

A participatory process for identifying and prioritizing policy-relevant research questions in natural resource management: a case study from the UK forestry sector

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Summary

There is growing interest in widening public participation in research and practice in environmental decision making and an awareness of the importance of framing research questions that reflect the needs of policy and practice. The Top Ten Questions for Forestry (T10Q) project was undertaken in 2008 to investigate a process for compiling and prioritizing a meaningful set of research questions, which were considered by participating stakeholders to have high policy relevance, using a collaborative bottom-up approach involving professionals from a wide set of disciplines of relevance to modern forestry. Details are presented of the process, which involved an online survey and a workshop for participants in the UK and Republic of Ireland. Survey responses were received from 481 researchers, policy makers and woodland owners, who contributed 1594 research questions. These were debated and prioritized by 51 people attending the workshop. The project engaged people who were outside the traditional boundaries of the discipline, a trend likely to be more important in the future, particularly in the light of complex problems connected with climate change, bioenergy production or health and well-being, for example, which require multidisciplinary partnerships within the research and policy communities. The project demonstrated the potential for combining web-based methods and focussed group discussions to collect, debate and prioritize a large number of researchable questions considered of importance to a broad spectrum of people with an active interest in natural resource management.

Introduction

Environmental policy making in Europe is focussed strongly on increasing public engagement with science (European Commission, 2007b). The UK is supportive of an approach that engages the public ‘upstream’ in science and technology developments (i.e. at the start of the process of designing research and technology programmes, rather than at the end, providing feedback). This would include end-user involvement in programmes operated by the research councils, an initiative strongly endorsed by the British Science Association (Wilsdon and Willis, 2004; Whitmarsh *et al.*, 2005). Greater public participation in setting research priorities and framing research questions might enhance the integration between environmental policy and science (Holmes and Savgård, 2009). However, the diversity of stakeholders with specialized interest in forests presents challenges if a more participatory approach is to be adopted.

This paper describes the Top Ten Questions for Forestry (T10Q) project and the process developed to engage forestry professionals in participatory exercises to prioritize an agenda for policy-relevant research. The aim was not simply to respond to current policy, nor to suggest new policy, but to explore a novel way of identifying research which the forestry sector considers important to inform policy and practice.

In the T10Q project, the term ‘forestry’ was defined very broadly to include any aspect of trees and wooded landscapes and products and services derived from forest and woodland (The definition used in the project and in this paper is based on one published after extensive consultation by the Food and Agriculture Organization (2006): “Forestry” is broadly defined to include livelihoods, social aspects, environmental services, forestry policies and institutions and economic considerations. In addition to traditional aspects of forest management, production, health and protection, forestry considers the broad landscape of trees outside forests, including urban forestry and agroforestry. Forestry includes the management of wildlife and protected areas. Forestry considers the impacts of other sectors on the forest, as well as the impact of the forest on other sectors’). The project did not attempt to engage the ‘lay public’: the target group were woodland owners and managers, researchers and those with policy interest working in the broadly defined field of forestry in the UK and the Irish Republic.

Co-ordination of forestry research priorities

The Forestry Research Coordination Committee (FRCC) was established in 1982 as a forum for the main funders of forestry and forest products research in the UK to discuss research priorities, encourage effective funding and avoid duplication of effort. Co-ordination of forestry research was felt to be necessary because of the increasing diversity of research and the large number of bodies funding it (Evans, 1992). The key sponsoring agencies funding forestry research were Government ministries and departments, the Forestry Commission, nature conservation bod-

ies, research councils and universities. Some members of the committee represented particular constituencies, for example one member represented all UK universities offering forestry degrees and another represented forestry charities. Among its original terms of reference was ‘to identify and define forestry research needs and opportunities’ (Burdekin, 1989). ‘Defining research needs’ was removed as a specific objective after a review of FRCC activities in 1997, but it retained a specific brief to “identify gaps or overlaps and encourage the co-ordination of research programmes in forestry”.

The FRCC remained, until its demise in 2007, the only body which systematically examined forestry research across disciplines in the UK and made its findings public through an annual collation of forestry and tree-related research which summarized expenditure by subject and organization. The summaries provide information about trends in research and funding activities (Evans, 1992; Lawson and Hemery, 2007) but no information about the process of decision making that had been used to set research priorities. It is difficult to assess the extent to which representatives on the committee liaised with their constituents except for the purpose of compiling the annual research summaries or included information from individuals or organizations that engaged in activities not traditionally defined as forestry but nevertheless of broader forestry importance.

Currently, most of the functions of the FRCC are taken by The Environment Research Funders’ Forum (ERFF), which was established in 2002 ‘to make the best use of public funding for environmental research’ (Environmental research is defined by ERFF to be research and associated monitoring, survey, policy, regulation and training in traditional environmental sciences and in areas of economic, social and engineering research concerned with the interaction of people with the environment.). Forum membership is drawn from UK public bodies that fund or use environmental research. There are three tiers of membership, which are based on subscription (2008 subscriptions were £5k, £15k and £25k year⁻¹) and entitle members to different levels of governance representation.

Forestry research that is funded by ERFF members is co-ordinated by the ERFF. The Forestry Commission is represented on the main ERFF board, though not on the research co-ordination group, which is tasked with ‘driving forward the Forum’s core purpose of fostering collaboration between public funders of ‘environmental research’ in its broadest sense’. Unlike the FRCC, universities are not separately represented in the ERFF, nor are charities.

In common with the FRCC, the ERFF does not routinely engage individuals; the mode of operation is by committee, membership of which is restricted to public bodies.

Participation in research priority setting

Public involvement in environmental decision making was one of the central themes of the 1992 United Nations Conference on Environment and Development, the ‘Earth Summit’. Public involvement also accords with current thinking

on governance and democracy; ‘participation’ and ‘citizen engagement’ being now part of the political lexicon, even though consultation is clearly not a ‘magic bullet’ that guarantees policy change (Carnegie United Kingdom Trust, 2008).

In the past two decades, a large body of literature has emerged on public engagement and participatory processes, with much of the early literature growing out of theoretical development work or political science research on citizenship and democracy (Jasanoff, 2003; Rayner, 2003), and work in developing countries on equitable access to natural resources (e.g. Côté and Bouthillier, 1999; Buchy and Hoverman, 2000; Van Herzele *et al.*, 2005; Leach, 2006; Pagdee *et al.*, 2006; Des Roches, 2007).

Even though the virtues of using participatory methods to engage stakeholders with important decision making have been vigorously extolled, and well funded, by development agencies in developed countries for use in developing countries, these practices have not been systematically applied domestically in developed countries. One example of a participatory process pioneered in a developing country and subsequently adapted for a developed country has been work on mental health in the UK (Rose *et al.*, 2008) and pulmonary disease in The Netherlands (Caron-Flinterman *et al.*, 2006), which both built on work with small-scale farmers in developing countries (Broerse and Bunders, 2000). There are a very large number of forestry professionals in Europe and North America, who have worked on participatory decision-making projects in developing countries who have practical experience which could supplement the body of published literature.

In Great Britain, government departments were required to engage with stakeholders to develop research and innovation strategies and to include statements in their strategies about mechanisms for stakeholder involvement. The Science and Innovation Strategy for British Forestry was one of these outputs (Forestry Commission, 2005). Details of the stakeholder processes in the separate countries of the UK and the steps taken to weigh the evidence received have not been published, however, making it difficult to evaluate how useful this was considered to be by the sector generally. The most recent Science and Innovation Strategy for British Forestry (Forestry Commission, 2010) did not involve formal stakeholder engagement; however, the strategy endorses the importance of “regular contact with diverse stakeholders in order to identify research questions and needs”, and it seems likely that broader consultation will be a feature of future strategy development. This type of consultative approach is now mainstream for developing national forest policies in European Union countries. The pan-European Union Forestry Strategy was also developed using a participatory and transparent approach that recognized the importance of engaging with individuals, an estimated 16 million private forest owners, who together own some 60 per cent of the European Union’s forest and wooded land, mostly in small holdings (European Commission, 2005).

In the UK, the concept that ‘communities of interest’ should be involved in agenda setting sits well with the fact

that some 35 per cent of the nation’s forests and woodlands are publicly owned. The development of separate forestry strategies for England, Wales, Scotland and Northern Ireland, which included substantial consultative elements and allowed stronger stakeholder representation, ushered in an era of greater public participation in the national forestry debates (O’Brien and Claridge, 2001). The more recent forestry strategies of England (2007, updating the 1998 strategy), Scotland (2005, updating the 2000 strategy), Wales (2009, updating the 2001 strategy) and Northern Ireland (2006) were all produced after public consultation (Forest Service, 2006; Forestry Commission Scotland, 2006; Department for Environment, Food and Rural Affairs, 2007; Forestry Commission Wales, 2009). There is, however, a much less tangible sense of broad stakeholder engagement with the research process. The Carnegie Trust suggests that a robust evidence base is necessary, though not sufficient, for effective involvement of civil society in policy-making decisions (Carnegie United Kingdom Trust, 2008). For effective engagement, the public should be actively involved in setting the research agenda because they need to participate in the creation of the evidence base. This accords with Fischer’s (2003) view that by transforming citizen’s ways of knowing and acting, participatory deliberation can extend decision-making capabilities and reduce the tension between democracy and science.

Holmes and Clark (2008) identified a need for closer collaboration between scientists and policy makers at the stage of ‘setting research questions and agendas’ in the area of environmental science. The problem of planning, managing and communicating research to inform environmental policy making was further investigated by Holmes and Savgård (2009) in an empirical study involving 95 people from 33 organizations in 11 European countries. Two of the good practice guidelines developed from this research were

- 1 Engage researchers and potential users to ensure their perspectives are appropriately reflected in the framing of the research question and
- 2 Specify research questions and project deliverables at a level of detail sufficient to ensure outputs do actually meet user needs.

Two principal methodologies have been used in the fields of medicine and public health to enable public participation in setting research agendas (Oliver *et al.*, 2004): collaboration (involving patient representation on decision-making bodies) and consultation (involving questionnaires, focus groups and consensus conferences).

A model for prioritizing specific policy-relevant ecological research questions was undertaken in 2005: a group of policy makers, advisers and lobbyists from 28 organizations and researchers from 10 UK universities and research institutes participated in a workshop to determine the 100 most important ecological questions of relevance to policy in the UK (Sutherland *et al.*, 2006). Just over 1000 candidate questions were collected in advance from the organizations represented at the workshop. Academics at the workshop were involved in suggesting questions

and facilitating discussion, while the final set of questions were selected and composed entirely by policy specialists drawn from a range of governmental institutions and non-governmental organizations (NGOs) that were either creating policy or were involved in influencing policy in the UK. The strength of the process was the very large number of research questions collected from different stakeholders; the weakness was perhaps the tendency for those questions to be framed in somewhat general terms, rather than as specific research topics.

The present paper describes a two-phase participatory process adopted in the project titled T10Q, which built on Sutherland's model and related work on horizon scanning (Sutherland and Woodroof, 2009; Sutherland *et al.*, 2009, 2010), to engage stakeholders in the process of refining a short list of high-priority research questions for forestry.

Methods

T10Q involved two phases. First (Phase 1), questions were submitted using an online survey from individuals across the forestry sector. The survey ran from May until September 2008. Second (Phase 2), a 2-day workshop with 51 people, involved professionally in UK or Irish forestry, was held on 25 and 26 September 2008 to discuss the questions gathered under the Phase 1 and to arrive at a list of 10 high-priority questions for forestry research using a process of discussion and voting. Figure 1 summarises the steps taken to reach a final list of 10 questions and the number of people involved at each stage of T10Q.

Phase 1: internet-based survey

Survey participants

A total of 1600 individuals were invited to participate in a structured online survey, using LimeSurvey (Version 1.71+, Build 5147), which is an open-source survey tool (www.limesurvey.org).

Participants were identified in a number of ways:

- They had participated in forestry meetings or consultations organized by four of the partner organizations who funded the T10Q project (Forestry Commission, Natural England, University of Oxford and Woodland Trust).
- They responded to a call for participants published in UK newsletters and automated electronic mailing lists aimed at an audience of people with an interest in environmental sciences, forestry (including agroforestry) and forest policy and on the project Website (www.forestryevidence.org).
- They were members of the Forest Research Co-ordination Committee or the Environment Research Funders Forum.
- They were academics either working in the UK or Irish Republic or whose work was focussed on forestry in the UK or Irish Republic, who had published scientific articles within the previous 5 years (Authors were identi-

fied from email addresses indexed in ForestScience.info (published by CAB International) between 2004 and 2008.).

The survey posed a total of 45 questions arranged across seven sections (Woodland ownership & management, Attitudes to the environment, Attitudes to research, Ability to influence policy, Access to information, Organizational profile and Personal profile). Questions were presented as variables that could be selected by participants through the use of multiple choice options or Likert scales (A psychometric scale commonly used in questionnaires in which respondents express their strength of agreement with each of several statements, typically with an odd number of response options varying from 'strongly disagree' to 'strongly agree' (de Vaus, 2002).) that assessed the extent of agreement/disagreement with statements. The questionnaire contained 274 variables (Variables are defined as characteristics which have more than one category (de Vaus, 2002), which can be thought of in the present survey as the response options available for each question. For example, the question asking 'In which country (or region of England) do you live?' had 14 variables from which to select (9 regions of England, Wales, Scotland, Northern Ireland, Irish Republic and country other than UK or Ireland).) generated from multiple choice elements of the 45 questions. There were also sections that enabled free text responses. Only two questions were mandatory, and these were inserted to route certain participants through relevant questions that were not applicable to everyone (for example, the set of questions about aspects of woodland ownership was only available to those who had indicated that they owned woodland; a similar set of questions about aspects of research was only available to people who described themselves as researchers).

One of the key objectives of the survey was to collect a series of policy-relevant research questions of high importance to individuals. Participants in the survey were invited to submit up to five policy-relevant research questions in each of three categories: environment, people and society and economics (Figure 1), the three 'pillars' of sustainable development.

Coding the questions

Submitted questions were coded by three independent people using a specialized thesaurus of forestry and applied life sciences terms, which is used by Intute (2002) and other international documentation services (Ahsan-ul Morshed and Sini, 2009). Coders applied up to three keyword terms for each question.

All the questions submitted were sorted into one or more of 14 themes (Figure 1), which were determined on the basis of the most commonly occurring keywords. Ten questions were selected for each theme as representatives of the most frequently occurring topics within the themes. These 140 representative questions were presented on the Website in their themes, together with the complete list of 1594 questions.

A Delphi-style approach was taken to cycle the results of Phase 1 back to the same set of 1600 people to gauge

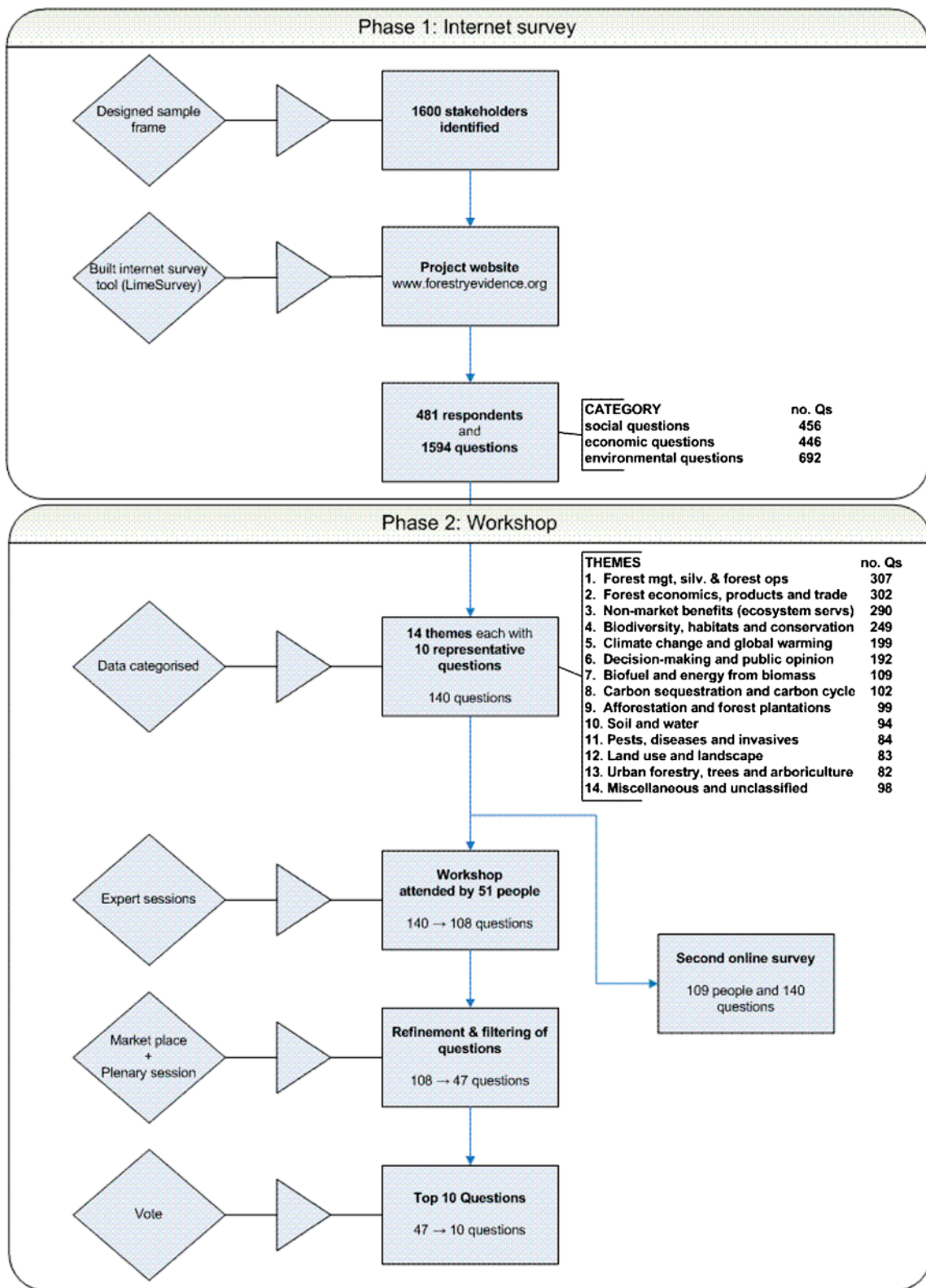


Figure 1. Key stages in the T10Q project leading to the final top 10 questions.

their views on the comments submitted by other stakeholders. Delphi methods have been used with some success in forestry, notably for issues where detailed data are lacking, uncertainty is large and informal judgements are a fundamental source of information (Mendoza and Martins, 2006). Results from this phase of T10Q will be analysed separately. In parallel, the workshop was organized to discuss the questions submitted in Phase 1 and to arrive at a set of 10 policy-relevant research questions for forestry.

Phase 2: workshop

Invitations to attend a 2-day workshop to discuss the research questions submitted in Phase 1 of the project were sent to people who had registered an interest in attending a workshop after completing one or both online surveys or after reading about it on the project Website or in promotional articles (e.g. Petrokofsky *et al.*, 2008).

The aim of the workshop was to arrive at a list of 10 research questions by a process of repeated filtering through discussion and finally voting. This was achieved by parallel facilitated discussions on separate themes, focussed drafting sessions, two whole-group sessions (that considered, revised or rejected the outputs of the drafting sessions) and, finally, a confidential vote.

Results

Phase 1: Internet-based survey

A total of 481 people responded to the survey, of whom 21 provided no useable information. Table 1 shows the sector participants selected from a menu of 15 options to describe their current work or their principal work before retirement.

Responses to the survey questions yielded a total of 37585 separate pieces of information (multiple options within questions generated a large volume of data) from the 481 respondents, with an average of 78 per person (the range was 1–167). Analyses of responses to all sections of the survey are outside the remit of this paper (Details of the survey structure are available from the principal author.), which focuses primarily on the 1594 separate research questions that were submitted by respondents.

Preliminary tests showed a high degree of uniformity in term selection by the three coders. A total of 2819 unique keywords and keyword phrases were used, 187 of which were used once only. These terms were not used in subsequent stages of sorting the questions into themes and topics. Questions were sorted into one or more of 14 themes on the basis of the most commonly occurring issues identified during coding. The number of questions in each theme was not equal (see Figure 1) and 629 were listed in more than one theme (534 in two themes, 90 in three and 5 in four).

Important sources of potential bias in survey-based work are the coding and data analysis methods used. Therefore, experienced external indexers were used to add keywords

Table 1: Sector of participants (not all participants identified their sector; 43 workshop participants and 313 survey participants provided information)

Sector	Responses from participants			
	Online survey participants		Workshop participants	
	%	<i>n</i>	%	<i>n</i>
Forest industry/woodland management	18	57	19	8
International organization	5	17	0	0
NGO/community organization	12	38	19	8
Public sector – central/devolved government	17	54	7	3
Public sector – local authority	4	11	0	0
Research institute	15	48	12	5
University research	22	70	35	15
Other	6	18	9	4
Total		313		43

to all the original questions submitted in Phase 1. These keywords were used to group the questions into themes. The themes emerged from the keyword groupings; they were not set up *a priori*. By this mechanism, questions could be listed under more than one theme. This process enabled questions to be viewed from different perspectives. Although the process created replication for survey participants, the effect of subjective judgements by the lead author in allocating questions to particular topics was thereby reduced.

Table 2 shows the spread of questions by sector of participant across the 14 themes.

Phase 2: workshop

A total of 51 people attended one or both days of the workshop, 43 of whom took part in the final online vote (Figure 1). Participants came from England, Scotland, Wales and the Irish Republic and included people working in all three ‘pillar’ areas of sustainability. There were proportionally more university researchers and fewer people working in the public sector or for NGOs than there had been in the online survey (Table 1). Two groups were not represented at the workshop: public sector–local authority and international organizations, though several of the participants had worked for international organizations at some time during their careers. The workshop participants included people who owned woodland and/or had practical experience of forest management. The university researchers worked on widely different aspects of forestry, with research interests spread across the three pillar areas.

The facilitated themed discussion sessions were organized in a way that maximized mixing among participants. The

Table 2: Questions in themes by sector of participant submitting the question

Sector	Theme													Total	Misc	LU	UR	PD	SW	AF	CS	BF	OP	CC	BI	NM	MG	EC	Total unique questions	Sector, n
	EC	MG	NM	BI	CC	OP	BF	CS	AF	SW	PD	UR	LU																	
Forest industry	7	57	38	34	29	30	19	16	13	9	17	16	12	11	371	281	57													
International	7	11	4	10	7	8	10	4	4	2	2	2	2	4	72	62	17													
NGO	29	43	36	23	22	29	14	12	10	16	9	9	13	12	277	207	38													
Central public sector	49	37	48	33	31	28	25	18	19	21	18	19	22	16	384	259	54													
Local authorities	14	8	14	9	11	9	3	5	2	3	2	2	2	2	95	58	11													
Research institute	46	58	56	54	36	37	14	14	15	13	17	3	16	25	404	283	48													
University research	69	69	73	68	49	28	22	23	28	14	15	21	13	21	513	361	70													
Other	18	24	21	18	10	10	12	10	8	11	4	5	3	7	174	83	18													
Total	302	307	290	249	199	192	109	102	99	94	84	82	83	98	2290	1594	313													

Cells with dark shading indicate higher than expected values; cells with light shading indicate lower than expected values (determined by chi square test). EC, forest economics, products and trade; MG, forest management, silviculture and forest operations; NM, non-market benefits (ecosystem services); BI, biodiversity, habitats and conservation; CC, climate change and global warming; OP, decision making and public opinion; BF, biofuel and energy from biomass; CS, carbon sequestration and carbon cycle; AF, afforestation and forest plantations; SW, soil and water; PD, pests, diseases and invasives; UR, urban forestry, urban trees and arboriculture; LU, land use and landscape; Misc, miscellaneous and unclassified.

10 representative questions for each theme were presented for each theme group to discuss, amend and prioritize. The complete set of 1594 questions was also available for consideration. At the end of these sessions, parallel drafting sessions for each theme considered the prioritized list of questions that emerged from the discussions and produced a set of five questions of high priority. These 70 questions were further reduced to 47 after parallel facilitated small-group discussions that aimed to consolidate similar questions and remove duplication. The final list of 47 questions was presented to the participants in the form of a very short survey using the LimeSurvey tool. Participants were invited to select the 10 questions that they considered most important from the list of 47 and provide details of the sector in which they work (see Appendix 1). The survey was assembled soon after the short list of 47 questions had been agreed and participants voted online at computer terminals provided at the workshop. LimeSurvey allows very rapid export of results and these were analysed to determine the questions receiving the highest number of votes and to classify the sectors of those voting.

Top Ten Questions for Forestry

Table 3 shows the final 10 questions that attracted the most votes from participants voting at the workshop, with percentage of votes cast.

The remaining 37 questions on the short list were selected by fewer than 30 per cent of voting participants. All 47 questions gained at least one vote.

Clearly, not all workshop participants felt that the final set of 10 questions reflected their own personal views. However, more than half of those who voted chose at least four of the top 10 questions and every voter chose at least one of the top 10 questions, which supports the view that the workshop process gave rise to more agreement in choosing 10 questions than would have arisen by random voting (The variance in the frequencies with which each question was chosen will be higher where there is agreement between respondents. In order to test for agreement between respondents, therefore, we calculated the variance in the frequencies with which our 47 questions were chosen and compared it with the distribution of the variance assuming no agreement between respondents. We simulated 10000 rounds in which 43 respondents randomly chose 10 of 47 possible responses. The 95 per cent confidence interval of this variance was (0.002824, 0.006514); the observed variance of 0.0122 lies far outside this confidence interval, allowing us to reject the null hypothesis of no agreement between respondents.) by 43 people choosing from 47 questions.

Discussion

The 1594 questions submitted in Phase 1 of T10Q were distributed across a broad spectrum of forestry interest: 13 key subject themes were identified. Of these, the largest two themes, containing over 300 questions each, were traditional core issues of forest management, silviculture,

Table 3: Top 10 questions determined by votes cast at workshop

Question	Percentage of votes cast
What are the most technically and financially effective ways of identifying, monitoring and controlling invasive species, pests and disease?	45
How can we achieve better understanding between foresters and other parts of society?	42
What are the most effective landscape planting schemes to ensure connectivity between woodland fragments while maintaining connectivity between other land use types?	39
How will climate change affect both natural forest ecosystems and forestry and how should management be adapted to minimize adverse impacts and optimize benefits?	34
What is the value of forestry to human health and well-being?	34
Who are the private woodland owners and how can they be engaged and influenced? What are their concerns?	34
Which parts of forest ecosystems form the largest and most stable carbon pools and how are these impacted by forest management and climate change?	32
How can we address the economic, environmental, social and institutional constraints of expanding woodfuel in the UK?	32
What species or provenances should we be considering in relation to a range of forestry systems including urban and agroforestry, in the light of climate change?	32
What are the barriers to knowledge transfer in forestry from research to practice and how can they be removed?	32

forest economics, products and trade. Ecosystem services and non-market benefits were almost as well represented, with just under 300 questions, followed by biodiversity, habitats and conservation, climate change, then decision making and public opinion, all ranging between 190 and 250 questions. The final top 10 questions were also drawn from the smaller themes, so there is no evidence that weight of numbers dictated the final top 10 choices.

The process was well supported and compared favourably with the level of responses in stakeholder consultations for national forestry strategies in the UK: 221 written responses (plus 187 participants at two workshops) in England in 2006 (Department for Environment, Food and Rural Affairs, 2007), 231 responses in Wales in 2009 (Forestry Commission Wales, 2009) and 189 and 149 in the two rounds of the 2006 Scottish strategy (Forestry Commission Scotland, 2006). Janse (2006, 2008) reported similar response rates (average 32 per cent) in recent European surveys of forest policy makers and scientists (using much

lower sample sizes) and an international online survey on science communication by researchers by the International Union of Forestry Research Organisations in 2006 attracted 340 responses in an open survey with an unknown population size (Kleinschmit and Real, 2009). Response rates were of a similar size for the consultation on creating a unified European Research Area (681 responses to an open online questionnaire (European Commission, 2007a)).

There has been very little systematic evaluation of the effectiveness of participation for environmental decision making (Newig and Fritsch, 2009) but increasing participation in decision making is a central element in European environmental policy (European Commission, 2007b). The European Strategic Research Agenda for the Forest-Based Sector, drawn up after a stakeholder consultation in all European Union countries, recommended greater engagement of scientists from all relevant disciplines with the process of developing research priorities across five forest-based value chains (Forest-Based Sector Technology Platform, 2006). In attempting to remove the actual bias or the perception of bias inherent to closed decision making by experts, new sources of bias are potentially created by giving unequal and potentially unrepresentative weight to contributions from certain stakeholders. Price (2000) expressed poetically what many view as a real weakness of the practice, namely that the 'idealised sweet reasonableness of participatory discussion is not always found in real-world debate, where decisions may favour not the most deserving, but the most obstinate'.

The workshop format, using facilitators, changing groups of delegates and a final secret ballot, was designed to reduce the effects of obstinate voices dominating debates as far as possible.

The most important source of potential bias in any survey is undoubtedly the people who participate. T10Q employed purposive sampling, a type of non-probability sampling in which the 'population' of 'those with a professional interest in forestry' is not known precisely. The issue of non-response bias is impossible to quantify in a non-probabilistic survey (de Vaus, 2002). However, Table 1 categorises survey respondents and workshop participants and Table 2 provides a more detailed breakdown of the topics of questions submitted by the different sectors. Although not a tool for removing bias, it enables some sectoral comparisons to be made and provides a check against dominance of the process by one sector. This would be an essential element in using this methodology more widely or in, for example, a European context to gather inputs for international research agendas of the type undertaken in conservation (Sutherland *et al.*, 2010). It is particularly noticeable that the NGO sector, which was well represented, displayed no particular leaning in the topics of questions it submitted. Submissions by participants from NGOs were divided among the 14 themes in numbers which were not statistically different from expected, the only sector for which this was true. Greatest variance was from the forest industry sector, who not surprisingly contributed more questions to the theme 'Economics, products and trade'. Though a small group, local authority participants

favoured questions on climate change and, again not surprisingly, urban forestry. It should be noted that even within sectors, participants came from different areas of interest. Researchers in particular, both in the survey and workshop, had widely differing research fields and certainly did not constitute a 'unified voice' in terms of identifying priority research topics. Similarly, members of NGO organizations, that were relatively over-represented at the workshop compared with the survey population, expressed widely different views during group discussions; their voting patterns were equally varied.

Within the UK context, forestry policy is heavily influenced by the devolved governments in Wales, Northern Ireland and Scotland. These governments were not represented officially at the workshop, although individuals from all three had participated in the online surveys submitting research questions. It would be interesting to investigate further the extent to which the questions submitted had a regional or national 'flavour' given the differences between the different forestry strategies.

The themes that emerged from the T10Q project align very closely with the eight strategic research priority areas identified in the Science and Innovation Strategy for British Forestry (Forestry Commission, 2005): social and economic research, monitoring and evaluation, climate change*, soil and water management*, forest products*, changing silviculture*, biodiversity and habitat restoration* and plant health. These priorities describe almost the entire range of forestry activity in the UK; they are not so much 'priorities' as broad categories of interest. It is of little surprise, therefore, that the themes that emerged in the T10Q project fall within the compass of six of these priority categories (indicated by an asterisk above) (Figure 1). Our T10Q themes emerged as clusters of interest from the questions submitted and were not deliberately designed to be coherent with these established categories. The researchable questions submitted within these themes are a potentially rich resource that could be analysed and considered further in the context of discussing a forestry research agenda that was responsive to perceived knowledge needs from a broad section of the forestry sector.

According to Taylor (2005) the first rule in the process of making science more influential is to win the argument about what the problem is, before trying to win the argument about the solution. Collectively framing research questions that relate to what a broad spectrum of stakeholders view as the important policy challenges of the 21st Century will be fundamental to commissioning relevant research that makes the best use of the limited funding resources likely to be available for a rapidly diversifying forestry research sector.

Conclusions

Using combined online and face-to-face participation, a diverse group of people with a professional involvement in forestry engaged in a process that produced a set of 10 questions, from close to 1600 suggested by stakeholders, which were

felt to warrant further research in forestry. The T10Q project demonstrated that it was possible to compile and prioritize a meaningful set of research questions using a collaborative 'bottom-up' approach that involved professionals from a wide set of disciplines of relevance to modern forestry.

Within the UK, the ERFF, which is the body currently co-ordinating publicly funded forestry research, offers a framework for identifying research that matches national policies and priorities in forestry and environmental science. The method described in this paper could complement this activity by readily engaging a large number of people and stakeholder groups, in a process of framing research questions highly relevant to their sector. The process itself is scalable and could be readily adapted for local, regional or international consultations that aim to determine research priorities in natural resources management.

The T10Q project engaged people who were outside the traditional boundaries of the discipline, a trend likely to be more important in the future, particularly in the light of complex problems connected with climate change, bio-energy provision or health and well-being, for example, which require multidisciplinary partnerships within the research and policy communities.

There is no particular significance to the fact that the project aimed to prioritize 10 questions. Top 10 lists are ubiquitous across all subjects and countries. The key message is that the process can be adapted to achieve lists of research questions that can be analysed and prioritized collectively in a variety of appropriate ways.

Through the T10Q project an effective method for reaching a large number of stakeholders engaged in forestry research and policy in the UK was developed. The process demonstrably delivered a precise and detailed roadmap of use to researchers and policy makers in assisting responses and adjustments to current research priorities over coming years.

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Conflict of Interest Statement

None declared.

References

- Ahsan-ul Morshed, M. and Sini, M. 2009 Creating and aligning controlled vocabularies. In *Proceedings of the Workshop on Advanced Technologies for Digital Libraries 2009 (AT4DL 2009)*, 8th September 2009, Trento, Italy. R. Bernardi, S. Chambers and B. Gottfried (eds). Bozen-Bolzano University Press, Bolzano, Italy, pp. 50–53. ISBN 978-88-6046-030-1.
- Broerse, J.E.W. and Bunders, J.F.G. 2000 Requirements for biotechnology development: the necessity for an interactive and participatory innovation process. *Intern. J. Biotech.* **2**, 275–296.
- Buchy, M. and Hoverman, S. 2000 Understanding public participation in forest planning: a review. *For. Policy Econ.* **1**, 15–25.
- Burdekin, D.A. 1989 *Trends in Forestry Research 1982–1988. Occasional Paper*. Forestry Commission, Edinburgh, UK, p. 10. No. 23.
- Carnegie United Kingdom Trust. 2008 *Power Moves: Exploring Power and Influence in the UK*. Carnegie UK Trust, Dunfermline, UK.
- Caron-Flinterman, J.F., Broerse, J.E.W., Teerling, J., van Alst, M.L.Y., Klaasen, S., Swart, L.E. et al. 2006 Stakeholder participation in health research agenda setting: the case of asthma and COPD research in the Netherlands. *Sci. Public Policy*. **33**, 291–364.
- Côté, M. and Bouthillier, L. 1999 Analysis of the relationship among stakeholders affected by sustainable forest management and forest certification. *For. Chron.* **75**, 961–965.
- de Vaus, D.A. 2002 *Surveys in Social Research*. 5th edn. Routledge, Abingdon, UK. ISBN 978-0-415-26858-5.
- Department for Environment, Food and Rural Affairs. 2007 *A Strategy for England's Trees, Woods and Forests (ETWF)*. <http://www.defra.gov.uk/rural/forestry/strategy.htm> (accessed on 8 March, 2010).
- Des Roches, C.T. 2007 Policy advice for public participation in British Columbia forest management. *For. Chron.* **83**, 672–681.
- European Commission. 2005 *Report from the Stakeholder Consultation on the Draft Commission Staff Working Document on the Implementation of the EU Forestry Strategy*. http://ec.europa.eu/agriculture/consultations/forestry/report_en.pdf (accessed on 8 March, 2010).
- European Commission. 2007a *Green Paper: The European Research Area: New Perspectives*. European Commission, Brussels, Belgium. http://ec.europa.eu/research/era/consultation-era_en.html.
- European Commission. 2007b *Taking European Knowledge Society Seriously*. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate, ISBN – 978-92-79-04826-5. Directorate-General for Research, European Communities, Luxembourg.
- Evans, J. 1992 *Ten Years of Forestry Research: An Account of the Work of the Forestry Research Co-ordination Committee, 1982–1992*. ISBN 0 85538 247 3. Forestry Commission, Edinburgh.
- Fischer, F. 2003 *Reframing Public Policy. Discursive Politics and Deliberative Practices*. Oxford University Press, Inc., Oxford, p. 266. ISBN 0-19-924263-1.
- Food and Agriculture Organization. 2006 *Global Forest Resources Assessment 2005: Progress Towards Sustainable Forest Management*. FAO Forestry Paper No. 147. Food and Agriculture Organization of the United Nations, Rome, Italy, 320, pp.
- Forest-Based Sector Technology Platform 2006 *A Strategic Research Agenda for Innovation, Competitiveness and Quality of Life*. FTP, Brussels, Belgium. http://www.forestplatform.org/easydata/customers/ftp/files/pdf/SRA_FTP_Final.pdf (accessed on 8 March, 2010).
- Forest Service. 2006 *Northern Ireland Forestry. A Strategy for Sustainability and Growth*. <http://www.forestservice.gov.uk/index/publications/policy-and-standards/a-strategy-for-sustainability-and-growth.htm> (accessed on 8 March, 2010).
- Forestry Commission. 2005 *Science and Innovation Strategy for British Forestry*. Forestry Commission, Edinburgh. www.forestresearch.gov.uk (accessed on 8 March, 2010).
- Forestry Commission. 2010 *Science and innovation strategy for British forestry 2010–2013*. Forestry Commission, Edinburgh. www.forestresearch.gov.uk.
- Forestry Commission Scotland. 2006 *The Scottish Forestry Strategy. SE/2006/155*. Scottish Executive, Edinburgh. <http://www.forestresearch.gov.uk/forestry/INFD-6AGGZW> (accessed on 8 March, 2010).
- Forestry Commission Wales. 2009 *Woodlands for Wales. The Welsh Assembly Government's Strategy for Woodlands and Trees*. CMK-22-01-146. ISBN Number: 978 0 7504 5034 8. <http://www.forestresearch.gov.uk/forestry/INFD-7GDE7A> (accessed on 8 March, 2010).
- Holmes, J. and Clark, R. 2008 Enhancing the use of science in environmental policy-making and regulation. *Environ. Sci. Policy*. **11**, 702–711.
- Holmes, J. and Savgård, J. 2009 The planning, management and communication of research to inform environmental policy making and regulation: an empirical study of current practices in Europe. *Sci. Public Policy*. **36**, 709–721.
- Janse, G. 2006 Information search behaviour of European forest policy decision-makers. *For. Policy Econ.* **8**, 579–592.
- Janse, G. 2008 Communication between forest scientists and forest policy-makers in Europe – a survey on both sides of the science/policy interface. *For. Policy Econ.* **10**, 183–194.
- Jasanoff, S. 2003 Technologies of humility: citizen participation in governing science. *Minerva*. **41**, 223–244.
- Kleinschmit, D. and Real, A. 2009 *Communicating Forest Science*. Paper presented at the XIII World Forestry Congress, Buenos Aires, 18–23 October 2009.
- Lawson, G.J. and Hemery, G.E. 2007 *World Timber Trade and Implementing Sustainable Forest Management in the United Kingdom. A Report to the Woodland Policy Group*. The Land Use Policy Group, Exeter, UK.
- Leach, W.D. 2006 Public involvement in USDA forest service policymaking: a literature review. *J. For.* **104**, 43–49.
- Mendoza, G.A. and Martins, H. 2006 Multi-criteria decision analysis in natural resource management: a critical review of methods and new modelling paradigms. *For. Ecol. Manage.* **230**, 1–22.
- Newig, J. and Fritsch, O. 2009 Environmental governance: participatory, multi-level – and effective? *Environ. Policy Governance*. **19**, 197–214.
- O'Brien, E.A. and Claridge, J.N. 2002 Trees are company: social science research into woodlands and the natural environment. In *Proceedings of the Forestry Research Co-ordination Committee*

- Conference convened by Forest Research on 19–20 June 2001 at Glamorgan Building, Cardiff University, Cardiff.* E. O'Brien and J. Claridge (eds). Forestry Commission, Edinburgh.
- Oliver, S., Clarke-Jones, L., Rees, R., Milne, R., Buchanan, P., Gabbay, J. *et al.* 2004 Involving consumers in research and development agenda setting for the NHS: developing an evidence-based approach. *Health Technol. Assess.* **8**, 1–148. III.
- Pagdee, A., Kim, Y. and Daugherty, P.J. 2006 What makes community forest management successful: a meta-study from community forests throughout the world. *Soc. Nat. Res.* **19**, 33–52.
- Petrokofsky, G., Hemery, G.E. and Brown, N.D. 2008 Knowledge feeds decision making. The people's say in UK forestry. *Quart. J. For.* **102**, 221–225.
- Price, C. 2000 Valuation of unpriced products: contingent valuation, cost-benefit analysis and participatory democracy. *Land Use Policy.* **17**, 187–196.
- Rayner, S. 2003 Democracy in the age of assessment: reflections on the roles of expertise and democracy in public-sector decision making. *Sci. Public Policy.* **30**, 163–170.
- Rose, D., Fleischman, P. and Wykes, T. 2008 What are mental health service users' priorities for research in the UK? *J. Ment. Health.* **17**, 520–530.
- Sutherland, W.J., Adams, W.M., Aronson, R.B., Aveling, R., Blackburn, T.M., Broad, S. *et al.* 2009 One hundred questions of importance to the conservation of global biological diversity. *Conserv. Biol.* **23**, 557–567.
- Sutherland, W.J., Armstrong Brown, S., Armsworth, P.R., Brereton, T., Brickland, J., Campbell, C.D. *et al.* 2006 The identification of 100 ecological questions of high policy relevance in the UK. *J. Appl. Ecol.* **43**, 617–627.
- Sutherland, W.J., Clout, M., Côté, I.M., Daszak, P., Depledge, M.H., Fellman, L. *et al.* 2010 A horizon scan of global conservation issues for 2010. *Trends Ecol. Evol.* **25**, 1–7.
- Sutherland, W.J. and Woodroof, H.J. 2009 The need for environmental horizon scanning. *Trends Ecol. Evol.* **24**, 523–527.
- Taylor, M. 2005 Bridging research and policy: a UK perspective. *J. Intern. Develop.* **17**, 747–757.
- Van Herzele, A., Collins, K. and Tyrväinen, L. 2005 Involving people in urban forestry – a discussion of participatory practices throughout Europe. In *Urban Forests and Trees*. C.C. Konijnendijk, K. Nilsson, T.B. Randrup and J. Schipperijn (eds). ISBN: 978-3-540-25126-2. Springer-Verlag GmbH, Berlin, Germany, pp. 207–228.
- Whitmarsh, L., Kean, S., Russell, C., Peacock, M. and Hatala, R. 2005 *Connecting Science: What We Know and What We Don't Know About Science in Society*. British Association for the Advancement of Science, London. <http://www.britishsocietyscience.org> (accessed on 8 March, 2010).
- Wilsdon, J. and Willis, R. 2004 *See-through Science. Why Public Engagement Needs to Move Upstream*. Demos, London. ISBN 0-84180130-5.

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