2019 of a new forest national park should add more than 0.3% of forest area and allow to reach 2% of the total forest land.

The **French strategies relative to climate, energy and bioeconomy** policies are driven at the global level by the United Nations Framework Convention on Climate Change (United Nations, 1992) and its Paris Agreement approved by 195 Parties on 12 December 2015 at the end of the 21st Conference of the Parties to the UNFCCC (United Nations, 2015). The long-term goal is to keep the increase in global average temperature to well below 2°C above pre-industrial levels and if possible to about 1.5°C. At the European level, a 2030 EU climate and energy framework has been adopted in October 2014 and sets three targets to the year 2030: a 40% reduction of greenhouse gas emissions from 1990 levels, a 27% share for renewable energy and a 27% improvement in energy efficiency. It builds on the previous 2020 climate and energy package (elaborated in 2007 and enacted in 2009) for which the same three targets were 20%-20%-20%. It is also in line with the European Roadmap for moving to a competitive low carbon economy in 2050 (European Commission, 2011b) and the European Energy Roadmap 2050 (European Commission, 2011c). To address the potential of renewable biological resources to meet the needs for products and bioenergy, A Europe's Bioeconomy Strategy has been adopted in 2012 and updated in 2018 because, even though the objectives of the 2012 strategy remained valid, the deployment had to be accelerated and the scope of the actions refocused in order to be in line with the Sustainable Development Goals, the Paris Agreement and new European priorities highlighting the importance of a sustainable, circular bioeconomy (European Commission, 2018).

In correspondence with these European developments, there are finally in France six main strategies dealing with energy, climate and bioeconomy:

- Multiannual energy planning has been initiated in 2016 and renewed in 2018 for the next five-year period (MTES, 2018a); it can be a framework for bioenergy production and other strategies;
- Climate Plan considers simultaneously the two different sides of climate change with three main aspects concerning forestry:

    - the National Adaptation Plan to Climate Change has been renewed in 2016-2018 for the period 2018-2028 after a first phase from 2011 to 2015 (MTES, 2018b; MEDDTL, 2011); regarding forestry, it is dealing with the prevention of forest fires concerning that are likely to affect new areas, with forests considered as ecosystem, biological reservoirs and sources of amenities, and with the forest-based sector in its capacity to provide wealth and to mitigate climate change;
    - a National Low Carbon Strategy has first been adopted in 2015 (MEDDE, 2015a) and then renewed in 2018 until 2050 (MTES, 2018); it identifies measures in order to better use the harvest potential of French forests due to the fact that only half of the net annual increment is felled; an increase of the harvest reduces the carbon sink in forests but also avoids carbon emissions, especially from fossil resources;
    - a national strategy against imported deforestation has been elaborated in 2018 as a part of the Climate Plan (MTES, 2018d); of course, it concerns biodiversity as well; it does not derive from an equivalent strategy at the European level where a Feasibility study on options to step up EU against deforestation has only been published until now (COWI *et al*. 2018);
- the National Biomass Mobilisation Strategy develops recommendations in order to achieve this increase of fellings in the French metropolitan forests (MTES, 2018e): they concern the investment level for innovations and the improvement of the financial situation of firms acting in forest operations, the use of local resources, the preservation of landscapes, soils, large trees and dead wood for biodiversity purposes, the identification of forest sites at risk because of climate change, the development of R&D projects on issues such as sustainable forest management, the return of wood ashes to the forest floor, the nutrient balance in forests, the evaluation of different silvicultural alternatives on biodiversity and landscapes;
- the National Bioeconomy Strategy for 2017 and beyond (MAAF, 2017b) suggests also to increase the mobilisation of biomass and the optimisation of its use and, in the same time, to preserve ecosystems (biodiversity, landscapes, soils); it is completed by an action plan (2018-2020) with measures organised in five domains :(i) improvement of knowledge, (ii) promotion of bioeconomy, (iii) conditions for a meeting of supply and demand, (iv) sustainable production, mobilisation and processing of bioresources, (v) relaxation of constraints and incentives.

Research and innovation are important in general but all the more in the case of a complex sector based on natural resources and subject to multiple uses and structural changes. It is mainly organised at the European level around Framework Programmes for Research and Technological Development with the eighth Framework Programme Horizon 2020 (2014-2020) and the coming ninth Horizon Europe (2021-2027). The French Research Strategy (2015-2020) is in line with the European one and subtitled France Europe 2020 (MENESR, 2015). It promotes scientific excellence, support to technological development and response to ten societal challenges, rather similar to those established at the European level. Among those, some concern closely forestry: Sober management of resources and adaptation to climate change, Clean, secure and efficient energy, Industrial renewal, Food security and demographic challenge (including sustainable forestry), Information and communication society.

Sustainable development has recently been analysed under the seventeen Goals adopted at the World level in 2015 for the period 2016-2030 (United Nations, 2015). They follow the Millenium Ecosystem Assessment edited in 2005 (Millenium Ecosystem Assessment, 2005. Their scope is much larger than forestry to which they however apply particularly. Dealing with terrestrial life, the 15th goal includes forests and many others as well, for example the 13th one on climate change. At the European level, an EU approach to sustainability has been defined for the same period (European Commission, 2016). In France, a National strategy for an ecological transition towards sustainable development had been adopted as soon as the early 2015 for the period 2015-2020 (MEDDE, 2015b). It can be considered as a cross-cutting issue of biodiversity, climate, energy and bioeconomy. Forestry is highly concerned by its first priority on resilient and sustainable landscapes but also by circular and low carbon economy, ecological conversion of economies and knowledge advances.

The **French forest policy** is formulated in the National Forest and Wood Programme 2016-2026 (MAAF, 2017a) that follows the former National Forest Programme (2006). It corresponds to the Forest Principles at the World level (United Nations, 1992b), Forest Europe resolutions at the pan-European scale and European Union Forest Strategy, first elaborated in 1998, renewed in 2013 (European Commission, 2013) and under review in 2018. It

comes in addition to the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan and its European Union Timber Regulation (EUTR) that set out measures to ensure that no illegal forest products can be sold in the EU and tackle illegal logging in the world's forests (European Commission, 2003; European Union, 2010).

The French Forest and Wood Programme is structured around four objectives:

- create value as part of the transition to green growth and low carbon economy, with a sustainable management of the French available resources;
- take into account citizens´ expectations, in particular at landscape level;
- consider jointly mitigation of and adaptation to climate change;
- develop synergies between forests and industries with new outlets for available forest products and silvicultural practices adapted to market demand.

This Programme clearly takes into account climate change and the development of bioeconomy, particularly in its first, third and fourth objectives. Because only half of the net biological increment is felled, a strategic contract for the forest-based sector is developed and focused on the fourth objective: it starts from market demand with the aim to use wood resources as much as possible.

As regards biodiversity, the French forest and wood programme suggests to improve knowledge, as well as to preserve and valorise natural assets; it specifically creates a Platform for Biodiversity and Forests (PBF) with scientists, managers of protected natural areas, and economic actors in order to reflect on the coordination of objectives and means of R&D in the field of biodiversity in forests.

Research and innovation is also an important aspect of this programme and has been developed in addition in a specific Plan for Research and Innovation in the forest-based sector to the year 2025 (Amécourt *et al*., 2016). This Plan is divided in three priorities:

- increase the performance of the sector through system approaches,
- develop wood uses and new uses of wood in a bioeconomic perspective by strengthening industrial competitiveness,
- adapt the forest and prepare the forest resources of the future.

Four to five projects have been elaborated for each of these priorities and thirteen in total. Two to three actions are attached to each project and twenty-nine in total.

Table 1. Structure of the main forest-relevant policy documents in France

Scale➔ ↓Themes	World	Europe/EU	France	French regions
Biodiversity	UN CBD	EU biodiversity strategy (incl. Natura 2000)	French biodiversity strategy (2013-23) French Natura 2000 network +creation of protected areas (2010-19…)	➔ yes
Climate & energy	UNFCCC Paris agreement	EU climate and energy framework Roadmaps 2050 for energy & low carbon economy (2011) Study against Imported deforestation (2018)	Multiannual energy planning (2016-18, 2019-2023) Climate plan : +adaptation plan (2011-2015, 2018-28) +low carbon strategy (2018 until 2050) Biomass mobilisation (2018-19-24-29…) French strategy against imported deforestation (2018)	➔ yes
Bioeconomy		EU strategy (2012, 2018)	Bioeconomy strategy (2017 and beyond) and its action plan (2018-2020)	
Research		Framework programmes (from 1984 to 2014-20)	Research strategy (2015-2020)	
Sustainable development	Sustainable development goals (2016-2030)	EU approach to sustainablity (2016-2030)	French strategy for an ecological transition towards sustainable development (2015-2020)	
Forestry	Forest principles	Forest Europe EU forest strategy (1998, 2013, 2018)	Forest and wood programme (2016-26) +Wood-based sector contract (2014-18..) +Research & innovation plan (2016-25)	➔ yes
Timber		FLEGT action plan (2003) Timber regulation (2010)	Application of the European regulation	

3. Science/policy interfaces in France

Many science/policy interfaces are acting in France in the forest-based sector. Some of them are well identified as legal bodies entirely dedicated to the links between science and public policies but many of them are part of larger bodies such as ministerial services, public agencies, or environmental non-governmental organisations. Figure 1 represents this distinction on its X-axis.

These interfaces can also be close to:

- science when they aim to ask good questions to research;
- policy when they aim to provide messages to policy processes;
- a science/policy balance when they include enough policy makers on the first case and scientists in the second.

Their proximity to science or policy is represented on the Y-axis of Figure 1.

These interfaces can deal mainly either with biodiversity or climate, energy and bioeconomy, or research and innovation, or sustainable development, forestry and timber use as a cross-cutting issue.

Ministries have special Advisory High Councils that work as required with research organisations:

- CGAAER is the Advisory High Council for Food, Agriculture and Rural Areas that is a part of the Ministry of Agriculture and Food;
- CGEDD is the Advisory High Council for Environment and Sustainable Development that is a part of the Ministry of Ecological and Inclusive Transition;
- CSFB is the High Council for the Forestry and the Forest-based sector that is with the Ministry of Agriculture and Food;
- CSF Bois is the Strategic Committee of the Forest-based sector that is with the Ministry of Economy and Finances.

Ministries have also special services at the interface between science and policy:

- The Forest Health Service (DSF) for the Ministry of Agriculture and Food;
- the Team in charge of the French evaluation of ecosystems and their services (EFESE) that works with six different ecosystem types among which one on forest ecosystems; it is a part of the Ministry of Ecological and Inclusive Transition; this activity corresponds to Mapping and Assessment of Ecosystems and theirs Services (MAES) at the EU level.

When emerging or urgent issues arise, Ministries generally order scientific (and technical) joint expertise studies as it has been the case after the storms in 1999 or the drought and heat in 2003. These panel studies use all scientific and grey literature in order to answer questions and they also identify some gaps that should be filled by future research projects.

Although the future of this system is now not sure, some Ministries have also their own research programmes and for example:

- Biodiversity, forest management and public policies (BGF) led by the Ministry of Ecological and Inclusive Transition, supported by the Ministry of Agriculture and Food and animated by ECOFOR;
- Applied research projects under the Strategic Fund of Forest and Wood (FSFB) managed by the Ministry of Agriculture and Food.

Research and Innovation governance is also organized in link with Ministries and now in link with the corresponding Plan to 2025 for the forest-based sector.

In the middle of the science/policy gradient, several interfaces depending highly on Ministries are acting either on all forest issues (ECOFOR, see below) or on particular themes:

- biodiversity for the Foundation for Research on Biodiversity (FRB), that is a platform for the different scientific players and stakeholders in society concerned with biodiversity; it has been created in 2008 by

eight public research institutes on the basis of the former French institute of biodiversity (2000-2008) and the Office of genetic resources (1983-2008);

- biodiversity also for the Platform on Biodiversity for the Forest (PBF), gathering scientists, land managers of natural protected areas and economic actors in the sector, is responsible for reflecting on the coordination of objectives and means of R & D around the challenges of forest biodiversity;
- socio-economy for the Network on economic, human and social sciences (SEHS) animated by ECOFOR.

Public agencies dealing with agriculture, environment, timber and forestry have often their own science/policy interface or actions in that field:

- associations of public research institutes analyse the needs for new knowledge and seek to incorporate this information into new research programs; this is the case of Alliances such as ALLENVI dealing with the environment (biodiversity, climate change, agriculture and forestry);
- research institutes usually have their own valorisation services: INRA (agriculture, environment and forestry), IRSTEA (environment and landscape), FCBA (forestry and forest products)
- individual agencies are active as interfaces:
    - The environment and energy agency (ADEME) is an interface with operational actions; it also manages a research programme dealing with bioeconomy (GRAINE);
    - The French Biodiversity Agency (AFB) does not cover much forestry but take part in a research unit on Natural Heritage dealing with terrestrial ecosystems and thus forestry;
- Extension services are usually a part of operational organisms such as the French forest agencies for public forests (ONF) and private ones (CNPF); for climate change, a special entity has been created with these two agencies and many others; it deals with adaptation of forests and forestry to climate change (RMT AFORCE);
- Education and monitoring organisations are naturally at the interface between science and policy; they are a major part of
    - AgroParisTech (including the French faculty of forestry in Nancy),
    - the French National Museum of Natural History (MNHN established in 1635 and renewed in 1793)
    - the French National Institute of Geographical and Forest Information (IGN, responsible for the national forest inventory);
    - AGREENIUM, an educational platform that coordinates actions of four research institutes and fourteen high education institutions.

Environmental non-governmental organizations have many scientists among their members and are active in the science/policy interface. They use much science for their own action but also within the certification bodies whose references are based on the state of knowledge.

This picture of science policy interfaces could appear much complex and fragmented. However, there are many links between these multiple interfaces; the strategies that have been presented in the first part are a way to discuss frequently the main issues; many events are also organised, generally in partnership between several of these interfaces.

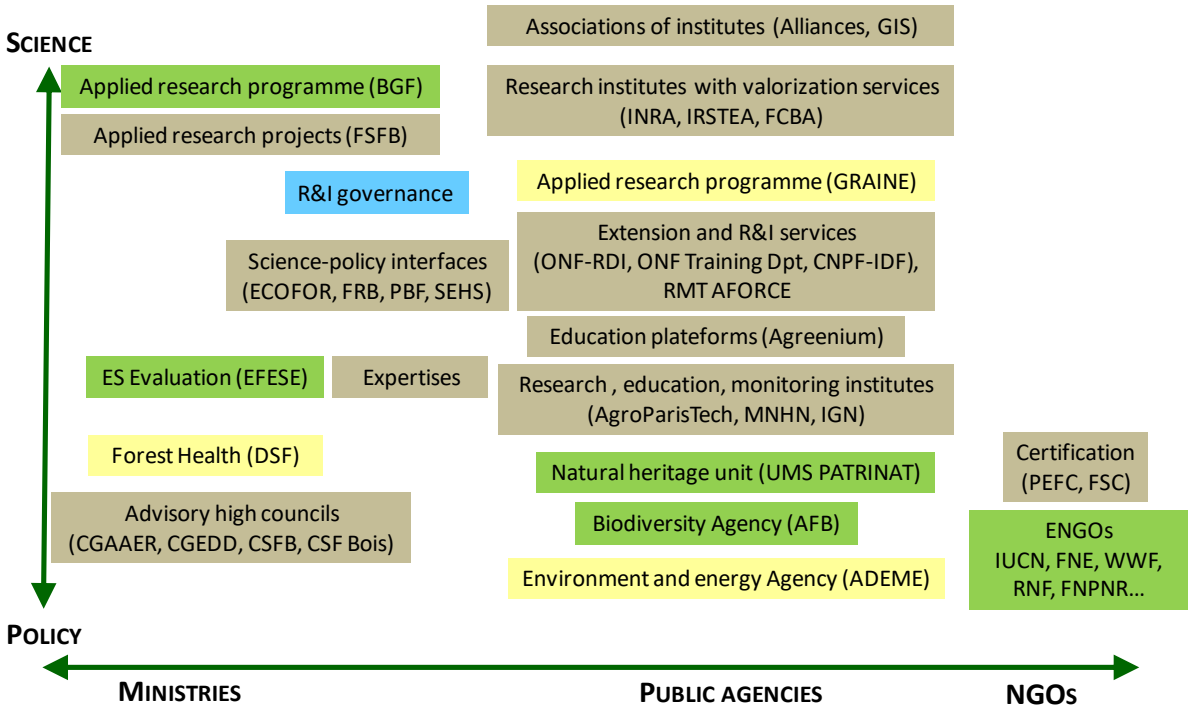

Figure 1. French science/policy interfaces organized according to a public/private gradient (X-axis), their proximity to science or policy (Y-axis), and their main theme (green for biodiversity, yellow for climate, energy and bioeconomy, blue for research and innovation, grey for sustainable development, forestry and timber use).

4. Examples of science/policy interfaces in France

Five examples of science/policy interfaces are presented here. They concern:

- ECOFOR,
- the French evaluation of ecosystems and ecosystem services (EFESE),
- the expertise with foresight views that has been developed in Gascony after the windstorm Klaus in 2009,
- another expertise that has been developed by INRA and IGN in order to evaluate the carbon balance of the French forest-based sector to 2050,
- the research and innovation plan of the forest-based sector to 2025.

ECOFOR

ECOFOR is a public body that aims to respond to societal challenges related to temperate and tropical forest ecosystems. It was created in 1993 while forest diebacks in Europe challenged scientists, managers and politicians. Three years before, the need for research networks at national and European levels had been raised by the first Ministerial Conference on the Protection of Forests in Europe held in Strasbourg in 1990 as a French-Finnish initiative. Six members were joint at the time under the aegis of the French State. They are now a dozen. These members pool resources in personnel, infrastructure and money. Complementary resources are mobilized to conduct studies and research in targeted areas. The objectives are to make research progresses, integration and valorisation to meet the challenges in the overlapping fields of biodiversity, resilience and bioeconomy. In the end, a small permanent team relies on a few hundred members of working groups to inform several thousand interested correspondents.

The first theme is to analyse and understand biodiversity, the functioning of forest ecosystems and the provision of ecosystem services. There is also a need to develop the capacity of the forest sector to overcome and adapt to a variety of risks such as fire, drought, storms, pollution, insect pests, pathogenic fungi and large ungulates. These risks are often combined. They are increasing as a result of population growth, globalization and climate change. Sustainable forest management generates a whole bioeconomy of goods and services. The challenge is to

reconcile ecological, economic and socio-cultural perspectives by comparing various options over time. It is based on broad and varied knowledge often organized in the form of a set of indicators.

ECOFOR supports research advances by stimulating or animating multi-year research programs or projects. It consolidates knowledge in the context of studies, collective expertise and foresights to answer urgent or emerging questions. It ensures the sharing of information and the good use of knowledge. It thus constitutes an interface and a mediator between actors and institutions with unequal information and diverging opinions. To meet the challenges of sustainable development, it is more than ever necessary to direct knowledge towards the concrete and potentially contradictory needs of stakeholders, in close consultation with them.

ECOFOR is funded by its members (0,8 M€/year) and additional resources from projects and studies (0,5 M€/year). ECOFOR organizes many events on its own initiative or jointly with its members. It is involved in most forest-related processes both on science and policy aspects. It takes part in most of other processes mentioned in figure 1 and especially those that are described below. It can be considered as a bridge between its members, other institutions and processes.

EFESE: French assessment of ecosystems and ecosystem services

The Millenium Ecosystem Assessment (2005) and the works carried out under the United Nations Convention on Biological Diversity emphasized the concept of ecosystem services that focuses not only on remarkable but also on ordinary biodiversity. They demonstrated the interest to map and assess ecosystem services. This is why Mapping and Assessment of Ecosystems and their Services (MAES) has been developed at the European level and EFESE, the French assessment of ecosystems and ecosystem services, in France. Forest ecosystems are one of the six types of ecosystems distinguished in EFESE. ECOFOR animates the corresponding working group and a first report has been published (Dorioz *et al.,* 2018).

The objectives of EFESE are to better know and make known the state of ecosystems and their multiple values so that they are better taken into account in public and private decisions. EFESE is not a research project but a "place" where scientific and practical knowledge features are gathered to answer questions about the provision, use, ecological consequences and social benefits of ecosystem services. Scientists and stakeholders take part in the elaboration process. The corresponding funding for forest ecosystems has been about 0,2 M€ in total for four years from the Ministry of the Ecological and Inclusive Transition. The final report integrates graded key messages agreed by a committee of stakeholders.

The exercise has been based on six different forest states (open spaces, plantation forests, coppices, sub-natural high forests, natural forests and mature forests). A state-transition model has been used. The level of a dozen ecosystem services has been characterized for each forest state. The different forest states and transitions allowed between them can be assessed. The exercise emphasized also some debate subjects at the interface between science and policy, showing that science cannot always avoid controversy:

- the sylvo-cynegetic balance is subject to debate because it is viewed from an economic perspective by foresters but an ecological perspective by conservationists; and the debate occurred although an overpopulation of ungulates could threaten both timber production, forest resilience and biodiversity;
- in the same way, the state and evolution of forest biodiversity is compared by foresters and conservationists to two different references that are the real past and an ideal future, respectively;
- the felling rate in France is only 50% of the biological net increment and should be thus progressively increased in order to reach a sustainable level of more or less 100%; however, many actors see such increase as a problem for biodiversity;
- when dealing with ecosystem services, the contribution of the forest-based sector to mitigation climate change mitigation is limited to carbon sequestration in forests; however, it should also take into account avoided emissions when timber or wood are used instead of other fossil-fuel intensive materials or energies; this substitution effect is the result of an anthropic service, not an ecosystem one: it means that decisions should not be made solely on the basis of ecosystem services;
- the existence or not of an ecosystem service of regulation of the water quality by forests via a land-use effect has also been much discussed: is the fact that water quality is degraded by other land-uses than forestry a forest service?

Finally, the assessment of ecosystem services is a way to integrate scientific results with stakeholder expectations and to discuss about the future of forestry. Here, the interface aims at facilitating the building of a common vision, although debates are partly subjective.

Landes de Gascogne's future

The Landes de Gascogne's forest covers about one million hectares in the South-West of France on poor sandy soils. Although maritime pine (Pinus pinaster) stands existed already in the past, the present stands are mainly artificial, monospecific, and intensively managed with a rotation age of 40 to 60 years. This forest is the largest planted forest in Europe. It experienced several threats during the last decades and, for example, strong forest fires (1947, 1949), severe frosts (1962/63, 1985) and, finally, strong wind storms (December 1999, January 2009) that divided its growing stock approximately by 2: 140 million cubic meter in 1999 before the first storm, 116 after it; 112 million cubic meter after the second storm and 75 after it. This nearly division by two of the growing stock in less than one decade motivates studies in order to question possible futures of this forest area after such troubles. This is why a panel study, or expertise, on the future of this forest area in the South West of France has been carried out from 2009 to 2010 by ECOFOR under the auspices and with funds of the French ministries of ecology and agriculture (0,12 M€ in total), and in coordination with the region Aquitaine (Peyron, Monnet, 2013).

This expertise has been organized in five tasks: (i) initial and expected conditions and contexts; (ii) main issues regarding the future; (iii) alternative solutions (options) in relation to these issues; (iv) evaluation of these options according to a multi-criteria analysis; (v) conclusions. Issues (ii) and solutions (iii) have been identified inside five working groups on environment, wood and carbon, society expectations, risk management, forest planning. The evaluation (iv) has been structured in fifteen economic, environmental, risk, social and political criteria and carried out by as many experts or (or small expert panels). The initial and expected conditions and contexts have been described both by the working groups for their identification of issues and options and by experts in their own criterion scope. About 120 scientists and stakeholders took part in this expertise as members of a working group, experts, or both.

In the particular circumstances in which it was conducted, this expertise has clearly demonstrated the importance of reasoning on a wide range of possible solutions to be assessed in a multi-criteria manner. It was useful and clear in Landes de Gascogne because some diversification was obviously necessary. But it leads to several lessons that go far beyond the local situation in which it developed. Scientists worked alongside with socio-professionals because the skills of each other could be crossed. The results are not ready to be applied but encourage decision makers to make their choices among several options according to their own perception, position and constraints. This interface was in fact entirely created to deal with the specific situation encountered.

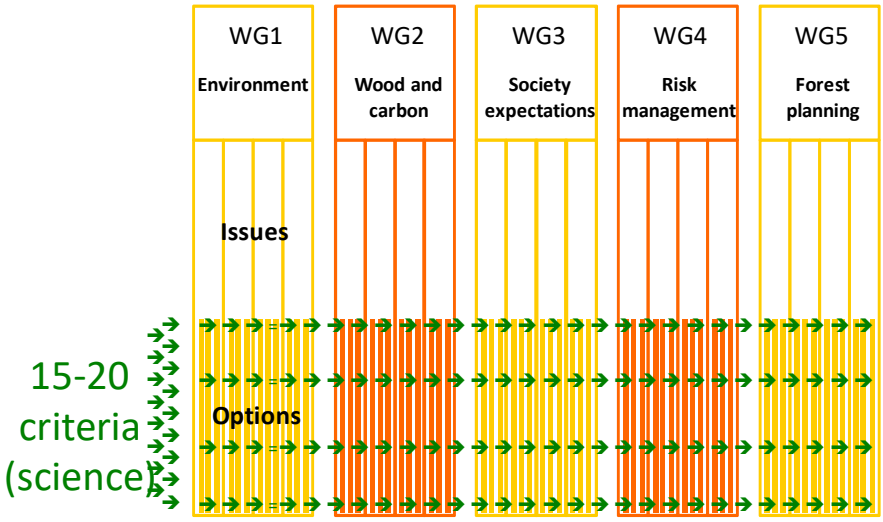

Figure 2. Science/policy interface organized in Landes de Gascogne in order to shape the future of this forest region after two dramatic windstorms. Five working groups (WGs) have been created to identify the main issues and the potential management options for each of them; 15 to 20 criteria have been used to structure the description of past, present, and expected future situations and to assess these options. From Peyron and Monnet (2013).

Levers for climate mitigation

A study was carried out by INRA and IGN at the request of the Ministry for Agriculture and Food in order to focus on the potential of the French forest-based sector and the corresponding options to mitigate climate change between now and 2050 (INRA, IGN, 2017). These options, or levers, are numerous and often debated. They consist in sequestrating carbon in forests and storing it in soils and stands, or in wood products, or to substitute wood to fossil intensive materials and energies. Several groups of actors usually promote different levers and debate about storing carbon in forests versus cutting trees in order to substitute fossil intensive materials or energies and about substituting materials first or energies first.

The objectives were to compare the carbon balance of three main scenarios corresponding to three different levels or removals and its evolution to 2050. These scenarios take part differently to the bioeconomy development and are also differently subject to climate change impacts and risks.

The study was funded by the Ministry of agriculture and food. The results of this study gave the opportunity of a large debate among actors. They show few differences in carbon balance of the different options and did not complete all discussions, mainly because the carbon balance depends much on uncertain aspects such as future risks and on the limits of the models and their scopes.

However, this study or expertise can be considered as a facilitator of exchanges between actors who would like to go on developing this kind of projection up to 2100.

Research and innovation plan to 2025

In parallel with the elaboration of the National forest and wood programme, it appeared necessary to focus more deeply on research and innovation in order to produce a roadmap for the next decade. The representatives of four organisms covering the range of forest research, innovation and funding applied to forest and wood issues received the mission to elaborate a ten-year plan for research and innovation in the forest-based sector (Amécourt e*t al.*, 2016).

This plan adopts an organisation and a formulation that are adapted to decision makers and not only to scientists. It includes three priorities on (i) system approaches for the forest-based sector, (ii) new uses of wood, and (iii) adaptation of forests to both climate change and a bioeconomic era.

System approaches consist in considering upstream forestry and downstream industrial processing as a whole in order to increase the competitiveness of the forest-based sector while avoiding any prejudices to the environment and supporting the provision of multiple forest ecosystem services. Five issues are particularly addressed:

- ensure greater mobilisation of economic, human and social sciences,
- develop methods and indicators for multi-criteria evaluation of forest-based systems,
- gather research and innovation actors at the local level in order to foster open innovation,
- support digital transition in the forest-based sector,
- adapt training and education in the forest-based sector to the new challenges for the future.

High performances of wood processing and uses are a prerequisite to adapt forestry to new challenges. They support production objectives of forestry but are also a means to maintain forests in good conditions. New uses of wood play an important role to stimulate the economic activity while remaining compatible with ecosystem functioning. Four issues are particularly addressed:

- develop robotic technologies with respect to industrial processes and digital techniques,
- create added-value with timber resources and large sawlogs,
- develop new, robust and safe timber construction methods, including for high-rise buildings,
- develop new markets, processes and products towards a bioeconomy.

Forests have to supply a variety of goods and services, particularly to mitigate climate change, and to reduce expected impacts of global warming. Four issues are particularly addressed:

- improve the resilience of French forests to climate change and other risks,
- reinforce innovations on varietal breeding evaluation of new species, long-term maintenance of soil fertility and precision forestry,
- promote smart forestry with information technologies, monitoring and prediction tools,
- take care of biodiversity and its ability to support forest functioning and ecosystem services.

The objective is now to follow up this plan, to discuss its implementation with scientists and stakeholders and to adapt the future actions. Ecofor should facilitate this mission together with a network on wood sciences and the more professional Strategic Council of the Forest-based sector.

5. Challenges and development needs

This situation of science policy interfaces in the French forest-based sector leads to some thoughts that are probably shared with other countries and even sectors.

Science policy interfaces should be considered as bidirectional.

A science policy interface is still often considered as working from science to policy. This is probably due to two complementary facts: (i) science is supposed to develop knowledge and then to disseminate it and (ii) practical issues are too large and complex to be directly translated to a research problem. However, exchanges between scientists and stakeholders allow to develop in addition an information flow from policy to science. In most joint scientific and technical expertise studies (as seen for EFESE, the Landes de Gascogne's future or the Levers for climate mitigation), scientific results and other knowledge are used to answer a policy question; they help to build a response but also highlight research gaps and suggest future research studies. Thus expertise studies both use scientific knowledge and identify new research questions. The definition of a scientific agenda as it has been done in the research and innovation plan to 2025 is also a way to include societal challenges and policy issues in research orientations.

The challenges of science policy interfaces deserve greater means.

The means that can be made available to science policy interfaces include of course staff and money. These are surely not enough as regards challenges in terms of both opportunities and threats. But means should necessarily go beyond purely material aspects. On the one hand the interfacing methods are far from being established: how in fact can we respond quickly to complex practical questions from scientific bases broken down into disciplines that develop progressively and, partly, independently? If, on the other hand, scientific research and the conduct of public policies are perfectly organized and recognized, it is not at all the case for any work at the interface between the two, with the exception of education. This probably explains why so many interface processes have been identified previously above (Fig.1).

It would be presumptuous to pretend here to give a solution to this problem. However, some general remarks make it possible to progress in this direction. In the first place, it can be considered that the complex and wide practical questions posed by public policy makers cannot be addressed directly and comprehensively. They need to be broken down into basic questions that science can grasp. This has been done, in a way, in the example of the Landes de Gascogne. The scientific results obtained with regard to these basic questions can then be aggregated to reconstruct a comprehensive answer. This way of doing things, however, does not take into account the interactions likely to exist between the different components of the problem. This is why it is often necessary to go further by using the potential of modelling. In many cases, the will to build a single model that takes into account all parts of the problem is neither accessible nor effective because of the size of the problem and the variety of disciplines involved. The risk is to lead to a black box of whom overall operation is poorly understood, difficult to interpret, so also to expose to a decision maker.

Schematically, it is possible to propose a strategy of the type shown in figure 3. The scope of the issue is supposed to be partially covered by scientific models 1 to n. Some of them can be aggregated (for example models 1 and

2) but not all of them. Some parts of the scope are not covered (scientific model n+1 doesn't exist and should be replaced for instance by expert opinion). Scientific models are probably unsuitable for a good interface with users because they are too scientific, too specialized and they do not completely cover the field. There is a need for a simpler model that is more comprehensive and accessible to decision-makers if they want to understand for themselves what is being proposed to them. It uses the outputs of the scientific models, completes them as needed by expert statements, and interfaces their results. This suggestion remains schematic but could be useful to deal with science policy practice interface.

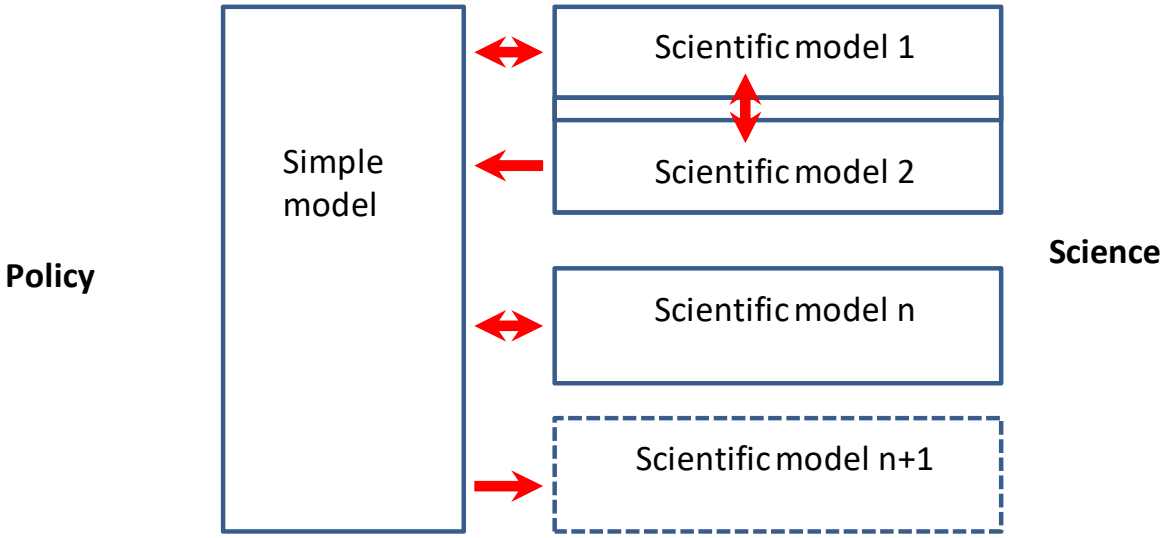

Figure 3. Science/policy interface and two-step modelling.

The need to intensify exchanges between science and policy

As global change takes us off the beaten path and poses a lot of uncertainty about the future, it is increasingly important and urgent to develop knowledge and its contribution to the development of forest management strategies and policies. This involves identifying the right questions, formulating them in the language of the scientists or experts who will have to deal with them, using appropriate methods to deal with them and formulate an integrated response comprehensible by decision-makers.

Communication is important at several levels: (i) identification of the right questions, (ii) discussion and evaluation of possible options, (iii) development, discussion and dissemination of recommendations, (iv) identification of gaps to be filled, (v) establishment a concerted process of continuous improvement ... The discussions concern scientists, experts and decision-makers, but also professionals and the general public who are affected by all the consequences for the ecosystem services they benefit directly or indirectly. This point is more and more pregnant and tricky. It increases the challenge for any science policy interface in the future.

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SNS-EFINORD network meeting and international workshop
Tools for improving science-policy interaction in forestry
Biri, Norway, May 15-16, 2018

Tools for improving science-policy interaction in forestry
Country report Germany

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1. Forest-relevant policy documents in the country

In Germany, forest sovereignty lies with the individual federal states (Länder). The Federation takes on higher-level tasks, coordinates the activities of the Länder and sets the legal framework for sustainable forest management through the Federal Forest Act (Bundeswaldgesetz). Due to the diversity of forest structures and the distinctive level of importance of forestry in the individual federal states, different policy documents exist in the individual federal states. The following explanations are based on higher-level documents issued by the Federal Government and the Federal Ministries, in particular the Forest Strategy 2020 - Waldstrategie 2020 (Bundesministerium für Ernährung, 2011), the National Strategy on Biological Diversity - Nationale Strategie zur biologischen Vielfalt,(Bundesministerium für Umwelt, 2007) and the Nature Conservation Offensive 2020 – Naturschutzoffensive 2020 (Bundesministerium für Umwelt, 2015), as well as the Charter for Wood - Charta für Holz (https://www.charta-fuer-holz.de).

Forest Strategy 2020

In Germany's forests, more wood has been grown than is being used for a long time. The results of the third Federal Forest Inventory have shown that there is still potential for sustainable use in German forests, as fellings have always been below growth over the last 10 years. Increased use of wood in the energy and in particular in the material sector also supports the climate protection goals of the Federal Government and the decisions on the energy transition. However, the German forest is facing great challenges: The growing demands on forests in the areas of climate, nature and environmental protection as well as recreation and hunting are already leading to conflicts of interests in some places, which could intensify in the future - to varying degrees in different regions. And climate change also increasingly requires new solutions from forest owners and forestry.

As a strategy for the natural and economic area of forests, the Forest Strategy 2020, addresses these complex interrelationships and different levels of demands. Existing challenges and opportunities are identified in nine fields of action, possible conflicts of objectives are analysed and possible solutions formulated:

1. Climate protection and adaptation to climate change
2. Property, work and income
3. Raw materials, use and efficiency
4. Biodiversity and forest conservation
5. Silviculture
6. Hunting
7. Protection of soil and water balance
8. Recreation, health and tourism
9. Education, Public Relations and Research

The aim is pointing out solutions to a sustainable balance between the increasing demands on forests and their sustainable performance. The Federal Government's forest strategy is aimed at all relevant actors at federal and state level. Its implementation makes an important contribution to creating the necessary awareness among the population of the diverse functions of domestic forests and to strengthening the advantages and opportunities of sustainable forestry for climate, nature and environment, economy and society.

There is a need for additional research and information in certain areas. Questions concerning the adaptation of forests to climate change, the interrelationships and effects of forest management and nature conservation must be answered, as well as questions concerning the efficient use of raw materials or the maintenance and expansion of value creation potentials for the forestry and timber industry. Practically relevant research, innovation and information transfer, education and consumer information are therefore important measures in almost all fields of action of the forest strategy.

National Strategy on Biological Diversity & Nature Conservation Offensive 2020

On 7 November 2007, the Federal Government adopted the National Strategy on Biological Diversity (NSBD) drawn up under the auspices of the Federal Ministry for the Environment. The NABD is a comprehensive and ambitious strategy for implementing the UN Convention on Biological Diversity and contains around 330 objectives and 430 measures on all biodiversity-related issues. The implementation of this National Strategy is not a task for the Federal Government alone, but must involve all societal actors. For this reason, the Federal Ministry or Environment launched a dialogue-oriented implementation process. Major components of this process are large National and Regional Forums on Biodiversity, various Actors' Dialogue Forums and Länder Forums. All state and non-state actors are invited to participate in the implementation process.

The results of the 2014 Indicator Report on the National Strategy have made it clear that the measures taken so far to protect and conserve biological diversity are not sufficient to achieve the ambitious goals of the NSBD. One of the largest deficits is in the central indicator "Biodiversity and landscape quality". The "Nature Conservation Offensive 2020" action programme assigns a total of 40 priority measures to ten priority fields of action. (Bundesministerium für Umwelt, 2015). The action programme “FORESTS - Forestry in harmony with nature” lists measures for the development of forests in the sense of nature conservation. Among other things, funds are to be made available to ensure that long-term contractual nature conservation programmes take effect on ten percent of the area of private forests. Special emphasis is placed on deadwood and old growth forests. Together with all relevant actors, clear and comparable criteria for good practice in forest management should be defined. In addition, natural development is to be achieved on ten percent of the public forest area by 2020, and the promotion of contractual nature conservation in private forests on ten percent of the area is to be ensured.

Charter for Wood

With the goals "Climate protection - Value creation - Resource efficiency", the Charter for Wood 2.0 focuses on qualitative growth to support central international, European and national political goals. The goal of the Charter for Wood in 2004 was to increase wood consumption in Germany by 20 percent per inhabitant within ten years. This goal could already be achieved before the end of the set period. In the meantime, the focus is on securing the supply of raw wood, aspects of increasing the use of wood as a material, recycling, material and resource efficiency for more climate protection and added value. The Charter for Wood 2.0 is therefore characterized by the following basic understanding:

- Forests are important ecosystems and habitats
- Forests have owners – about 50 percent of German’s forests are privately owned
- Using timber from sustainable, legal forestry
- Science and research are the basis for knowledge-based decisions
- Use environmental advantages and act non-discriminatory
- Committed to fair dealings with consumers
- Maintaining transparency and social dialogue

The implementation of the political goals focuses on priority fields of action in which the greatest effects are expected or where special action is seen as necessary. In the priority field of "Building with wood in town and country", the wood construction quotas in the different building categories and the use of wood in the renovation of buildings shall be increased. The potential of wood in bio-economy is to be utilized through innovative products and processes. The main topic of resource-efficient recycling is the improvement of cascade use in the forestry and timber industry, i.e. the multiple use of raw materials or products made from them with the aim of keeping them in the material or economic cycle for as long as possible. Important aspects for achieving this are improvements in the collection and sorting of waste wood as well as in product design. The positive socio-economic and important climate-relevant effects of the Forest & Wood cluster are based on the use of raw timber provided by forestry. Securing and expanding timber supplies is therefore a high priority, which is considered in the priority area of sustainable raw material supply. Consumer information and communication should be developed in order to promote awareness of the positive aspects of forest and wood use in society.

Research and development is designed as a cross-cutting theme for the six fields of action of the Charter for Wood and supports the topics and measures defined there. Classical forestry/wood research is required here as well as scientific support in the area of socio-empirical and socio-economic issues in the context of sustainable forest management, wood use and the relevance of the Forest & Wood cluster for the environment and society. The aim is to identify and prioritise research requirements and contributions in the respective field of action in exchange with experts from science and practice.

The priority fields of action and focus areas addressed by the Charter for Wood were conceptualised together with experts from the Federal Government, the federal states and the fields of science and business as part of a joint working group between the Federal Government and the federal states. They provide the framework and create the foundation for the further development and implementation of the Charter for Wood. A steering committee and various working groups are being set up to coordinate and implement the Charter

Further Information:
https://www.charta-fuer-holz.de/fileadmin/charta-fuer-holz/dateien/service/mediathek/charter_for_wood_2.0_web.pdf

2. Science-policy interfaces

According to van den Hove (2007) science–policy interfaces are defined as social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making. They are implemented to manage the intersection between science and policy. Here we deal with three forms of interfaces, which exemplify the exchange of knowledge and the formulation of information requirements: (1) scientific advisory boards, (2) project allocations, and (3) departmental research.

Scientific advisory boards

The *Scientific Advisory board on Forest Policy* advises and supports the Federal Government in shaping the framework conditions for sustainable forest management. The Advisory Board is made up of representatives of various scientific disciplines that reflect the social requirements placed on forests. This includes

- a secure supply of the wood industry and energy industry with the renewable raw material wood,
- job security, especially in rural areas,
- the conservation of biodiversity,
- climate protection and the adaptation of forests to climate change,
- the use of the forests as a recreation and experience area for the population as well as
- respecting the balance between the interests of the owner and social responsibility.

The board examines the objectives and principles of national and international forest policy. It submits proposals for the further development of the forest policy framework conditions and the instruments for

implementing the Federal Government's Forest Strategy 2020. In addition, it strives for a balance between the different social demands on forests and promotes scientific discourse on sustainable, multifunctional forest management. Furthermore, the board discusses and evaluates conditions, provides impulses for change and takes up initiatives from different scientific and social fields. It advises politicians through status reports and recommendations.

The *German Advisory Council on Global Change* (Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, WBGU) provides policy-makers with orientation on global environmental and development problems. It conveys complex contexts, assesses risks and proposes ecological and socio-economic "guard rails" that should not be exceeded. Policy advice on global change thus serves to facilitate fact-based and knowledge-based political and social debate and to make it easier for decision-makers to act under uncertainty. In particular, these are precautionary options that avoid irreversible, serious damage to people and nature.

Project funding

Public institutions award research contracts in the form of expert opinions and scientific studies. Both at federal and state level, this instrument is used to create the scientific basis for policy decisions. Some examples of research funding are given below.

Within the framework of the Forest Climate Fund, which is jointly managed by Federal Ministry for Food and Agriculture and the Federal Ministry for the Environment, research projects are initiated to enhance the CO_2 emission reduction, energy and substitution potential of forests and wood and adapt German forests to climate change. The aim is to support the achievement of the Federal Government's climate targets.

The Federal Ministry of Food and Agriculture (BMEL) supports forestry research cooperation with third countries and the transfer of tried and tested know-how in the forestry sector. Funding is be provided for measures in the following funding priorities:

- bilateral forest research projects,
- project with International Organizations,
- forest science exchange and project initiation,
- knowledge transfer (in Germany and partner countries).

The aim is to convert the use of forests worldwide to sustainable forest management in order to counter the progressive deforestation and degradation of forests.

The Federal Ministry of Education and Research supports the implementation of research and innovation projects within the framework of topic-specific and open-topic funding programmes. The broad range of funding is tailored to important fields of innovation or technology, but also to different challenges and starting conditions. The promotion of research and innovation is based on many aspects. Basically it is important to know:

Degree of innovation: How innovative is a project from a scientific or technical point of view?

Utilization: How are the chances of success to be evaluated, is there a utilization concept for technological developments?

There are also a large number of funding opportunities at federal state level, which are intended to integrate universities and research institutions in particular into politically relevant issues. For example, the German state of Rhineland-Palatinate awarded a research contract "Scenario analysis of the potential climate protection performance of the Rhineland-Palatinate forestry/wood cluster through the simulation of alternative forest management measures and wood use options".

In order to cope with the research requirements for its judgement formation and concrete decisions, the Federal Ministry of Agriculture can fall back on organizationally streamlined research institutions. These perform research services according to the specifications of the BMEL. A number of federal states also maintain their own forestry research institutes.

3. Selected science-policy interfaces

Two examples of successful cooperation between science and politics are presented below.

Integrate

Scenario analysis: Enhancement of nature protection in sustainable managed forests (INTEGRATE)

The European network INTEGRATE promotes and advances forest management approaches for the integration of nature conservation into sustainable forest management at three levels: the decision-making policy level, the level of forest practitioners/managers, and the level of research and academic knowledge.
The network was initially brought into life by German federal minister Christian Schmidt for Food and Agriculture and his Czech colleague Marian Jurečka, and subsequently supported by the European Commission's Standing Forestry Committee

We are facing a growing demand to increase nature conservation in Europe's forests as well as the request to leave more forests un-managed, to take them out of the economic loop. These demands however, the latter in particular, are very difficult to combine with other societal demands on the forests as well as with intentions of forest owners. Moreover, as science tells us, setting aside managed forests is not always the best way to protect species and habitats in the cultural landscapes of Europe. Besides that, there is the urge to increasingly bring European forest management in line with climate change adaptation.

The INTEGRATE network fosters knowledge transfer across borders and aims for capacity building in the field of integrated forest management. A great feature of the network is the integration of science, field experience and practical examples into its pool of knowledge. Participants are able to exchange best-practice and success stories, and collaborate in answering questions that are particularly relevant in forest management practice: Are successful integrated forest management concepts applicable in different contexts? How do those concepts affect other requirements on European forests? What are the extra costs?

The identification of key habitat elements and structures is a crucial pre-requisite for the integration of biodiversity conservation aspects into commercial forest management. Forest managers are often not trained to identify these elements and structures supporting species diversity. They may simply lack the abilities for recognition and assessment or how to consider them both in forestry operations and planning procedures. Recent scientific findings are entering many practical approaches for integrative conservation measures throughout Europe. Such practical approaches accompanied by science represent a pool of good practice examples. One excellent trainings and demonstration tool here are the so called Marteloscope with more of 40 sites in more than 13 European countries a successful tool developed by the European Forest Institute (EFI).

The Marteloscope demonstration sites include selected sites for field visits and excursions for a wider audience, as well as permanent plots based on the French Marteloscope (M-scope) approach. M-scopes are 1 hectare forest plots in which tree measurements and innovative software for hand held devices are linked to provide a framework for in-forest training. That includes for example the marking and selection of trees and identification of habitat structures. Results of the exercise can then instantly be visualized on a tablet computer or laptop in the stand and thus serve as input for stimulating discussions in the field. This discussion is also beneficial to solve the dispute between nature conservation NGOs and foresters and also to explain to the public the options how to enhance nature conservation in sustainable managed forests.
Thus, the overall objective of INTEGRATE is to promote successful forest management concepts across borders, based on empirical experiences and on science, to identify successful management practices and to transform

them into recommendations targeted at forest practitioners. The European Forest Institute will accompany the process in its role as facilitator and scientific advisor. Other relevant research initiatives are taken into account as well.

For further information:

https://informar.eu/european-network-integrate

Scenario analysis: potential climate protection performance of the Rhineland-Palatinate

The research study "Scenario analysis of the potential climate protection performance of the Rhineland-Palatinate forestry/wood cluster through the simulation of alternative forest management measures and wood use options" was awarded to the University of Hamburg and Knauf Consulting. The study examined the effects of different management measures on the climate protection performance of forests and wood against the background of the fact that the climate protection performance of wood products can be taken into account in the greenhouse gas balance and the importance of emission reduction through material and energy substitution. For this purpose, the University of Hamburg has designed four basic and three combination scenarios for forest management between mass optimization and non-utilisation and predicted forest C storage and timber harvest volumes by 2100. Building on the results of the timber harvest, Knauf Consulting analyzed the use of wood in a basic scenario and alternative uses for wood products C-storage and material and energetic substitution effects.

Table 1 presents the current annual carbon sequestration and GHG-mitigation of the forests of Rhineland-Palatinate, which cover an area of 840.000 ha. It is obvious that the carbon effects by timber utilization (i.e. increase of the C-pool of forest products and the substitution effects exceed) exceed the increase of the removals by the forest C-pool.

Table 1. Current Carbon sequestration and GHG mitigation in the forest of Rhineland-Palatinate

Source	Annual removals [tC]
Forest C-pool	1.025.400
Timber products C-pool	127.200
Energetic substitution	515.300
Material substitution	706.800

The same effect can be seen, when the dynamics of carbon effects by timber utilization and forest C-pools are simulated for the period 2005 to 2100. Timber utilization compensates the losses of forest C-pools by harvesting. In the scenario “no timber utilization” harvesting of timber was abandoned, which results in a substantial increase of forest C-pools. However, the comparatively lower forest C-pools of the other management scenarios are compensated by the substitution effects and the C-pools of harvested products, which makes harvesting and associated timber utilization superior in terms of total C removals (Fig. 1).

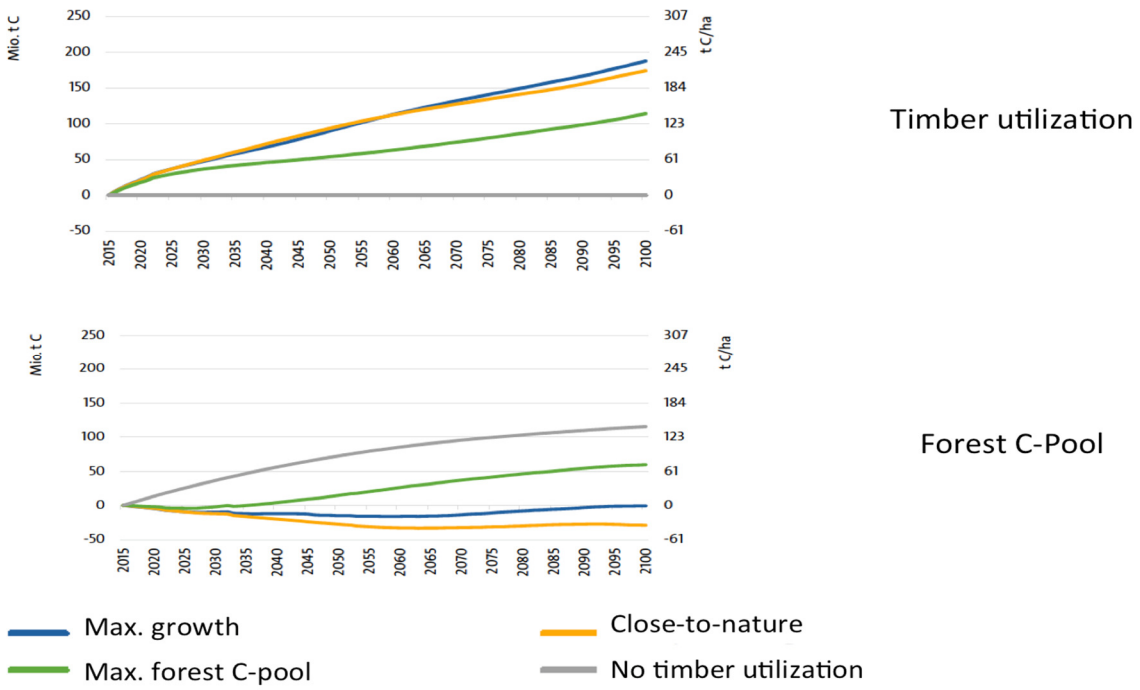

Figure 1. Simulation study C-sequestration and GHG-mitigation

The results of the study have been published in a brochure for policy makers and the general public (Ministerium für Umwelt, 2018). The current C-removals are shown here as an example (Fig. 2).

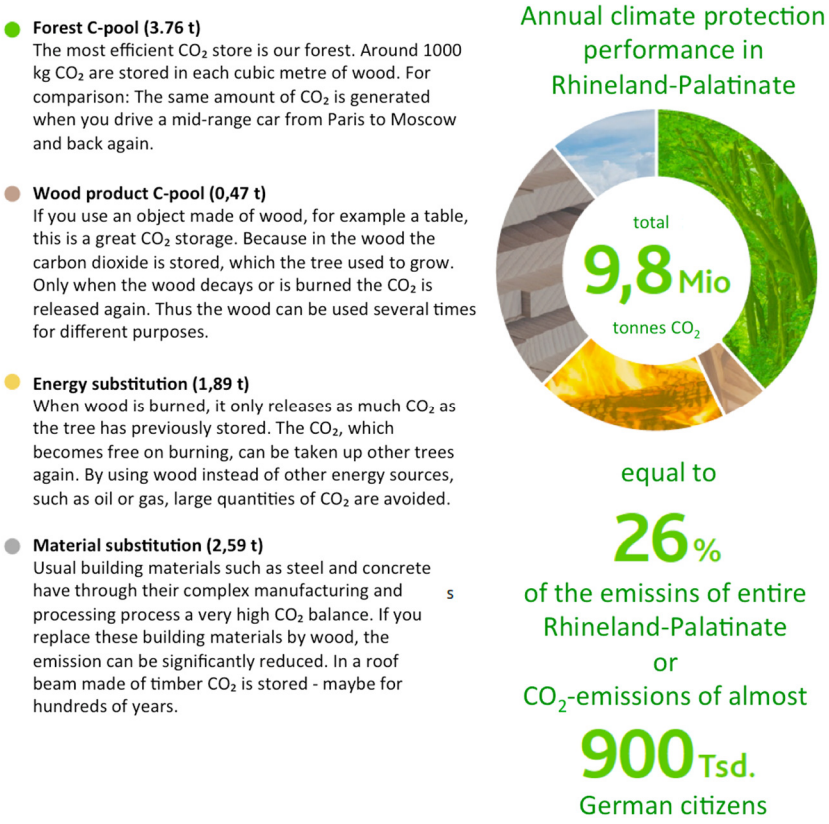

Figure 2. Implementation of the results in an information brochure (translated from (Ministerium für Umwelt, 2018)

4. Challenges and development needs

In computing, an interface is a shared boundary across which two or more separate components of a computer system exchange information. Science-policy interfaces similarly connect two worlds, which are characterized by different working methods, time horizons and degrees of detail. Scientists are often disappointed that their evidence, which has often been gained over many years, is hardly affecting policy. Often policy responses are incremental at best. For their part, politicians are concerned that scientists are often unable to put their findings in the context of timely and targeted policy solutions. Scientists often fail to take account of the fact that policy decisions are complex. Policy-making is a network process that must meet a wide variety of demands and in which scientific evidence is only one of many decision criteria. Moreover, scientists and politicians have a different view of what evidence is. Scientists are working on verifying or falsifying hypotheses and will only represent what is undoubtedly recognizable and reproducible. For politicians, evidence can take various forms. For them, opinion polls or anecdotes are certainly evidence for taking action. Much of the scientific and social debate arises from the fact that different views of evidence can shape the opinion. This applies in particular to questions of the forest sector, where the most diverse interests and demands come together. What seems to be a logical chain of argumentation from one perspective, for example from an economic point of view, can be a completely erroneous result from another perspective, for example nature conservation. Well-founded decisions in the forest sector must therefore always take into account a variety of perspectives, both in terms of scientific expertise and social demands. Or to put it in the words of Ludwig Wittgenstein: the limits of my world are the limits of my language.

In this context, contract research by own research institutes or project funding by government-related organisations must also take a critical look. The German National Science Council (Wissenschaftsrat) criticizes the federal research institutions in particular[3]. An epistemological conflict is preprogramed when recommendations for political action are made which are driven by singular norms of action and imply a particular number of addressees. According to Lenzen (2017), the fine line between an empirical result and an action standard must be drawn clearly.

As shown in the two scenario analyses there exists for issues of high political and public relevance good examples how science – policy interfaces can function and both sides can benefit from the other. In future it will be needed to continue in these successful lines. In addition, a professional public relation work is also needed to explain to the public the need to forest policy measures.

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SNS-EFINORD network meeting and international workshop
Tools for improving science-policy interaction in forestry
Biri, Norway, May 15-16, 2018

Science-Policy Interaction in Icelandic Forestry

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1. Forestry in Iceland

At the time of the settlement of Iceland, around 900 A.D., birch (*Betula pubescens*) covered between 25 and 40 percent of Iceland's land area. In sheltered inland valleys, relatively tall birch forests were found, but lower birch and willow shrubs grew in areas closer to the shore and on exposed sites (Eysteinsson 2017). Following the settlement, forests were cut down to create fields and grazing land. Sheep grazing prevented regeneration of the birch woods after cutting. This led to decline of the woodland cover and around 1300 there are indications that woodland remnants were becoming valuable resources because of their increasing rarity. In the beginning of 20th century the birch woodlands probably reached their post-glacial minimum of about 1% of land area (Aradóttir and Eysteinsson 2005).

The severe decline of woodlands in Iceland, followed by general land degradation and desertification, especially in the late 19th century, finally resulted in the submission of law on woodland and soil conservation in Iceland (Fannarsson et.al. 2017). First in 1894, a statute was passed to preserve woodlands and lyme grass but the *Act on forestry and protection against soil erosion* in 1907 is generally recognised to mark the beginning of formal soil and woodland conservation in Iceland.

The afforestation efforts in Iceland started in 1899 with planting in Thingvellir, the arena of the old parliament. However, the transition from deforestation to reforestation and afforestation takes time and the intensity has largely depended on state funding. In the year 1958 the number of planted seedlings reached 1 million with a maximum number in 2009 when little over 6 million tree seedlings were planted. Since, the number has declined and in 2017, the total number of planted trees was little over 3 million plants. Almost 1/3rd is the native birch, but other important tree species include Siberian larch (*Larix sibirica*), lodgepole pine (*Pinus contorta*), sitka spruce (*Picea sitchensis*) and black cottonwood (*Populus trichocarpa*). The forests in Iceland are slowly increasing their area, and according to the forest registry, the total cover of forests and woodlands in Iceland 2017 was 1.9% (figure 1).

Figure 1. In 2017, the cover of natural birch forests and woodlands was 151 600 ha or 1.5% of land cover (left) and cultivated forests covered 42 000 ha or 0.4% of land cover (right). Maps by Björn Traustason, Icelandic Forest Research.

2. Forest-relevant policy documents in Iceland

Policy documents covering the issue of forestry are mainly in the form of legal documents and bylaws, since no governmental processes are manifested for the development of a national policy or plan.
Legislation and bylaws relevant to forestry in Iceland.

Current legislations and bylaws covering forestry are:

1. Act on Forestry no 3/1955 (Lög um skógrækt 1955)
2. Act on Regional Afforestation Programs on Icelandic farms no 95/2006 (Lög um skógrækt á lögbýlum 2006 nr 95 13. júní)
3. Regulation on regional afforestation programs on Icelandic farmland (Reglugerð um landshlutaverkefni í skógrækt 285/2015)

Laws pertaining to forestry reflect the fact that forests form a very small part of the Icelandic landscape, the main policy points being that existing forests should be protected, and afforestation of treeless land is encouraged. To this end, the Icelandic Forest Service (IFS) has a mandate to educate and advise the public in forestry matters. These goals have been in effect since the first Forestry Act of 1907 and is reflected in the current forestry act from 1955. Apart from these goals, the current act is for the most part out of date, mirroring the fact that at the time of this legislation, forestry was almost non-existing. However, the goal of increasing forest cover through afforestation is affirmed in the Act on Regional Afforestation Programs (RAP) of 2006, where for the first time a concrete goal of 5% forest and woodland cover of lowlands is set. Apart from that, the RAP act mainly reflects on rules and regulations regarding contracts and subsidies to farmers.

Since the passing of the current act on forestry from year 1955, international conventions and national policies and laws concerning forestry have grown and developed. This includes environmental conventions like the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC) as well as international cooperation like Forest Europe. Policy instruments like physical planning and environmental impact assessment for development (EIA) and plans (SEA) have entered the stage of land use planning. Forestry, like other land use sectors, therefore needs to adapt to this. Work on drafting a new forestry act is ongoing and by September 2018, a bill is pending for review by the Icelandic Parliament. If passed, the new forestry act will support and legitimise developments that have already taken place and lead to some much-needed changes.

Other legislations that are relevant to forestry in Iceland are e.g. the law on agricultural land (Act no 81/2004), nature conservation law (Act no 60/2013) and planning act (Act no 123/2010).
Agricultural policy in Iceland does only to a minimal degree include forestry, but since forestry is an emerging sector in the country, this may change. For now, Icelandic legislation covering the use of land for agriculture is tailormade for traditional livestock grazing practices, stating that land owners are allowed to fence livestock out, excluding the responsibility of the livestock owner. This has posed additional cost on land use sectors like forestry in the form of fencing.

Nature conservation law make for the fundamental references for all land use including forestry. This includes stipulations for the use of invasive alien species and for the protection of landscapes, geological formations and ecosystems.

The Planning Act and its bylaw do provide the framework for physical planning. However, this does not include guidelines on how to include environmental factors like landscapes in physical forestry planning. Neither is this included in the National planning strategy, which is decided by Parliament as a resolution, the first one since year 2015.

Other policy documents not confirmed by the government

Forestry in Iceland – Policy for the 21st century was developed jointly by the IFS and stakeholders of the forestry sector and published in 2013 after open review. It contains a strategy referring to e.g. Forest Europe and the forestry strategy for Scotland.

The strategy emphasises:

- Building up a forest resource
- Forest utilisation, value and innovation
- Society, access and health
- Environmental quality and biodiversity
- Climate change

Under each of these headings are goals and means to achieve them. Included among these goals are:

- That at least 12% of Iceland be afforested by the year 2100 through both planting and natural forest expansion
- To develop sustainable forest utilisation and forest industry
- To improve public access to forests and increase the recognition and role of forests in public health
- To increase the role of afforestation in soil and water conservation, enhancement of biodiversity and amelioration of the environment
- To enhance the role of forests as carbon sinks and to adapt forestry to climate change.

In 2016 five Regional Afforestation Projects (RAPs), responsible for implementing farm afforestation, merged with the IFS forming a new agency, Skógrætkin, which is nevertheless still translated into English as the Icelandic Forest Service. *Icelandic Forest Service, Policy and Organisation* is a strategy report where the role of the IFS as well as the organisation's values and vision of the future, are listed. Special emphasis is put on the following matters:

- Increased forest cover and development/implementation of a national forest programme
- Improved research and knowledge in Icelandic forestry
- Public relations and image-building
- Layout and infrastructure of the new organisation
- Sales and marketing

3. Science-policy interfaces in Iceland

The main formal science-policy interface in Iceland is via the Science and Technology Policy Council, which has the role to support scientific research, education and innovation in Iceland. Members of the council include the Prime Minister, the Minister of Finance and Economic Affairs, the Minister of Education, Science and Culture and the Minister of Tourism, Industry and Innovation. Other members are nominated by different Ministers, the Rector's Conference of Higher Education Institutions, the Icelandic Confederation of Labour and SA-Business Iceland. The Icelandic Centre for Research (RANNIS) cooperates with the Icelandic Science and Technology Policy Council, providing professional assistance in preparation and implementation of the national science and technology policy. In addition to this, RANNIS administers competitive funds in the fields of research, innovation, education and culture, as well as strategic research programmes. Forest science has a very weak link to both the council and RANNIS.

In 1968 an executive board was established for the Icelandic Forest Research. The role of this body evolved from being directive into an advisory committee and was finally terminated in 2016. It served as a direct link from forest science into the Ministry of Agriculture, which at that time was responsible for forestry. The board also included other parties and stakeholders such as The Icelandic Forest Service, The Icelandic

Forestry Association, The Agricultural Research Institute and the Regional Afforestation Projects. Both the research director and deputy research director attended the meetings of the board.

The most efficient interface between forest science and policy makers in Iceland is probably the informal personal connection scientists have to the Minister, MPs and employees of the Ministry. Being a small nation, personal connections and man-to-man approach can be of huge advantage.

An example of this is a recent initiative by the Icelandic Forest Service (IFS), with participation from the Icelandic Association of Forest Owners (IAFO) and the Icelandic Forestry Association (IFA). The goal was to raise the awareness with MPs on the beneficial effect of increased afforestation on carbon sequestration. To achieve this goal a short memorandum was prepared describing two scenarios, the first one showing estimated carbon sequestration with status quo in annual numbers of planted seedlings, the second showing potential carbon sequestration by quadruplicating these numbers. In addition, the predicted cost of increased planting efforts was calculated.

Several actors, including foresters, forest scientists and PRs from all three organizations (IFS, IAFO, IFA), participated in the initiative. The approach was to present the data directly man-to-man targeting specifically, but not only, MPs who had already shown some interest in forestry and global warming matters.

This approach of elusively presenting scientific data directly to MPs seems to be of success, if the goal is to raise awareness amongst them and increase their knowledge of the correlation between afforestation and carbon sequestration. The Icelandic Government has put afforestation and reforestation amongst its top priority actions for reaching the goals of the Paris Declaration and Iceland's goal of carbon neutrality in year 2040.

4. Challenges and development needs

In general, one can argue that Icelanders are not a model nation when it comes to policy and long-term planning. In fact, one of the most commonly used phrases in Iceland is "þetta reddast" (pronounced: theh-da red-ust) which can be translated to "it will all work out OK". This relaxed attitude towards long-term planning can also be seen in policy making regarding forestry and forest research in Iceland, even though forestry is essentially a long-term project. Therefore, challenges are many and much development needed in the case of Icelandic science-policy interfaces.

First, a new legislation on covering forestry needs to be implemented since current law is outdated and not in tune with the evolution of environmental law and policy, neither on the national nor international level. That is of great urgency since the pending bill does provide for the development of a long-awaited National Forestry Plan, a key instrument for developing and revising the policy in forestry in broad consultation. Just as any other country on the globe, Iceland faces the tremendous challenges of ongoing climate change. Especially in countries such as Iceland, that have large eroded areas with low vegetation, forestry and afforestation can be key mitigation actions. There are large opportunities in improving the productivity of degraded land on large scale, sequestering carbon in wood and soil and at the same time halting the release of carbon from degrading soils. The right choice of tree species will remain a constant challenge, obtaining and maintaining the genetic material suitable for the changing climate. This is one of the fundamental projects of forestry and forest research in Iceland.

Climate change also generates other challenges, e.g. the introduction and spread of new pests and diseases on trees and shrubs. Higher temperatures in Iceland, along with various new channels for new species to enter the country, has enhanced the stress on trees and shrubs in Iceland, not only by the increased numbers of new pests but also due to changed behaviour of older ones (Halldorsson etal 2013).

Afforestation affects ecosystems, landscapes and rural development in several ways. The introduction and distribution of new tree species may increase the biodiversity but can also affect the native flora and fauna by enhancing habitats for some species but degrading others. The impact of forestry on native flora and fauna has been systematically studied in certain areas, indicating that afforestation have little effect on total species

richness, but species composition may change (Halldorsson et al 2008). However, since the effect of afforestation on biodiversity can vary between regions and tree species, further information are needed both on the effects of afforestation on biodiversity and on the natural seeding and spreading of different tree species. It must also be noted that the ecosystems of Iceland are to a large extent affected by human induced action like extensive grazing and wood cutting since settlement, causing the barren landscape that characterizes the country today.

It is highly recognised that forests can improve quality of life providing ideal settings for different outdoor activities, shelter and improved air quality. The total value of this service is increasing with more people pursuing outdoor life and should be paid more attention.

Timber production and harvesting is an emerging and growing industry in Icelandic economy. Furthermore, the emphasis on carbon sequestration in forest and soil and decreased carbon loss from poorly vegetated land areas will lead to increased value of forests and forestry in Iceland, especially in rural areas. Therefore, research and clear policy must go hand in hand to increase efficiency and value of products.

Debated aspects such as landscapes and scenery, effects on the quality of life and more need to be taken into consideration in forestry planning, designing forests in such a way that they will conform with other elements and characters of the landscape ensuring diverse recreation opportunities for people. The impact of forests on landscape and scenery has come more into the public debate, especially with increasing tourism and may itself be counted as a rising challenge. However, forests already provide recreation opportunities for hiking, camping and other activities. The value of these services should be further investigated.

It is clear from the above chapter, that forests and forestry will play a big role in the future, and there are multiple challenges regarding forestry and forest policy in Iceland. However, perhaps the biggest challenge remains to ensure the human resource needed for future research and development in this field. Directions and guidelines based on national or regional policies should be developed for a more focused dialogue on this subject.

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SNS-EFINORD network meeting and international workshop
Tools for improving science-policy interaction in forestry
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Tools for improving science-policy interaction in forestry: Norway

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1. Forest-relevant policy documents in Norway

Some of the most recent and most relevant forest policy documents from the Norwegian Government would be:

- The Norwegian government's Bioeconomy Strategy (Departementene 2016)

The Norwegian Government's bioeconomy policy targets sustainable, effective and profitable production, extraction and use of renewable, biological resources into food, feed, ingredients, health products, energy, materials, chemicals, paper, textiles and numerous other products. Priority will be given to measures with a national effect on both value creation and employment as well as reduced climate gas emissions and/or more efficient and sustainable use of resources.

- The Norwegian Government's expert panel's report on green competitiveness (Hedegaard and Kreutzer 2016)

A process for developing input to:

- The Norwegian government's strategy for green competitiveness (Ministry of Climate and Environment 2017)

The Norwegian Governments strategy for Green Competitiveness is laying out objectives and measures for technological changes, corresponding policies and measures and the relation to develop pathways for a low carbon society.

- The Norwegian government's White Paper on forest policy (Meld. St. 6 2016–2017)

The most recent white paper on the Norwegian forest policy is emerging from the climate policy agreement in Norwegian Parliament, environmental policies and the Norwegian government's policies for the bioeconomy. The white paper focuses on the competitiveness of the forest sector and has a value chain approach.

- The Norwegian Government's climate strategy towards 2030 (Meld St 41 2016 – 2017)

This is the most recent white paper and strategy for the Norwegian government in a series of white papers covering the climate change policies in Norway. Forests and land use feature prominently in the

Norwegian climate change policy. This paper presents the strategy of the Government for the fulfilment of the commitments related to the climate agreement for 2030, and states that the Government has an ambition to fulfil the Paris Agreement together with the European Union.

- Regulation (EU) 2018/841 of the European Parliament and Council on the inclusion of greenhouse gas emissions and removals from land use, land-use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU

Norway has been part of the EU Emissions Trading System (ETS) since 2008. A significant change in the Norwegian climate policy is the ambition on a joint fulfilment of climate change commitments also for the non-ETS. This imply that regulations on LULUCF and effort sharing becomes relevant for Norway. Similarly, the regulation for Renewable Energy is included in the European Economic Area (EEA) agreement and the revised Renewable Energy Directive will become a framework for renewable energy in Norway.

2. Science-policy interfaces in Norway

Nature types in Norway (NiN)

Nature Types in Norway (NiN) is a classification system for the ecological variation found in Norway developed through the Norwegian Biodiversity Information Centre (NBIC).

NiN was designed to recognize that most of the variation in nature derives from a more or less gradual variation in species composition in response to gradual variations along ecological gradients. The NiN system covers the entire mainland of Norway, the Arctic islands and the marine areas that are under Norwegian sovereignty, and has been designed to meet the needs of as many users as possible and to reflect the patterns of variation in the environment.

NiN is a dynamic system, and in cooperation with most of the scientific institutions in Norway, the NiN system is regularly revised and upgraded.

The Norwegian National Forest Inventory (NFI)

Norway was the first country in the world to establish a nationwide forest inventory. The Norwegian National Forest Inventory (NFI), first established in 1919, has for almost 100 years produced knowledge about the forest resources.

One hundred years ago, the primary motivation for establishing national forest inventories was to obtain an overview of timber resources. While monitoring timber resources and sustainability is still a major component, national forest inventories have gradually evolved to provide answers to a much broader range of issues. Today's national forest inventories also monitor forest damage, carbon sequestration as well as biodiversity indices, and many other ecosystem services.

The results of the Norwegian NFI are used as basis for decision-making in forest policy, forest management, forest products industries, and for evaluating the consequences of decisions taken. Norway's National Forest Inventory provides data vital to decision making about the utilization of forest resources at the national, regional, and even local levels. NFI data are also used for international reporting under the UN Climate Convention, to international forest health monitoring programs, and on the health status of forests and many biodiversity indicators.

One example of the use of NFI data for biodiversity assessment is the measurement and reporting of coarse woody debris.

Reporting obligations for many international processes and organizations are fulfilled using NFI data and results. Reporting processes include: the Forest Resources Assessment (FRA) of the Food and Agriculture

Organization of the United Nations (FAO), the national reports on Land Use, Land-Use Change and Forestry (LULUCF) under the United Nations Framework Convention on Climate Change (UNFCCC) and under Article 3.3 of the Kyoto Protocol, and the indicators and criteria for sustainable forest management in Europe (FOREST EUROPE, UNECE and FAO 2011).

Environmental Registrations in Forests («Miljøregistreringer i skog (MiS)»)

Environmental Registrations in Forests (MiS) is the Norwegian forestry sector's mapping methodology for assessing environmental values associated with forestry planning. The main objective of the methodology is to improve the knowledge base and management of biodiversity in forests by recording important habitats for red-listed species.
The selected MiS registrations are the main basis for establishing the key biotopes that will be managed in accordance with the guidelines in the Norwegian PEFC Forest Standard and the provisions of the Regulations for Sustainable Forestry. In addition to the MiS data, it is also supplemented by information from Naturbase and Artskart, run by the Norwegian Biodiversity Information Centre (NBIC).

Environmental registrations in forests (MiS) is a scientifically based registration scheme. The aim of MiS is to locate areas in the forest nature, especially important for red-listed species. Based on these results, a plan is established for the registration of environmental values in forests related to forest management planning. Many individuals scientists from a number of different research institutions have contributed to the development of the MiS system, and nearly 100 scientific publications have been published on the methodology. The Norwegian Ministry of Agriculture and Food finance the development of the method, and the Norwegian Institute of Bioeconomy Research (NIBIO) has conducted most of the research and development work, and implemented the method as an operative part of the Norwegian Forest management planning. The MiS registrations started as an integral part of Norwegian forest management planning in 2001. From 2004, it has been a prerequisite, in order for the forest owners to receive a grant for the mapping of their forest, that the MiS data be sent to NIBIO and stored in a national database (Skogportalen 2018). It is also required that environmental values from forestry planning are made publicly available.

The MiS registrations are based on field assessments according to their own instructions, where criteria for design and content are specified. The registration elements are standardized nationally, but entry values and prioritization are based on regional and local adaptation. The registrations mainly take place in older forests, and preferably in areas where there is active forestry.

The registrations are ranked and prioritized by value in a separate process where several parties are involved, and the landscape concerns are taken care of. The MiS process depends on the involvement of forest owners, and the selected units enter the forest owners' plan for management of the holding. Forest owners choose which measures should be prioritized on their own holding.

Skog22 – Strategy for the Norwegian Forest Sector

The Norwegian Ministry of Agriculture and Food initiated the strategy work SKOG22 (2015), forming a strategy group with participants from all over the forest value chain and national research and development environments.

The purpose of SKOG22 was to prepare a holistic, national strategy to contribute to a short and long-term development of one competitive forestry sector. SKOG22 points out what challenges and opportunities the Norwegian forestry and wood processing industry are facing and where new knowledge and new solutions are needed.

The conclusion of SKOG22 was that Norway’s forestry and wood processing industry has the resources and market opportunities for growth and development. It was pointed out that the potential of a sustainable industry with major positive contributions to the society's climate challenges makes it extra important to increase the use of forest resources.

In the conclusions of SKOG22 are listed the following options:

- The forestry and wood processing industry will take a key role in developing and realizing the green shift in Norway
- The forestry and wood processing industry has an economic potential of at least NOK 180 billion per year. Building and construction activities represent the largest share of the industry's sales potential.
- According to NIBIO, there is a sustainable basis for a 35 per cent increase in the annual harvest of timber from the Norwegian forests from [2008-2012]-levels to at least 15 million m3. If larger areas are made available through the development of forest roads and other measures that reduce operating costs in forestry, the annual harvest quantity may be further increased.
- White paper No. 39 (2008-2009) points out that active forestry and increased use of wood and bioenergy can lead to reductions in CO2 emissions of up to 9.5 million tonnes in hundred years.
- The potential for further increases in Norway‘s forest production is mainly through measures such as planting of new areas, denser planting on existing forest areas, improved plant material and fertilization, creating a basis for further industrial growth and also increasing CO2 capture by three million tonnes per year, already in 2050.

3. Selected science-policy interfaces

Publication: Sustainable Forestry in Norway

The report Sustainable Forestry in Norway («Bærekraftig skogbruk i Norge») (Tomter & Dalen 2018) aims to provide relevant and updated information and knowledge on Norwegian forests, forestry and various environmental variables. The report collects data from various sources, including Statistics Norway, the Norwegian Agriculture Agency, Norwegian Institute for Nature Research, the Norwegian Environment Agency, the Norwegian University of Science and Technology and NIBIO.

The report is often cited in both scientific journal publications, student work (MSc/BSc thesis), and in governmental/county reports, and provides a reliable source for factual information about Norwegian forestry.

Forests and climate change - NIBIO Climate Centre

NIBIO’s Department of Forestry and Climate provide research forming a basis for important policy decision on climate-related questions concerning forests and forested areas. Some of the key questions are: what effects does changes in land-use have on climate? How does forests affect the climate? What are the optimal forestry practices in order to alleviate climate change and adapting to a changing climate?

NIBIO’s Climate Centre provides this knowledge – as a foundation for a future low-emission society – both to the forestry sector, public administration and the public at large.

The Climate Centre also has the national responsibility for Norway’s climate gas reporting for the LULUCF-sector (Land Use, Land-Use Change and Forestry) under UN’s climate convention and the Kyoto protocol, including development and improvement for methods and models for the calculation of emissions and uptake of climate gases from forests and other land use.

For both of these examples the funding is provided by the government.

4. Challenges and development needs

A number of policy documents relevant for forest policies in Norway looks at the competitiveness for the sector (Skog 22, white paper on forest policy, strategy for green competitiveness and the Norwegian bioeconomy strategy), climate change and other environmental topics related to nature conservation.

There is no lack of strategic policy documents for the sector covering economic, social and environmental aspects of Norway's forest policy, but a challenge would be to relate the different policy processes together. In general, a national forest programme intends to do so. Norway has all the elements of a national forest programme covered in different strategies, but the comprehensive overall programme is not developed. This may not be needed, according to the international definition of a national forest programmes or similar (United Nations Forum on Forests 2008), but a close integration of different strategies is required, in order to make the balance needed for a holistic forest policy implementation. Furthermore, this also require involvement of stakeholders – both from the forest sector, public administration, research and development and NGOs.

Another challenge contributing to the development of forest policies in Norway is the "Europeisation" of different policies relevant to sustainable forest management. Norway is not a member of the EU, but still a part of EU's internal market, through the EEA agreement. The EEA agreement requires that Norway implement regulations relevant for those sectors included in the EEA agreement.

Fisheries and agriculture (and forest) policies are outside the EEA agreement. However, processing of products from these sectors will fall inside the EEA agreement. Similarly will most other sectors affecting forest policies in Norway. This may call for a science-policy development that needs a closer connection to other affected sectors.

An important feature in Norwegian forestry's science-policy interaction is the close cooperation between research institutes, the private sector and government in developing forest policies. The strong public-private partnership in in the forest sector in Norway should be maintained in order to continue effective policy development and implementation. The challenge would be to expand - and to include other sectors (such as energy, transport, environment, trade and industry) affecting forest policies.

More complex policy choices require more, not less knowledge-based analyses. Current developments call for more inter-disciplinary approaches in research in order to provide policy-makers with a broad scientific basis for future policy development.

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Tools for improving science-policy interaction in forestry - Poland

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1. Forest-relevant policy documents in Poland

Documents regulating functioning of Polish forestry can be divided into two general categories: (a) documents related to the legal regulations, (b) strategy documents. The main document from the first group is the Forest Act of September 28, 1991 (Forest Act, 1991). This document applies to all forms of ownership of forest in the country, including both public (state or local government) and private forests (e.g. individual owners or religious communities). However, it should be noted that within almost 30% of Poland's forest cover (9.23 million ha of forests) 7.6 million hectares are state forests managed by the State Forests National Forest Holding (Forestry, 2017; Forest Act, 1991).

Forest Act in its current form (since 1991 it has been amended several times) contains general provisions concerning, among others, defining the concept of forest, the shape of forest surveillance in Poland, but also regulates the forest management model including its objectives, defining general rules of conduct through, for example, the principle of forest sustainability, universal protection of forests and the sustainable use of all forest functions. Achieving the objectives included in Forest Act is implemented by using the Forest Management Plan - a document that is a detailed economic plan developed for a period of 10 years for both State Forest units and, in the simplified version, for private forests. A special place in the Forest Act is held by the State Forests National Forest Holding, a unit established to manage forests owned by the State Treasury. Therefore, there are regulations defining the legal status of this unit, its structure or rules related to of its financing (Forest Act, 1991).

The second act that has a real impact on the functioning of forests in Poland (also regardless of the form of forest ownership) is the Nature Conservation Act of April 16, 2004. This document regulates in detail the purposes, principles and forms of nature and landscape protection. Therefore, it mainly concerns objects for which specific forms of protection have been established (Nature Conservation Act, 2004). Both legislative documents have been assigned a number of executive documents that are the ordinances of the Ministry of the Environment.

Another act strongly influencing forest policy in Poland, in particular in state forests, is the Act on preserving the national character of the strategic natural resources of the country of June 6, 2001. This document includes state forests to the strategic natural resources of the country, and therefore, in general, prohibits the ownership transformation and obliges to maintain, expand and improve these resources. On the other hand, the management of strategic resources is carried out in accordance with the principle of sustainable development in the general interest (The Act on preserving the national character of the country's strategic natural resources, 2001). The next two acts affecting the functioning of forestry in Poland are the Act on Hunting of October 13, 1995, and the Act on Environmental Protection of April 27, 2001. Both above documents regulate the details of conduct for one (as in the case of hunting) or a series of (as in the case of environmental protection) elements of forest management and policy.

The State Forest Policy approved by the Polish government in 1997 is an important example regarding to second forest-relevant policy documents – strategic documents. The main objective of forest policy is to define

a complex of actions shaping the relationship between man and forest, aiming to preserve in the changing natural and socio-economic reality conditions for permanent multifunctionality of forests in an unlimited time perspective, their versatile usability, protection and role in the natural environment in accordance with current and future expectations of the society. The State Forest Policy also indicates the bodies responsible for its implementation and groups of stakeholders necessary to achieve its goals. The forest policy refers to a significant part of nature which are forests (Forest Policy, 1997).

The first National Ecological Policy was adopted by the Polish Parliament in 2003 with perspective until 2006. The next elaboration of this policy concerned the period until 2016. Currently the Ministry of the Environment analyzes this document regarding to the 2030 perspective. This document in general terms applies of all areas of the country's functioning. The most important challenges identified in the document include:

- activities to ensure implementation of the sustainable development principle;
- adaptation to climate change;
- protection of biodiversity (Environmental Policy, 2003)

The National Forest Program, as another example of a strategic document, was created together with the concept of sustainable and sustainable development during the United Nations Conference on Environment and Development (UNCED) in 1992. This program is a State Forest Policy tool built on the basis of participation, partnership and cooperation of all interested parties in a country. The aim of the Program is to define the vision of Polish forestry in the perspective of 2030 and beyond until 2080. It is a far-reaching, strategic program of forest development and forest management, and in fact it is an integrated program for the whole forest-wood sector and nature protection in forests. The program was developed in 2016 within the framework of various stakeholder groups, including scientists, employers, and environmental organizations (www.npl.ibles.pl).

The Strategy for Forestry Development in Poland until 2030 is a study which is the result of the Third Session of the Winter Forestry School organized by the Forestry Research Institute and the General Directorate of State Forests. It consists of three thematic parts: (a) strategies in the country economic policy, (b) production aspects of forest strategies, (c) economic, organizational and social aspects of forest strategy. In particular, the Strategy refers to the contemporary role of State Forests as an institution managing state forests, private forests, European Union strategies for forestry, directions of research development in the forestry and wood sector, structure and destination of forest resources, economic aspects of forestry, development of forest management or proper directions of changes for particular areas of forest management (Winter Forest School…, 2011).

Analyzing of strategy documents should also refer to National Program for increasing the forest cover of the country – one of the most important elements of the State Forest Policy (1997). Consistent implementation of the objectives of this policy should ensure an increase in the forest cover of the country to 30% in 2020 and 33% after 2050. The first version of this document was developed in 1993 and was accepted by the Government on June 23, 1995. However, State Budget was not able to guarantee funds for its implementation in a long-term perspective. There have been significant changes in this document in recent years, among others, in terms of competences at particular levels of the administrative structure or excluding land from agricultural production. In addition, the area abandoned farmlands has increased, with the simultaneous increase in farmers' interest in their afforestation. At the same time, new sources of financing afforestation appeared along with Poland's accession to the European Union. This led to the need of modifying the Program in 2003. As a part of this modification, it was assumed that in the years 2001-2005, a total area of 120 000 ha will be afforested, further in 2006-2010 160 000 ha, and in 2011-2020 - 400 000 ha. Subsequent program updates along with the evaluation of the status of implementation took place in 2009 and 2014 (Kozak et al., 2016). At the same time the General Directorate of State Forests commissioned research on the actual forest cover in Poland. Based on the various spatial data, Remote Sensing Center of the Institute of Geodesy and Cartography determined the total area of forests in the country according to the domestic and international (Kyoto Protocol) definitions. The results confirmed that the actual forest extent is higher by almost 800 thousand hectares then the official statistics provided by the Central Statistical Office of Poland. The official statistics report forest cover equal to 29.4% of the country, while they occupy 32% of the country considering the domestic forest definition, and 33.5% considering the definition under the Kyoto Protocol (Hościło et al. 2016).

2. Most relevant Science-policy interfaces in Poland

Scientific Council of Forestry is one of the examples of science policy interfaces relevant to forests and forest issues. This body was created by the Prime Minister of the Republic of Poland in 1996. The Council is an advisory and consultative organization of the Prime Minister on scientific issues related to forest management and the functioning of forest ecosystems in Poland. The tasks of the Council include, among others:

- presenting opinions, evaluations, analyzes, expert reports or other studies to the Prime Minister regarding actions taken in the event of a natural disaster in forests, as a result of abiotic and biotic factors,
- presenting methods of solving problems related to forest management and functioning of forest ecosystems in Poland,
- explaining the processes and dependencies occurring in forest ecosystems and matters related to forest ecosystems and forest management in Poland, recognized as significant by the Prime Minister,
- cooperation and exchange of information with units involved in activities related to forest environment.

Forest Sciences and Wood Technology Committee of the Polish Academy of Sciences (KNLiTD PAN, www.knlitd.pan.pl) is also an important unit among the science-policy interfaces in Poland. This Committee is a permanent body of the Polish Academy of Sciences, which is a self-governing representation of scientists dealing with forestry and wood technology, and aimed at the integration and cooperation. KNLiTD was established in 2016 within the Department of Biological and Agricultural Sciences. It was formed from the merger of two committees: Forest Sciences Committee existing since 1956 and Wood Technology Committee existing since 1961. The Forest Sciences and Wood Technology Committee consists of members of Polish Academy of Sciences as well as outstanding academics, representing higher education institutions and research institutes, elected every five years This unit deals with all the issues related to forestry and wood technology sciences and (jointly with the Forest Research Institute) publishes an English quarterly magazine "Folia Forestalia Polonica", which is indexed by Copernicus and the Polish Ministry of Science and Higher Education. The Organization serves also as the Polish National IUFRO Committee and the Polish National EFI Committee.

Polish Forest Society (PTL) is the oldest Polish NGO related to forestry. Its beginnings date back to 1882, when the First Congress of the Galician Forest Society was held in Lviv. Under the present name, the Society has existed since 1925. World War II interrupted his activities. It was resumed in 1946, and a year later another issue of Sylwan - the oldest forest magazine in Poland and one of the oldest of its kind in the world since 1820 – was published. The members of the society are mainly foresters they are both practices and scientists. Members of PTL may also be, and are, people interested in the forest, but not professionally related to it. In addition to foresters, representatives of other professions belong to the Polish Forest Society. The Society's ranks are open to anyone who is not indifferent to the fate and condition of Polish forests. One of the Society's basic tasks is to initiate scientific research for the needs of forestry and link science with practice, that is, effective implementation of the most valuable solutions to practice. The Society actively participates in the ongoing discussions on the future shape of forest management, including developing of forest development strategies, forest policy assumptions and ways to protect forest resources.

Another important active professional organization in the Association of Foresters and Wood Technologists (SITLiD). From the very beginning of activity, the Association undertook various tasks serving Polish forestry and wood industry, meeting the needs of these branches of the national economy, and resulting from the situation of forests and plants of the wood industry after the end of the Second World War. Hence, as the most important statutory activities, there were issues of educating technical forestry staff decimated during the war, increasing qualifications of survived employees, introducing new techniques and technologies, making the

most of wood raw materials, creating new areas of wood processing, developing new modern legal regulations in forestry or protection of forests against the harmful impact of industry. The various stages of forestry and wood industry development required the adaptation of the directions and forms of the Association's work to the changing conditions. However, the main statutory goals of SITLiD have remained basically unchanged. Thus, the current issues of upgrading professional qualifications, protection of the natural environment and integration of engineering and technical staff are still valid. SITLiD undertakes various types of activities for their implementation. It organizes scientific and technical conferences, seminars and symposia on its own initiative or on the basis of orders from interested institutions.

The State Forests units operate on nationwide, regional and local levels. Holding employs over 25 000 people and it is the largest organization of this kind in the European Union. Its annual revenues exceed 1.9 billion euro. Around 90% of this amount come from wood sales. Due to a special financial mechanism the State Forests National Forest Holding is economically independent and do not rely on taxpayers' support. Self-financing in the State Forests on the countrywide scale is possible due to the existence of the forest fund – that can be seen as an example of science-policy interface. Its current form was created under the Forest Act of 1991, paragraph 58.1. Forest districts with good financial condition transmit surpluses there, which are later used by other units with unfavorable natural and/or economic conditions. The fund also finances other projects, including nationwide ones such as: joint ventures of the organizational units of the State Forests, in particular in the field of forest management, creating the necessary infrastructure for forest management, preparation of forest management plans and scientific research. It is worth noting that in 2016 State Forest allocated 42 606 thousand PLN for infrastructure (e.g. local roads), 44 897 thousand PLN for co-financing national parks, 50 028 thousand PLN to scientific research activities and 74 715 thousand PLN for preparations of forest management plans (Sprawozdanie finansowo - gospodarcze za 2016 rok, 2017).

Winter Forest School organized by Polish Forest Research Institute and General Directorate of State Forest is an annual meeting, where Polish foresters and scientists discuss the most important topics in forestry. Every forest school is dedicated to different main topic; the last one was dedicated to: „Forestry challenges towards ongoing environmental changes, public expectations and economic and legal conditions". The aim of the School is to share with the foresters the results of scientific studies, discuss "hot" and problematic topics and share examples of practical solutions from other countries. This school give the participants theoretical knowledge about important issues and provide opportunity to discuss it (image 1).

Image 1. Winter Forest School, Sękocin Stary, 13-15 March 2018 (phot. Leszek Kruczek, Artur Sawicki)

An informal example of Science-policy interfaces in Poland could be consortium meeting within the implementation of research international project – TECH4EFFECT. The TECH4EFFECT project (Knowledge

and Technologies for Effective Wood Procurement) focuses on increasing access to wood resources through data and knowledge-based forest management. One of the project activities was the organization of the consortium meeting. Warsaw University of Life Sciences (SGGW, Poland) welcomed the consortium to third meeting in Warsaw, followed by field trip to the Polish State Forest. During this trip, together with local foresters and scientists from SGGW general specificities of Polish forests, but also local issues were discussed in the Forest Education Centre. The visit to a harvester during thinning operations in a pine stand was a highlight of the field session and a good opportunity to talk with the local forest company owner and harvester operator about details of their daily work. A campfire lunch (image 2) was used for final discussions and it was great occasion for improving science-policy interaction.

Image 2. Campfire lunch during field session (phot. Luis Rodrigues)

3. Challenges and development needs

One of the most important issues both on a global and local scale regarding challenges and development needs is the functioning of forests in changing climatic conditions. Especially that in the light of changing natural conditions, disease processes are more and more often observed, and even massive deaths of the main forest-forming species in Poland occur. Climate warming and droughts that are more and more common cause the dieback of spruce stands harassed by parasitic fungi and pests such as eight-toothed bark-beetle (*Ips typographus.* L.) as well as pine stands representing more than half area of Polish forests suffering from engraver bark-beetle (*Ips acuminatus* Gyll.). This causes that new solutions are sought that involve spreading the risk of breeding by setting up mixed stands composed of species that are relatively resistant to occurring threats. Therefore research according to long-regenerated felling enable to development of multi-species stands are carried out.

Close to nature silviculture is another important thread. Along with the transformation of forest farming based on agricultural patterns into ecosystem forestry, the role of breeding a forest close to nature has increased. This is mainly reflected in the imitation and planned use of natural processes occurring in nature for commercial stands formation. To initiate close to nature stands knowledge, practical skills and the belief of forest owners that such a forestry model can fully implement the main functions of the forest are needed. Therefore, scientific researches according to silviculture, productivity as well as economic conditions of such a forestry model as well as training of forest administration employees are obligatory.

Image 3. Mechanized timber harvesting in multi-species stand (phot. Michał Zasada).

Appropriate silviculture according to changing climatic conditions and forest transformation is important challenge and development need. However, this issue should be also referred to socio-economics changes occurring in Poland. One of the phenomena has to be faced is lacking labor force and its costs. Therefore mechanization of forest operations, especially timber harvesting (image 3) is one of the challenge. That's why the biggest development need is connection of all above issues in order to improving science-policy interaction in forming biodiverse, stable and future forestry in Poland.

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SNS-EFINORD network meeting and international workshop
Tools for improving science-policy interaction in forestry
Biri, Norway, May 15-16, 2018

British Woodlands Survey: a case study of long-term engagement between science, policy and practice

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1. Forest-relevant policy documents in the UK

Forestry is a devolved matter in the UK, with each of the four constituent countries responsible for their own policies. Very similar key themes are present in each, with variations in policies and measurables for achieving the desired outcomes:

Scotland

The Scottish Forestry Strategy (Scottish Executive 2006) is organised around key themes, which reflect the interconnectedness of forestry: Climate change; Timber; Business development; Community development; Access and health; Environmental quality; Biodiversity.

Northern Ireland

Northern Ireland's forestry policy (Department of Agriculture and Rural Development 2006) has two key themes: sustainable management of existing woods and forests; and steady expansion of tree cover to increase the many diverse benefits that forests provide.

Wales

The Welsh forestry strategy is organised around four key themes: responding to climate change – coping with climate change and reducing carbon footprint; woodlands for people – serving local needs for health, education and jobs; a competitive and integrated forest sector – innovative, skilled industries supplying renewable products from Wales; environmental quality – making a positive contribution to biodiversity, landscapes and heritage, and reducing other environmental pressures.

England

The policies in England are focused on meeting three key objectives (in priority order): protecting the nation's trees, woodlands and forests from increasing threats such as pests, diseases and climate change; improving their resilience to these threats and their contribution to economic growth, people's lives and nature; expanding them to further increase their value.

2. Science-policy interfaces in the UK

While forestry policy is a fully devolved responsibility of the four separate countries, the Science and Innovation Strategy (SIS) for British Forestry provides the context and framework for the research undertaken by the Forestry Commission to meet the needs of the forestry policies across the UK (Forestry Commission 2014). Science programmes are delivered across seven themes: Assessing resilience;

Understanding biotic threats; Delivering resilient forests; Valuing and governing forest ecosystem services; Sustainable Markets for Forest Products; Forest resource assessment and modelling; Integrating research for policy and practice. The strategy complies with the Government Chief Scientific Adviser's guidelines on the use of scientific and engineering advice in policymaking. This sets out four key messages, which underline the importance of science-policy-practice interactions:

- identify early the issues which need scientific and engineering advice and where public engagement is appropriate;
- draw on a wide range of expert advice sources, particularly when there is uncertainty;
- adopt an open and transparent approach to the scientific advisory process and publish the evidence and analysis as soon as possible;
- work collectively to ensure a joined-up approach throughout government to integrating scientific and engineering evidence and advice into policy making

3. British Woodlands Survey: a case study of long-term woodland owner/manager engagement

About the British Woodlands Survey

The British Woodlands Survey (BWS) gathers evidence about Britain's woodlands and woodland sector from people who own, manage or work with privately-owned woodlands. The BWS aims to provide an evidence base on which future policies and practice can be developed. The first survey under this name was conducted in 2012 (Nicholls *et al* 2013), which built on an important series of surveys undertaken by the Department of Land Economy at the University of Cambridge since 1963. Many of the original questions were retained in more recent surveys so that long-term trends in attitudes and practices can be assessed. The most recent survey was in 2017 (Hemery *et al* 2018), which is the project that is referenced here as a case study of a tool for improving science-policy interaction.

Research method

Science can be criticised for being remote from the 'real world' and as a consequence, of failing to hear the views, or meet the needs, of practitioners. For BWS2017 a new method was devised, which saw many more stakeholders involved in helping design the shape of the survey. As a result, the results from BWS2017 are highly attuned to the current needs of the sector. Using this novel approach stakeholders were repeatedly engaged in the design and delivery of the survey, from setting the main themes through to interpreting its results, an approach termed '360-degree research'. The method consisted of five phases co-ordinated by a steering group. The five phases involved both online engagement and face-to-face workshops in three of the four countries of the UK- England, Scotland and Wales (Figure 1).

Figure 1. Five phases of BWS2017

Phase I – preparatory online survey
A shortlist of priority themes of current interest to the forestry sector in Great Britain was derived from the set of ten priority research questions developed by Petrokofsky et al (2013, 2010), which had gained some policy and research traction. Participants were asked to rank by importance the themes represented by these ten questions (T10Q) in a short online survey in 2016 and suggest new themes which could be added to (or replace) the original ten. Stakeholders were invited to take part directly via email following individual expressions of willingness to engage further in work of this type during an earlier BWS (Hemery et al 2015). This group was termed the 'engager group'. In total 221 respondents took part in the Phase I online survey in which 50 new themes were identified. The seven most frequently occurring themes were added to the original ten, resulting in 17 new main themes

Phase II - workshops
Forty-eight people responded to an open call to the engager group to attend one of four one-day workshops. Workshop delegates prioritised the list of 17 themes for Great Britain, with each workshop identifying its own shortlist of 10 priority themes. In addition, each workshop focused on issues of individual country importance (England, Wales and Scotland) by identifying up to three further themes of regional importance (Table 1). Attendance ranged from 10 to 14 people, and included researchers, forest owners and managers, and representatives of forestry business, government policy-making, and NGO groups. Several people indicated that they had multiple identities (owner and policy maker, for example) and opinions expressed by participants differed widely within and between each 'type'.

Table 1. Results of themes ranked at the four workshops. Those ranked in the top 10 in all three countries (1-8), additional themes ranked in the top ten within one or more countries (9-14), and themes specific to each of the three countries (unranked).

Theme	England	Wales	Scotland
Societal attitudes (1)	x	x	x
Climate change (2)	x	x	x
Pests and diseases (3)	x	x	x
Profitability (4)	x	x	x
Timber production (5)	x	x	x
Natural capital (6)	x	x	x
Knowledge transfer (7)	x	x	x
Private woodland owner engagement (8)	x	x	x
Tree planting (9)	x		x
Human health and wellbeing (10)	x	x	x
Woodchain (11)		x	
Genetic diversity (12)	x		
Landscape connectivity (13)		x	
Managing for carbon (14)			x
Skills, education and training	x		
Governance	x		
Funding and policy to integrate forestry in wider landscape	x		
Vision for English forestry	x		
Landuse change		x	
Knowledge transfer		x	
Small-scale collaboration		x	
Landuse change			x
Delivery of woodland expansion			x
Scottish landuse strategy			x
CAP reform			x

Phase III - Shaping survey

An Advisory Committee was convened and met at a workshop with 19 members, largely self-selected (but balanced to achieve broad sector representation) from those people who attended the country workshops, along with the steering group. The aim of the Committee was to help translate the findings from the Phase II workshops into questions suitable for an online survey. The survey was built in LimeSurvey, an open-source survey tool (www.limesurvey.org). A bilingual (Welsh-English) introduction was prepared for respondents taking the survey in Wales, but the survey itself was presented only in English on the advice of attendees at the Welsh workshop in consideration of cost. It was designed to operate on desktop computers as well as mobile devices such as phones and tablets. It was hosted online by Sylva Foundation. The survey consisted of 132 questions (almost none of which were mandatory) in 24 groups, organised within three main sections – personal data; UK-wide themes; country-specific themes.

Phase IV – engaging the sector to participate in the online survey

The survey was open to anyone and widely promoted by organisations represented by the steering group and Advisory Committee. Respondents to previous surveys conducted by BWS, who had indicated willingness to be contacted for future projects, were invited to participate by email. While the survey was live - for 2 weeks (July – September 2017 – there was a large amount of correspondence between the authors of the current paper and respondents requesting clarifications, or help with technical issues, or sharing their reflections and

ideas prompted by participation in the survey. This is felt to be an essential part of building trust with stakeholders and helping remove the view that online engagement can be remote and unresponsive.

Phase V - re-engagement of workshop participants
Once the responses of the survey (Phase IV) had been statistically analysed (mainly summing data by respondent type for each question) and interpreted, the findings were circulated to the delegates in the country workshops, who were first engaged in Phase II. Stakeholders were asked to consider the results presented for their country of interest and to suggest further ways of combining data in more granular analyses, and to ask questions raised by the results, which, if analysed further, could generate insights for policy or practice in their country of interest.

Results

A total of 1,630 people throughout the UK responded to the online survey. The majority (660) were private woodland owners, who together with 180 forestry agents, owned and/or managed 3,629 woodland properties covering 645,370 hectares. The response represented 28% of all private sector woodland area in the UK (2.30Mha), and one-fifth of the total UK woodland area (3.17Mha). A further 235 tree and forestry professionals responded to the survey, representing: forestry industry (26%); NGO community organisation (15%); public sector (21%); research (10%); other [professional] (20%); and personal interest only (8%). For a complete analysis and discussion of the results of BWS 2017, see Hemery et al (2018). A summary of the type of participants and their responses to key questions is presented in Figure 1. For the current paper, selected results of questions related to science and policy are addressed.

In terms of method and process, it was clear from the enthusiasm with which stakeholders contributed to the research and the very high representative sample of UK's woodland area that the sector is willing to engage with this type of policy-relevant activity. Most BWS2017 respondents felt poorly-represented in the development of practice guidance, policy formulation, and setting of research priorities for the sector and there was interest in greater engagement.

The prominence of 'Societal attitudes' as the top-ranking theme emerging from Phase II was striking. This reflects greater awareness among woodland owners of the outside world's interest in aspects of care for the natural world (see, for example, Ranacher et al 2017). This increasing interest taken by the 'public' comes with challenges, however: professional foresters were for the most part concerned about the potential constraints that public opinion has on many forestry activities, particularly felling trees and controlling pests and diseases. There is clearly space to encourage further interactions between woodland owners and policy makers over increasing concerns related to tree diseases in particular (see, for example, Hill et al (in press), Potter and Urquhart 2017).

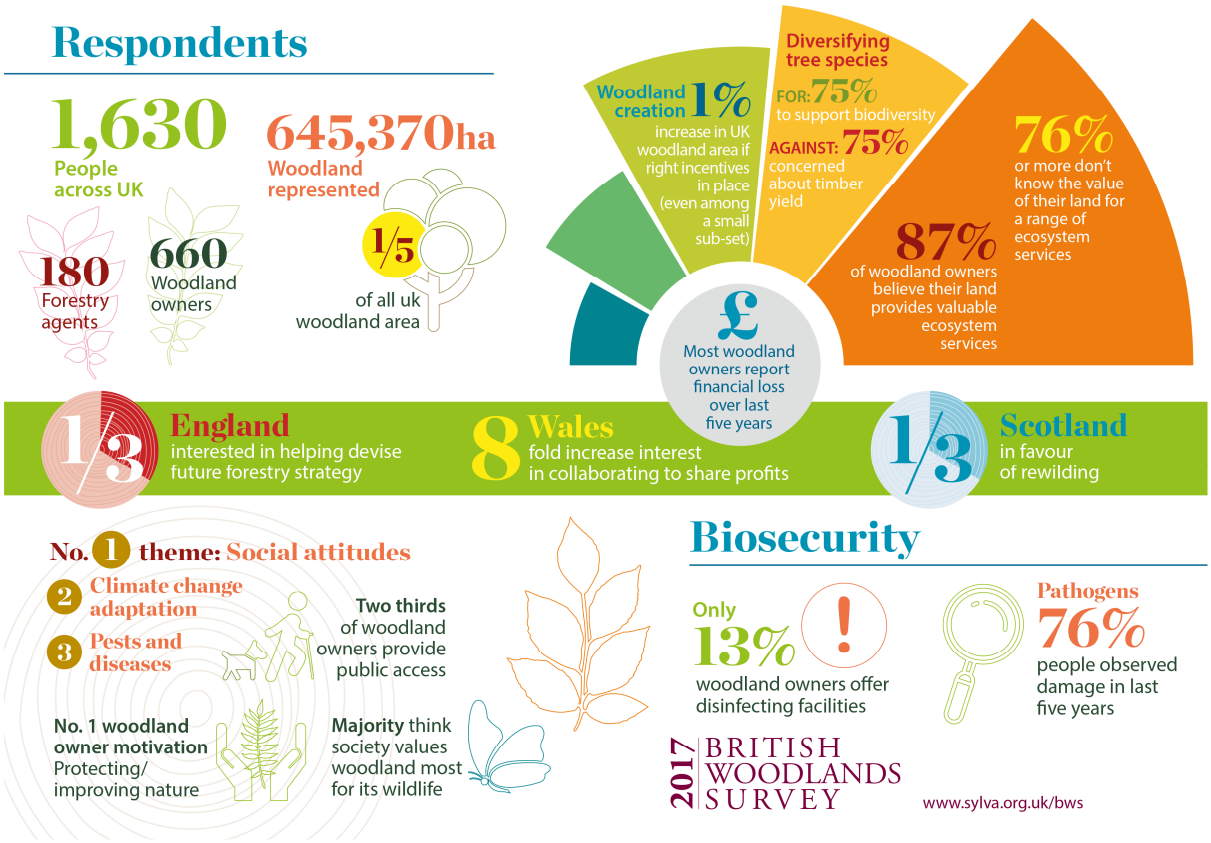

Figure 2. Summary results of British Woodlands 2017 (reproduced by kind permission of Sylva Foundation)

Respondents recognised the high value held among wider society of woodlands as places important to wildlife and human health and well-being, with a significant number actively managing their woodlands to support these beliefs. This is encouraging in the light of growing interest in policies linking green space and human health and well-being (Clarke and Wentworth, 2016).

Only a fifth of respondents reported making a financial gain from their woodlands, while the majority reported a financial loss. Comparing 2017 results against those of 2012 there were signs of slight improvements, but there is clearly scope for policy interventions to help rural economies and individual woodland owners. The qualitative data received in the surveys can also provide a useful body of evidence to further investigate possible policy avenues.

'Natural capital' ranked sixth as an overall theme during the workshop phase, yet there was considerable uncertainty about the term itself. However, a large majority (87%) considered their land provided valuable ecosystem services, but did not know, or were uncertain, about its economic value. A majority were uncertain about entering into a binding contract to provide ecosystem services in return for an income, and this highlights an area of immediate concern to the UK government while it engages in discussions about possible post-CAP (Common Agricultural Policy) arrangements for land owners. Again, the qualitative information received in BWS2017 can feed into these discussions and provide a useful evidence base.

There was strong awareness of environmental changes observed in woodlands in the last five years, particularly for pathogen damage (76% observing change), and vertebrate pest damage (48%). Controlling or minimising adverse effects from vertebrates, and sourcing tree planting material were the two most widely reported practices owners and managers engaged in by way of mitigation or adaptation. Although respondents were strongly motivated to diversify tree species in order to support biodiversity (76%) and forest health (72%), timber yield was cited as the strongest motive against (75%) tree species diversification, which indicates an area for in-depth policy engagement to meet future challenges of environmental change and future goals for more 'home-grown timber'. Failure of policy impact was perhaps most strongly noted in

the section of the survey dealing with biosecurity measures. While most respondents considered risks when acquiring planting stock, only a minority provided cleaning and disinfecting facilities, either for visitors or for those working in their woodland. There is room for science-policy interaction here to determine why known hazards and policies to alleviate them are routinely ignored in practice.

It came as no surprise to discover that woodland owners continued to express a strong preference to receive advice from an onsite advisor over any other type of support, with printed information reported the least popular way. Policy delivery continues to rely less on this type of onsite communication, and arguably continues to waste money on printed guidance.

Finally, most respondents felt that their views were poorly represented in policy formulation, development of practice guidance, and in the setting of research priorities, although professionals and businesses felt better represented, especially among members of membership organisations.

Reflections on future science-policy-practice interactions

The following eight recommendations and key development activities arose from a broad discussion of the responses received to BWS2017 and are summarised here:

Societal attitudes - Improve qualitative research to understand better the attitudes of woodland owners towards the general public, and vice versa.
Ecosystem services - Target outreach to owners and practitioners, plus tools and services to assist with valuation.
Collaboration within the sector - Explore opportunities and constraints to collaborative working, and highlighting potential for formalised co-operatives.
Tree species diversity - Explore barriers to diversifying, gathering more evidence, and improve guidance for practitioners.
Biosecurity - Explore constraints and opportunities for the forestry sector in proactively reducing/mitigating current and future threats.
Engagement with policy and research - Realise potential to increase meaningful engagement with more owners and practitioners in policy development and research prioritisation.
Policy - Policy makers to ensure that forestry is more deeply integrated in broader land management strategies.
Competitiveness - Explore barriers to a competitive home-grown timber market, and develop policy innovations to improve profitability.

In summary, there is a general perception that the wider public does not understand forest management. Improving dialogue between the sector and the public will undoubtedly be necessary to improve science, policy and practice in UK forestry and tools such as online surveys of the forestry sector can contribute to this dialogue, particularly in revealing gaps between ‘big ideas’ that may gain public support and implementation by land owners struggling with multiple challenges. A similar engagement exercise, combining iterative workshop and online phases, conducted across multiple countries in Europe would be a useful way of gathering and sharing information in the forestry sector, particularly amongst those who feel less ‘listened to’, as a means of setting high-priority research agendas and improving policy and practice.

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Annexes

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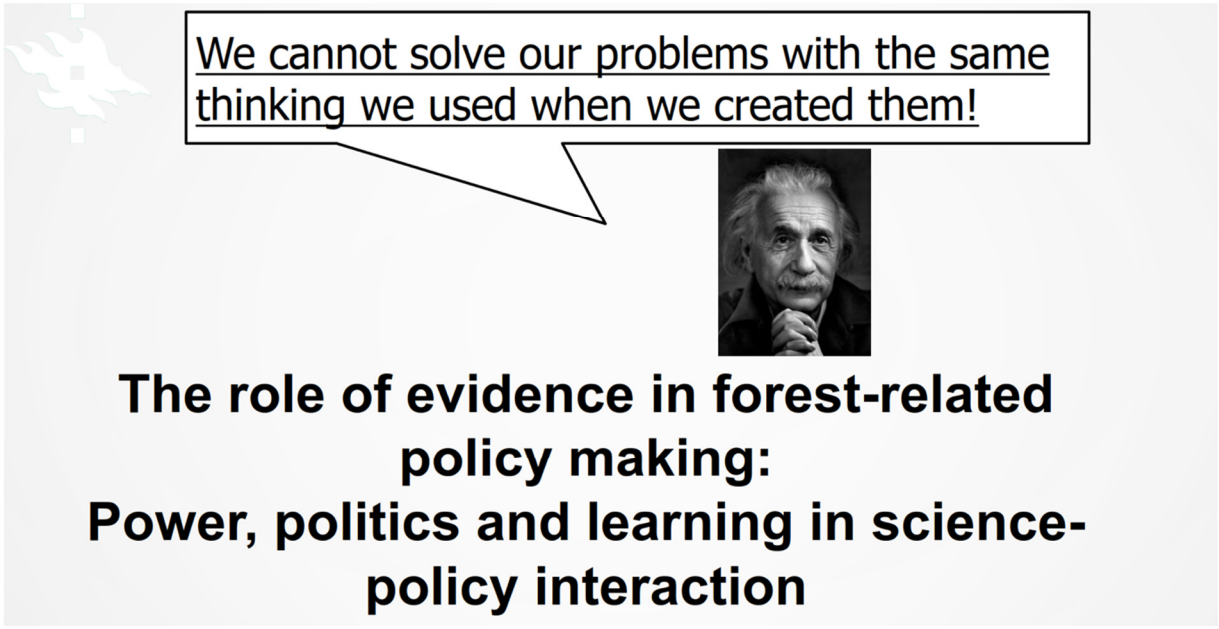
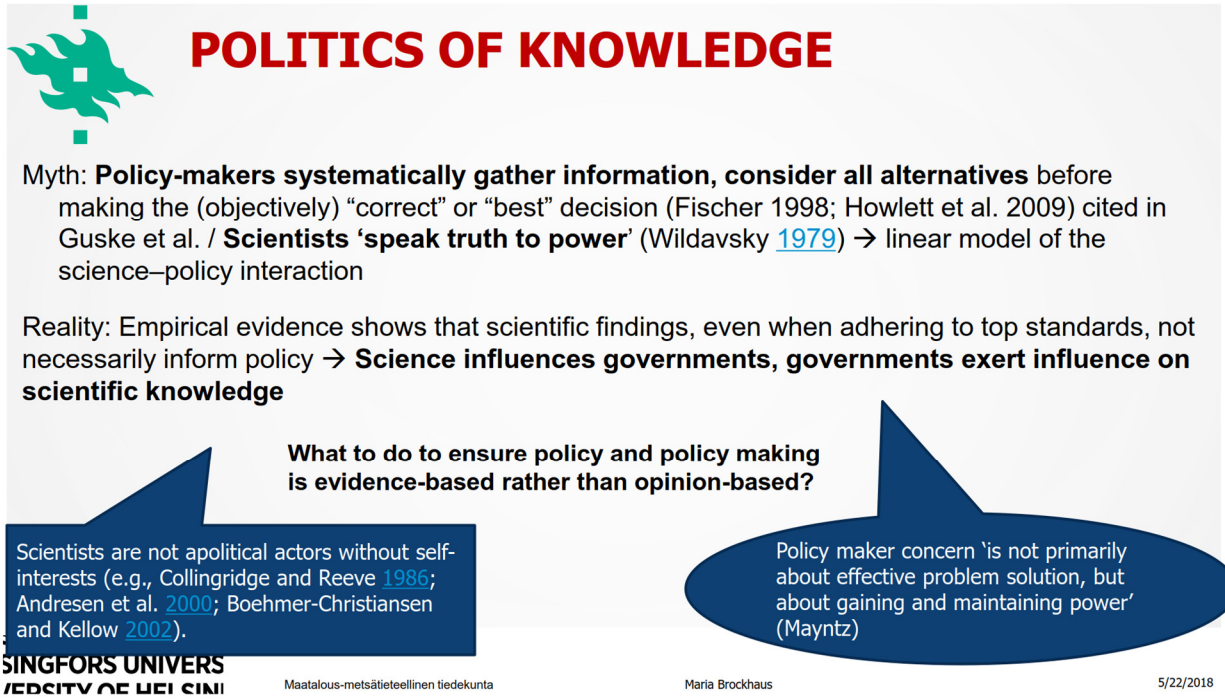
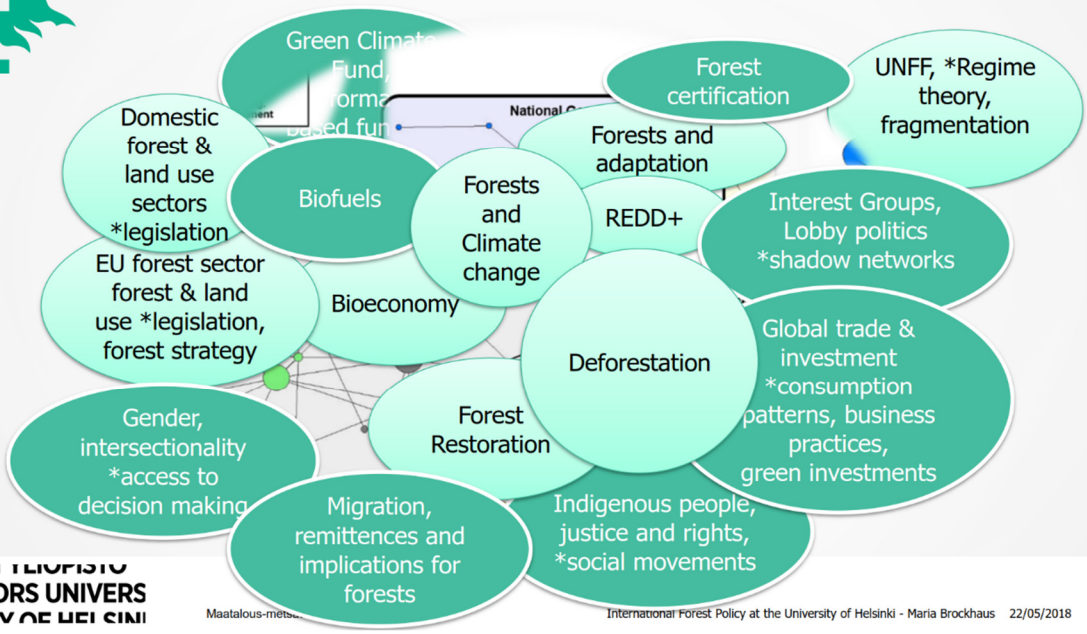




OVERVIEW

1. Why evidence - Policy problems and the need for evidence
   - Changing nature of our environmental and forest related puzzles
   - What is the problem? How to tackle it? Different actors, different policy proposals
2. What evidence - Gathering and assessing evidence for policy learning
   - Definition, characteristics
   - Grading evidence
3. How to facilitate evidence-based decision making - Science policy interaction and learning
   - SPIs and knowledge brokering
4. Ways forward

FOREST POLICY RELATED ARENAS



FOREST POLICY DOMAIN CHARACTERISTICS

Forest policy relevant policy domains and sub-systems are characterized by

- Multi-actor
- Multi-interest
- Multi-beliefs
- Multi-level, highly diverse institutional contexts

Forest policy related problems characterized by different degrees of

- Uncertainty
- Lack of consensus

ACTORS

policy actors interact to influence decisions:

- politicians and public officials,
- managers of public and private companies,
- members of pressure groups,
- academics and researchers,
- active citizens
- ….. Other individuals

	TYPE OF ORGANIZATION
Governmental Organization	Legislative actor: committee, body involved in policy formation, political party
	Executive department: ministerial/government department, body involved in policy implementation
	Independent advisory body
	Educational / research institution
NGO: non-membership based	Foundation/Charity/ NGO network
NGO: membership-based (individual or organizations)	Individual membership-based NGO (grass-root organization or union or federation of grass-root organizations) (e.g. farmers' union, indigenous groups)
	Professional membership-based association (e.g. journalist association)
	Business association (e.g. plywood producer association)
National Business	National private business: specify sector: .....
International	International NGO
	Intergovernmental Organization (UN, World Bank….)
	Foreign or Multinational Business specify main sector relevant to REDD: .....
	Foreign Government Agency
Other	Other, specify: .....

ACTORS BEHAVIOR - SOME ISSUES

Scientific knowledge is deeply **embedded in politics** and the broader culture of the society (e.g., Jasanoff 1996),

Scientific **findings may reflect the bias of funding institutions** (e.g., Andresen and Østreng 1989; Jasanoff and Wynne 1998)

Knowledge is deliberately ignored by policy-makers (Innes 1990);

Scientists overestimate the value of their work and misunderstand how it is used in policy-making (Lindblom & Cohen 1979);

Scientists **present their findings selectively** (Barber 1987);

Knowledge remains incomplete due to exclusion of relevant stakeholders or types of knowledge (Fischer 1998; Healey & Hillier 1996);

Scientists and policy-makers use **different assumptions, values, and language** to discuss policy problems (Lindblom 1990);

Lack of widely accepted set of criteria to measure the credibility, relevance, and legitimacy of knowledge and compare them against one another so far (Jahn et al. 2012).;

Environmental **knowledge made fit into a dominant discourse**", i.e. it is used at will (Runhaar, 2009).

META-LEVEL ISSUES

(i) strategic use of knowledge by policy;

(ii) strategic development of knowledge by science; and

(iii) the operational misfit between demand for and supply of knowledge.

(van Enst et al. 2014)

→ Overcoming these issues requires the production and use of science that is credible, salient and legitimate (Cash et al. 2003)

POLICY LEARNING

At its most general level, 'policy learning' can be defined as adjusting understandings and beliefs related to public policy. (Dunlop & Radaelli, 2013 Dunlop, C., & Radaelli, C. (2013) as cited in Moyson et al. 2017)

→ To achieve learning and overcome science policy issues:

Evidence based policy making:'rigorous in gathering, critically appraising, uses high quality research evidence to inform policymaking and professional practice' (Davies, 2004)

Science policy interactions to communicate, translate, mediate evidence (Cash et al. 2003)

Science policy interfaces (SPIs): aim at decisions that are well-informed about the problems and the range of available intervention strategies while acknowledging that science is just one part of the complex decision-making processes (Lackey, 2007; Pielke, 2007).

TYPES OF EVIDENCE

Qualitative

Quantitative

Expert knowledge-based

Theory-based

Models

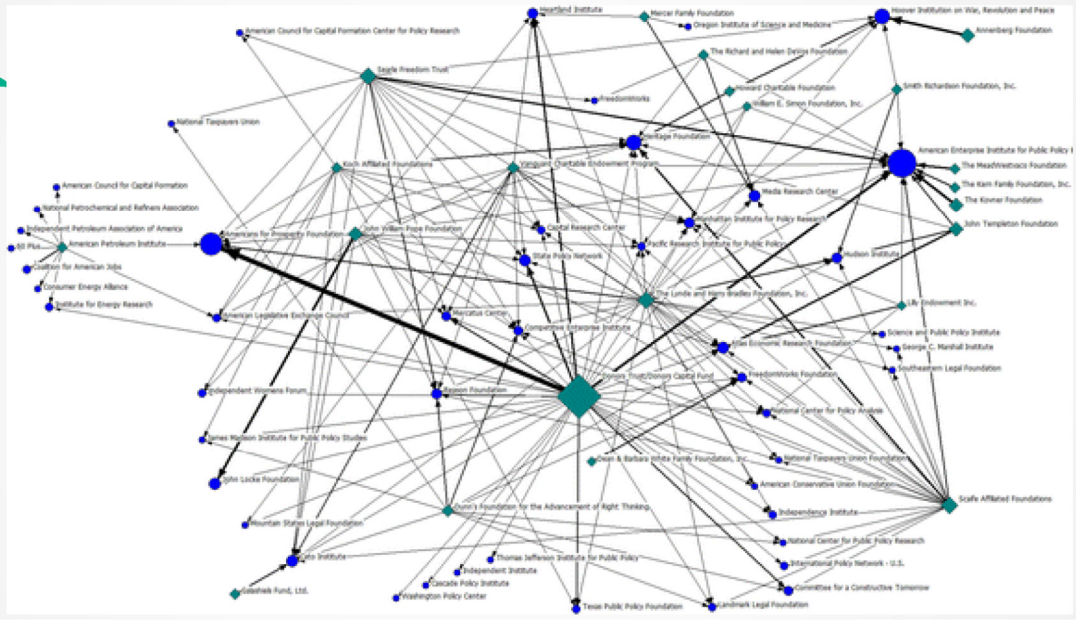
…..

→ Implementation Evidence, Impact Evidence, Descriptive Analytical Evidence, Economic/Econometric Evidence, Ethical Evidence, Statistical Modelling, Attitudinal Evidence (Davies, 2004)

STRENGTH OF EVIDENCE

- Long history especially in medicine and related disciplines to asses evidence → example for efforts in forestry are systematic literature reviews, BACI impact assessment, etc
- Multitude of grading/assessment schemes exist, often establishing a hierarchy among types of knowledge/data → can lead to exclusion of relevant evidence
- Some (of the many) general criteria: **Credibility**, Relevance, Transparency, Applicability, Timeliness, Consistency, ….

→ **Credibility**: Is the source of evidence ensuring quality standards in research design and analysis/ interpretation? How much of the candidate evidence is from other sources with limited, unclear or none standards? Funding, agendas, biases ?



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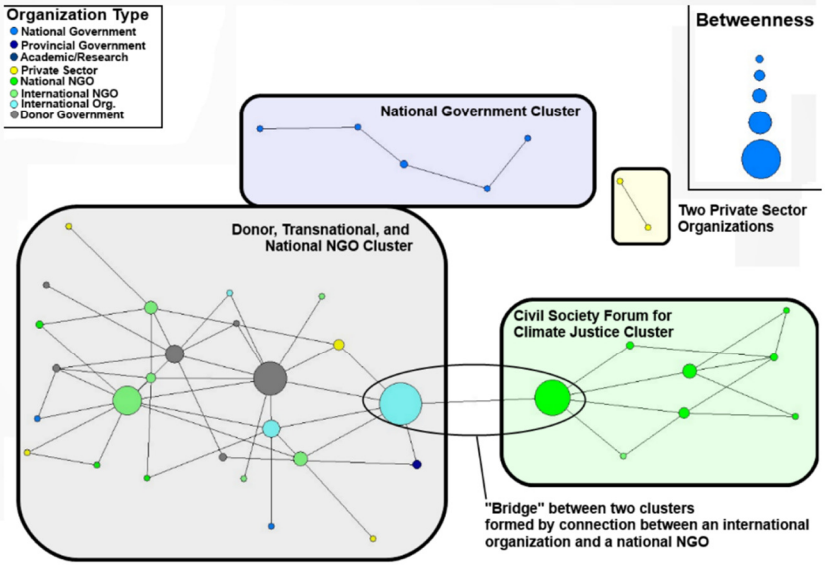
SCIENCE POLICY INTERFACES

SPIs differentiated by dimensions 'actors, goals, strategies' (van Enst et al 2014):

- **Co-production of knowledge – CREATE** (process of participatory knowledge development, WITH MULTIPLE ACCOUNTABILITIES e.g., scientific, expert, lay actors, with goal of creating common understanding and knowledge in a participatory way, exchange strategy should lead to increase level of **salience and legitimacy**);
- **Institutional, boundary organisations – BRIDGE** (e.g. often formal institutions with legal base, boundary organisations, such as IPCC, to serve as platform for interdisciplinary collaboration, strategy to collect and disseminate scientific knowledge, structure research questions, focus on the **salience and credibility** of knowledge)
- **Individual science policy mediators - FACILITATE** (e.g. boundary workers, knowledge brokers, goal to facilitate knowledge sharing, strategic bridge building, being able to create awareness, share knowledge, identifying and producing **salient and legitimate** knowledge)

REDD+ RELATED INFORMATION EXCHANGE IN INDONESIA (MOELIONO ET AL. 2013):

- 4 distinct clusters
- Homophily strong in national government cluster
- One bridge



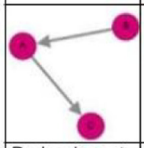
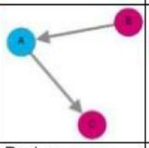
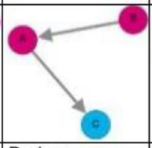
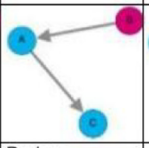
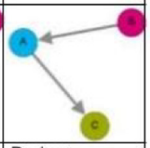
SCIENCE POLICY INTERFACES

SPIs differentiated by dimensions 'actors, goals, strategies' (van Enst et al 2014):

- **Co-production of knowledge – CREATE** (process of participatory knowledge development, WITH MULTIPLE ACCOUNTABILITIES e.g., scientific, expert, lay actors, with goal of creating common understanding and knowledge in a participatory way, exchange strategy should lead to increase level of **salience and legitimacy**);
- **Institutional, boundary organisations – BRIDGE** (e.g. often formal institutions with legal base, boundary organisations, such as IPCC, to serve as platform for interdisciplinary collaboration, strategy to collect and disseminate scientific knowledge, structure research questions, focus on the **salience and credibility** of knowledge)
- **Individual science policy mediators - FACILITATE** (e.g. boundary workers, knowledge brokers, goal to facilitate knowledge sharing, strategic bridge building, being able to create awareness, share knowledge, identifying and producing **salient and legitimate** knowledge)

BROKERAGE ROLES

(Katy Jordan 2015)

Coordinator	Itinerant broker	Representative	Gatekeeper	Liaison
				
Broker is part of a community and mediates between other members of the same community	Broker mediates between members of the same community without being a member herself.	Broker mediates flow of information out of a community.	Broker mediates flow of information into a community.	Broker mediates between two different groups, neither of which she belongs to.

EFFECTIVENESS OF SPI

CONTEXT

related to the

- level of structuredness (certainty and consensus) of the policy problems;
- presence of legal frameworks for knowledge production and use.

KNOWLEDGE, INTERESTS, BELIEFS

related to

- who's knowledge counts, who's interest matters, who's voice is dominant

WAYS FORWARD

Credibility credibility credibility : a responsibility i) for those that generate evidence, when designing and conducting research and analysis, and sharing in transparent manner findings; ii) for those that mediate and manage science policy interfaces, when assessing and selecting, interpreting available evidence; iii) for those that make decisions and policy, when being presented with multiple evidence and different bodies of knowledge, and learning about trade-offs.

- Critical assessment of funding:
  - **Follow the money**
- Sensitivity to biases:
  - **What is counted, counts!**
  - **Who counts, counts!**
  - **Who shouts? Dominant discourses ..**
- Engagement in **genuine learning**, formally or informally .. to ensure **transparency** and enable **reflection**

Agenda of the meeting

Tuesday, May 15, 2018

16.00 *Registration & coffee*

16.15 *Opening address*
Local hosts

16.30 *Keynote: Role of evidence in forest-related policy making*
Maria Brockhaus, Professor of International Forest Policy, University of Helsinki

17.15 *Goals for the workshop & examples of international cooperation on science-policy interaction*
Risto Päivinen, Tapio Ltd.

18.00 *End of Day 1*

19.00 *Informal get-together with welcoming drinks for the SNS-EFINORD network participants at hotel Honne's restaurant* www.honne.no

Wednesday May 16, 2018

8.00 *Country reports on interaction between forest research and forest policy*

Estonia
Finland
France
Germany

9.20 *Coffee Break*

Iceland
Norway
Poland
Sweden
UK

11.00 *Discussion – what have we learned?*

12.00 *Next steps*
SNS-EFINORD application for activities in 2019
Other possible activities (EU-funding – COST action?)
Finalizing the proceedings of the workshop
Any other business

13.00 *Lunch*

14.00 *Adjourn*

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