What do you think about the policy relevance of ecosystem service science?

Results of a survey amongst the Belgian ecosystem services expert community

Hans Keune (INBO) & Tom Bauler (ULB)

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Summary

Introduction

The BEIgium Ecosystem Services (BEES) cluster project (funded by BELSPO; 2009 - 2012) aimed at identifying and stimulating research on ecosystem services in Belgium. It did so mainly by organizing a series of workshops covering different aspects of ecosystem services research. Though largely focusing on scientific issues, the BEES-project and ecosystem services science in general have the ambition to produce socially and policy relevant knowledge. Policy relevance was touched upon in some of the first workshops of the BEES-project, but the potential diversity of viewpoints was never made explicit in a structured manner within the context of the BEES-project, nor were the fundamental epistemological issues related to the complexity of ecosystem services science within the societal context. We consider this aspect of ecosystem services to be of the utmost relevance considering the current developments in the field, e.g. regarding all the TEEB (http://www.teebweb.org/) initiatives being started up in Europe and also in Belgium.

In Work Package 7 *"Linking ES to policy instruments"* policy relevance of ecosystem services science is specifically addressed. As part of this endeavour a survey was set up as to highlight the views of a diversity of actors, considered to be members of what we may call the Belgian *Community of Ecosystem Services Practice*: scientists, policy representatives and others. 53 actors responded to the survey questionnaire (an estimated response rate of some 10%). 52% of respondents have a scientific *institutional background*, 31% a policy background. 67% have a natural scientific *educational background*, 22% a hybrid (natural and social scientific) educational background and 11% a social scientific background.

In this report we present the results of the survey in order to inform the debate and to be transparent on the survey outcomes. We present two types of results: 1. percentages reflecting how the total group of respondents answered to the questions and 2. argumentative comments that some of the respondents added to there response. We start the description concerning the different topics with the total response in percentages and then add descriptions of the argumentative material.

Scientific or socio-political valuation of ecosystem services?

81% considers valuation of ecosystem services to be a *scientific responsibility*. Simultaneously, 79% considers valuation of ecosystem services to be a *topic for social and political debate*. How can we explain this vast majority pro scientific valuation and simultaneously pro socio-political valuation? Does this mean there is no contradiction between on the one hand valuation as an issue of scientific (objective) measurement and valuation as an issue for (subjective) debate on the other? Should we interpret this as both viewpoints being considered to be complementary or even need to coincide, as they represent two legitimate or even vital aspects of valuation? Or should we interpret socio-political preferences to be a topic for scientific measurement and as such as part of scientific valuation?

In their comments, some respondents propose *a strict division of responsibilities between science and society*, pleading either for valuation to be a responsibility for *society* or for *science*. The latter including (social) *scientists with expertise on societal preferences*. Proponents of the *scientific responsibility* point at 1. the <u>complexity</u> of the issues demanding scientific credibility, 2. the need for <u>objectivity</u> and knowledge about <u>facts</u>, and 3. the concept of ecosystem services still being <u>controversial</u>, thus in need for scientific support. A diversity of arguments is mentioned specifically pleading for *social and political valuation*: 1. a way to <u>create support</u> for the ecosystem services concept outside the scientific arena, 2. it's a <u>shared responsibility</u> of all

stakeholders to sustain ecosystem services, and 3. it <u>raises awareness</u> about the impact of political choices (policy) on our ecosystem. Some respondents *limit social and political valuation to specific valuation issues* such as: non monetary aspects, spatial planning and defining specific targets for specific areas.

Some respondents also propose a division of responsibilities between science and society, but both with *complementary tasks:* science may support society by means of knowledge or tools, but society decides. Based on the above *two scenarios of complementarity* can be conceived, 1. science comes first and supplies society with the information basis for social choice, and 2. science is knowledgeable about social preferences and takes this into account next to ecological and other aspects.

Some respondents do not make a clear distinction between science and society regarding valuation and point at the *need for close collaboration, between scientific disciplines, between science and society*, and some do not even make a distinction between science and society at all when it comes to science, e.g. by pointing at the importance of citizen science.

Quite some respondents (mainly those in favour of scientific valuation) touch upon the debate about valuation and monetization. As pro-monetization arguments especially the *awareness raising capability* is mentioned. Opponents of monetary valuation point at *context dependency* of ecosystem services, therefore monetary value having little significance.

Social context specificity of the value of ecosystem services

92% considers *the value of ecosystem services not to be fixed because of the social context being a significant determinant*, depending of characteristics of the context (space, time, culture, …) and being based on dynamic preferences. In their comments, some argue this to be *only true for some aspects of ecosystem services*, e.g. cultural services or parks, or depending from other contextual elements such as the availability and acceptability of technological alternatives to ecosystem services.

The role of biodiversity

The contribution of biodiversity to ecosystem services appears to be challenging: quite some difference of opinion here amongst respondents. 59% consider the contribution <u>not</u> to be context specific, whereas one third does think the contribution to be context specific. 10% of respondents indicate they do not know. The difference of opinion is reflected on the level of institutional and educational background; especially the divide amongst both policy representatives and scientists is striking. In their comments, some stress the *biophysical relationship*, some the *social context*, some *distinguish between different types of ecosystem services*.

The interface capacity of ecosystem services.

As the concept of ecosystem services has the ambition to link nature with benefits for society, we were interested to learn if respondents agreed to this interface capacity, and how they would typify it. We asked respondents about three types of interface characterizations of the concept of ecosystem services: systemic, interdisciplinary and transdisciplinary. Respectively 83%, 92%, 90% agree to these interface characterizations. In their comments, some criticize *the nature – society divide* inherent to the concept, considering humans and nature to be part of one and the same system. Regarding the ideals of *interdisciplinarity* and *transdisciplinarity*, it is pointed out that there still is a long way to go. Some though stress the *distinctive nature of science and policy* in this regard. The concept demands *a new sort of scientist* it is also stated: scientists focussed more at societal instead of mere scientific (career) challenges.

The policy relevance of scientific knowledge on ecosystem services

As the focus in the BEES project was mainly on scientific, methodological issues, and policy relevance was more or less taken for granted, we were interested to go more into depth on issues that might be relevant for the policy relevance capacity of ecosystem service science. We specifically focussed on *the relation between scientists and policy makers* in this respect: how intensely should they communicate and/or collaborate about the research, and at which stages of the process, as to promote science to be policy relevant? We proposed three scenarios: 1. science discusses all research choices with policy representatives, 2. scientists and policy representatives collaborate as much as possible, and 3. they only discuss research topics before the research, and after the research policy representatives decide upon policy relevance. The collaborative scenario is least disputed: 85% agrees to it. The other two scenarios show more difference of opinion, especially amongst scientists and policy representatives. Regarding more intense contacts between scientists and policy makers, in the comments concerns are raised about the *independency/neutrality of science from political influence*.

Science – policy interface

We proposed two scenarios about the responsibility of scientists and policy representatives regarding ecosystem services methods: 1. science develops best practices to be used by policy or 2. science and policy collaborate in the use of methods. Respondents are inconclusive about the choice between on the one hand a rather strict division of labour between science and policy and close collaboration on the other: a majority clearly sees benefits from both scenarios (respectively 86% and 77%), and thus does not necessarily see them as excluding options.

In the comments, the concept of *best practices* is either favoured (awareness raising, guidance) or criticized (context specificity, complexity). *Independent use of methods by policy representatives* is favoured because of either the value of scientific proof of a best method or because of the strict division of labour between science and policy. *Close methodological collaboration* is propagated mainly because of complementary expertise.

Scientific objectivity and independence

96% thinks *scientists have the responsibility to be objective and independent*. In the comments, *objectivity and independence* are considered important in order to be credible as a scientist, but it is also stated to be mainly an ideal that in reality is not straightforward, or even impossible. One respondent criticizes the *advocacy character of some ecosystem services scientists*. Honesty and full transparency, e.g. about probabilities and uncertainties, are considered to be supportive or good alternatives to the ideal of objectivity and independence.

The importance of objectivity and independence does not necessarily mean that *scientists should mainly focus on issues that can be objectified*: 57% agrees, 32% disagrees. In the comments, it is argued that subjective issues are also important to include and that indeed some issues are in fact hard or impossible to objectify. Concrete examples are mentioned: cultural issues, aesthetics, or even considering monetary valuation as being objective, which can be considered an example of neo liberal thinking which makes it not value free at all.

Knowledge communication from science to policy

Regarding knowledge communication we presented three scenarios: 1. scientists produce *simple knowledge* for policy makers, 2. scientists *black box* the knowledge production process for policy makers, and 3. *full transparency*. 100% consider transparency to be most important and black boxing is disliked by 92%. Still, in communicating to policy makers, quite some difference of opinion is apparent on how this should be done: to what extend should scientists

simplify and not bother policy makers with scientific nuances? 46% agrees with simplification, 54% disagrees. Respondents with a hybrid educational background (68%) and scientists (68%) disagree most with such simplification. These results perhaps touch upon a difference between one way communication and two way communication, the latter belonging more to a collaborative or negotiation style of science policy interaction/interface.

In the comments, regarding *simplification* some point at the need for a balance between doing justice to complexity and to addressing policy makers in a way that appeals to them and is practically useful for them: too much methodological detail may also paralyse adequate action. This can e.g. be achieved by multi layered communication: an executive summary with details in appendices or upon request, e.g. regarding methodological issues. Still some see a risk in simplification as providing a policy basis that is not realistic and may lead to popularism or bad decisions. *Full transparency* is propagated for scientific credibility (control and reproducibility), clarity and building trust. Some point at the importance of being transparent on choices that are made in the research and have a high impact on the outcomes, such as e.g. neoclassical assumptions underlying monetary evaluation.

Responsibility of social scientists

As social scientists are still underrepresented in ecosystem science and are still relative newcomers in the field of ecosystem services, we were interested to learn which kind of expertise is expected from them, by themselves, other disciplines and other actors such as policy makers. We proposed four scenarios for social scientific contributions: 1. measuring social preferences, 2. develop stakeholder deliberation processes, 3. develop knowledge assessment procedures and 4. develop policy translation procedures. The 'do not know' percentages are highest in this section compared to other sections of the survey; amongst whom even social scientists. This is probably due to the fact that a social science background and social science in general are still underrepresented in the emerging field of ecosystem services, as in fields related to nature, biodiversity and ecosystems in general, as well as amongst the respondents of this survey. Limiting social science to measuring social preferences only clearly is not appreciated by 65%. Especially deliberative processes are considered to belong within the realm of social science (73%). Also contributions regarding procedures for knowledge assessment (56%) and policy translation (64%) are considered a good opportunity for social scientific involvement.

In the comments, limiting the above mentioned contributions to social scientists only is criticized: some state that also other scientific disciplines can do it, and for more policy relevance related activities some state this to be a policy responsibility only. Others also point at disciplinary boundaries as such to be outdated, or at least next to specialists also generalists are needed. Also the need to leave social scientific expertise to social scientists only is mentioned. Finally, aiming only at policy relevance is criticized, pointing out that societal relevance may be a better term.

Handbook on ecosystem services tools and approaches

To what extent are handbooks on ecosystem services tools and approaches useful for non-scientific actors such as policy makers. Can handbooks be used independently? A limitation might be that they are always in need of specific methodological/scientific expertise to be involved in valuing, assessing, interpreting ecosystem services. Another limitation may be that ecosystem services are context specific. Still 68% accords the usefulness of a handbook on ecosystem services tools and approaches, and does not see it problematic due to either the importance of *context specifics* or the need for *methodological expertise*. Especially scientists seem to have confidence in the usefulness of a handbook; social scientists in particular. Another

problem for the usefulness of handbooks may be that the use of methods can be considered to be part of negotiation amongst the actors involved. Still 73% agrees to the usefulness of a handbook, despite the potential importance of *negotiation*. Here we also see this especially amongst scientists; again, social scientists in particular.

In the comments, the importance of *context specifics* is both addressed as a challenge to be incorporated in such handbooks, but also as a limitation to the value of such handbooks. Moreover handbooks are considered to be part of *methodological negotiation* amongst actors involved, potentially both scientists and policy makers included, both inspiring and avoiding to have to start from scratch.

Knowledge ability about science or policy

When communicating and/or collaborating, to what extent should policy makers be knowledgeable about ecosystem services science, and the other way around, to what extent should scientists be knowledgeable about policy making relevant to ecosystem services? We presented scenarios regarding the need for scientists and policy makers to be knowledgeable about each other's ecosystem services related knowledge and practice, as to enhance *mutual understanding* and *policy relevance of scientific knowledge*. Mutual understanding is considered to be important by most respondents, and *collaboration* is appreciated as a being supportive to this ideal. In fact, not all respondents think knowledge ability to be a prerequisite for fruitful collaboration, and place collaboration first, out of which mutual understanding will follow.

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1 Introduction

The BElgium Ecosystem Services (BEES) cluster project (funded by BELSPO; 2009 - 2012) aimed at identifying and stimulating research on ecosystem services in Belgium. It did so mainly by organizing a series of workshops covering different aspects of ecosystem services research. Though largely focusing on scientific issues, the BEES-project and ecosystem services science in general have the ambition to produce socially and policy relevant knowledge. In Work Package 7 *"Linking ES to policy instruments"* policy relevance is specifically addressed. As part of this endeavour a survey was set up as to highlight the views of a diversity of actors, considered to be members of what we may call the Belgian *Community of Ecosystem Services Practice*.

This community, partly involved in the BEES-project, consists not only of ecosystem services scientists and some selected policy makers who were participating in the workshops, but is to be considered a much larger, and in fact growing community. This wider and more diverse community is relevant to assessing the policy/societal relevance of the ecosystem services science. In fact, the question if knowledge production and assessing the societal/policy relevance of that knowledge should be limited to a scientists' responsibility only in the past decades has become a renowned subject for debate as such. Though touched upon in some of the first workshops of the BEES-project, the potential diversity of viewpoints was never made explicit in a structured manner within the context of the BEES-project, nor were the fundamental epistemological issues related to the complexity of ecosystem services science within the societal context. In order to not only stimulate debate on knowledge production, and the relevance of knowledge to society and policy, but to also make it more explicit and more tangible for debate, this survey was initiated. Next to viewpoints we also hoped to highlight issues considered important by the respondents and related argumentations.

In the following we will first briefly sketch the questionnaire and the response. Then we will present the results: the main scores on the Likert scale and the main argumentations of the respondents. In the Appendices you can find more details.

2 Survey questionnaire

Format

We used statements to which participants could respond on a Likert scale and offered the possibility to add arguments and comments. The following Likerst scale was used:

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

We chose to include the option *'Do not know'* and to not include a neutral *'nor agree, nor disagree'* response option. Including or excluding the *'Do not know'* option can sometimes lead to heated debates in the research community. By including the option, opponents state you run the risk respondents too easily opt for *'the easy way out'* thus escaping their responsibility, e.g. as a professional expert, to clearly state their opinion. On the other hand, proponents of the *'Do not know'* option state that when you force respondents to pick a specific response when in fact they don't think they are knowledgeable enough or just have difficulty in clearly choosing a position, you miss important information needed for good interpretation of the results. The reason we chose to not include a neutral 'nor agree, nor disagree' response option, was to trigger people to choose a position, if they thought to be knowledgeable on the topic, and not reside to *'the easy way out'* by choosing a neutral position. In order to stimulate free thinking without having to take into account potential social pressure, we promised the respondents to analyze their responses anonymously.

The topics for the survey and the formulation of specific statements were inspired by what we over the years picked up within the BEES-project, the wider ecosystem services community and environmental science and policy making in general (our professional background). We presumed these topics not only to be relevant for the focus of the survey (policy relevance) but also good proxies for the diversity of viewpoints present within the wider ecosystem services community. We used statements to make the topics clear and to trigger discussion. Next we give an overview of the subject categories that were part of the survey (in *Appendix A* you can find the full questionnaire):

- *Personal background*
- *Determining the value (monetary or non-monetary) of ecosystem services*
- *The interface capacity of ecosystem services.*
- *The policy relevance of scientific knowledge on ecosystem services*
- *Responsibility of scientists*
- *Responsibility of social scientists*
- *Handbook on ecosystem services tools and approaches*
- *Knowledge ability about science or policy*

We will now present you the main results of the survey. First the response rate and respondent's background will be discussed. The list of respondents can be found in *Appendix B.* After that the responses to the questionnaire. For the figures that we refer to: a full overview of results is presented in *Appendix C.*

3 Response rate

The questionnaire was distributed via email amongst 486 actors. The mailing list resulted from the combination of several network lists such as from the BEES project, an ecosystem services initiative of the Environment, Nature and Energy Department of the Flemish Government, and the Belgian network of ecological economics. After the initial mailing we also sent a reminder to those who did not respond the first time. In the mailing it was asked to also distribute it amongst other potentially interested actors. Due to this snow ball method we do not have full sight on the full amount of addressees. If we compare the amount of 53 participants to the survey with the initial list of 486 addressees, the response rate would be some 10%. Of the 53 participants, 11 were not amongst the original list of addressees. Some responded as a group, based on internal discussion. The full list of respondents can be found in *Appendix B*.

Respondents background

Three variables typify the respondent's background: geographical focus, institutional background and educational background. *Geographical focus* was constructed by the researchers based on the respondent information on the internet and information given by the respondents in the questionnaire. It was mainly used to give some indication of geographical orientation. These attributions are by no means unambiguous and are open for discussion. E.g. we attributed respondents working in the Antwerp harbour, an internationally oriented environment, with the category 'local' when responsible for the local environmental conditions. *Institutional background* also was attributed by the researchers based on the respondents institutional information available on the internet and information given by the respondents in the questionnaire. *Educational background* was attributed based on the information given by the respondents in the questionnaire.

The majority of respondents (67%; Figure 1) can be characterized as having mainly a Flemish *geographical orientation/background*. The rest can be characterized as having mainly a Federal (11%), Walloon (9%), local (7%) or international (6%) orientation/background. The majority of respondents (67%; Figure 2) can be characterized as having a natural scientific *educational background*. 22% can be characterized as having a hybrid (natural and social scientific) educational background, 11% a social scientific background. The majority of respondents (52%; Figure 3) can be characterized as having a scientific *institutional background*. 31% can be characterized as having a policy, 7% a business, 6% a consultancy, and 4% a NGO institutional background.

In the following results section we will only focus on respondent background diversity regarding educational and institutional background; we consider these to be most relevant and informative.

4 Results

Determining the value (monetary or non-monetary) of ecosystem services

We asked respondents about four characterizations relevant to the valuation of ecosystem services: as a scientific responsibility, a topic for social and political debate, determination by the social context and the relation to biodiversity. See Table 1.

Table 1	*Agree*	*Disagree*	*Do not know*
A. Determining the value (monetary or non-monetary) of ecosystem services is a scientific responsibility	81%	17%	2%
B. Determining the value (monetary or non-monetary) of ecosystem services is a topic for social and political debate	79%	17%	4%
C. The value (monetary or non-monetary) of ecosystem services is not fixed, but instead the social context is a significant determinant of the value (monetary or non-monetary) of ecosystem services	92%	8%	2%
D. The contribution of biodiversity to ecosystem services is not specific to the cultural, social, economic or geographical context in which they are enjoyed	32%	59%	9%

A vast majority (81%; Figure 4) considers valuation of ecosystem services to be a scientific responsibility. Simultaneously, a vast majority (79%; Figure 7) considers valuation of ecosystem services to be a topic for social and political debate. We see here limited difference of opinion also from the perspectives of institutional and educational background (most clearly amongst social scientists; Figures 6 and 9). How can we explain this vast majority pro scientific determination of value and simultaneously pro socio-political debate determining value? Does this negate a contradiction between valuation as an issue of measurement and being objective or an issue for debate and being subjective? Should we interpret this as both viewpoints being considered to be complementary or even need to coincide, as they represent two legitimate or even vital aspects of valuation, implying a division of responsibility/input/labour? Or should we interpret this as socio-political preferences to be a topic for scientific assessment/measurement, to be taken into account when scientifically determining value? This poses fundamental questions to the value of scientific knowledge and of social debate, to the relation between science and policy and social debate, and to value and valuation.

More food for thought is presented in the argumentation section: Box 1 and 2.

Box 1

Argumentations about scientific valuation

Science – society

Some respondents see *a strict division of responsibilities between science and society*, pleading either for valuation to be a responsibility for *society*…

"Valuing = political choice"

…or for *science*. The latter including (social) *scientists with expertise on societal preferences*.

Proponents of the *scientific responsibility* point at:

1. The complexity of the issues demands scientific credibility: the need for scientific knowledge, methods and experience

2. The need for knowledge about facts and objectivity

3. The concept of ecosystem services still being controversial, thus in need for scientific support:

"This theme is still controversial. Not all policy makers are convinced of the value of nature or other environmental aspects with no real direct monetary value. Trying to determine the value of these non-monetary items in a scientific and objective way, can lower the barriers and introduce more confidence in the concept and make discussions more rational."

Some respondents also see a division of responsibilities between science and society, but both with *complementary tasks: science may support society by means of knowledge or tools, but society decides*. Or as one respondent put it:

"Science supports (scientists know what's important) – society chooses/decides (public participation/decision making)"

Based on the above *two scenarios of complementarity* can be conceived:

1. Science comes first and supplies society with the information basis for social choice

2. Science is knowledgeable about social preferences and takes this into account next to other aspects such as ecological aspects

A distinction is sometimes made between **_different ecosystem services aspects_**, when it comes to **_different roles and responsibilities_**:

> *"Science is most capable, except for non-monetary aspects: other experts needed (social, political)"*

or

> *"Use of scientific methods to calculate the value, but input is needed from society to determine some of the values. Specific scientific knowledge is needed to estimate the value of intangible services like nitrogen cycle, etc.".*

Some respondents do not make a clear distinction between science and society in this respect and point at the **_need for close collaboration, between scientific disciplines, between science and society_**, and some do not even make a distinction between science and society at all when it comes to science:

> *"Valuation of ESS should be based on science expertise as well as 'citizen science'."*

Valuation – monetization

In their argumentations quite some respondents (mainly in favour of scientific valuation) open the debate about valuation and the monetization - non-monetary valuation debate. As pro-monetization arguments especially the **_awareness raising capability_** is referred to:

> *"Not all policy makers are convinced of the value of nature or other environmental aspects with no real direct monetary value. Trying to determine the value of these non-monetary items in a scientific and objective way, can lower the barriers and introduce more confidence in the concept and make discussions more rational."*
>
> *"If value is not determined, lot of projects will take it as 0"*

Opponents of monetary valuation point at **_context dependency_** of ecosystem services, therefore monetary value having little significance:

> *"nobody has to pay for it (…) The value of changes in ecosystem services is also a more relevant concept than the value of ecosystem services themselves. In practice the choices are between different states of the ecosystem services and not between having them or not."*

Box 2

Argumentations about social and political valuation

Two fundamental issues are mentioned regarding social and political debate about the value of ecosystem services:

> *"it's up to society to choose its topic of debate"*

> *"As there are currently many uncertainties regarding the actual potential of the monetisation of ecosystem services, there should first be a large social and political debate on the potential of this new frame"*

A diversity of arguments are mentioned specifically pleading for ***social and political valuation***:

1. A way to create support for the ecosystem services concept outside the scientific arena:

2. It's a shared responsibility of all stakeholders to sustain ecosystem services

3. It raises awareness about the impact of political choices (policy) on our ecosystem

> *"In the end it is all about quality of life"*

Science – society

Some respondents oppose social and political valuation, and rather see it to be a ***scientific responsibility***:

> *"Debating the economical value of ecosystems stands too far from reality"*

Other respondents ***limit social and political valuation to specific valuation issues*** such as: non monetary aspects, spatial planning and defining specific targets for specific areas.

> *"The social and political debate should be more on what to do with this value. Are we going to use this in the decision making process?"*

> *"It's a contested issue. E.g. tourism income can be opposite to flood management…"*

> *"they will only be interested in those ecosystem services that will be of interest for society, like cultural and productive services and some of the regulating services (floods). For other (regulating and supporting) services, like soil formation, will need more scientific debate."*

Quite some arguments are mentioned stressing the ***complementarity of scientific and socio-political valuation***:

> *"There is no "scientific" value (or this depends on what we call "science") but the social and political valuation should be based on scientific knowledge"*
>
> *"We need accurate data to refine value estimation and scientists should be involved in the analysis. But you cannot work in such intricate matters without working closely with stakeholders or scientists of very different disciplines."*
>
> *"If you exclude the social and political debate, you might overlook the emotional side of setting a price for ecosystem services."*
>
> *"The uncertainties (scientific and societal) attached to any valuation procedure make the debate inevitable."*

A huge majority (92%; Figure 10) agrees to the statement of *the value of ecosystem services not to be fixed because of the social context being a significant determinant*. This adds further food for thought to the previous discussion: the role of scientific knowledge and of social debate, the relation between science and policy and social debate, valuation being scientifically objective or an issue for debate and being subjective. We will get back to this when further discussing the *Responsibility of scientists*. In Box 3 argumentations are presented regarding the social context specificity.

Box 3

Argumentations about social context specificity

Some argue this to be ***only true for some aspects of ecosystem services***, e.g. cultural services or parks, or depending from other contextual elements, such as the availability and acceptability of technological alternatives to ecosystem services:

> *"from an agricultural point of view: do we make effort to attract natural predators and rely on them to control plague insects, or do we use pesticides nevertheless?"*

Others argue ***in general ecosystem services being specific to the social context***:

> *"Depends of time (in the history), space, generations, culture, context (social context, thematic context: "research question") and the moment"*
>
> *"Of course. Value is a human concept"*

> *"The value of ecosystem services is also subject to laws of supply and demand. Rare services will be estimated higher than abundant services. The social context can change and this can change the demand for a certain service."*

> *"Value, by definition, is shaped by our preferences, which in turn are shaped by a mix of 'individual sovereignty' and institutional context."*

> *"The monetary value is not fixed as this is significantly influenced by conditions (living standards, economic conditions, social context, ...). Also the non-monetary value is a significant determinant of the value, but some values which are not selected based on societal demands probably also have to be valued."*

Some **concrete examples of social context specificity** are given:

> *"We have historical examples: wetlands were formerly considered very negatively, now their value is usually considered as positive. See also the debate on large predators (wolves, bears)"*

> *"in some circumstances water conservation may be of higher urgency than e.g. clean air, in relation to a.o. demographic problems"*

One respondent argues for a **broader scope**:

> *"it should not be restricted to the value for humans only"*

A challenging issue seems *the contribution of biodiversity to ecosystem services*: quite some difference of opinion here amongst respondents. A majority (59%; Figure 13) disagrees the contribution to be context specific, whereas one third do think the contribution to be context specific. 10% of respondents indicate they do not know. The difference of opinion is reflected on the level of institutional and educational background; especially the divide amongst both policy representatives and scientists is striking (Figure 14). In Box 4 we present some of the argumentations.

Box 4

Argumentations about the contribution of biodiversity

The link indeed is challenging as we can read in the argumentations. Some stress the *biophysical relationship*:

> *"Biodiversity contributes to a robust ecosystem, thus is important to safeguard the services derived from them, independent of cultural, social, … context."*
>
> *"The contribution to services AND dis-services (bads) is independent of the human perspective. It is the human perspective which decides if it is useful or bad."*
>
> *"Link between biodiversity and ecosystem services is difficult to understand. More biodiversity does not necessarily lead to more ecosystem services."*

…some the *social context*:

> *"Contributions are evaluated in those contexts"*
>
> *"Since ecosystem services are contextual (e.g. different services matter in different contexts), also the contributions differ in a contextual way (e.g. the role of bacteria in sustaining the human body; role of species diversity for food provisioning, etc…)"*

…some *distinguish between different types of ecosystem services*:

> *"In case of e.g. regulating services, the contribution of biodiversity is independent of the cultural, social and economical context. For other ES (e.g. recreation) the cultural, social and economical context does play an important role. The economical valuation of these ES is always dependent of the context."*
>
> *"Rather true for provisioning and regulatory services, not for cultural services."*
>
> *"Some services are valuable for everybody (for example providing water and oxygen), others are culturally determined (for example providing game for hunting, or rhinoceros horn for medicine)"*
>
> *"the direct contribution to immediate well-being might be higher in societies living close to nature, as a whole, the underestimation of the importance of biodiversity in 'highly developed' societies is a serious flaw."*

The interface capacity of ecosystem services.

As the concept of ecosystem services has the ambition to link nature with benefits for society, we were interested to learn if respondents agreed to this interface capacity, and how they would typify it. We asked respondents about three types of interface characterizations of the concept of ecosystem services: systemic, interdisciplinary and transdisciplinary. The vast majority agrees to all three interface characterizations (respectively 83%, 92%, 90%; Figures 16, 19, 22). See Box 5, 6 and 7 for argumentations.

Box 5

Argumentations about the systemic interface capacity

> *"It is intrinsic in the expression "ecosystem service"."*
>
> *"e.g. interface agriculture vs pressure from fertiliser on soil and drinking water"*

The concept demands ***a new sort of scientist***:

> *"This implies a new sort of scientists who are not making research for research (publish or perish) or research for money but who are independent experts really at disposal of society to analyse interdependence and interrelations. We need specific scientists traducing science results for stakeholders"*

Quite some ***nuances*** are brought forward:

> *"I agree, but the value of nature in itself is also important"*
>
> *"'ESS is an interesting tool to value benefits of ecosystems, but not the only one and yet not proofed to be the concept par excellence…We think there are not enough research or expertise results to jump to this conclusion."*
>
> *"it best links economics to the natural systems, as "services" has a strong economic connotation. Unfortunately, so far, it does not do as well in bringing other social sciences and society aspects in the debate."*

…and ***the nature – society divide is criticized***:

> *"It is still a concept based on the human perspective: human social systems depend on natural systems. In fact, humans are part of the natural system."*
>
> *"It is possible that humans systematically underestimate the environmental services because it is a component of the "normal" context, and because he recognises no responsibility in the natural process"*

Box 6

Argumentations about the interdisciplinary interface capacity

Ideally it should, quite some argue, but:

> *"Rather: it should connect natural and social sciences, but are we this far?"*
>
> *" 'Connects' can have different meanings, for instance, it can be cooperation but fighting each other as well"*
>
> *"it is mainly a concept applied by ecologists (in the broad sense) and economic ecologists. Input from landscape ecology, political and sociological sciences is still lacking"*

A *division of complementary input* is proposed:

> *"Scientists can objectively describe ecosystem functioning and limits (including Humans as a specie within an ecosystem, with his toxicological and physical limits, even behavioural limits). Social scientists can study how Humans perceive them within specific contexts."*

…and *from the start*:

> *"and those disciplines have to work together from the start of "ecosystem services" research projects"*

Some highlight the *awareness raising capabilities* in this respect:

> *"The concept is a positive message leading to integration of knowledge and paying attention to multiple dimensions and policy objectives."*
>
> *"It is indeed a typical human perspective; it is nevertheless relevant to influence our decision-making."*

Box 7

Argumentations about the transdisciplinary interface capacity

Here again, ***ideally it should***, but:

> *"This must be the ideal situation. In this sense, policy sees the shortages and stimulates science to implement fundamental research into applied research."*

> *"Again, ESS has the potential (for example the people working on TEEB did a great job, providing different brochures for different audiences, including policy makers etc), however, so far, at least concerning Flanders, I do not have the impression that ESS is any more transdisciplinary than research on say, sustainable development."*

> *"the input of stakeholders should be increased."*

Some stress the ***distinctive nature of science and policy***:

> *"Policy makers can use the ecosystem services, but cannot determine them. They can influence the value of a service because they can change society, but the service on its own is not subject to politics."*

> *"Science is science, policy is policy. ES is a scientific concept to describe the interaction between man and his environment. As such it is a useful concept to base policy on. It can be used to influence policy and to push it towards a more sustainable outcome."*

> *"After or at the final stage of the scientific evaluation, policy makers remain in charge of making informed and transparent choices (for example regarding land settlement or agricultural methods)"*

The policy relevance of scientific knowledge on ecosystem services

As the focus in the BEES project has been mainly on scientific, methodological issues, and policy relevance was more or less taken for granted, we were interested to go more into depth on issues that might be relevant for the policy relevance capacity of ecosystem service science. We specifically focussed on the relation between scientists and policy makers in this respect: how intensely should they communicate and/or collaborate about the research, and at which stages of the process, as to promote science to be policy relevant? We posed three scenarios (Figures 25, 28, 31) for ensuring policy relevance of ecosystem services science: see Table 2.

Table 2	Agree	Disagree	Do not know
A. scientists discuss all research choices with policy representatives	54%	42%	4%
B. scientists and policy representatives collaborate as much as possible	85%	13%	2%
C. scientists and policy representatives only discuss the research topic before the research starts. After the research outcomes are produced the policy representatives have the responsibility to unilaterally decide upon the policy relevance.	33%	56%	11%

Clearly collaboration is considered most effective amongst respondents and least disputed. The difference of opinion is clearest amongst scientists and policy representatives regarding scenario A and C (Figures 26, 32). Box 8 presents main argumentations.

Box 8

Argumentations on policy relevant contact between scientists and policy makers

General arguments for *intense contact between scientists and policy makers*:

"Scientists sometimes have too little feel for political needs; timely feedback avoids unrealistic expectations, accents and decisions."

"You can't defend what you don't know!"

"To ensure that the scientific results are understood correctly, scientists should be involved in the translation to policy relevance"

"There is no interdisciplinarity and certainly no transdisciplinarity when there is only discussion at the start and/or at the end of projects."

"Researchers should aim to have the policy representatives onboard during the whole process and to create a "sense of ownership" with the research and the results. This will/can increase the mainstreaming of the research results in the policy making."

Regarding the policy relevance of intense contact between scientists and policy makers, some *success factors and stressors* are brought forward:

> *"Depending on how much the policy representatives are able to estimate what is policy relevant"*

> *"The question suggests a duty from scientists towards politicians, it should also be put in reverse order: policy representatives should question scientists about relevant ecosystem services"*

> *"Involving policy makers in an early stage helps to better orient research. On the other hand, policy makers are not interested in scientific choices but in end results. Where is this going and how can we use this?"*

> *"What scientists are producing should be of such a nature that it has at least the potential to be used by politicians. Research with regard to ecosystem services should be relevant for and to politicians, but should not be determined by politicians (they are changing to quickly) and it should be possible to use research on ecosystem services beyond the boundaries of a term of a politician. Policy makers should understand what scientists are bringing to them."*

> *"yes, but without hidden agendas and with a positive attitude."*

> *"Ok if there is a mutual respect of each other's work."*

> *" 'Collaborate' can mean different things of course. It also implies some complementarity, meaning that scientists and policy representatives each have their own role to play, and that tensions between their positions and perspectives are to be expected."*

> *" 'policy' is a house with many rooms, and what is relevant for one policy representative may be assessed as irrelevant by another one."*

> *"Interactions science-policy should take place during the whole study process but policy representatives should keep a role of advisors or stakeholders and should not take part to research itself."*

Not all phases and aspects of the research are equally fit for close interaction between scientists and policy makers:

> *"Research choice is the responsibility of the scientists. But policy representatives can give an input. "all" research choices is not needed – there's also the need to more basic scientific research."*

> *"at crucial decision making moments maximum collaboration is needed, e.g. when defining the research questions, and in between when choices have to be made affecting the research outcomes."*

> *"Not all research, even on ecosystem services is (immediately) relevant for policy"*

> *"scientists should involve policymakers. Ask for recommendations on knowledge gaps and adapt their research to those concerns. However, research methodology is the scientist's job."*

Regarding more intense contacts between scientists and policy makers some major concerns are raised on the **independency/neutrality of science from political influence**:

> *"Science can only be credible if its methodology is free of policy influence."*

> *"Scientists are already inevitably "politicians". The difficulty for a scientist is to remain "neutral". He should participate in the research question with politicians, but he needs to be for some times in his "ivory tour" in order to be able to make his job as a scientist. I think that it is necessary to have scientists (or say technocrats, experts) in the staff of politicians in order to be able to make the link, but that once the question research is given, that the scientist should have time to play his role as a "neutral" scientist."*

> *"Discussion is necessary, societal relevance too, but this is something different than policy relevance. A certain level of independence should be guaranteed."*

> *"would make the scientific research vulnerable to ideology"*

> *"Science should be independent and provide the different possibilities."*

> *"Scientists must be clear about the perspective and option they chose but it belongs to them to choose their research hypothesis."*

> *"Scientists should keep independence, but policy representatives can be part of steering boards for policy relevant research projects"*

> *"Scientific research should always have a degree of independency. Collaboration can set the focus on some matters, but should not steer the whole research, and definitely not the outcome of the research"*

> *"If the scientist is not able to inform correctly, or the decision makers are not able to receive the message (for example by lack of good technical staff or background or by failure of the political system or ideology not trusting the scientists), it is a pity, but if the research had the power to decide, they would not be scientists anymore but politicians. They would then not be credible and the politicians would not trust them."*

Some state policy relevant interaction between only scientists and policy makers to be too limited and advocate **broader interaction**:

> *"I believe the policy relevance should be determined by all the involved stakeholders (research, policymakers, ngo's, business, public, etc)"*

> *"I like the idea of steering groups etc. However this very often leads to influencing the research when inconvenient conclusions appear, or a substantial amount of effort in technical education (in se not bad). Policy relevance for them this is. Is this equal to societal relevance?"*

Responsibility of scientists

We focussed on several issues related to scientific responsibility that further add to the debate on the role of scientific knowledge and of social debate, the relation between science and policy and social debate, valuation being scientifically objective or an issue for debate and being subjective, as was already touched upon in the section on *Determining the value (monetary or non-monetary) of ecosystem services*. We posed several statements regarding the responsibilities of scientists different from or complementary or even potentially shared with policy makers, with respect to objectivity, independence and regarding the aspects of knowledge communication.

On the application of ecosystem services methods and approaches we asked about the responsibility of scientists and policy representatives: see Table 3.

Table 3	Agree	Disagree	Do not know
A. scientists have the responsibility to develop and pinpoint best practices ecosystem services tools, so that policy representatives know which tools they independently can use in which cases	86%	12%	2%
B. scientists and policy representatives have complementary expertise regarding ecosystem services and therefore have the responsibility to collaborate and negotiate about the use of ecosystem services approaches in specific policy contexts	77%	19%	4%

Regarding the choice between on the one hand a rather strict division of labour between science and policy (scenario A; Figure 34) and close collaboration (scenario B; Figure 37) on the other, respondents are inconclusive; the large majority clearly see benefits for both scenarios, and thus does not necessarily see them as excluding options. This inconclusiveness mirrors to some extent the inconclusive results in the section on *Determining the value (monetary or non-monetary) of ecosystem services*. Clearly food for further thought and debate, as we can also see in the argumentations in Box 9.

Box 9

Argumentations on the science – policy interface

Arguments *favouring best practices*:

"Highlighting these best practices remains the best way to raise awareness and extend their use."

"policy makers are flooded with tools and decision support systems that are partly finalised, half empty because the research project stops. Setting some boundaries and guidance there would be helpful"

"the role of scientists is to provide with policy relevant but non prescriptive tools"

Arguments *criticizing best practices*:

"Predictive ES-tools are only useful in well defined situations (specific scale, specific habitat,…) and often depend on a limited set of input variables to make it workable. In deviating conditions those tools could easily lead to wrong conclusions"

"There are no "tools" that work all the time in all conditions."

> *"It is always a bit tricky to develop tools for such complex matters. It is attempting, but at the same time there will be oversimplification"*

Arguments ***favouring independent policy use of methodological best practices***:

> *"Because the tool is independent and there is scientific proof that the tool works"*
>
> *"Research is one thing, policy making another."*

Arguments ***favouring close methodological collaboration***:

> *"Policy makers have always more feeling with real life. This is necessary to come to good estimates rather than too simplified desk top studies."*
>
> *"The science and policy worlds are interdependent regarding ecosystem services, we can't use one without the other"*
>
> *"Policy makers can not be experts on everything and sometimes subtle distinctions are lost in the debate which can lead to the wrong use of information"*
>
> *"Policy makers lack strong practical knowledge/experience"*
>
> *"But careful with the word 'independently', as they might need guidance on how to use the tools"*
>
> *"But this should not be limited to policy representatives"*

We further zoomed in on the responsibilities of scientists, on objectivity and independence, both in role and scientific content (Figures 40, 43): see Table 4.

Table 4	Agree	Disagree	Do not know
A. scientists have the responsibility to be objective and independent	96%	2%	2%
B. scientists have the responsibility to as much as possible focus on issues that can be objectified	57%	32%	11%

Clearly quite some respondents see a difference between a scientist being objective and focussing on issues that can be objectified. The latter issue especially is food for difference of opinion amongst scientists (Figure 44) and amongst respondents with hybrid educational background (Figure 45). Regarding the responsibility of scientists '*to be objective and independent'*, this mirrors part of the issues discussed in previous sections, about the division of labour between science and policy and the importance some attribute to the assurance of science being independent of 'outside' influence, e.g. from politicians. Regarding '*issues that can be objectified'* clearly a significant proportion of respondents has questions about the meaning of '*objectified'*. This also shows in the arguments: see Box 10.

Box 10

Argumentations on objectivity

Scientists should be objective and independent:

> *"Policy makers have to be able to lean on objective and independent science."*
>
> *"Is it not the definition of a professional scientist?"*
>
> *"If not, they would not be credible"*

Ideally scientists should be objective and independent, quite some argue, but:

> *"Even if it is an utopia. But this is his mandate."*
>
> *"Scientists are educated this way, and society expects them to be (in reality they not always are)."*
>
> *"As scientists we should aim for objectiveness (e.g. asking neutral questions, not steering our respondents in one direction), while nevertheless being aware that we will never fully reach that aim."*

Alternatives to objectivity and independence:

> *"this is impossible. When researchers try to be honest it is OK..."*
>
> *"They also must give full information, also on the level of probabilities and uncertainties"*

Critique on the ***advocacy character of ecosystem services scientists***:

"I have a feeling that the major group concerned with ecosystem services is situated in the green, left corner. Advocacy seems more important than accuracy and this should be prevented."

Critique to focus mainly on issues that can be objectified:

"There are a lot of other organisms around that have learned to live sustainably without numbers, facts and figures. In fact, most decisions we make are not rational, conscious and self-determined…"

"We often believe that something can be objectified, which is exactly the pitfall of the ESS paradigm. Monetary value is not objective, although from a western, neo-liberal point of view, it might appear to be so.. Hence, regarding ESS, we should exactly research the potential of this idea, while being aware of the fact that the research that we are doing is not value-free nor neutral. In the first place we should question the mere idea of 'monetising' processes."

"Aesthetics for instance is hard to objectify but is to me part of the ES."

"this also will lead to oversimplification. I had a professor who formulated it in this way: how objective you can be about dying?"

"I don't agree, but I can't think of any example to proof it."

"Interesting philosophical question."

Importance of including subjective issues:

"To clarify: In my opinion, qualitative statements or descriptions of processes can be objectified. Describing and being aware of the inherent subjectivity of a certain process seems to me like objectification of that process."

"There will always be issues that are hard to objectify, but to be complete (for eg. in valuating ecosystem services) those issues should also be part of research. If they cant' be objectified there should be a method to deal with them and it could be pointed out that it concerns a subjective (policy) choice."

> *"But what is objective and for whom. Certain social or cultural issues cannot be easily measured in parameters. A scientific reasoning is necessary in those cases, but it will*

Alternatives to a focus mainly on issues that can be objectified:

> *"That's a tricky one – yes and no. Depends on what you see as objectified. I think scientists also have the responsibility to point at societal challenges, even if the way to measure these is not yet well developed."*

> *"Research can be done on topics which at first sight may seem hardly "objectivable" but which can become "objectivable" thanks to the multiplication of studies."*

> *"Scientist can always add information, a scientific basis to the debate, even if information is limited. Stating that things are unknown or not well known is also of added value."*

Questions on the **concept of objectification**:

> *"Depends what you mean with objectified. The scientific approach needs to be objective but the issues themselves can be very subjective e.g. noise, beauty of scenery etc."*

> *"Not sure what 'objectify' mean. I guess research can help to try and disentangle complex issues, and highlight where choices and trade-offs are, without necessarily prescribing which choices would have which consequences, and which uncertainties there are."*

Regarding knowledge communication we also presented several scenarios (Figures 46, 49, 52):

Table 5	*Agree*	*Disagree*	*Do not know*
A. scientists have the responsibility to produce simple knowledge outcomes and not bother policy representatives with complex scientific issues	46%	54%	0%
B. scientists have the responsibility to black box the production process of their knowledge and not communicate about the methods used and the choices made during knowledge production	6%	92%	2%
C. scientists have the responsibility to be transparent on all important research choices they make in the knowledge production process	100%	0%	0%

Clearly transparency is considered most important and black boxing is disliked. Still, in communicating to policy makers, quite some difference of opinion is apparent on how this should be done: to what extend should scientists simplify and not bother policy makers with scientific nuances? Respondents with a hybrid educational background (68%; Figure 48) and scientists (68%; Figure 47) disagree most with such simplification.

These results add information to earlier results on policy relevant contact between scientists and policy makers (Table 2 and Box 8), and perhaps touch upon a difference between one way communication and two way communication, the latter belonging more to a collaborative or negotiation style of science policy interaction/interface. For further food for thought, see argumentations in Box 11.

Box 11

Argumentations on knowledge communication

Arguments *in favour of simplification*:

> *"The mandate of scientists is to be able to simplify and communicate the complex reality. Even if making information out of data is always subjective and that it is impossible to remain "pure" scientist doing this. Doing this, the scientist risks his credibility as a scientist, but not communicating, he is not seen useful and will probably not get funding. Scientific activity is like ecosystem services: they must run independently, and the decision makers take what they want. They delete the ecosystem processes and scientists they do not want. Even by error. So, the scientists are obliged to communicate, even if doing so, they are less scientific. The alternative is a minimum buffer of fundamental science, but this is not the direction taken by recent scientific policy. For example, in the UK, scientists are evaluated and can easily be fired. Therefore, I think there can be no pure scientist anymore in the UK."*

> *"This should be done, either by the scientist who produce the scientific results or by scientific experts who translate their outcomes"*

> *"Policy representatives are interested in how to implement the scientific knowledge."*

> *"Rather agree, in the sense that scientists shouldn't be afraid to try and reduce complexity."*

Arguments *conditionally in favour of simplification*:

> *"Yes, we need to simplify but we need to be ready to explain in more details if necessary. No black box or scientists giving the verity."*

> *"Unless there is a clear demand"*

> *"Simplification to a certain extent, but this should not lead to bad decisions"*

> *"Both simple and complex, eg scientific report and an executive summary (in order to enable policy makers to communicate with stakeholders)"*

Arguments *against simplification*:

> *"Scientists should ideally be able to explain complex issues and avoid simplifying knowledge outcomes."*

> *"Things can be complex and also non-scientists should understand them to a certain point to make the right decisions and anticipate on their effects."*

> *"The statement implies that *all* knowledge outcomes can be simple. This is, in other words, a "simple" statement."*

> *"Whether policy makers like it or not, reality is complex, and it is their job to try to explain this to their voters."*

> *"policy representatives (and the public) have to know that there are no simple solutions. This statement of the survey leads to popularism. We all have to make an effort to understand*

> *"No, nothing should be hidden. The trick is to present complex issues in a simple way (although some details may be irrelevant for policy makers but it is hard to say which one). It is important that policy makers and scientists trust each other so that should be the ultimate aim of science-policy communication and both parties should do what it takes to build that trust."*

Arguments ***conditionally against simplification***:

> *"But scientists are often forced to translate outcomes into simplified figures or bullet points Policy makers also have to do an effort. Simplification of a complex issue, can make it worse because not all the aspects are put clear. This doesn't mean that scientist don't have to do an effort on explaining something complex in an understandable way."*

> *"Scientists should present the outcomes in a way policy representatives understand the headlines of the outcomes. However, the "results for dummies" shouldn't be oversimplified and shouldn't cover the complexity and the uncertainty connected with the results."*

> *"Depends on the subject"*

> *"It depends on the case, if it is complicated, it needs to be a rather complex outcome"*

> *"We need an 'and' – 'and' strategy instead of an 'or' 'or' strategy."*

> *Scientists must produce two kinds of results: they must expose the results in details and summarize them as reliably as possible mentioning the limits if shortcuts have been taken during this summarizing step. This step could also be done by intermediaries who must be careful not to hide the major issues scientifically highlighted in the study."*

> *"Scientists should try to reframe complex problems that way the government is able to understand them. Government needs to invest in increasing the expertise of its staff too to improve understanding of research methods and results."*

Arguments ***conditionally in favour of black boxing***:

> *"But the methods are important so they should be at disposal"*

> *"Methodology has to be verifiable- so minimum on information is needed on the process as well"*

Arguments *against black boxing*:

> *"It would be selfish to do so and it makes it more difficult for outsiders to understand the outcomes and the consequences of their decisions based on it. And in some cases, for newly developed methods that took great effort or talent, patents can be obtained."*

> *"A crucial element of the scientific method is reproducibility; "black boxing" a science production process is a negation of science"*

> *"Regarding the collaboration science-policy, transparency is important."*

Arguments *conditionally against black boxing*:

> *"But they should be aware that policy representatives have usually little interest in methodological details"*

> *"I do not agree with this statement, but must admit that unpacking the black box sometimes confuses the interaction with the government very much."*

> *"Rather disagree, in the sense that they shouldn't try and hide the methods used. At the same time, they should also be able to convey their message without drowning it in lengthy elaborations about all the things they don't know yet ("we need more research") or about the methods they have used."*

> *"Transparency is crucial! But the scientific debates about methodological issues often confuse the policy makers and public because it paralyses adequate action. We need a more adaptive approach of learning by doing and doing by learning that allows fast adjustments to prevent negative outcomes. We also need a new attitude of scientists and scientific fora that will allow such a shift."*

Arguments *in favour of transparency*:

"That is in accordance with the principle of control and repetition of research"

"But this is in the annexe of the communication process. They still are obliged to keep simple messages "en cascade". Only the hypotheses that are of high impact on the results should be displayed on the top of the communication. Unfortunately, many communications do not follow this elementary rule. For example, monetary value of ecosystem services has a very strong and determinant hypothesis (illogism) that it is possible to give a price (different to zero) to a service whose price is zero. The hypotheses of neoclassical theory (substitutability, objectivity of the market prices etc) are never recalled when concluding the results of a multiregional equilibrium model."

"It's important to know statistical errors, variability of results, the assumptions used, etc."

"Yes, as research choices are never fully objective (this does not mean that they cannot be motivated)."

"Results can be influenced strongly by research choices made. Very important to mention."

"Transparency = trust, clarity"

Responsibility of social scientists

As social scientists are still underrepresented in ecosystem science and are still relative newcomers in the field of ecosystem services, we were interested to learn which kind of expertise is expected from them, by themselves, other disciplines and other actors such as policy makers (Figures 55, 58, 61, 64).

Table 6	Agree	Disagree	Do not know
A. social scientists only have the responsibility to measure and quantify the social preferences of stakeholders or the general public	22%	65%	13%
B. social scientists have the responsibility to develop processes in which ecosystem services issues of social relevance can be deliberated on in well informed discussions amongst stakeholders	73%	8%	19%
C. social scientists have the responsibility to develop knowledge assessment procedures in which the policy relevance of scientific knowledge is discussed	56%	23%	21%
D. social scientists have the responsibility to develop decision making procedures for translating science into policy options	64%	17%	19%

Clearly the 'do not know' percentages are highest in this section compared to other sections of the survey; amongst whom even social scientists (Figure 56, 60 and 63). This is probably due to the fact that a social science background and social science in general are still underrepresented in the emerging field of ecosystem services, as in fields related to nature, biodiversity and ecosystems in general, as well as amongst the respondents of this survey. Thus probably quite some respondents do not have substantive concrete experience with social science or social scientists. Also quite some respondents are probably unaware of the specific potential contributions of social scientists as proposed in this section. Still, most respondents are knowledgeable enough to assess the statements or at least have some idea of the potential of these statements for social science.

Limiting social science to measuring social preferences only clearly is not well appreciated by most respondents (65%; Figure 55). Especially deliberative processes are considered to belong within the realm of social science (73%; Figure 58). Also contributions regarding procedures for knowledge assessment (56%; Figure 61) and policy translation (64%; Figure 64) are considered a good opportunity for social scientific involvement. We go further into the depth of this in the argumentation section: Box 12, 13, 14 and 15.

Box 12

Argumentations on the role of social science in measuring social preferences

Quite some argumentations point at *a broader focus/role for social science than merely measuring social preferences*:

> *"It's their core business but not their only responsibility."*
>
> *"Other issues for social scientists: decision making process by policy rep's, society acceptance process,…"*
>
> *"Social scientists have to analyze the discourses underlying natural scientists' views too!"*
>
> *"They should also take into consideration future generations and parties that are left out…"*
>
> *"we understand 'social scientist' as an expert in participatory processes (not the degree in social science). Not only measuring, their role can be much wider"*
>
> *"They can also give solutions, tools, etc."*

Some respondents argue that *other experts can also measure social preferences*:

> *"Also other scientists can take this responsibility, but have to do this in the most relevant and scientific way."*

> *"Well-informed natural scientists can also be involved in measuring and quantifying these preferences, but they should be aware of their own limitations, mainly when qualitative research techniques are applied. Preferably, measuring preferences of stakeholders/general public is done by a interdisciplinary research team."*

…others argue to *leave it to the social scientific experts*:

> *"I have seen too many high qualified doctors who were convinced they could work out sociological issues, but in reality made great stupidities... Please, do work together!"*

…or plead for *overcoming disciplinary boundaries*:

> *"I no longer believe in this strict categorisation of scientists"*

> *"Next to specialists, we need generalists who can marry disciplines, viewpoints etc. So we certainly need researchers that cross the boundaries of their discipline"*

Box 13

Argumentations on the role of social science regarding stakeholder deliberation

Arguments in favour of *a role for social science regarding stakeholder deliberation*:

> *"Sure, they should lead this important process"*
>
> *"Depends on the government. If I was the government: yes."*

Arguments in favour of *other experts also having a role regarding stakeholder deliberation*:

> *"They are not the only ones to share this responsibility. I would think that this is a responsibility of the policy makers (and their social experts). Social scientists could help to show which political system is performing or not in managing environmental problems."*
>
> *"They develop the tools, not to use them. That's policy."*
>
> *"Always in cooperation with other relevant scientists"*

Arguments against *a role for social science regarding stakeholder deliberation*:

> *"Existing processes such as governance approaches can do the job."*
>
> *"Am not sure here…for me this is part of the policy process, not of the science process. But am willing to concede given arguments."*

Arguments *in favour of stakeholder involvement*:

> *"of course; every citizen is a stakeholder! and don't forget to educate (also in the heart, not only in the head) our children in this! Connect children to nature/earth!"*
>
> *"ESS is about human wellbeing, so stakeholders need to be informed."*

Box 14

Argumentations on the role of social science policy relevant knowledge assessment

Similar arguments as in Box 13 in favour of *other experts also having a role.*

Arguments against *a role for social science regarding policy relevant knowledge assessment*:

> *"I think it is very difficult to assess policy relevance in a scientific way, as the time horizon of elections is often very different from the time horizon of societal and environmental issues."*
>
> *"Policy relevance is best judged by the policy makers and relevant stakeholders."*
>
> *"Social scientists may be interested in doing this activity, but I very much doubt whether the activity is policy relevant (in the meaning of: requested by policy representatives)"*

Critique to calling it a procedure:

> *"More negotiation than a procedure"*

Critique to only aiming at policy relevance:

> *"I don't like policy relevance. Societal relevance is more important to me. Also, many many things that were very 'policy relevant' have emerged from completely 'policy irrelevant' research."*
>
> *"The policy relevance of research should be discussed but there has to remain some room for non-policy relevant research as well. However, these procedures could be developed, and indeed by social scientists."*

Box 15

Argumentations on the role of social science regarding decision making procedures

Arguments in favour of *a role for social science regarding decision making procedures*:

> *"I hope that this will happen one day. It would be a chance to get policy options more society relevant."*

> *"translation of science into policy; more is done to transfer knowledge in social sciences to the government to enable it to make better decisions. Yet, this is not just a matter of writing an extra paragraph at the end of a scientific article; this is a careful process that takes time and for which more resources should be made available. Doing so should become more rewarding to in terms of career perspectives etc"*

> *"Translation will be necessary since the complexity of ESS"*

> *"It is not enough to state the value of this or that ES. "Natural" scientists have to collaborate with "social" scientists in order to translate their findings in a language that policy representatives. will understand and embrace."*

Arguments in favour of *other experts also having a role regarding decision making procedures*:

> *"Social scientists should do this in close collaboration with the scientists who actually performed the research. Anyway, policy makers should be aware that decision making tools are not infallible."*

> *"This is not only the role of the social scientists, but also a role of any scientist (unless the "pure core fundamental" scientists if they still exist)."*

Arguments against *a role for social science regarding decision making procedures*:

> *"Have they ever done that before? It is the responsibility of policy makers to develop procedures."*

Critique to calling it a procedure:

> *"More negotiation than a procedure"*

Handbook on ecosystem services tools and approaches

To what extent are handbooks on ecosystem services tools and approaches useful for non-scientific actors such as policy makers. Can handbooks be used independently? A limitation might be that they are always in need of specific methodological/scientific expertise to be involved in valuing, assessing, interpreting ecosystem services. Another limitation may be that ecosystem services are context specific. Still 68% (Figure 67) accords the usefulness of a handbook on ecosystem services tools and approaches, and does not see it problematic due to either the importance of *context specifics* or the need for *methodological expertise*. Especially scientists (Figure 68) seem to have confidence in the usefulness of a handbook; social scientists in particular (Figure 69). Another problem for the usefulness of handbooks may be that the use of methods can be considered to be part of negotiation amongst the actors involved. Still 73% (Figure 70) agrees to the usefulness of a handbook, despite the potential importance of *negotiation* amongst the actors involved. Here we also see this especially amongst scientists (Figure 71); again, social scientists in particular (Figure 72).

These results add information to earlier results on the best practices discussion (Table 3; Box 9). More food for thought in the argumentation section: Box 16.

Box 16

Argumentations on handbooks

Arguments *in favour of handbooks*:

"Ecosystem service tools have sufficient generality to be worked out in such handbook; context specifics is one item in such handbook "

"See TEEB handbook, very useful. Or Study European Commission on valuation of Ecosystem services for Natura 2000 areas."

"A handbook can be useful even if context specific approaches are usually needed; the handbook should help find good ideas and ask relevant questions; of course it should emphasize the need for adapting the approaches to specific contexts."

"This will avoid to always begin again very similar research and will give a large panorama of how it is possible to apply general principles."

"We live in a complex world and this the only way context specifics can be taken into account."

"The problem is not the tool or approach, though the attitude or intention of the actors in the discussion.

> *"A handbook can inspire the negotiation"*

Arguments **conditionally in favour of handbooks**:

> *"The choice of tools and approaches could best be indicated by methodological expertise, which can –to a certain extent- be translated in a handbook"*
>
> *"we need both: generic approaches and case studies described in a handbook and local methodological expertise"*
>
> *"If the tools take context specifics into account, it can be very useful."*

> *"Contexts are specific but you have to start from something"*
>
> *"Though it is true that ES are highly context specific, such a handbook may be useful to at least guide the scientist in the right path, perhaps by trying to qualify the different possible contexts and use this to guide the scientists"*

Different views on the importance of context specificity regarding handbooks:

> *"A handbook on tools giving good information on when and how to use which tool is very useful and must not depend on negotiation amongst actors but on the context of the case."*
>
> *"I do not think that evaluation tools should be defined by the relative weight / influence of the diverse local actors. It is inconsistent with the idea of the independence of the ecosystem services evaluations."*

Arguments **against handbooks**:

> *"I doubt that policy representatives can independently use such tools."*

Alternative options to traditional hand books:

> *"Dynamic handbook maybe?"*
>
> *"(Digital) handbooks however will be needed. They have to be time framed (like environmental policy plans for example 2013-2018)"*

Knowledge ability about science or policy

When communicating and/or collaborating, to what extent should policy makers be knowledgeable about ecosystem services science, and the other way around, to what extent should scientists be knowledgeable about policy making relevant to ecosystem services? We presented several scenarios regarding the need for scientists and policy makers to be knowledgeable about each other's ecosystem services related knowledge and practice, as to enhance mutual understanding and policy relevance of scientific knowledge (Figures 73, 76, 79).

Table 7	Agree	Disagree	Do not know
A. policy representatives have the responsibility to be knowledgeable on the scientific ecosystem services debate and developments in order to be qualified to discuss with scientists the policy relevance of the ecosystem services knowledge to be produced	76%	20%	4%
B. scientists have the responsibility to be knowledgeable on ecosystem services -relevant policies, developments and policy potential in order to be qualified to discuss with policy representatives the policy relevance of the ecosystem services knowledge to be produced	84%	10%	6%
C. scientists and policy representatives not necessarily need to be knowledgeable about each other's ecosystem services related expertise and practices, but have to work together and try to understand each other on issues that are policy relevant	73%	21%	6%

The results present no clear preference for either scenario; all three scenarios are appreciated by large majorities of respondents. Clearly mutual understanding is considered to be important by most respondents, and collaboration appears to be appreciated as a being supportive to this ideal. For argumentations on knowledge ability: see Box 17, 18 and 19.

Box 17

Argumentations on knowledge ability of policy representatives about science

Arguments *in favour of the need for knowledge ability of policy representatives about science*:

> *"Understanding each other's practices and having 'feeling' with each other's expertise is necessary to be able to discuss and work together."*

> *"this is not only true about the ecosystem debate; politicians go to easily for quick wins on popularity in what they think are easy matters..."*

> *"Agree in the sense that policy representatives that are totally uninformed, seem less likely to take informed decisions."*

Arguments ***conditionally in favour of the need for knowledge ability of policy representatives about science***:

> *"Policy representatives must be knowledgeable to discuss the scientific (and also policy) relevance of the produced knowledge. To discuss the policy relevance for society, no specific knowledge of the ecosystem services is necessary if the conclusions of the knowledge are without scientific discussions."*
>
> *"I agree although they cannot be expert in everything; we should accept that some policy representatives take this responsibility and communicate with their colleagues"*
>
> *"You need a common language if you want to discuss effectively."*
>
> *"Depending on whether an actual debate exists"*

Arguments ***against the need for knowledge ability of policy representatives about science***:

> *"Politics uses a different rationale then science. There is also a distinction between the different types of people here referred to. Cabinet staff need different information than experts in institutions."*
>
> *"The scientists have to inform the policy representatives on the context of the knowledge to be produced and the scientific background involved."*
>
> *"Most policy makers do not need to know about the biogeochemical transformations in silica fractions or ecological functioning of the planktonic food web to make a decision for river restoration. Trust is essential. Therefore, communication of uncertainties and transparency is essential."*

Box 18

Argumentations on knowledge ability of scientists about policy

Arguments *in favour of the need for knowledge ability of scientists about policy*:

> *"It's easier for scientists to bridge the difference between science and policy. Representatives are often laymen, and it's important scientists therefore try to"*

> *"Scientists have to know the frameworks their "clients" are operating in, to maximise the chances on policy implementation of their results."*

> *"Potential end use is too much neglected. The goal is too much focused on papers, but who reads papers? Policy makers do not."*

Arguments *conditionally in favour of the need for knowledge ability of scientists about policy*:

> *"Agree, although I think that some scientists would have to read this question a couple times to understand it. I had to, at least."*

> *"If they are, it helps. If they are not, they need clear questions to answer. If there are no clear questions, these have to be formulated. Formulating the right questions is half the policy choice"*

> *"Some scientists do, but not all of them. It is impossible for one scientist to know it all… but there is a key need for what I call "bridgers" scientists i.e. open-minded scientists who know and are willing to know a bit about everything (from the natural science base of ES to the policy/society side of ES, including the social science side of ES) and who can make sure everyone understand each other."*

> *"The research of the scientist should be independent and not restricted by the policy potential, but knowledge on recent developments could help to indicate some relevant scenario's or management schemes."*

> *"Scientists should be conscientious about what is political acceptable and avoid frustration about compromises..."*

Arguments **against the need for knowledge ability of scientists about policy**:

> *"It is sufficient if scientists deliver the framework (methodology) for the policy debate."*

> *"They should mainly be able to communicate with the experts, teachers and other scientific journalists."*

Box 19

Argumentations on the need for collaboration

Arguments **in favour of the need for collaboration**:

> *"This "work together" of course is the platform to become knowledgeable about each other's expertise"*

Arguments **conditionally in favour of the need for collaboration**:

> *"working together is important, but knowing each other (and each other's expertise and practices) is a basic condition for working together in a productive way"*

Appendix A: Questionnaire

Introduction

For the project **BElgium Ecosystem Services** (http://www.biodiversity.be/bees) we are currently investigating the challenging topic of *'policy relevance of ecosystem services science'*. We developed a small survey in order to find out what the views of a diversity of actors (scientists, policy representatives and others) are on this topic. We look forward to your view on this!

We present you some challenging statements; you can score on a scale from *'Strongly disagree'* to *'Strongly agree'*. Please also use the space for arguments if you want to add comments. The results will be synthesized anonymously in a report of which you will receive a copy in due course.

Please fill out the survey and send it in the latest at **October 7th 2011** to hans.keune@inbo.be.

This survey will take about one hour.

If you know of colleagues in Belgium who might also be interested in joining this survey,

do not hesitate to send it to them.

Hans Keune (INBO; Belgian Biodiversity Platform) & Tom Bauler (ULB)

We thank you very much for your contribution!

For analytical reasons we first ask you some information about your professional background; this information will be treated confidentially.

Was is your educational background (training)?	
What is your professional background (work)?	
What is your main expertise in your current profession?	
How does the concept of ecosystem services relate to your work?	

-- Next page --

The value (monetary or non-monetary) of ecosystem services **Determining the value** *(monetary or non-monetary)* **of ecosystem services is a scientific responsibility.**						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

Determining the value *(monetary or non-monetary)* **of ecosystem services is a topic for social and political debate.**						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

The value *(monetary or non-monetary)* **of ecosystem services is** <u>not</u> **fixed, but instead the social context is a significant determinant of the value** *(monetary or non-monetary)* **of ecosystem services.**						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

The contribution of biodiversity to ecosystem services is <u>not</u> **specific to the cultural, social, economic or geographical context in which they are enjoyed.**						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

-- Next page --

The interface capacity of ecosystem services.

"Ecosystem services" is a systemic interface concept par excellence:

it connects the natural and social systems.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:

"Ecosystem services" is an interdisciplinary *(collaboration between different scientific disciplines)* **interface concept par excellence: it connects natural and social sciences.**

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:

"Ecosystem services" is a transdisciplinary *(collaboration between scientists and non-scientists e.g. policy makers)* **interface concept par excellence: it connects science & policy** *(or more in general science & society)***.**

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:

-- Next page --

The policy relevance of scientific knowledge on ecosystem services

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists should discuss all research choices with policy representatives*.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to collaborate as much as possible.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to only discuss the research topic before the start of the research. After the research outcomes are produced the policy representatives have the responsibility to unilaterally decide upon the policy relevance.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

* You can think of the following types of policy representatives: 1. Politically appointed members of staff working directly for policy decision makers like Ministers (e.g. cabinet staff). 2. Civil servants working for the administrations of policy making institutions like ministries or agencies with policy responsibility. 3. Experts from governmental expert institutions like monitoring agencies.

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Scientists have the responsibility to develop and pinpoint best practices ecosystem services tools, so that policy representatives know which tools they independently can use in which cases.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*

Argumentation:

Scientists and policy representatives have complementary expertise regarding ecosystem services and therefore have the responsibility to collaborate and negotiate about the use of ecosystem services approaches in specific policy contexts.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*

Argumentation:

Scientists have the responsibility to be objective and independent.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*

Argumentation:

Scientists have the responsibility to as much as possible focus on issues that can be objectified.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*

Argumentation:

-- Next page --

Scientists have the responsibility to produce simple knowledge outcomes and not bother policy representatives with complex scientific issues.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:

Scientists have the responsibility to black box the production process of their knowledge and not communicate about the methods used and the choices made during knowledge production.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:

Scientists have the responsibility to be transparent on all important research choices they make in the knowledge production process.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:

-- Next page --

Responsibility of <u>social</u> scientists

Social scientists only have the responsibility to measure and quantify the social preferences of stakeholders or the general public.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

Social scientists have the responsibility to develop processes in which ecosystem services issues of social relevance can be deliberated on in well informed discussions amongst stakeholders.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

Social scientists have the responsibility to develop knowledge assessment procedures in which the policy relevance of scientific knowledge is discussed.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

Social scientists have the responsibility to develop decision making procedures for translating science into policy options.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

A handbook on ecosystem services tools and approaches is of limited value as context specifics will always be in demand of thorough methodological expertise.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

A handbook on ecosystem services tools and approaches is of limited value as choices of tools and approaches are dependent of negotiation amongst actors responsible for the organization of ecosystem services assessments.						
What is your view on this statement? (*Please mark one answer category and give arguments.*)						
Strongly disagree	*Disagree*	*Rather disagree*	*Rather agree*	*Agree*	*Strongly agree*	*Do not know*
Argumentation:						

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Policy representatives* have the responsibility to be knowledgeable on the scientific ecosystem services debate and developments in order to be qualified to discuss with scientists the policy relevance of the ecosystem services knowledge to be produced.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:	

Scientists have the responsibility to be knowledgeable on ecosystem services-relevant policies, developments and policy potential in order to be qualified to discuss with policy representatives the policy relevance of the ecosystem services knowledge to be produced.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:	

Scientists and policy representatives not necessarily need to be knowledgeable about each other's ecosystem services related expertise and practices, but have to work together and try to understand each other on issues that are policy relevant.

What is your view on this statement? (*Please mark one answer category and give arguments.*)

Strongly disagree	Disagree	Rather disagree	Rather agree	Agree	Strongly agree	Do not know

Argumentation:	

* You can think of the following types of policy representatives: 1. Politically appointed members of staff working directly for policy decision makers like Ministers (e.g. cabinet staff). 2. Civil servants working for the administrations of policy making institutions like ministries or agencies with policy responsibility. 3. Experts from governmental expert institutions like monitoring agencies.

Thank you !!

Appendix B: Respondents

Name	*Organization*
Belpaeme K	Kustbeheer
Broekx S	VITO
Ceuterick M	INBO
Comhaire I	Mobiliteit en openbare werken - haven en waterbeleid - Vlaamse overheid
Cuypers B	PURATOS
Danckaert S	Landbouw Visserij Vlaamse Overheid
De Bie T	KUL
De Vreese R	VUB
Decleer K	INBO
DeCraene K	Port of Anwerp
Dendoncker N	FUNDP
Depraetere D	INAGRO
Desmedt K	LNE
Devrieze M	LNE
Dufrene M	SPW
Fautsch M	Cabinet Nollet
Flandroy L	FPS Health, Food Chain Safety and Environment
Fontaine C	FUNDP
Gora L	Provinciaal Natuurcentrum COMOLA
Gorissen L	VITO
Gulinck H	KUL
Heyrman H	VLM
Huge J	UGENT
Jacobs S	UA
Janssens L	Provincie Antwerpen
Kestemont B	FPS Economy

Laethem R	VMM
Lambrecht J	UGENT
Lambrecht S	Arcadis
Ledant J	Consultant
Liekens I	VITO
Mahy G	ULG
Panis J	ANB
Schroé P	MBZ
Segers H	RBINS
Simoens I	INBO
Smolders C	HoGent
Stel J	ICIS
Turkelboom F	INBO
Van Den Broeke E	LNE
Van Der Werf A	BELSPO
Van Duyse E	Port of Anwerp
Vanempten E	KUL
Van Gils B	ILVO
Van Herzele A	INBO
Van Heuckelom M	BELSPO
Van Passel S	UHasselt
Van Reeth W	INBO
Vandenabeele V	Hubertusvereniging
Vandermeulen V	UGENT
Witters N	UHasselt
Wouters F	KATHO
Wouters K	RLNH
Wustenberghs H	ILVO

Appendix C: Figures results

Figure 1 Geographical orientation of respondents
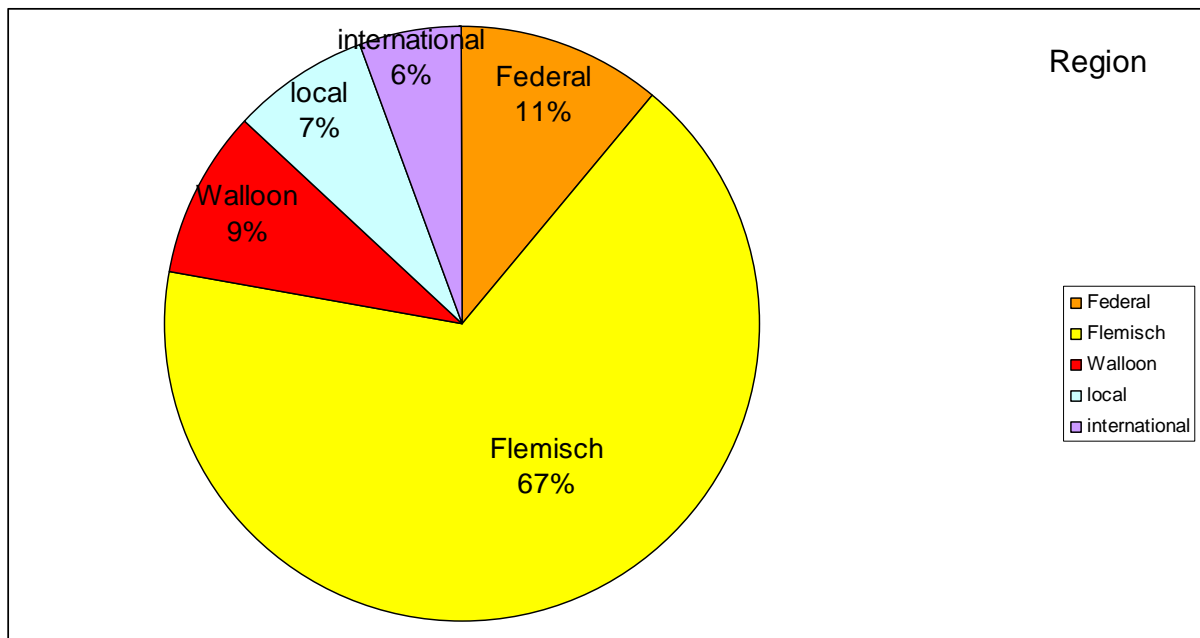
Figure 2 Educational background
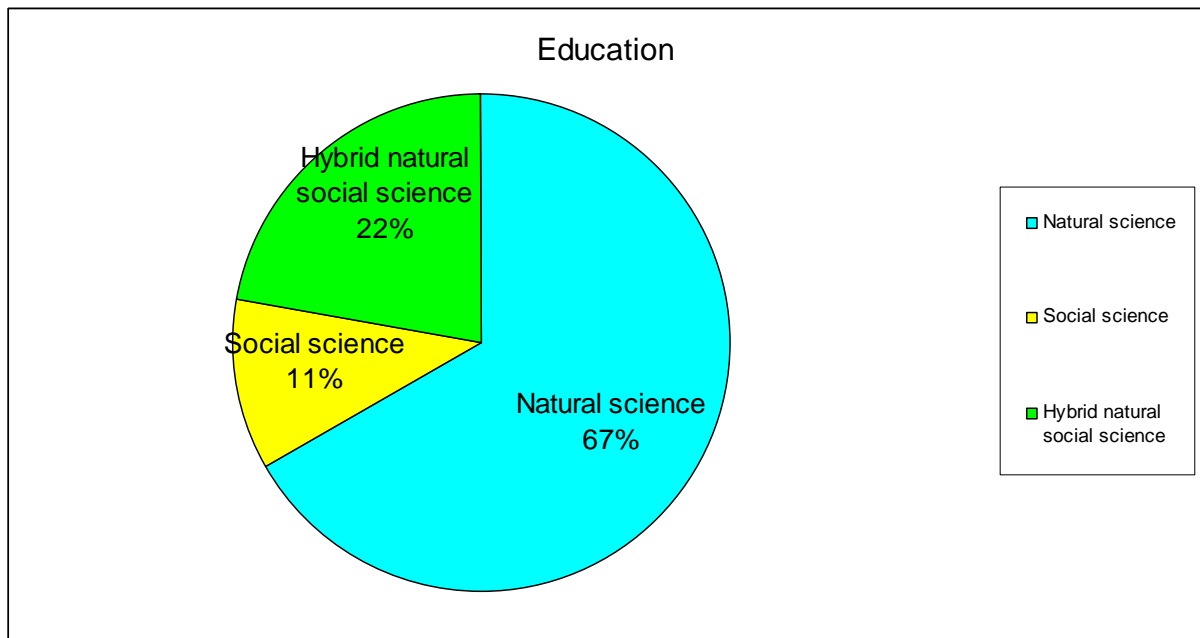
Figure 3 Institutional background respondents
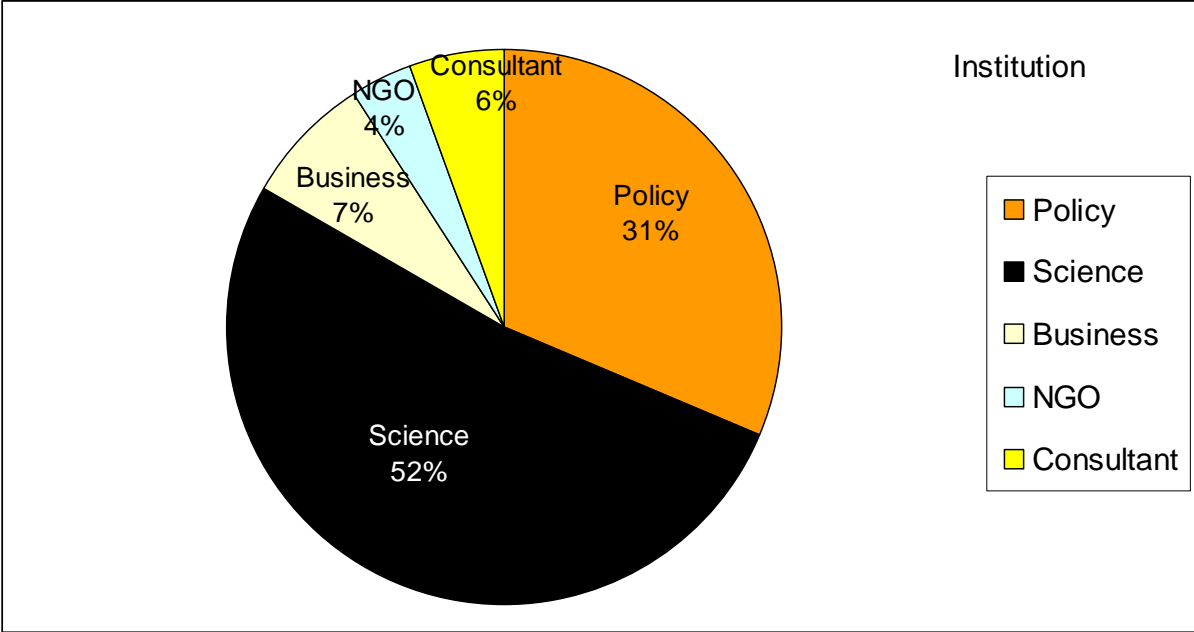
Figure 4 Valuing ecosystem services is a scientific responsibility?

What do you think about the policy relevance of ecosystem service science? www.inbo.be
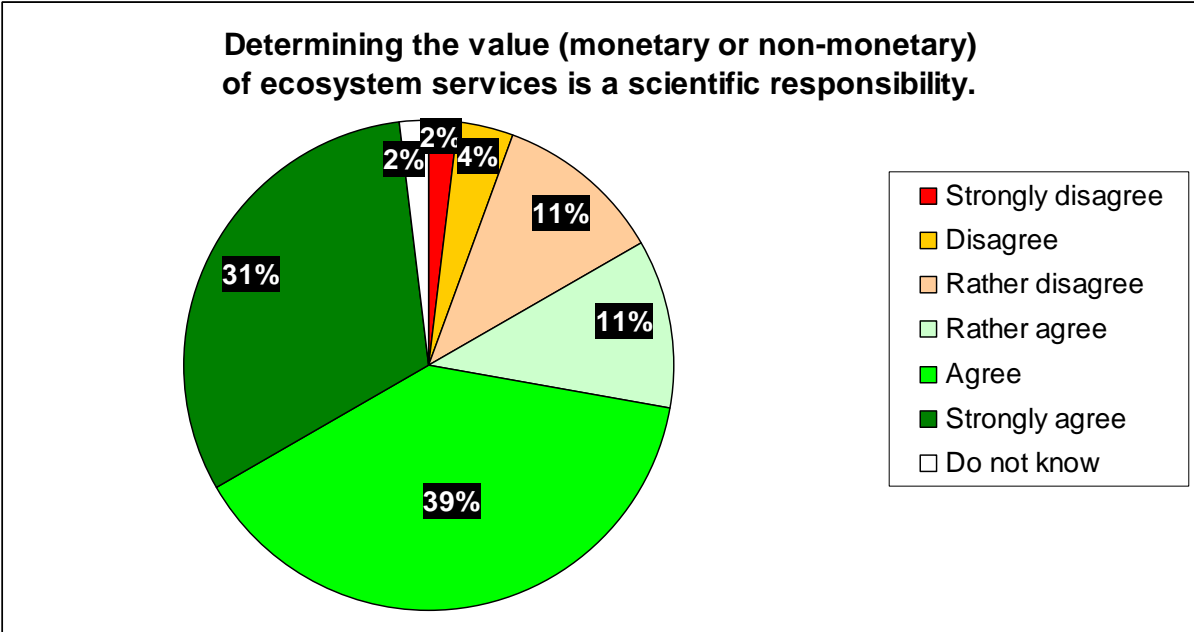
Figure 5 Valuing ecosystem services is a scientific responsibility? – Institutional background

Determining the value (monetary or non-monetary) of ecosystem services is a scientific responsibility.
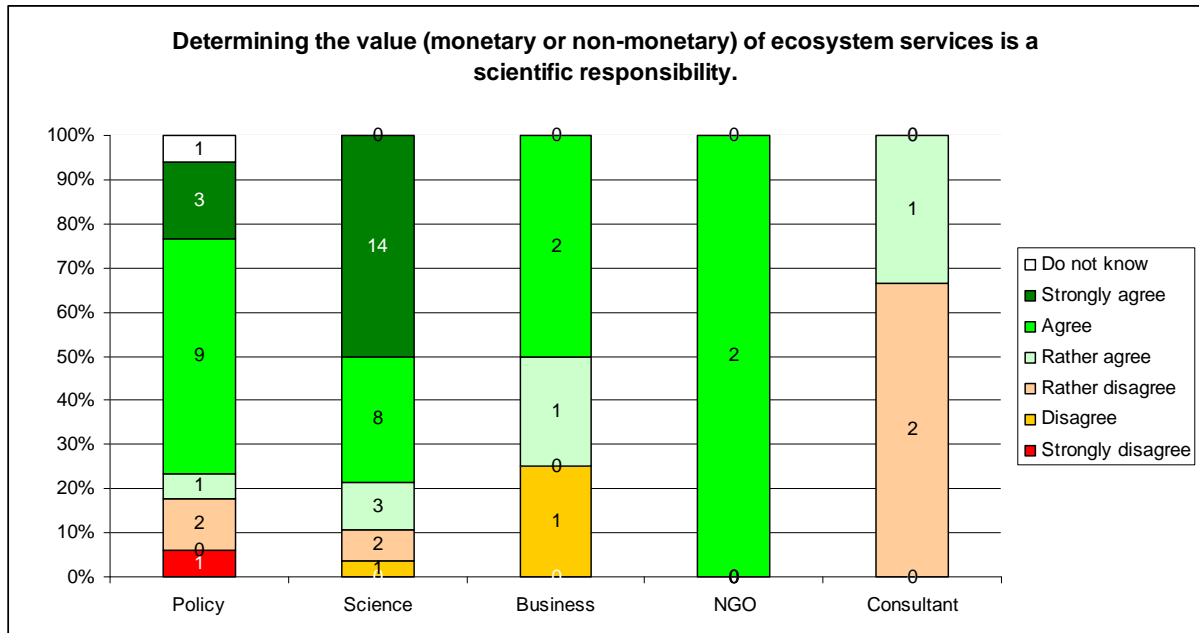
Figure 6 Valuing ecosystem services is a scientific responsibility? – Educational background

Determining the value (monetary or non-monetary) of ecosystem services is a scientific responsibility.
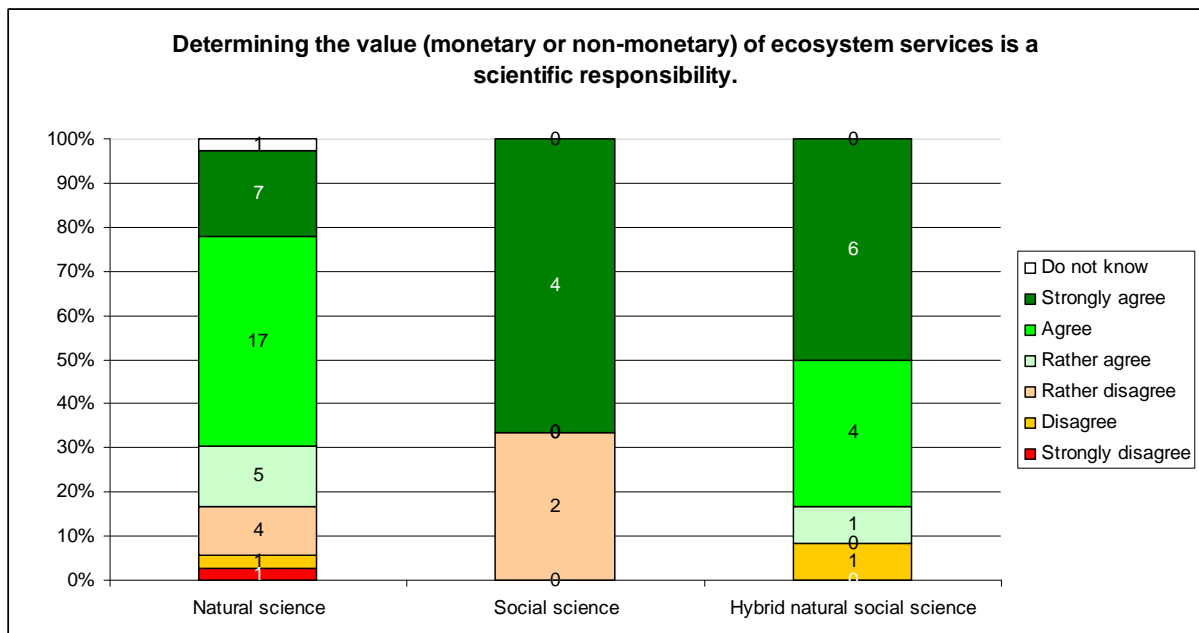
Figure 7 Valuation of ecosystem services a topic for social and political debate?
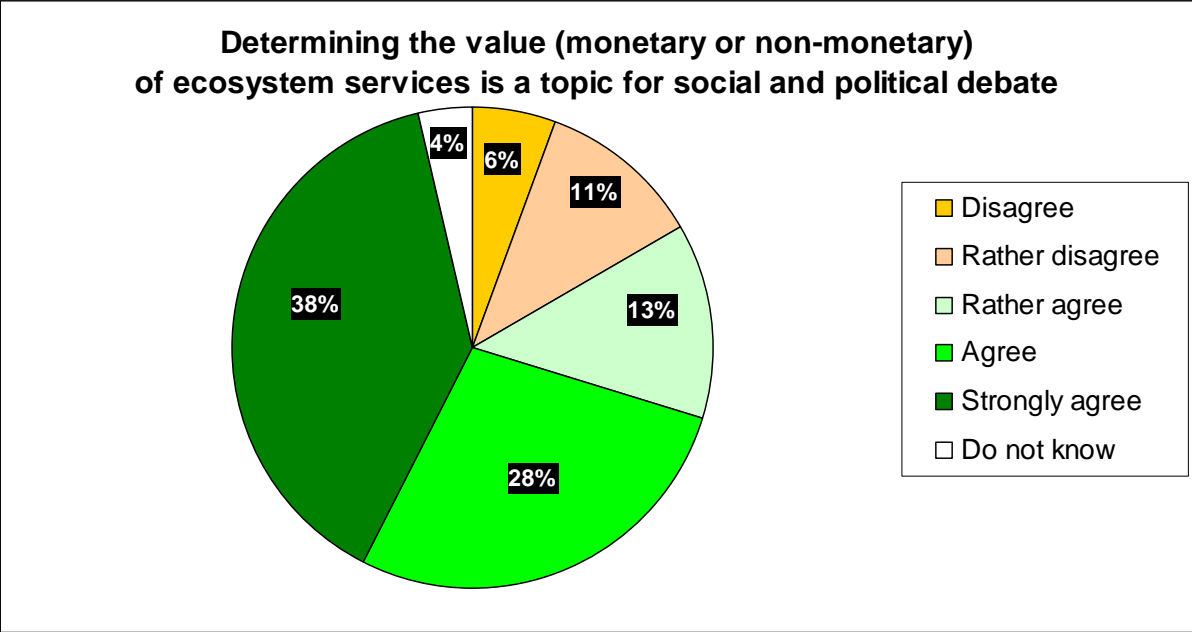
Figure 8 Valuation of ecosystem services a topic for social and political debate? – Institutional background
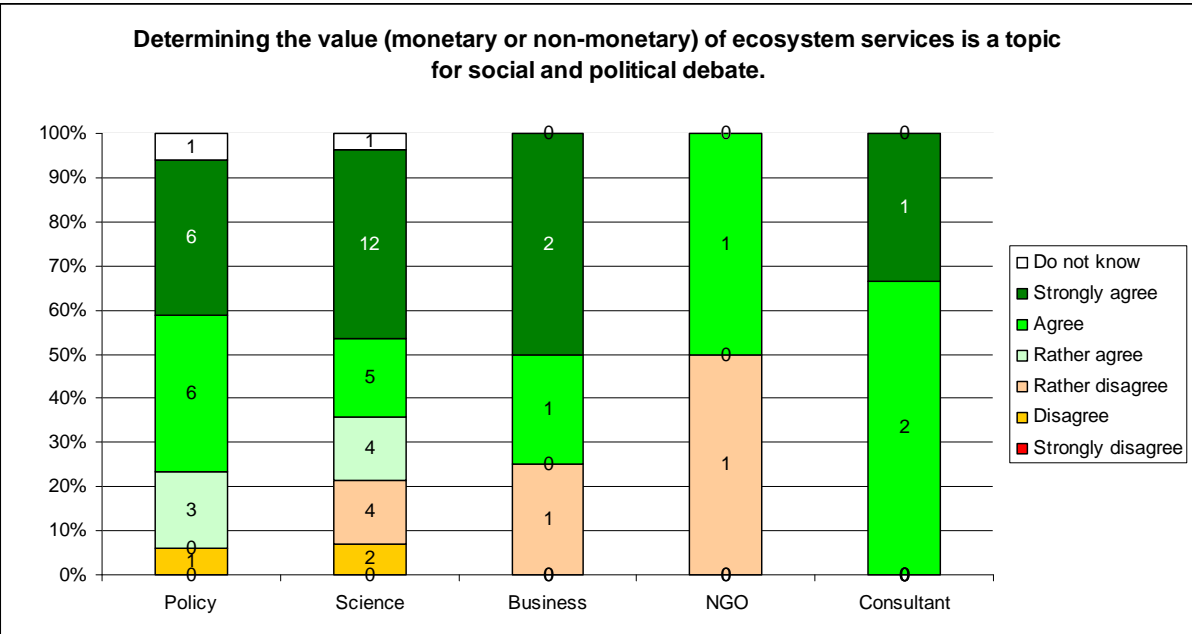
Figure 9 Valuation of ecosystem services a topic for social and political debate? – Educational background
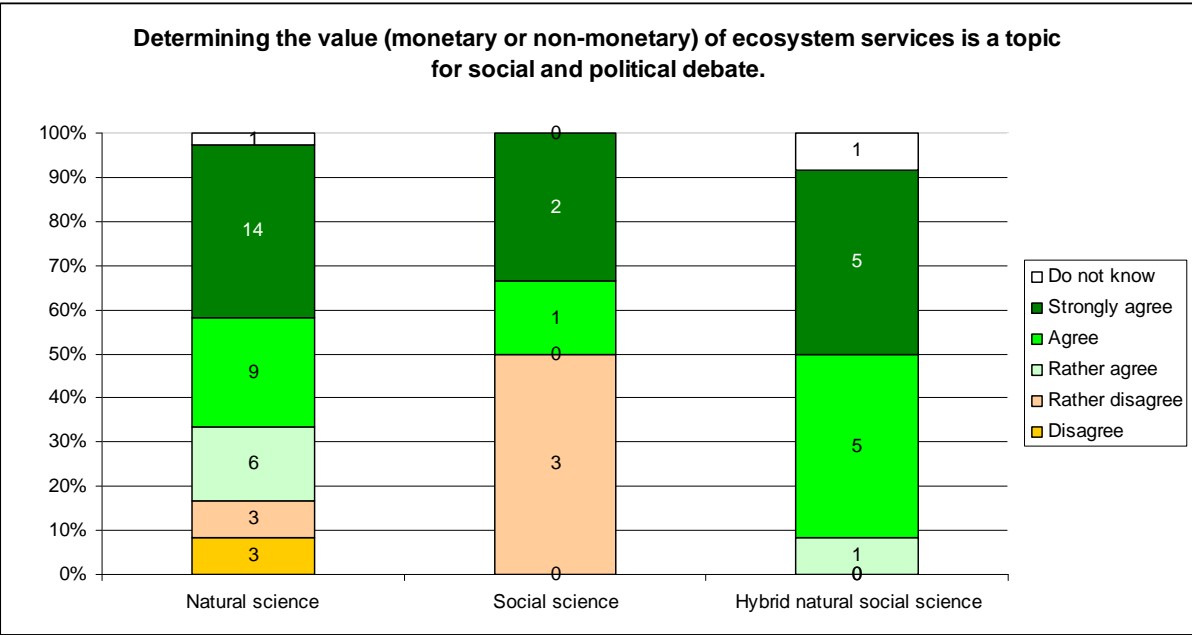
Figure 10 Value ecosystem services dependent of the social context?
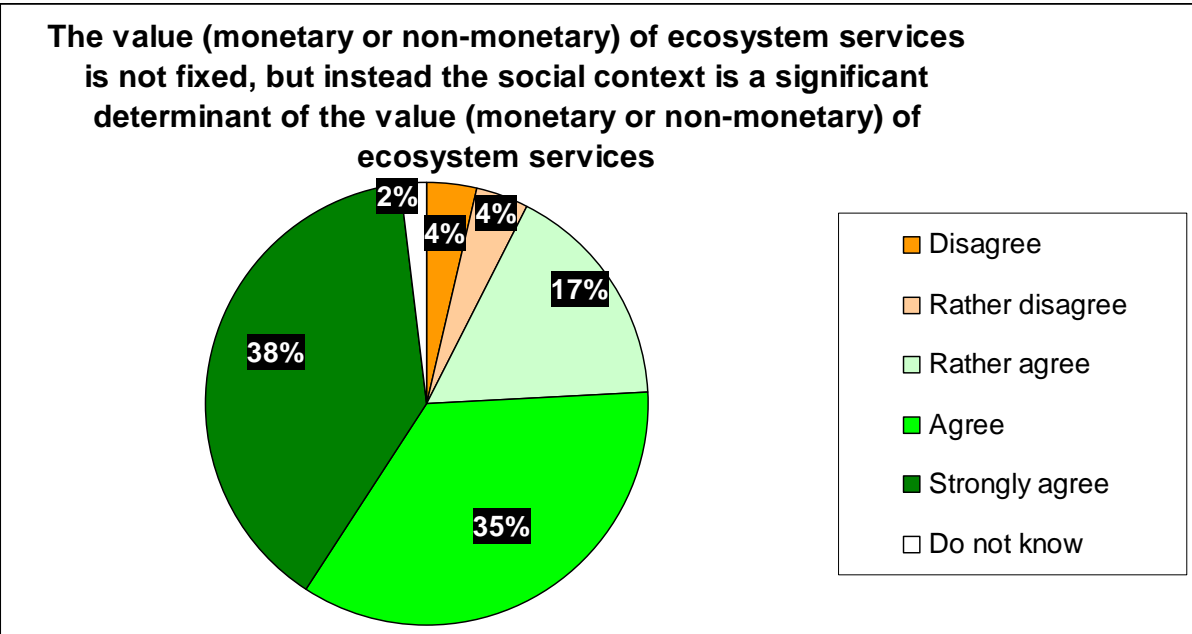
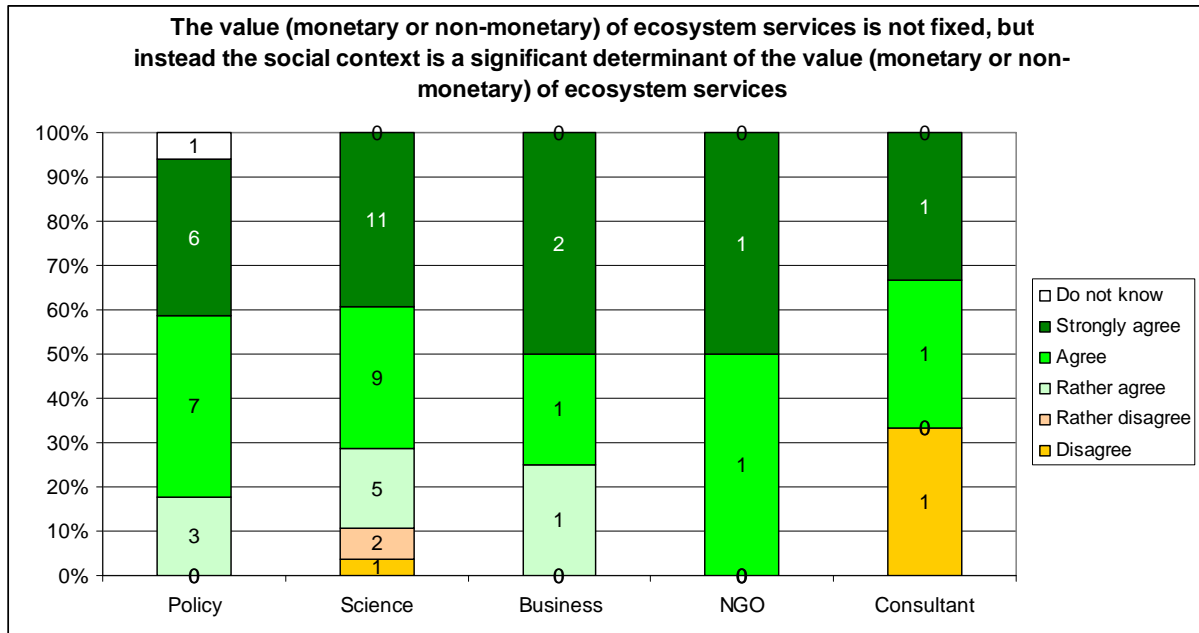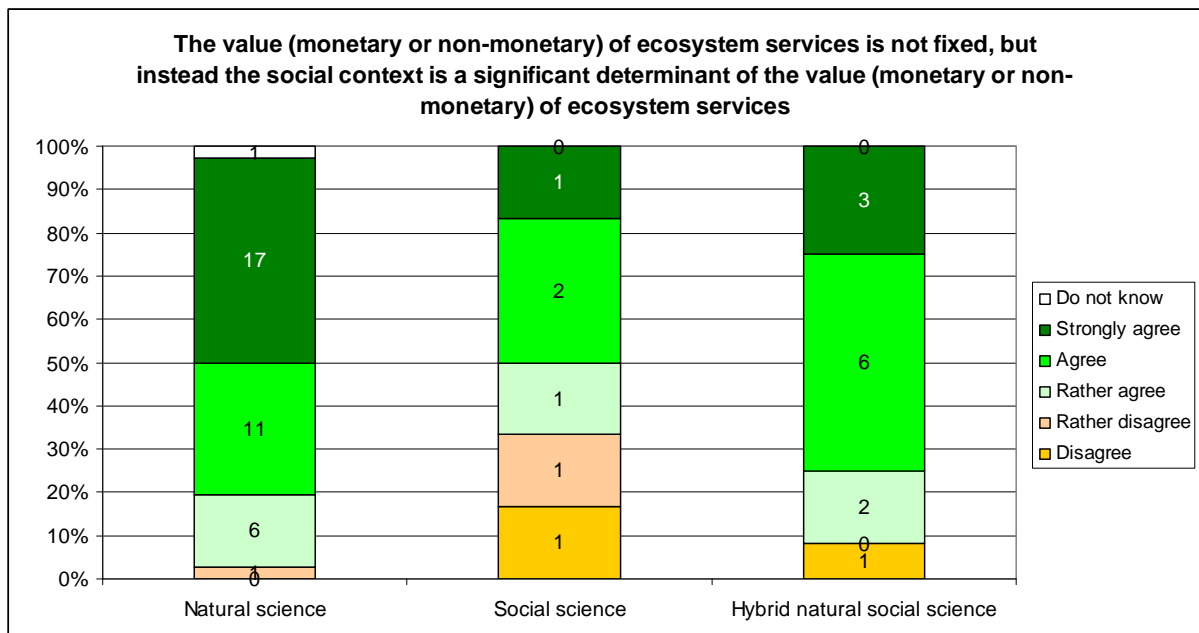Figure 11 Value ecosystem services dependent of the social context? – Institutional background

The value (monetary or non-monetary) of ecosystem services is not fixed, but instead the social context is a significant determinant of the value (monetary or non-monetary) of ecosystem services

Figure 12 Value ecosystem services dependent of the social context? – Educational background

The value (monetary or non-monetary) of ecosystem services is not fixed, but instead the social context is a significant determinant of the value (monetary or non-monetary) of ecosystem services

Figure 13 Contribution of biodiversity to ecosystem services
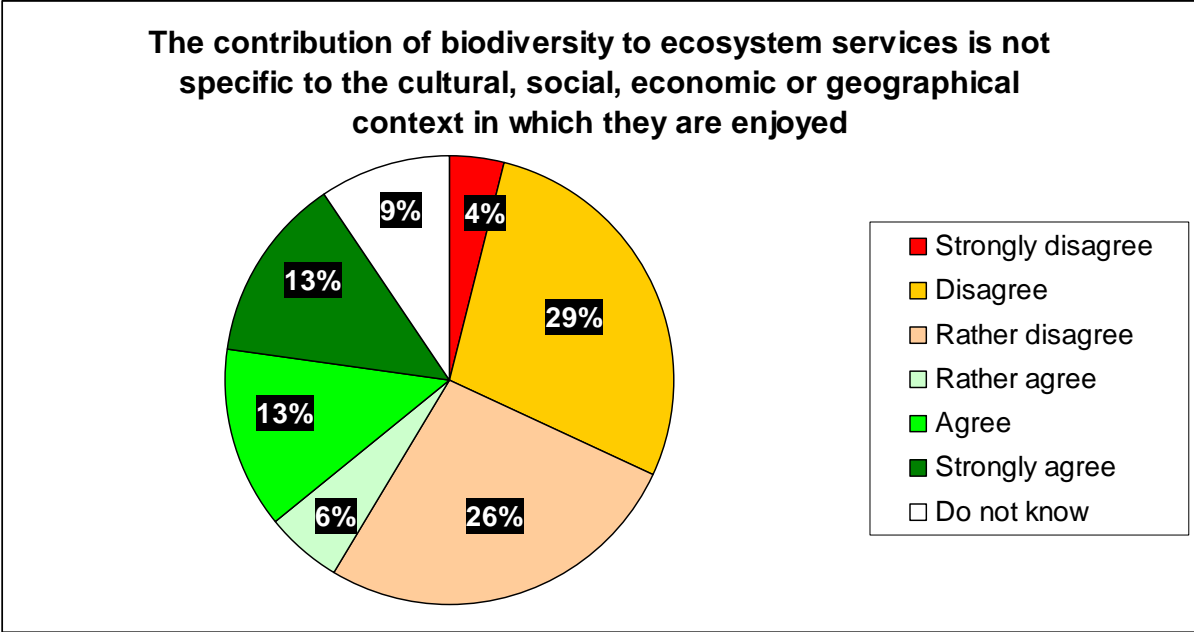
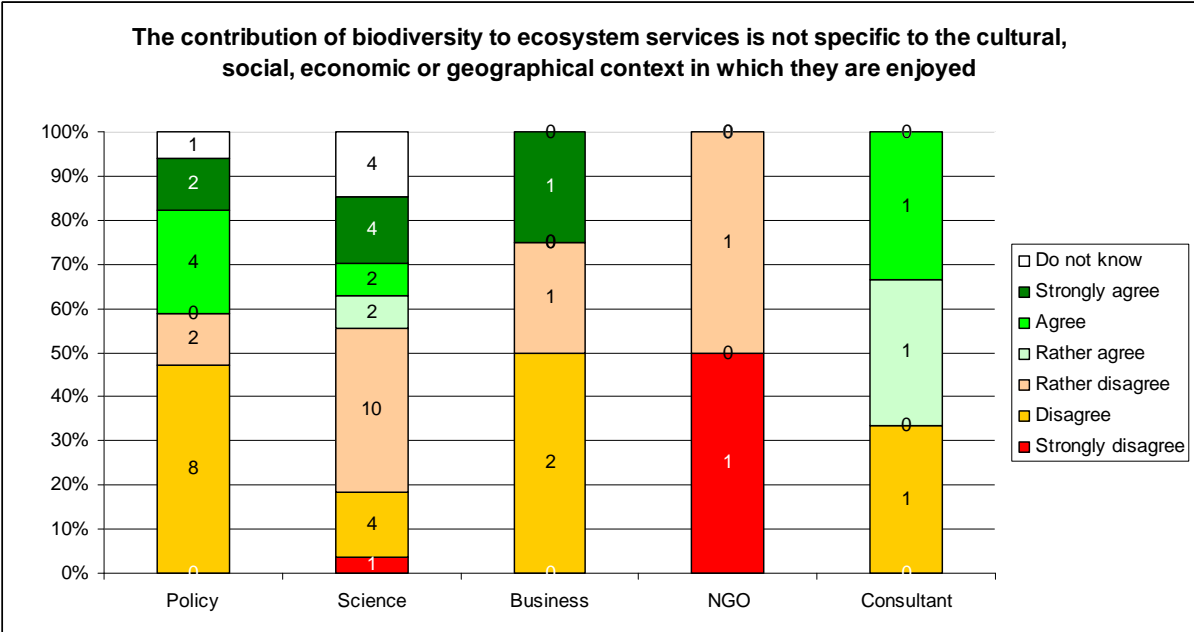Figure 14 Contribution of biodiversity to ecosystem services – Institutional background

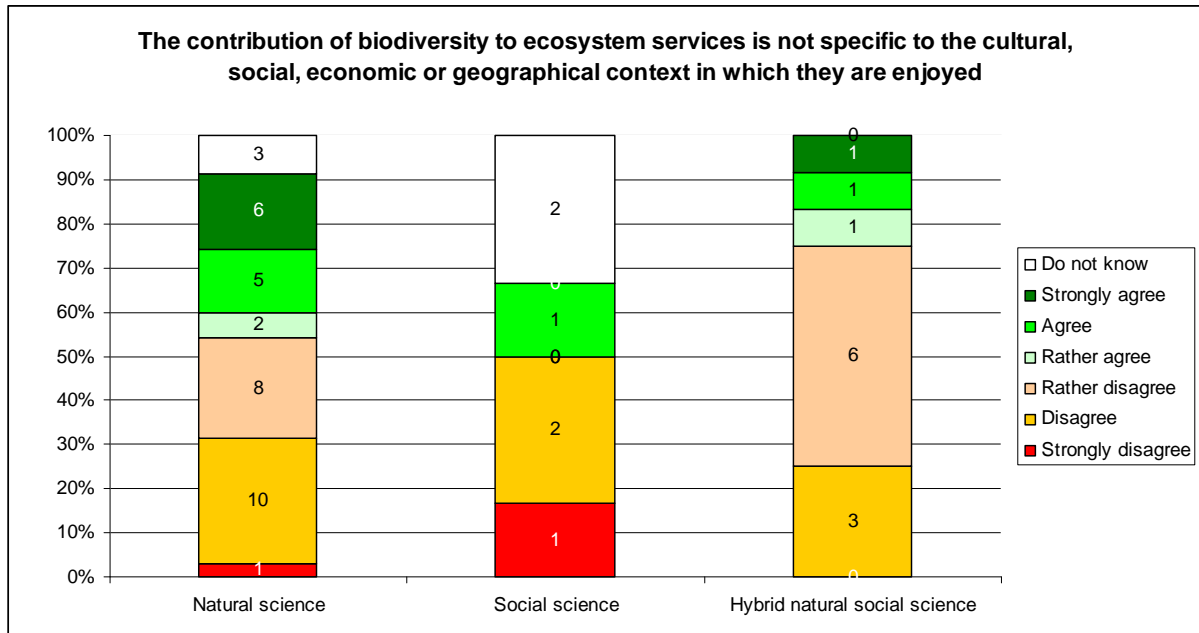Figure 15 Contribution of biodiversity to ecosystem services – Educational background

The contribution of biodiversity to ecosystem services is not specific to the cultural, social, economic or geographical context in which they are enjoyed

Figure 16 Ecosystem services systemic interface?

"Ecosystem services" is a systemic interface concept par excellence.
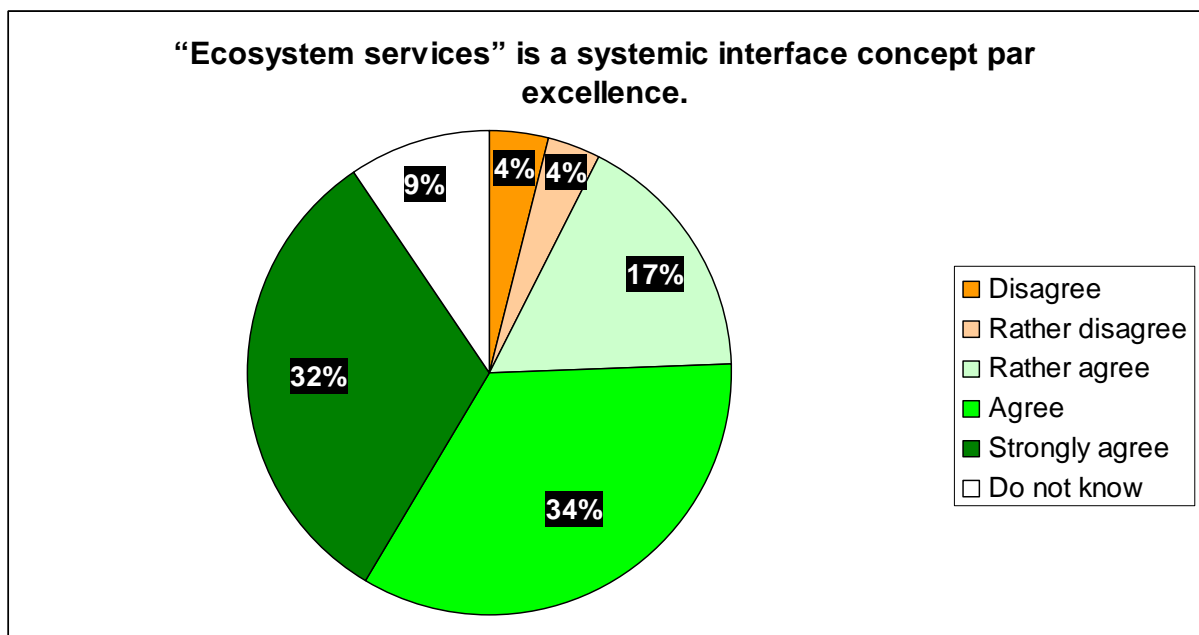
Figure 17 Ecosystem services systemic interface? – Institutional background
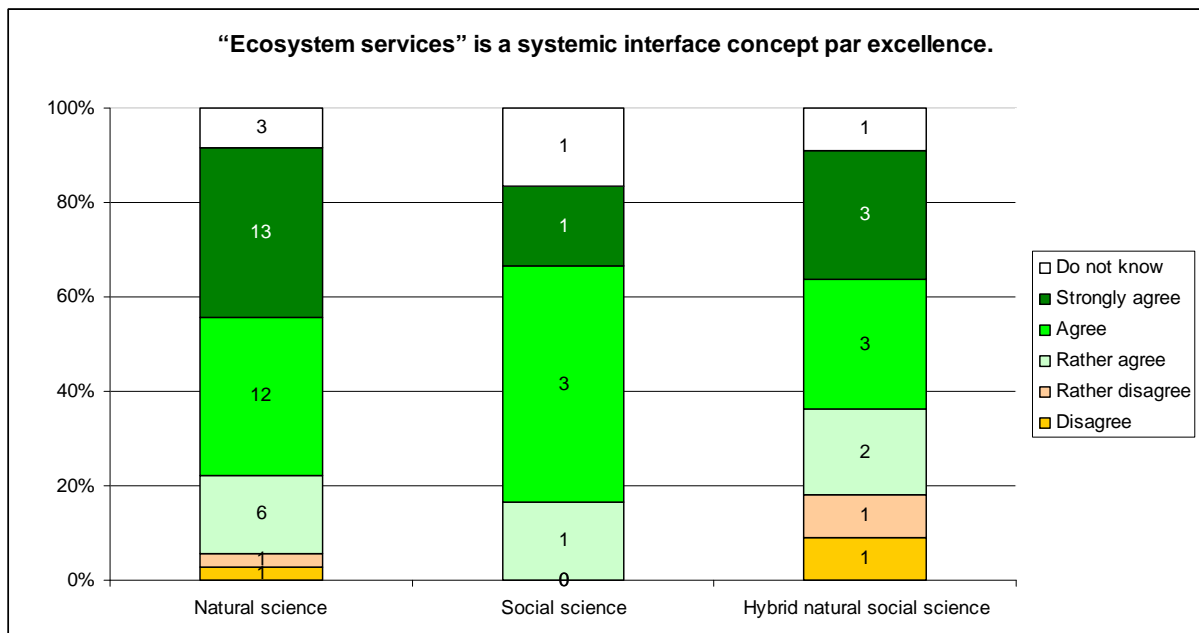

"Ecosystem services" is a systemic interface concept par excellence.
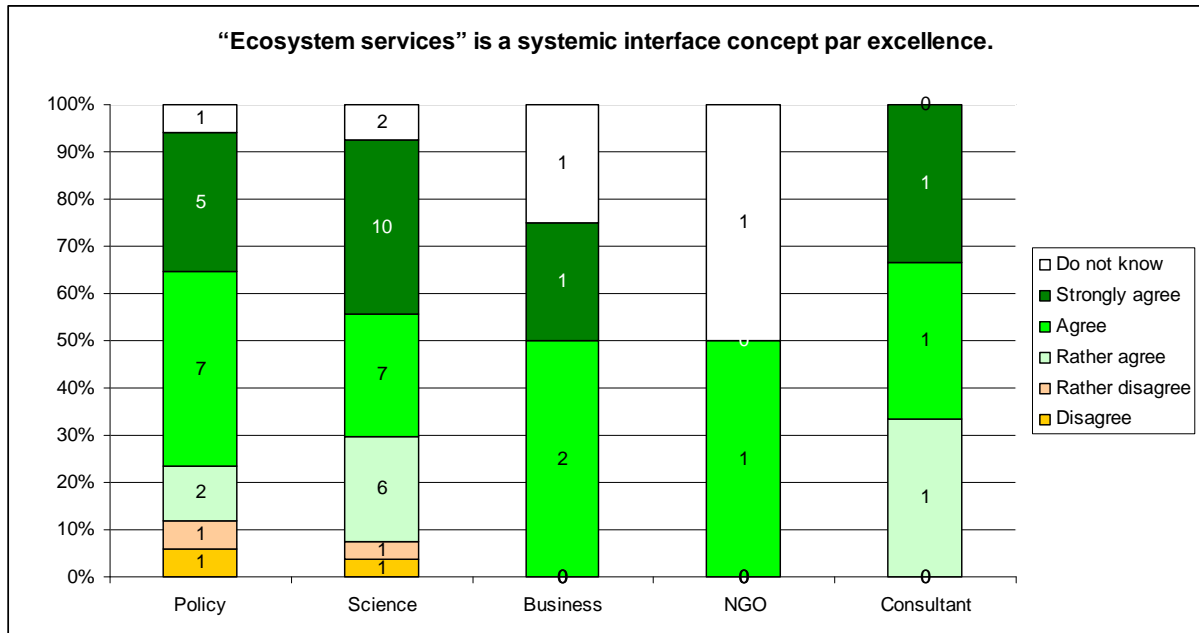
Figure 18 Ecosystem services systemic interface? – Educational background

"Ecosystem services" is a systemic interface concept par excellence.

Figure 19 Ecosystem services interdisciplinary interface?

"Ecosystem services" is an interdisciplinary (collaboration between different scientific disciplines) interface concept par excellence.
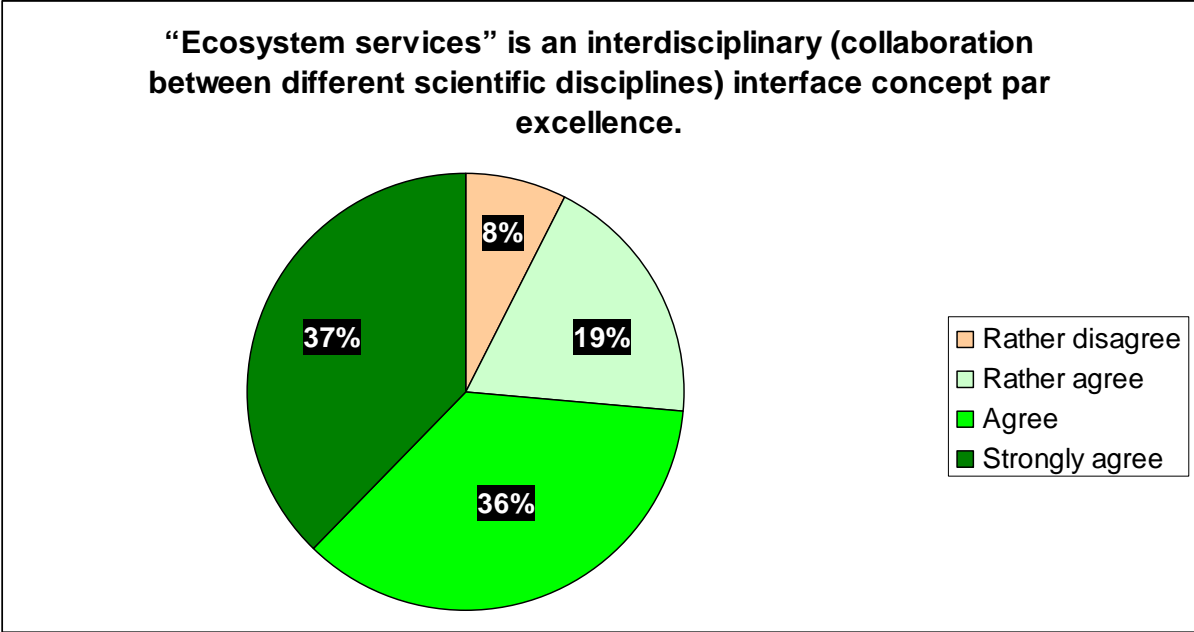
Figure 20 Ecosystem services interdisciplinary interface? – Institutional background

Ecosystem services" is an interdisciplinary (collaboration between different scientific disciplines) interface concept par excellence.
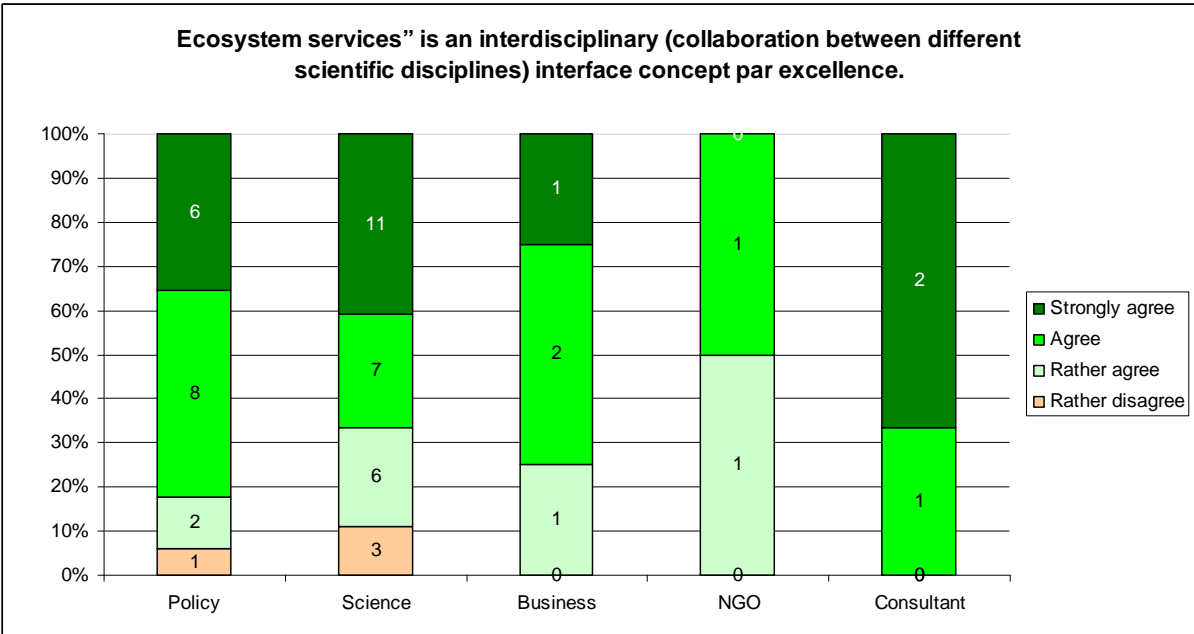
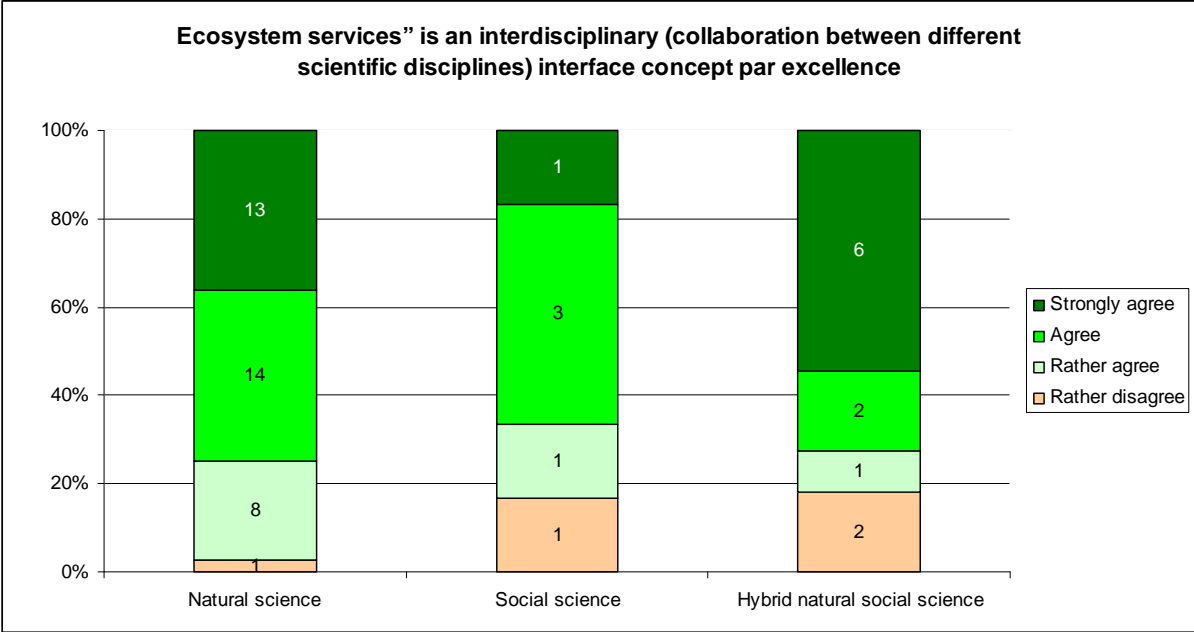Figure 21 Ecosystem services interdisciplinary interface? – Educational background

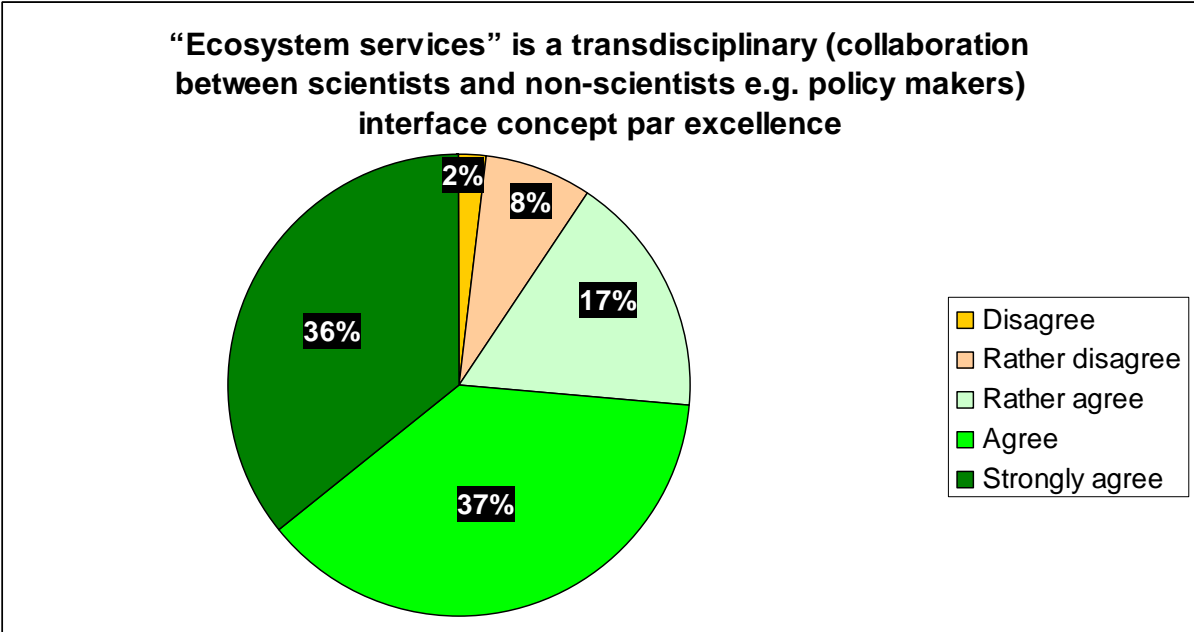

Figure 22 Ecosystem services transdisciplinary interface?

Figure 23 Ecosystem services transdisciplinary interface? - Institutional background
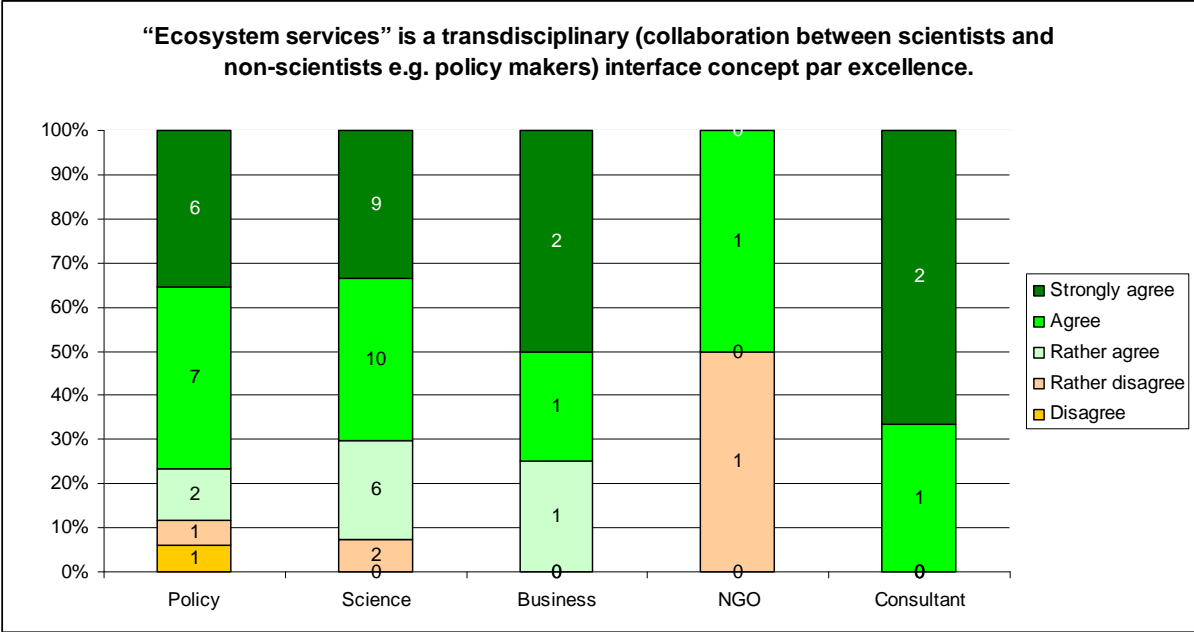

"Ecosystem services" is a transdisciplinary (collaboration between scientists and non-scientists e.g. policy makers) interface concept par excellence.

Figure 24 Ecosystem services transdisciplinary interface? - Educational background

"Ecosystem services" is a transdisciplinary (collaboration between scientists and non-scientists e.g. policy makers) interface concept par excellence.
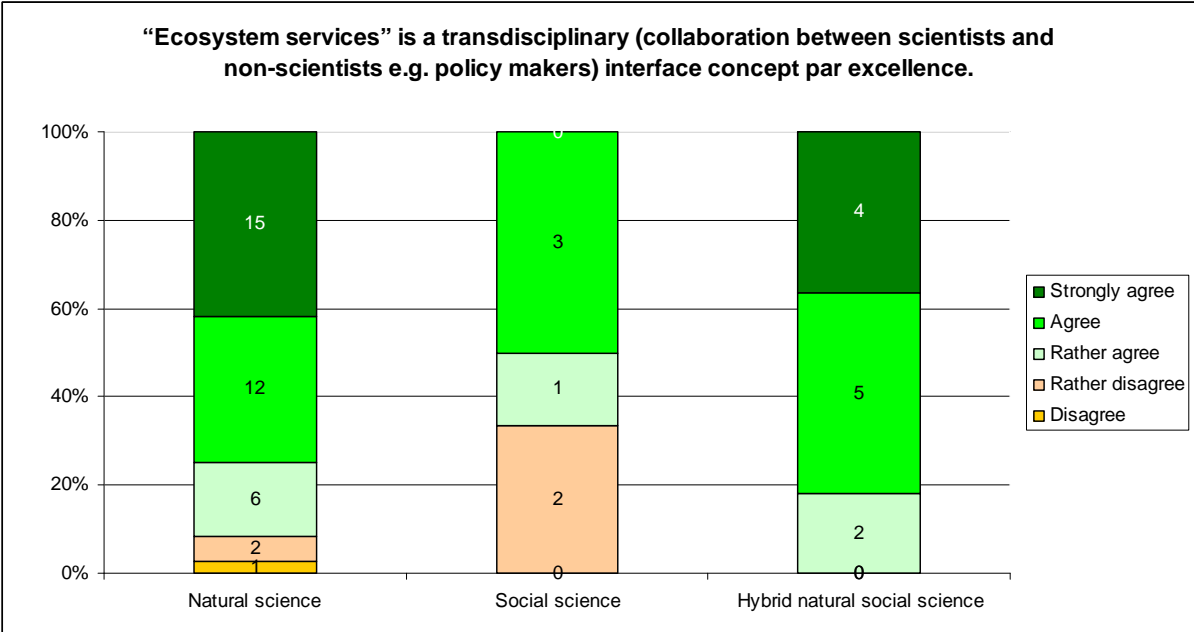
Figure 25 Discuss all research choices with policy makers?

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists should discuss all research choices with policy representatives

Legend:
- Disagree
- Rather disagree
- Rather agree
- Agree
- Strongly agree
- Do not know
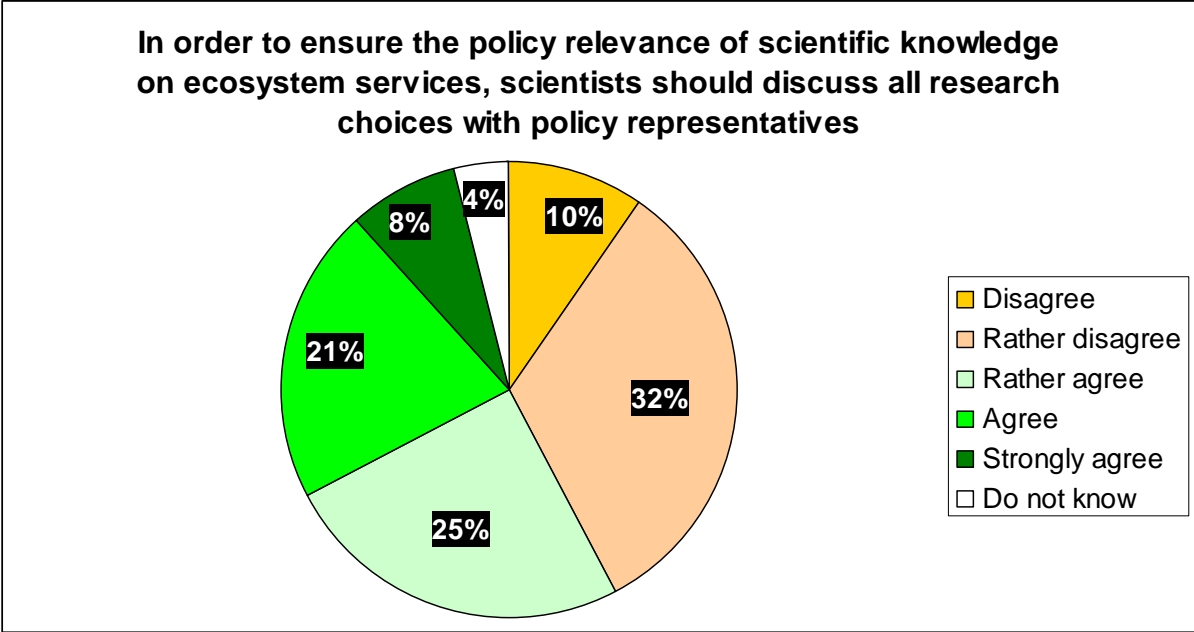
Figure 26 Discuss all research choices with policy makers? – Institutional background

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists should discuss all research choices with policy representatives

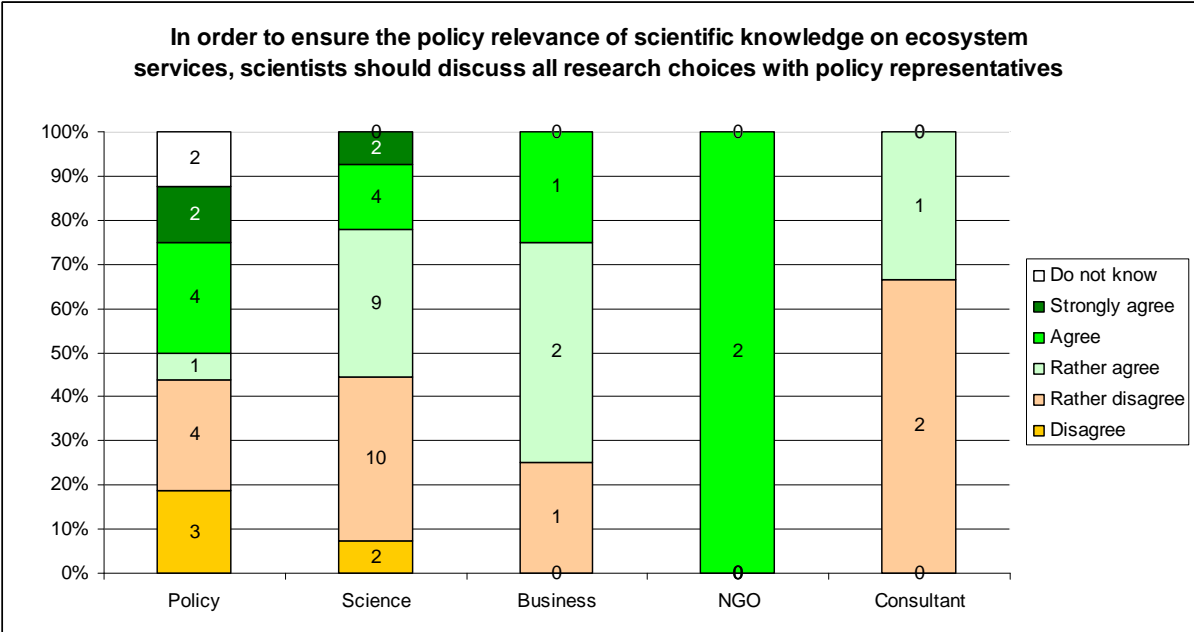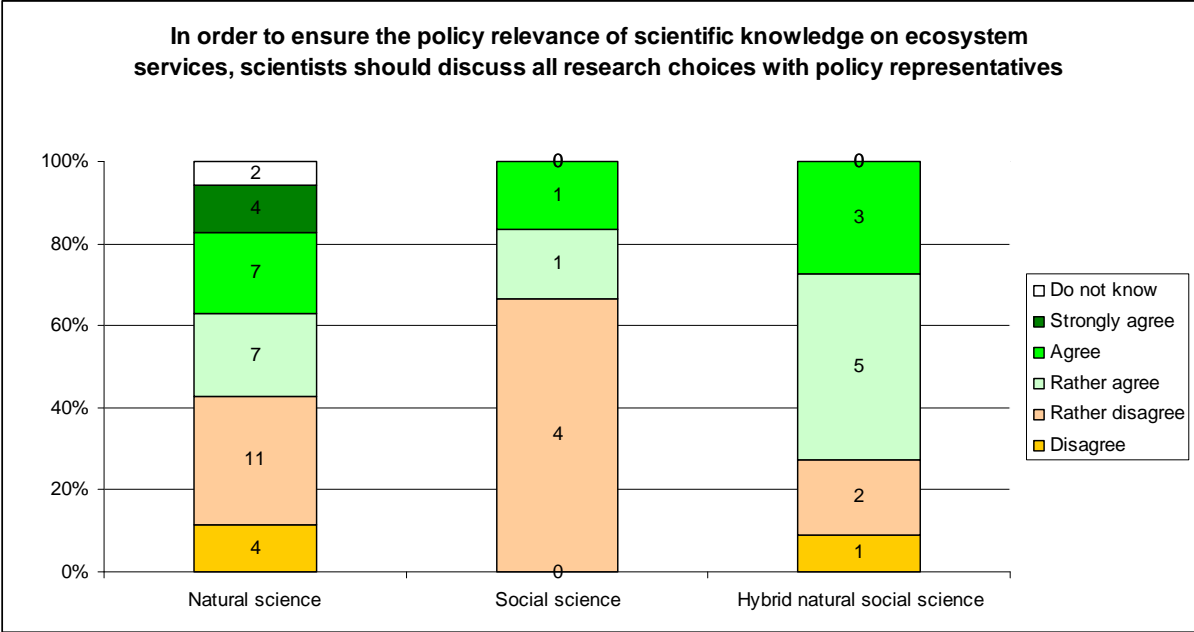Figure 27 Discuss all research choices with policy makers? – Educational background

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists should discuss all research choices with policy representatives

Figure 28 Collaboration science - policy?

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to collaborate as much as possible
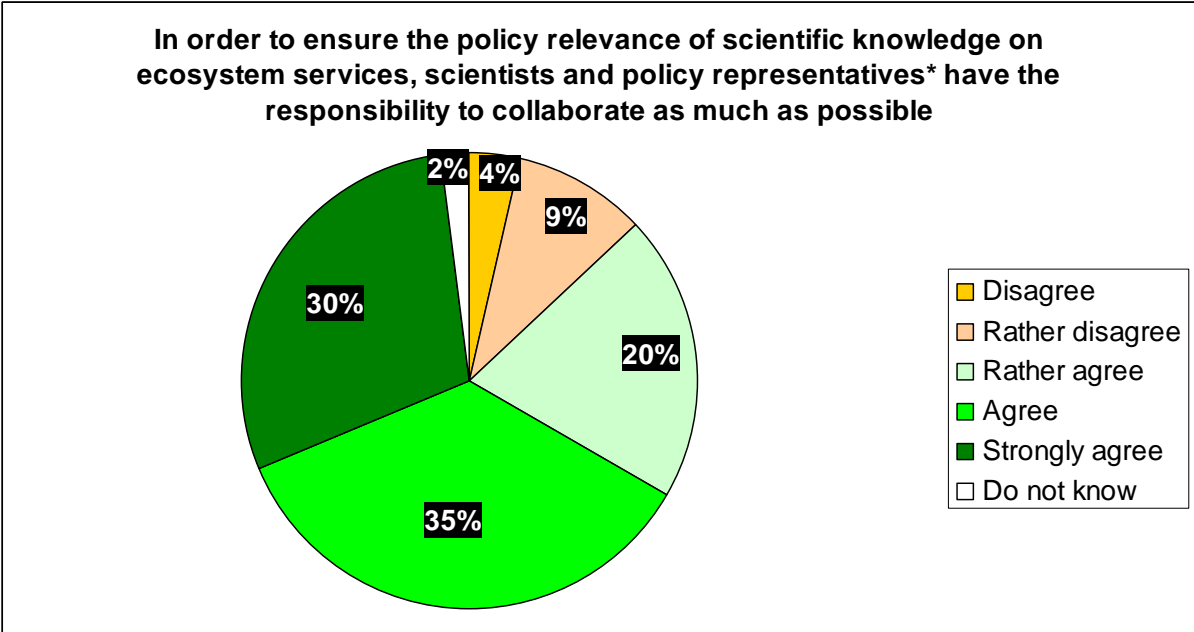
Figure 29 Collaboration science - policy? – Institutional background

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to collaborate as much as possible
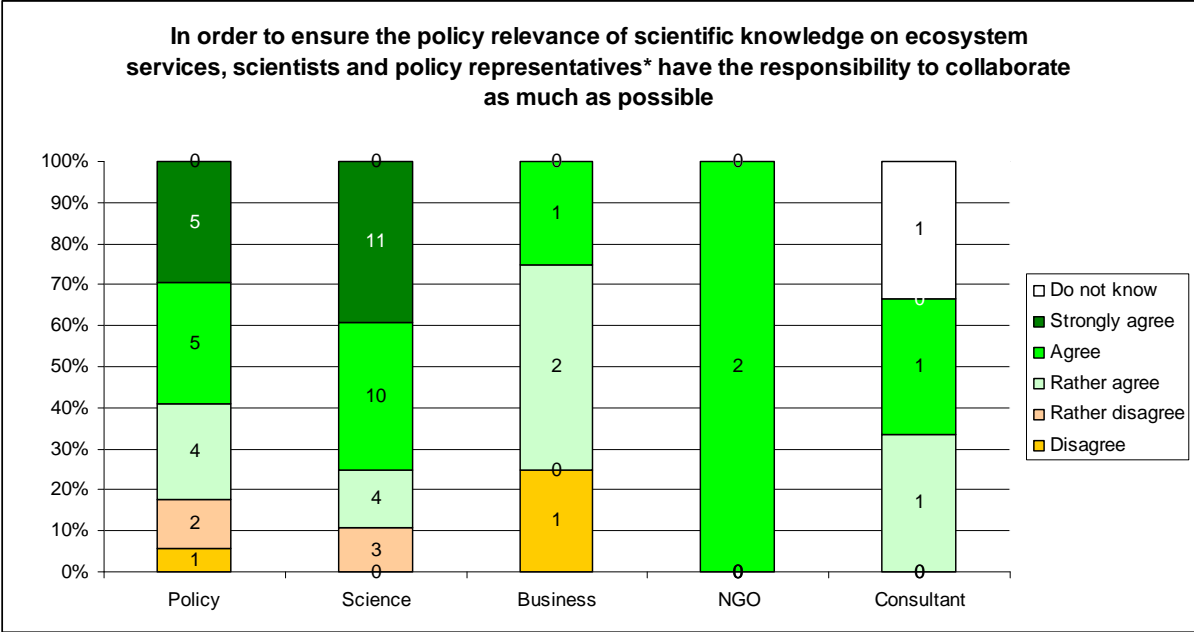
Figure 30 Collaboration science - policy? – Educational background

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to collaborate as much as possible
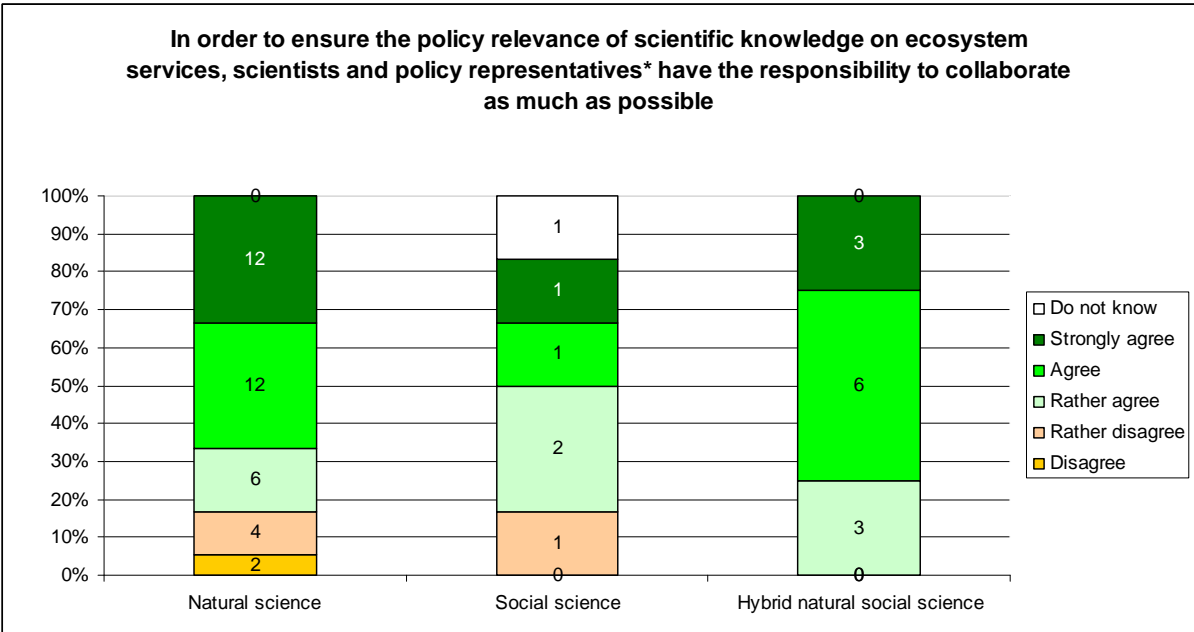
Figure 31 Only discuss research choices with policy makers before the research starts

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to only discuss the research topic before the start of the research.

Legend:
- Strongly disagree
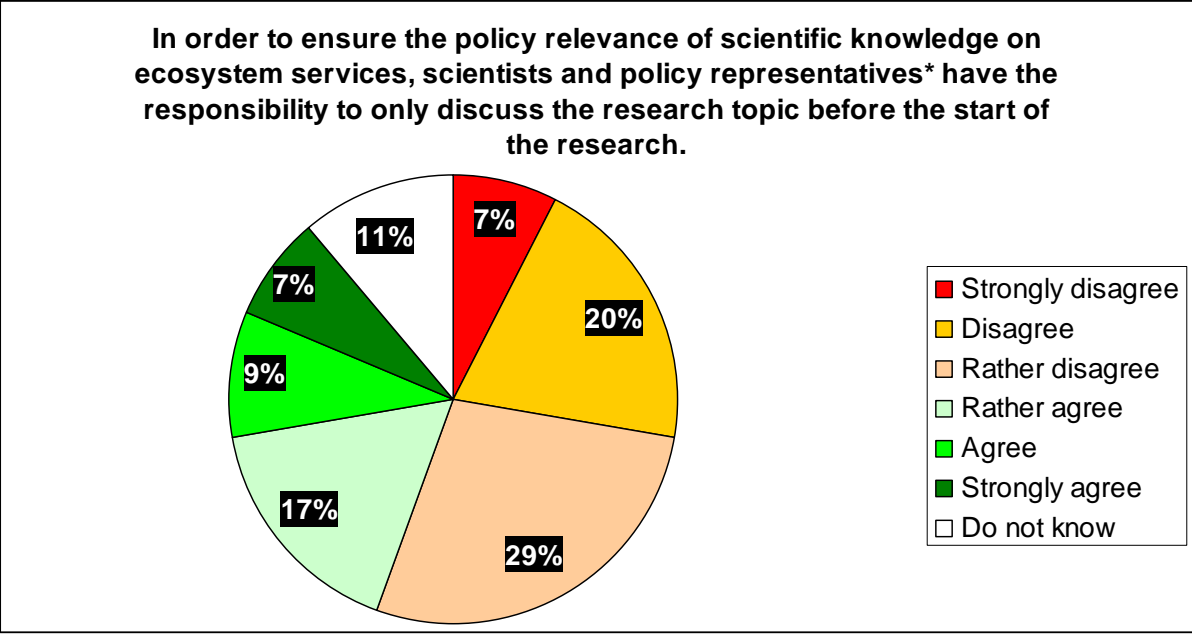- Disagree
- Rather disagree
- Rather agree
- Agree
- Strongly agree
- Do not know

Figure 32 Only discuss research choices with policy makers before the research starts – Institutional background

In order to ensure the policy relevance of scientific knowledge on ecosystem services, scientists and policy representatives* have the responsibility to only discuss the research topic before the start of the research.
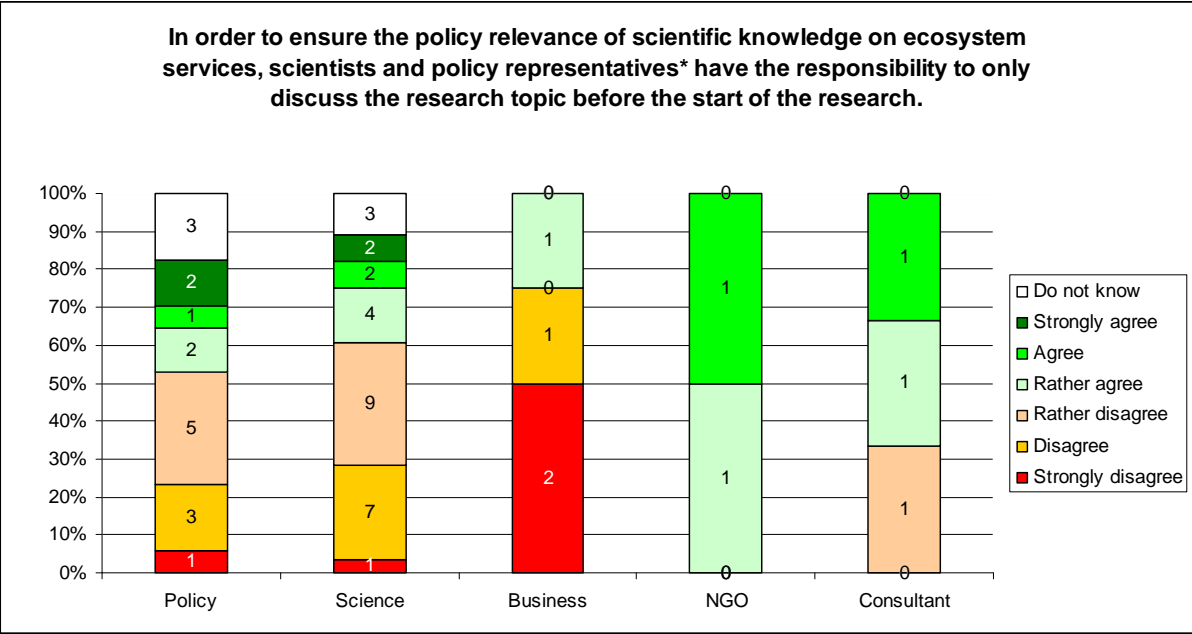
Figure 33 Only discuss research choices with policy makers before the research starts –
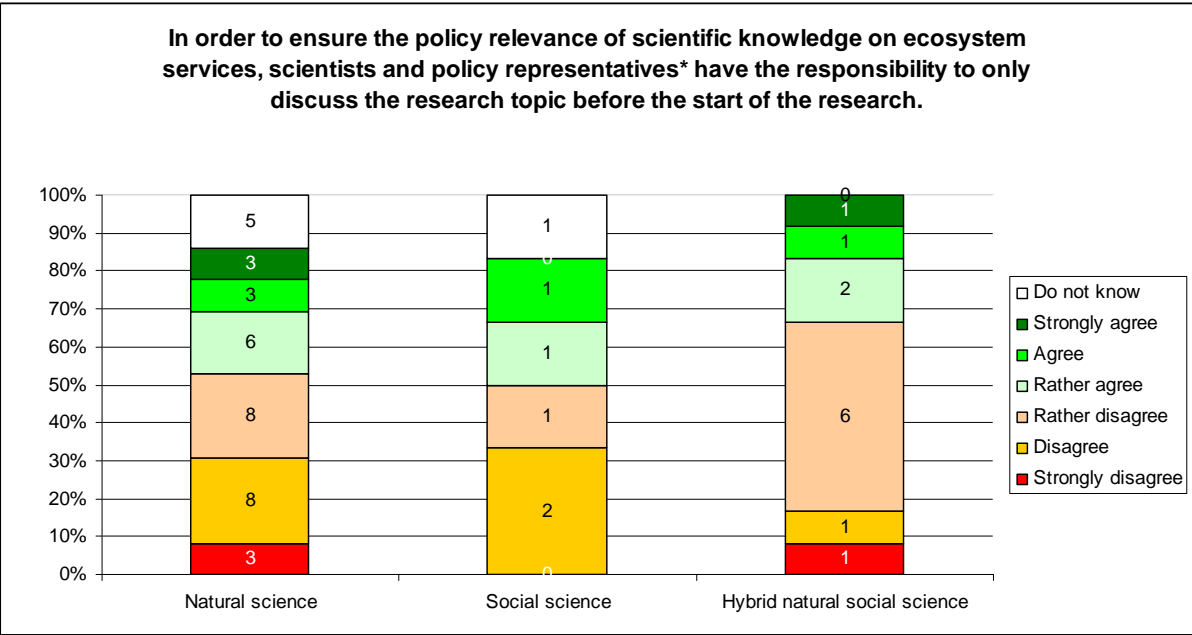Educational background

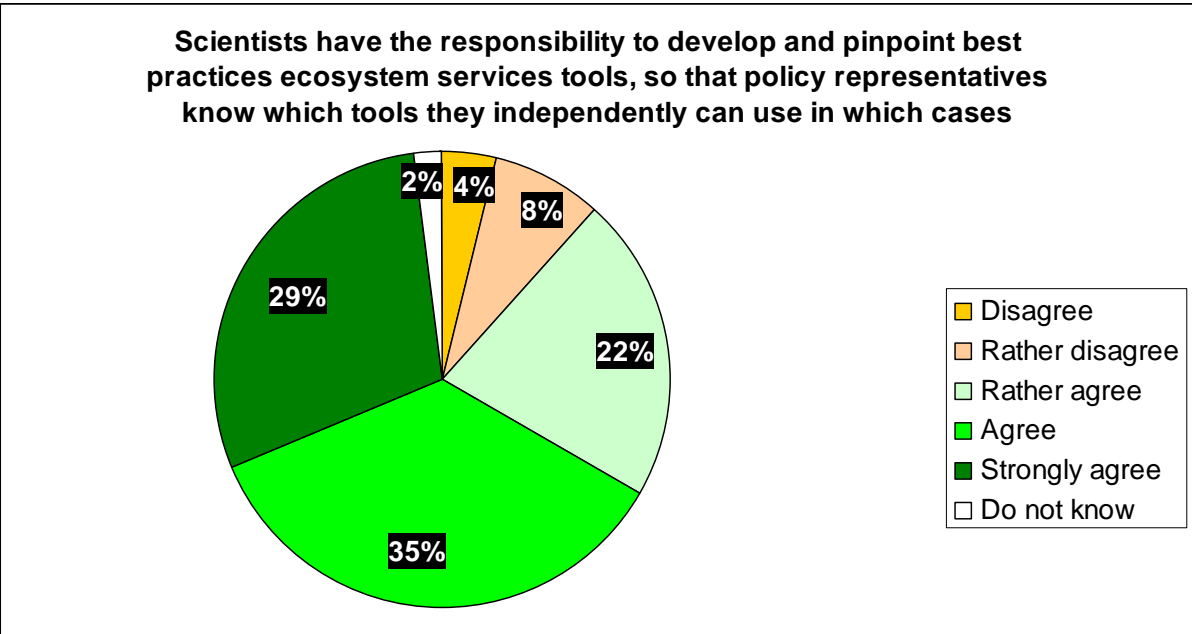Figure 34 Scientists pinpoint best practices, policy makers use them independently

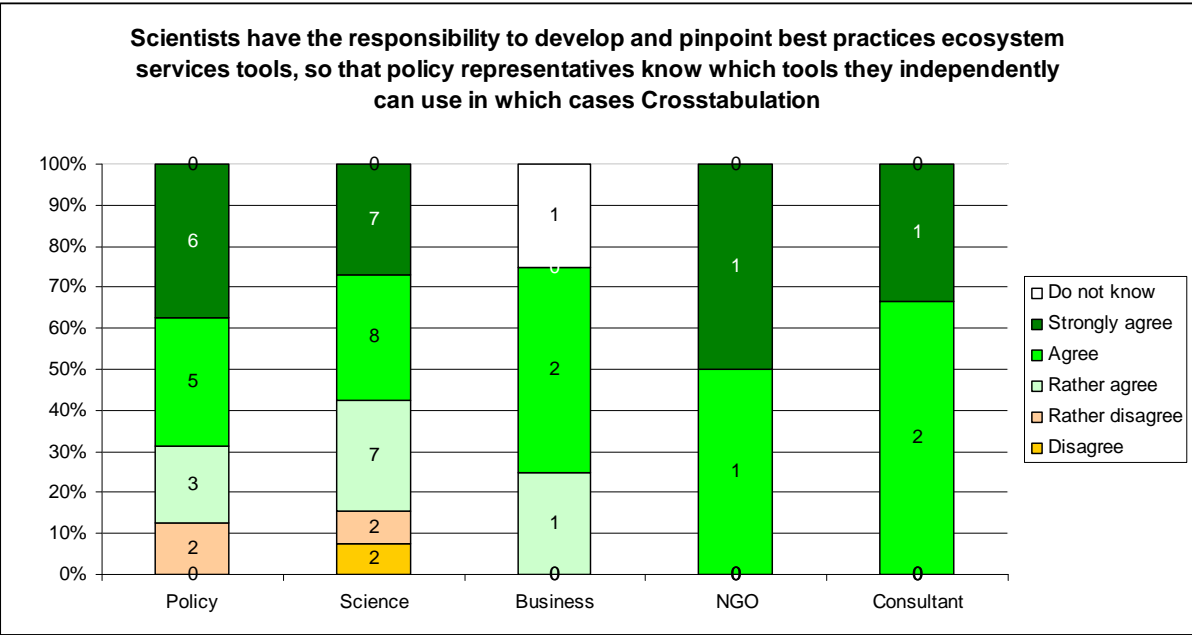Figure 35 Scientists pinpoint best practices, policy makers use them independently – Institutional background

Scientists have the responsibility to develop and pinpoint best practices ecosystem services tools, so that policy representatives know which tools they independently can use in which cases Crosstabulation

Figure 36 Scientists pinpoint best practices, policy makers use them independently – Educational background

Scientists have the responsibility to develop and pinpoint best practices ecosystem services tools, so that policy representatives know which tools they independently can use in which cases
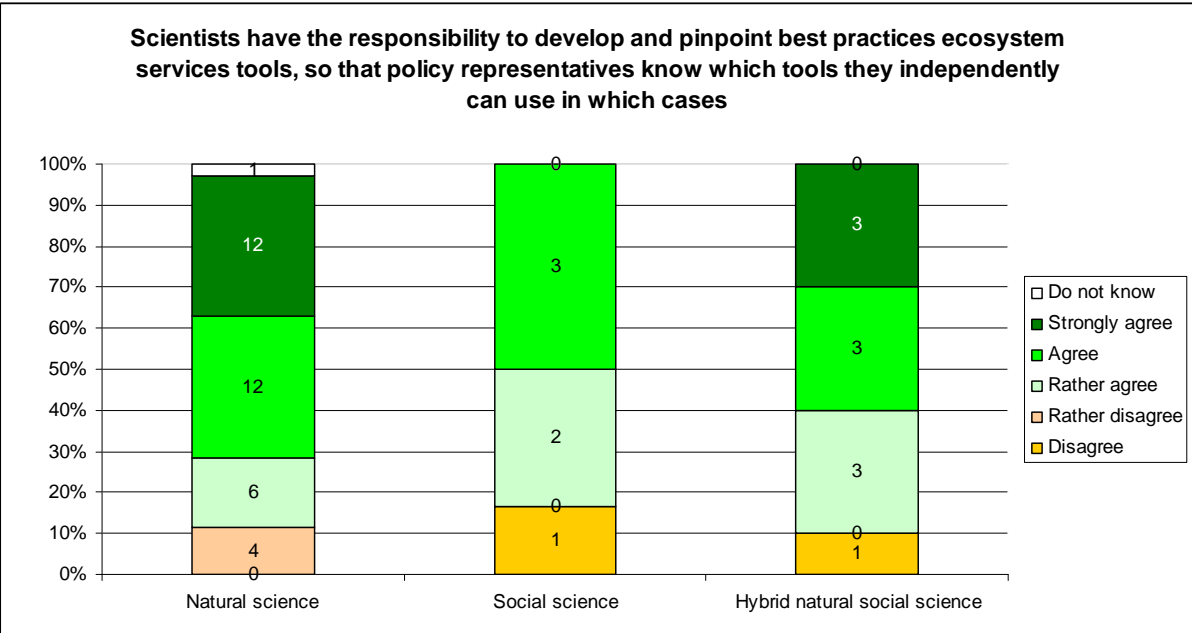
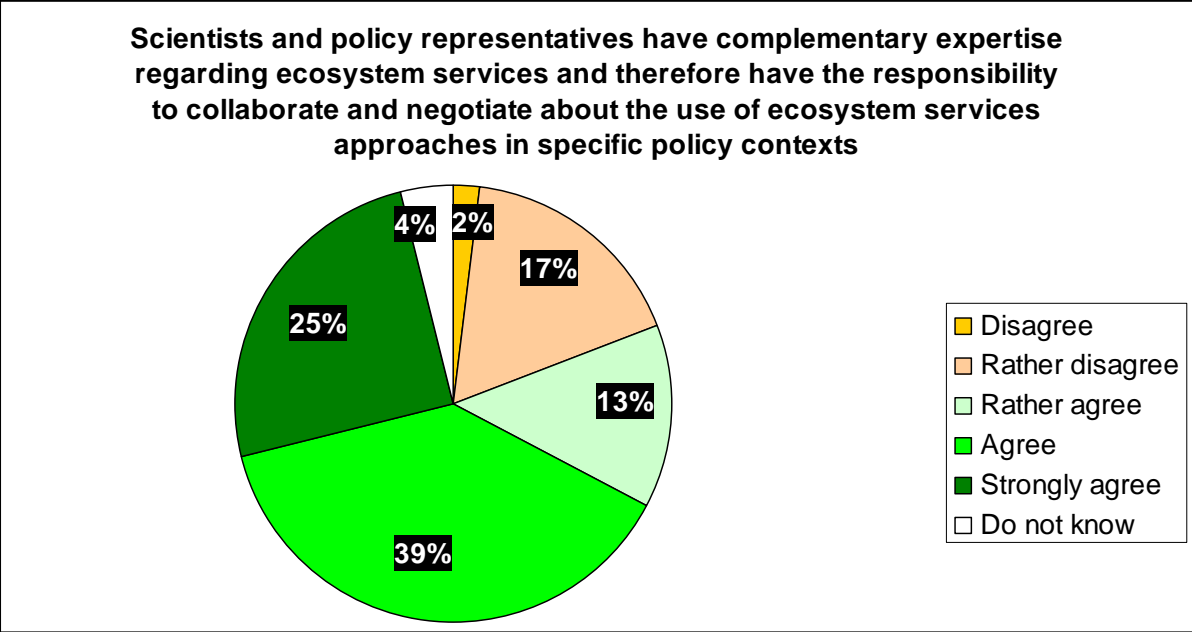Figure 37 Science and policy collaborate and negotiate about ecosystem use

Figure 38 Science and policy collaborate and negotiate about ecosystem use – Institutional background
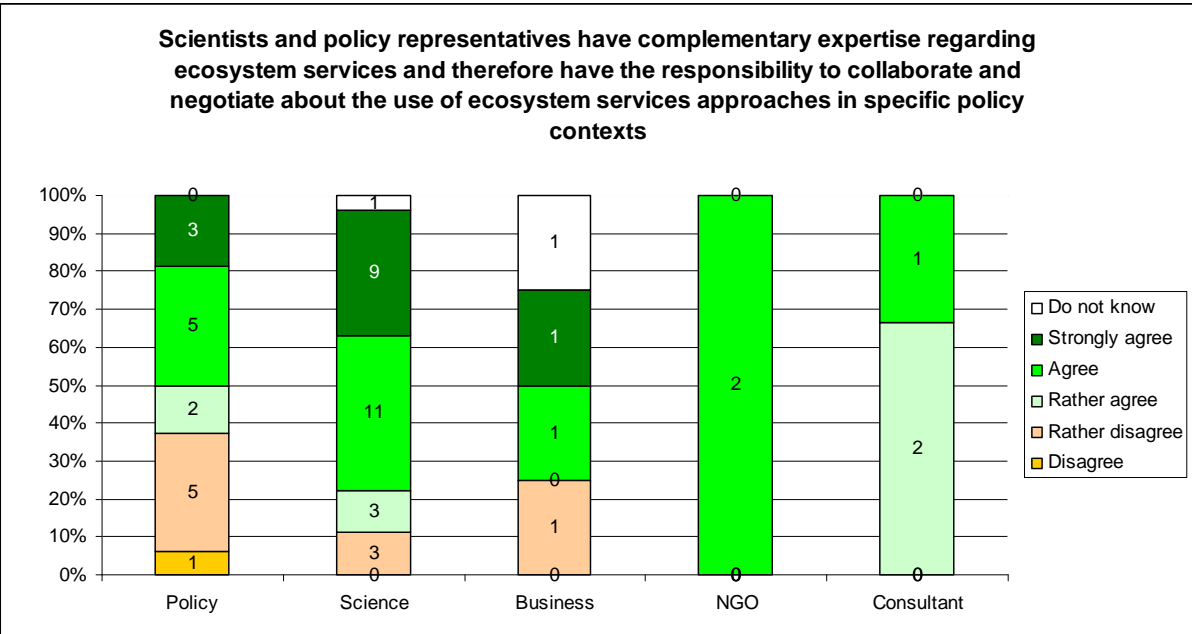
Figure 39 Science and policy collaborate and negotiate about ecosystem use – Educational background
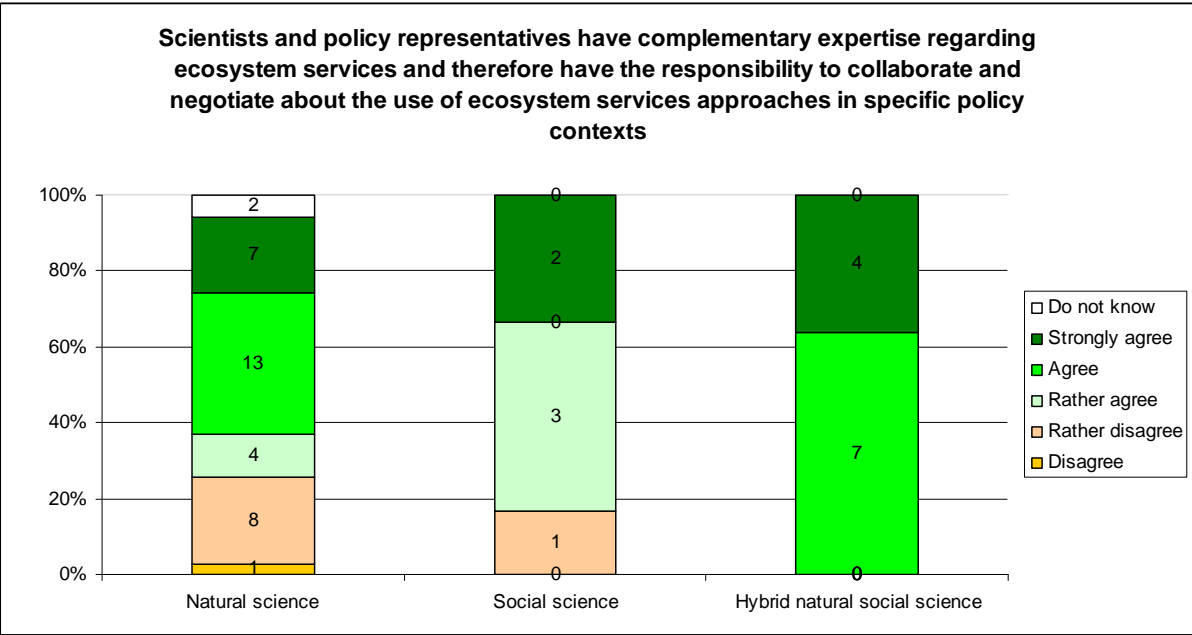

Scientists and policy representatives have complementary expertise regarding ecosystem services and therefore have the responsibility to collaborate and negotiate about the use of ecosystem services approaches in specific policy contexts

Figure 40 Science: objective and independent?

Scientists have the responsibility to be objective and independent.
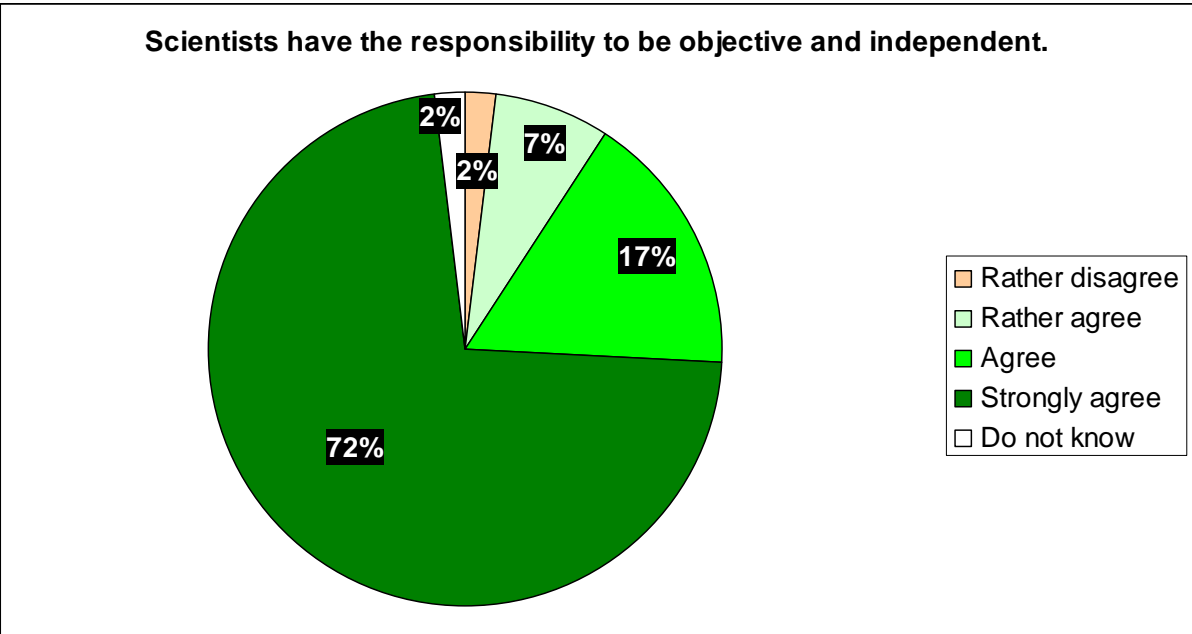
Figure 41 Science: objective and independent? – Institutional background

Scientists have the responsibility to be objective and independent.
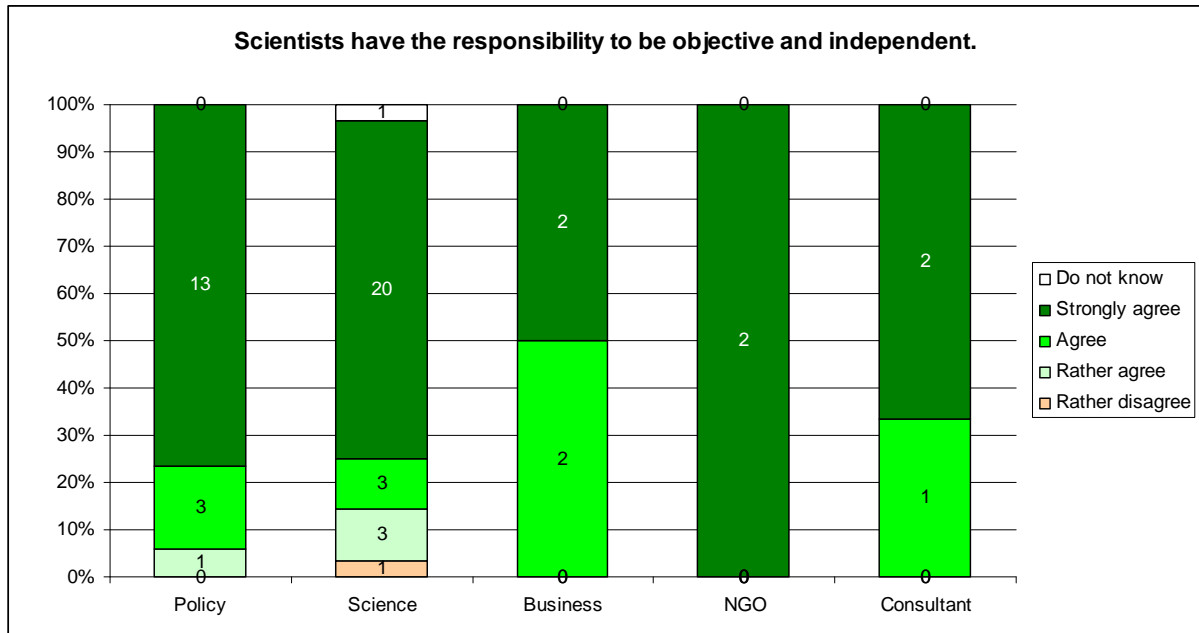
Figure 42 Science: objective and independent? – Educational background

Scientists have the responsibility to be objective and independent.
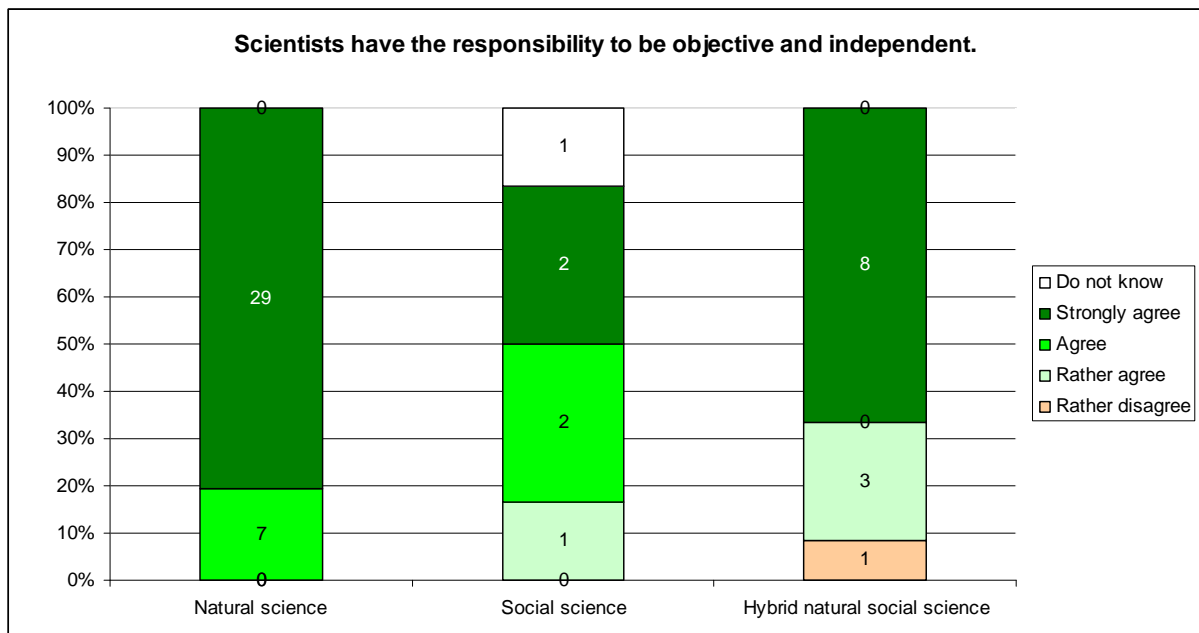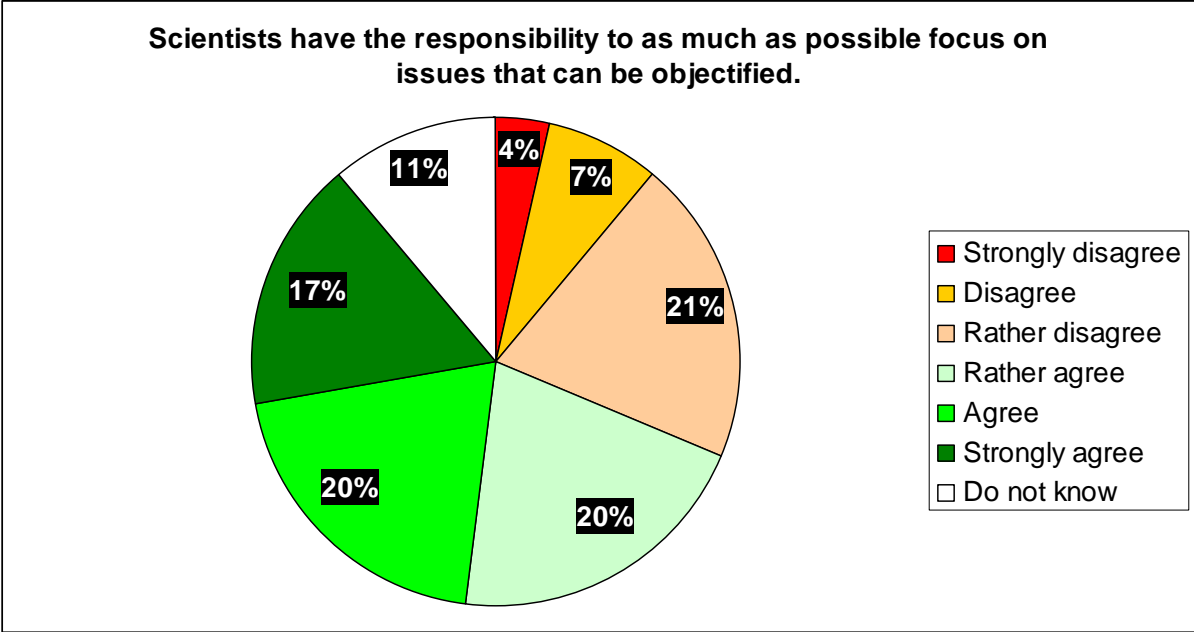
Figure 43 Scientific focus on issues that can be objectified?

Figure 44 Scientific focus on issues that can be objectified? – Institutional background

What do you think about the policy relevance of ecosystem service science? www.inbo.be
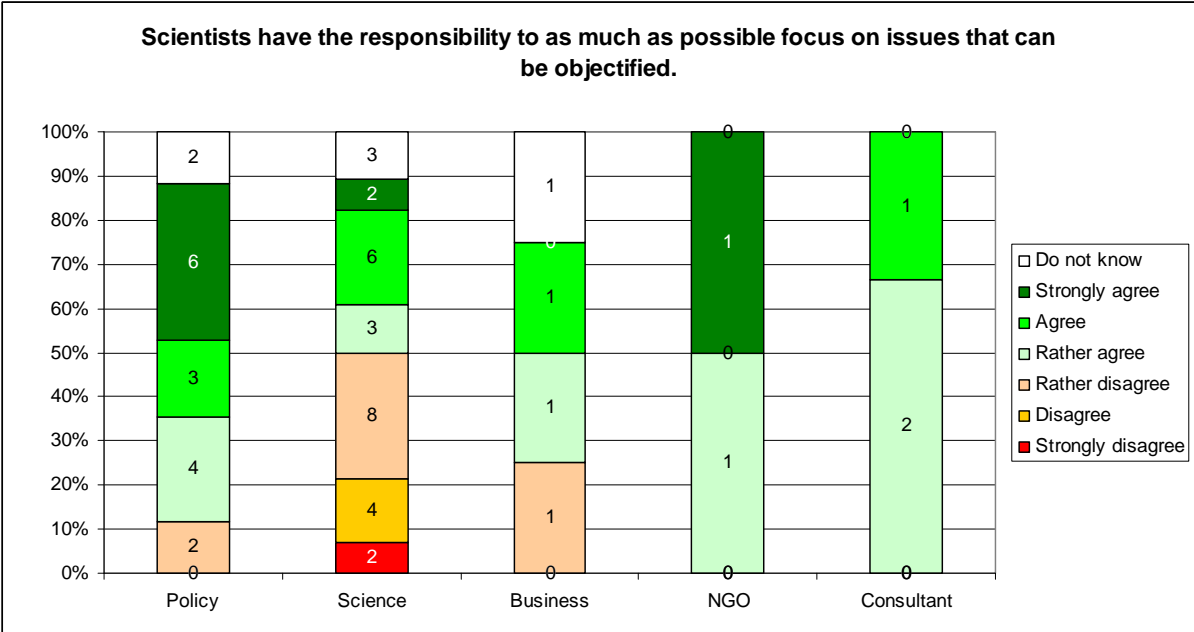
Figure 45 Scientific focus on issues that can be objectified? – Educational background
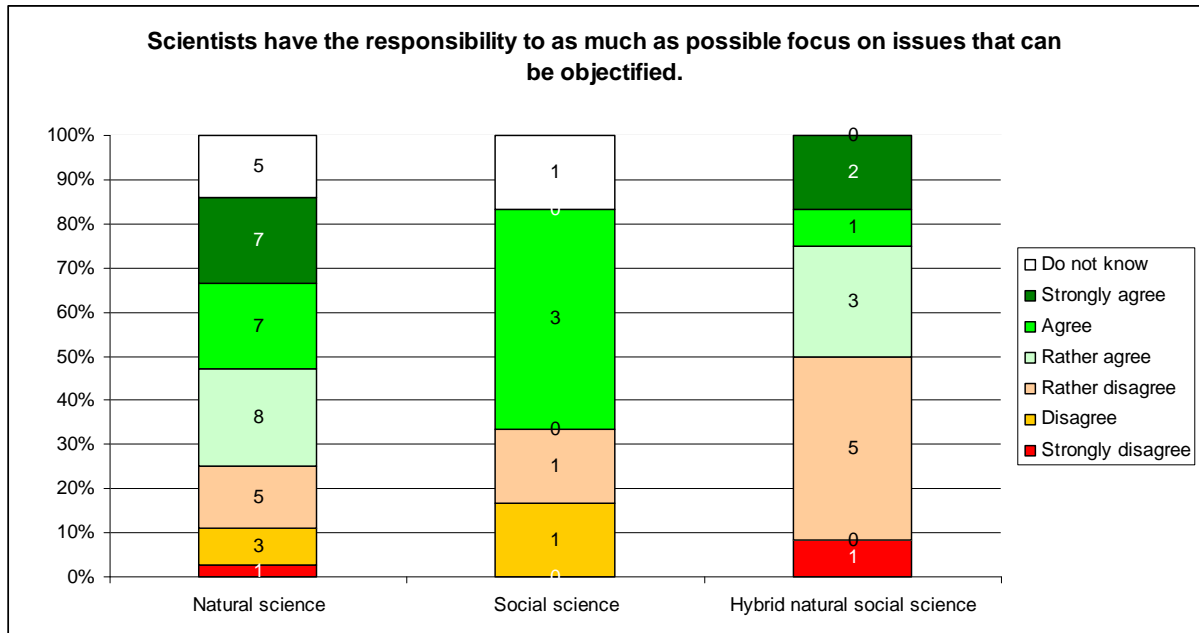
Figure 46 Science should produce simple knowledge
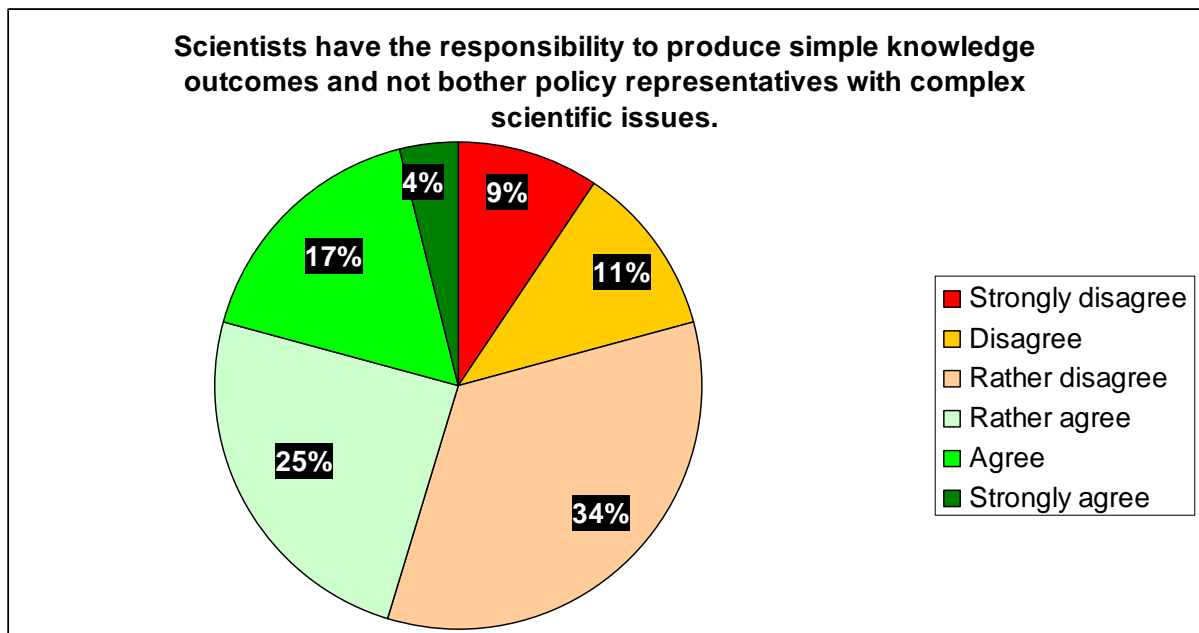
Figure 47 Science should produce simple knowledge – Institutional background

Scientists have the responsibility to produce simple knowledge outcomes and not bother policy representatives with complex scientific issues.

Figure 48 Science should produce simple knowledge – Educational background

Scientists have the responsibility to produce simple knowledge outcomes and not bother policy representatives with complex scientific issues.
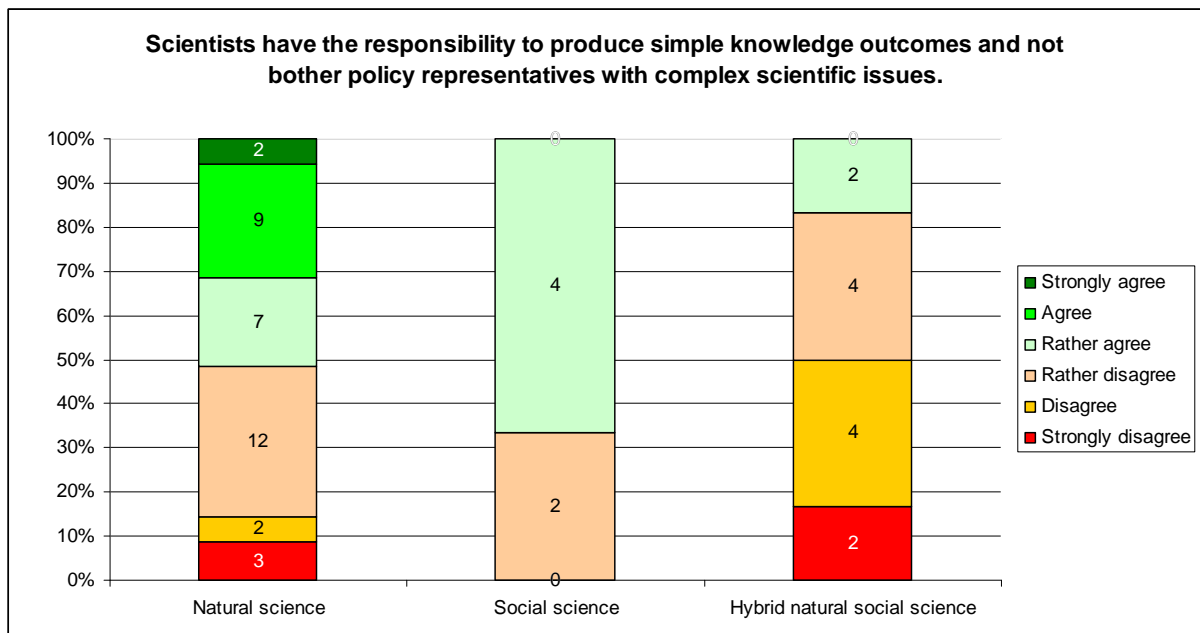
Figure 49 Black box the production of scientific knowledge

Scientists have the responsibility to black box the production process of their knowledge and not communicate about the methods used and the choices made during knowledge production.

Legend:
- Strongly disagree
- Disagree
- Rather disagree
- Rather agree
- Strongly agree
- Do not know
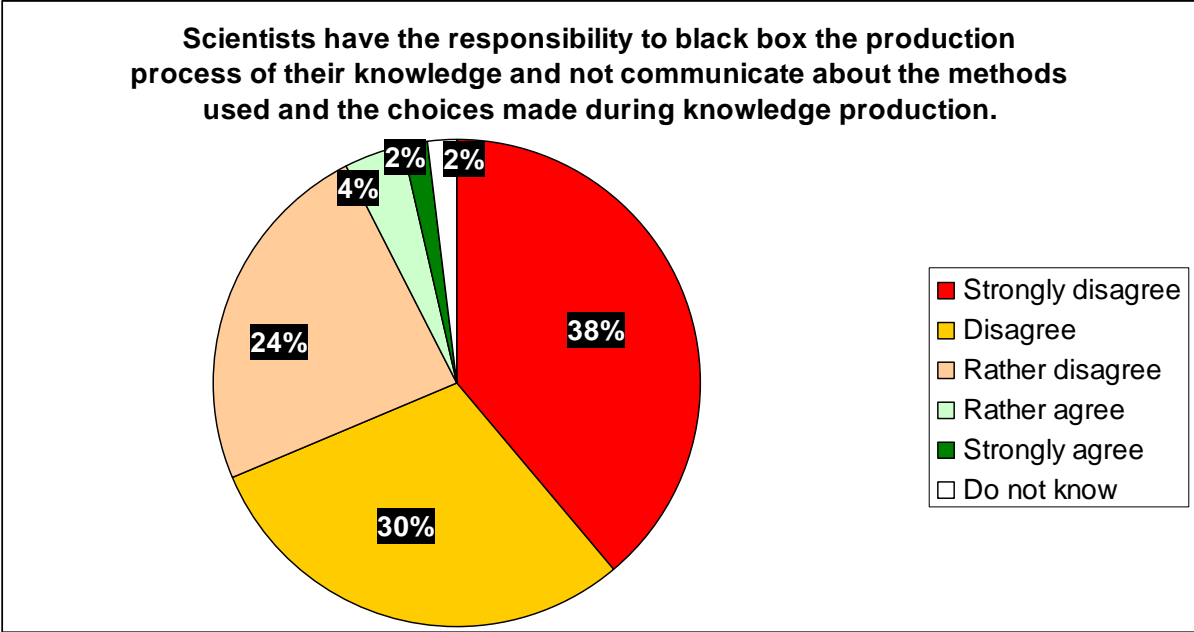
Figure 50 Black box the production of scientific knowledge – Institutional background

Scientists have the responsibility to black box the production process of their knowledge and not communicate about the methods used and the choices made during knowledge production.
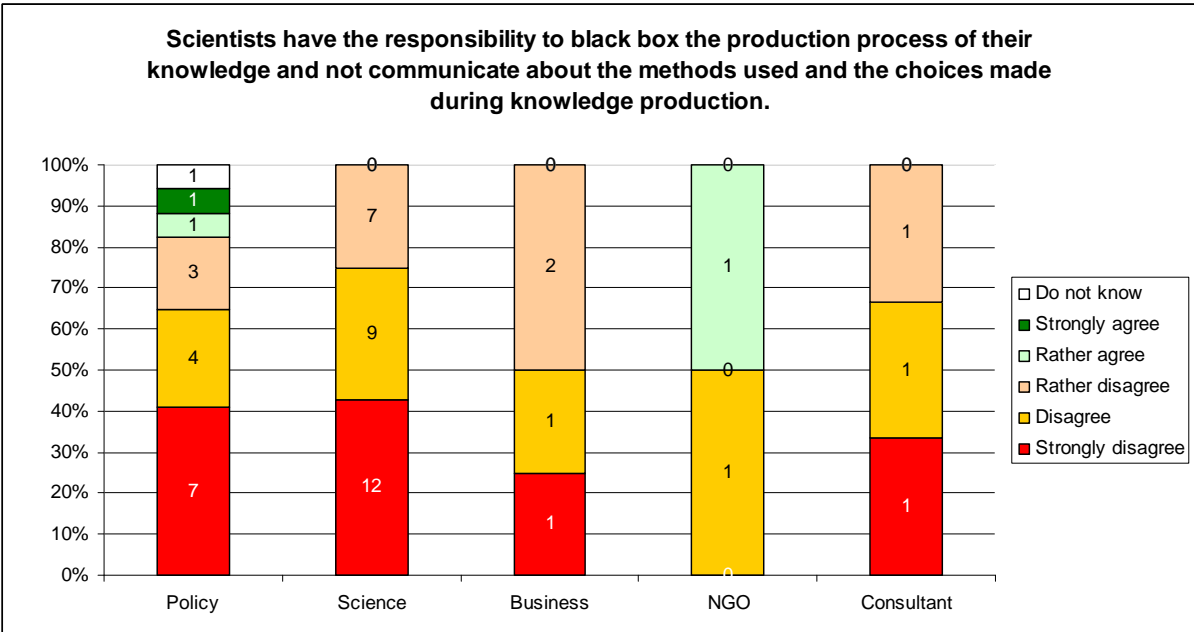
Figure 51 Black box the production of scientific knowledge – Educational background

Scientists have the responsibility to black box the production process of their knowledge and not communicate about the methods used and the choices made during knowledge production.
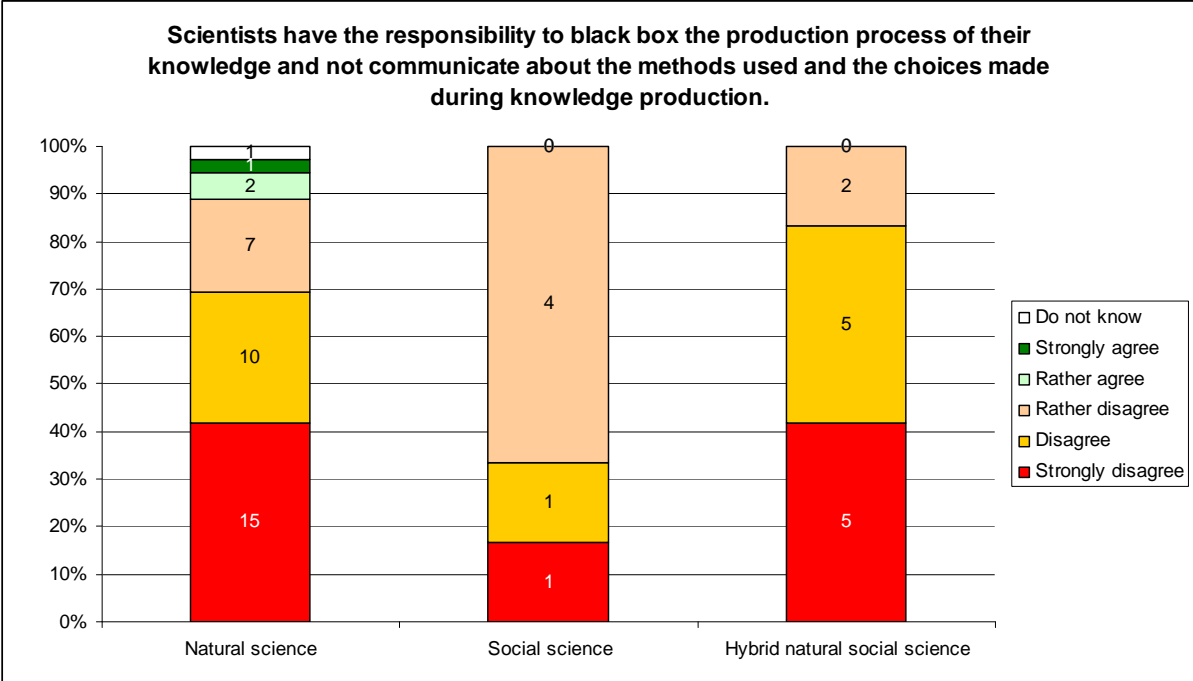
Figure 52 Scientific transparency

Scientists have the responsibility to be transparent on all important research choices they make in the knowledge production process.
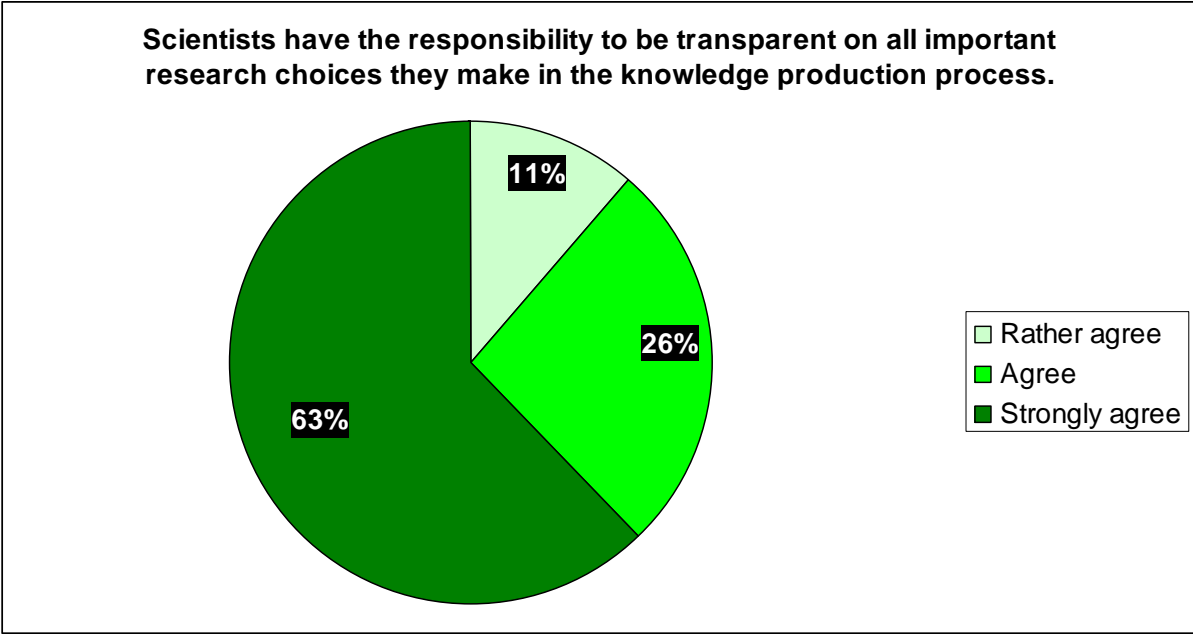
Figure 53 Scientific transparency – Institutional background

Scientists have the responsibility to be transparent on all important research choices they make in the knowledge production process.
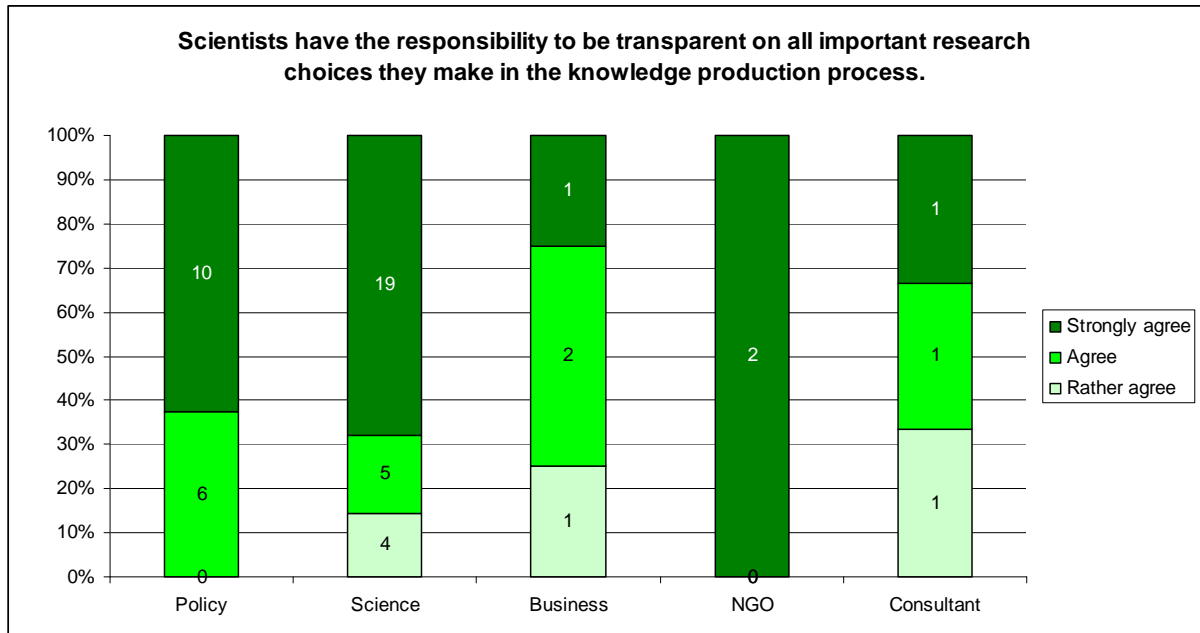
Figure 54 Scientific transparency – Educational background

Scientists have the responsibility to be transparent on all important research choices they make in the knowledge production process.
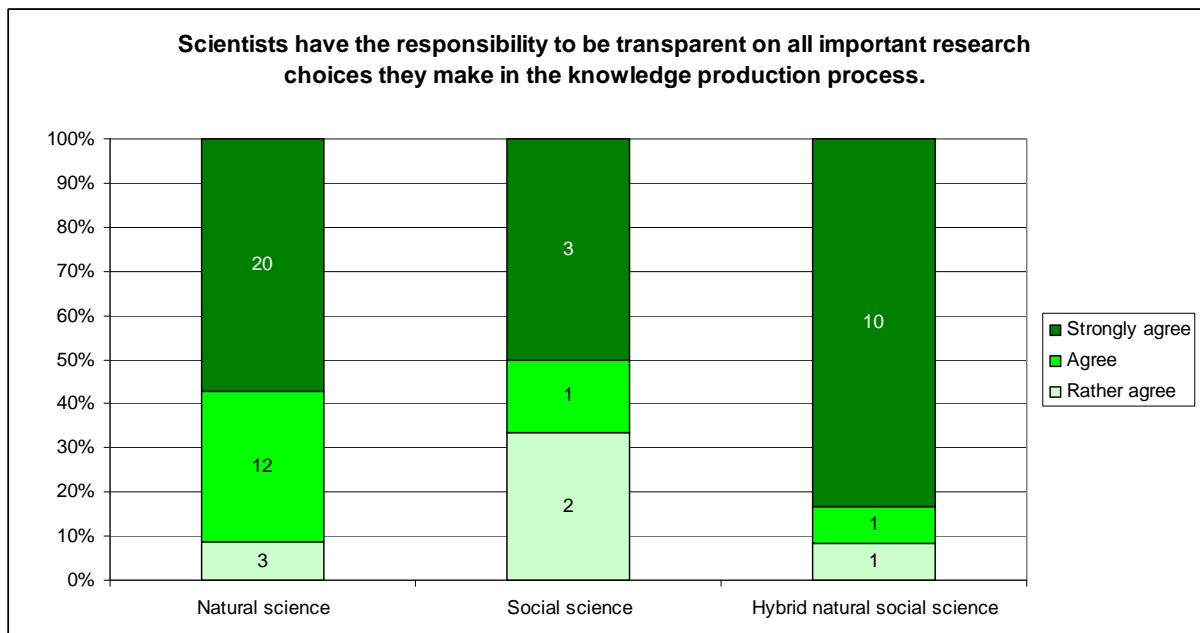
Figure 55 Social science and social preferences

Social scientists only have the responsibility to measure and quantify the social preferences of stakeholders or the general public.

Legend:
- Strongly disagree
- Disagree
- Rather disagree
- Rather agree
- Agree
- Do not know
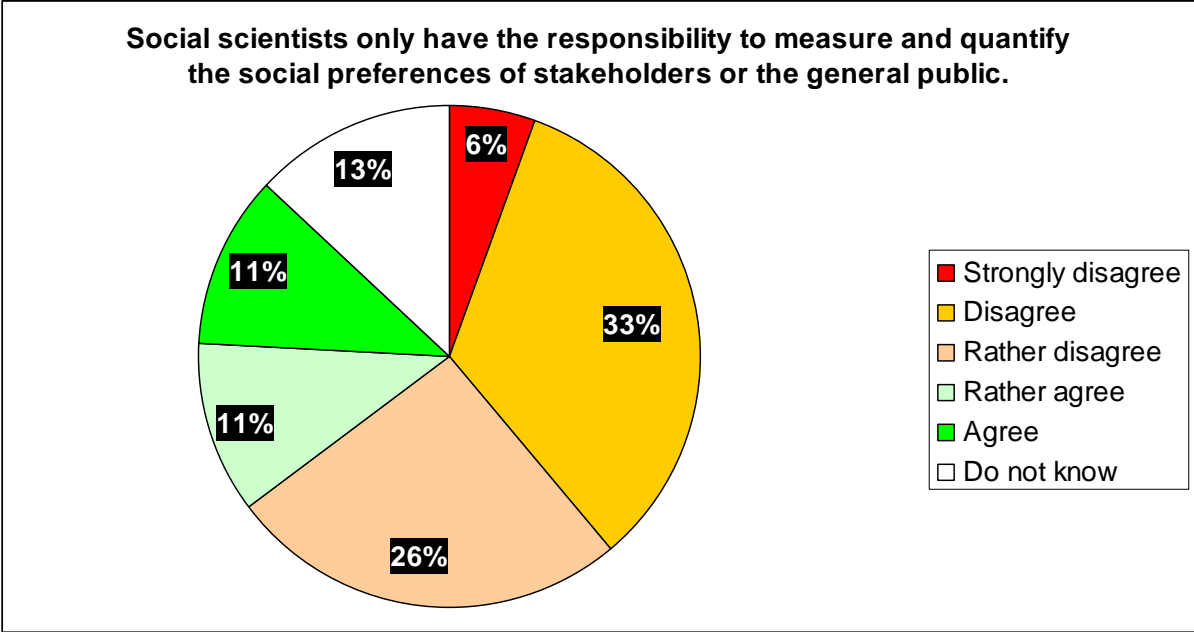
Figure 56 Social science and social preferences – Institutional background

Social scientists only have the responsibility to measure and quantify the social preferences of stakeholders or the general public.

Legend:
- Do not know
- Agree
- Rather agree
- Rather disagree
- Disagree
- Strongly disagree
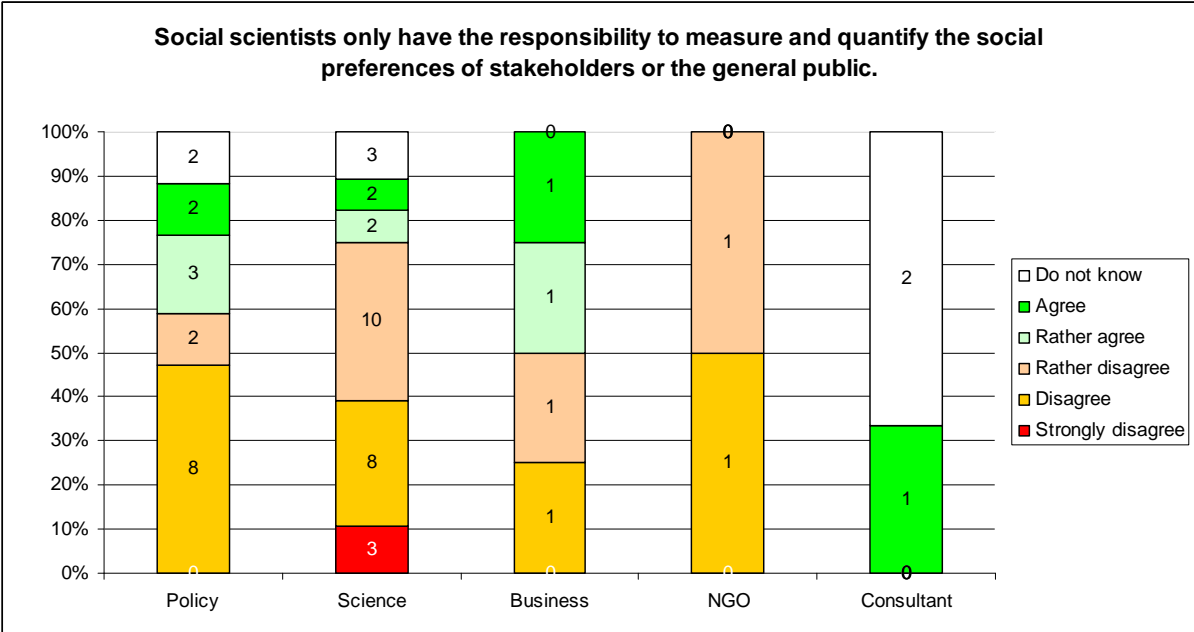
Figure 57 Social science and social preferences – Educational background

Social scientists only have the responsibility to measure and quantify the social preferences of stakeholders or the general public.
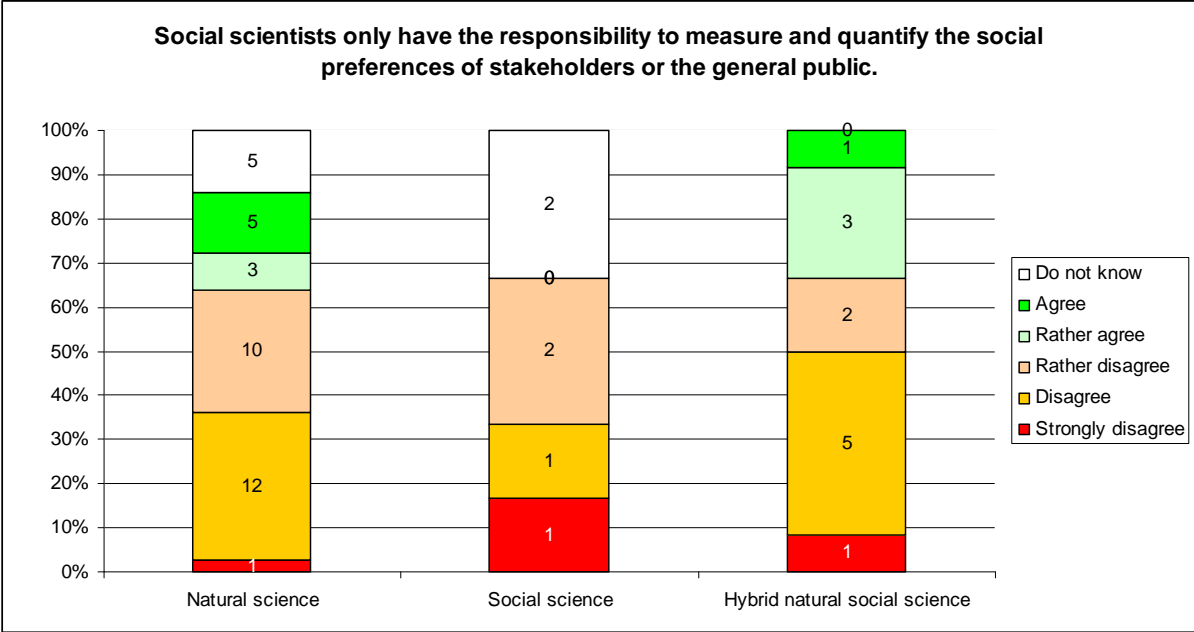
Figure 58 Social science and stakeholder deliberation

Social scientists have the responsibility to develop processes in which ecosystem services issues of social relevance can be deliberated on in well informed discussions amongst stakeholders.
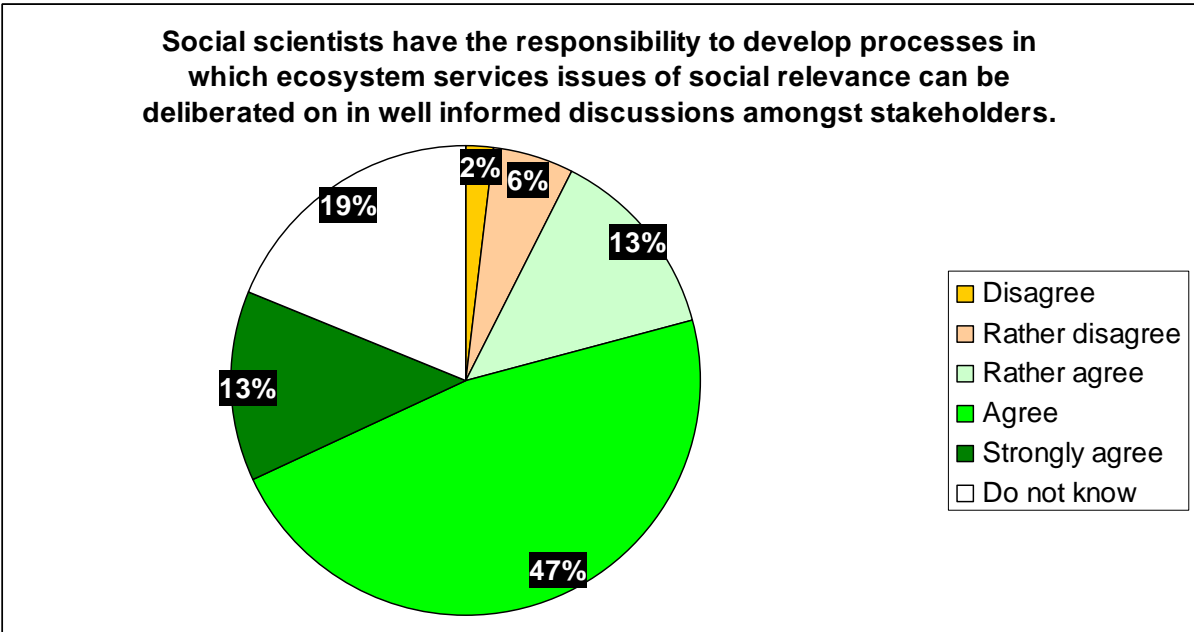
Figure 59 Social science and stakeholder deliberation – Institutional background

Social scientists have the responsibility to develop processes in which ecosystem services issues of social relevance can be deliberated on in well informed discussions amongst stakeholders.
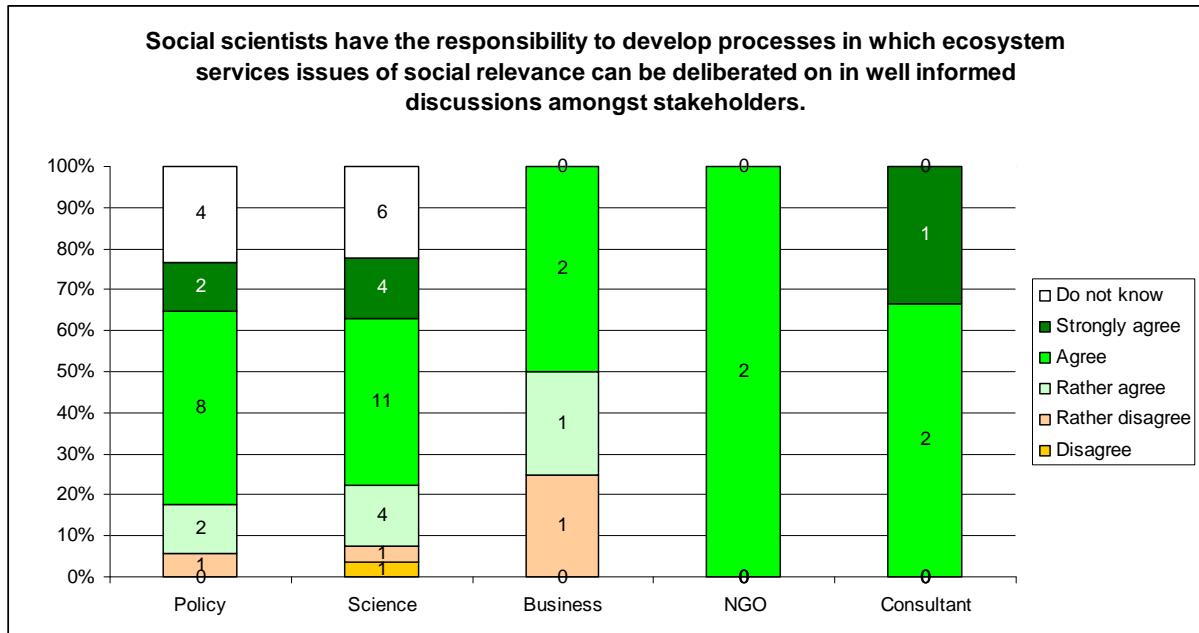
Figure 60 Social science and stakeholder deliberation – Educational background

Social scientists have the responsibility to develop processes in which ecosystem services issues of social relevance can be deliberated on in well informed discussions amongst stakeholders.
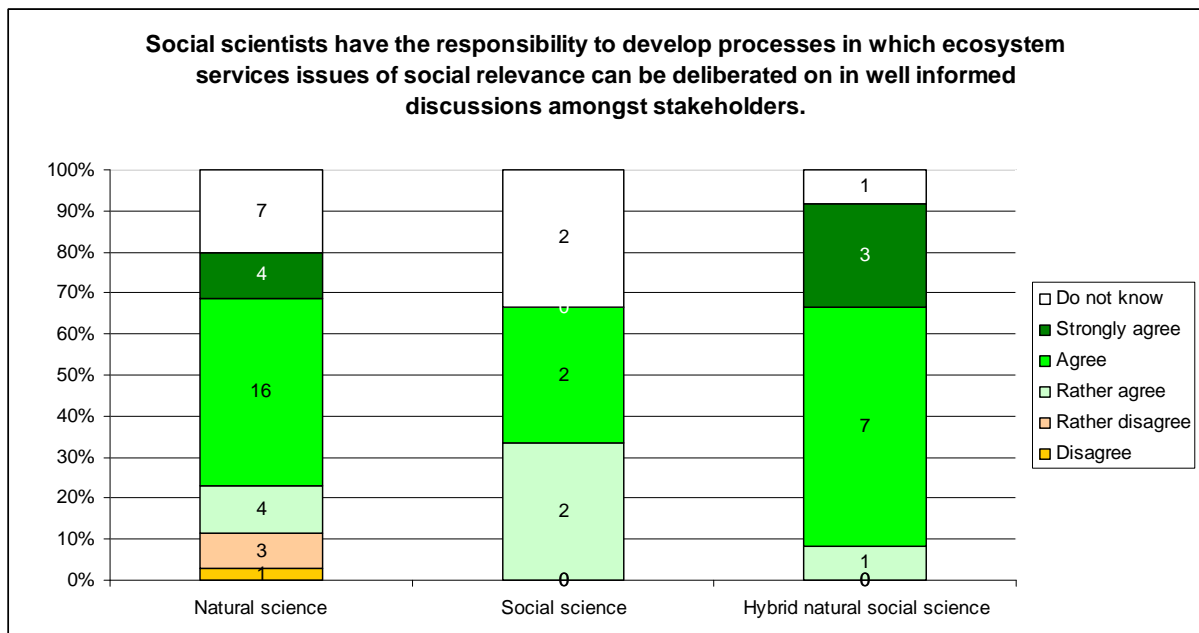
Figure 61 Social science and knowledge assessment

Social scientists have the responsibility to develop knowledge assessment procedures in which the policy relevance of scientific knowledge is discussed.

Strongly disagree: 2%
Disagree: 8%
Rather disagree: 13%
Rather agree: 19%
Agree: 31%
Strongly agree: 6%
Do not know: 21%
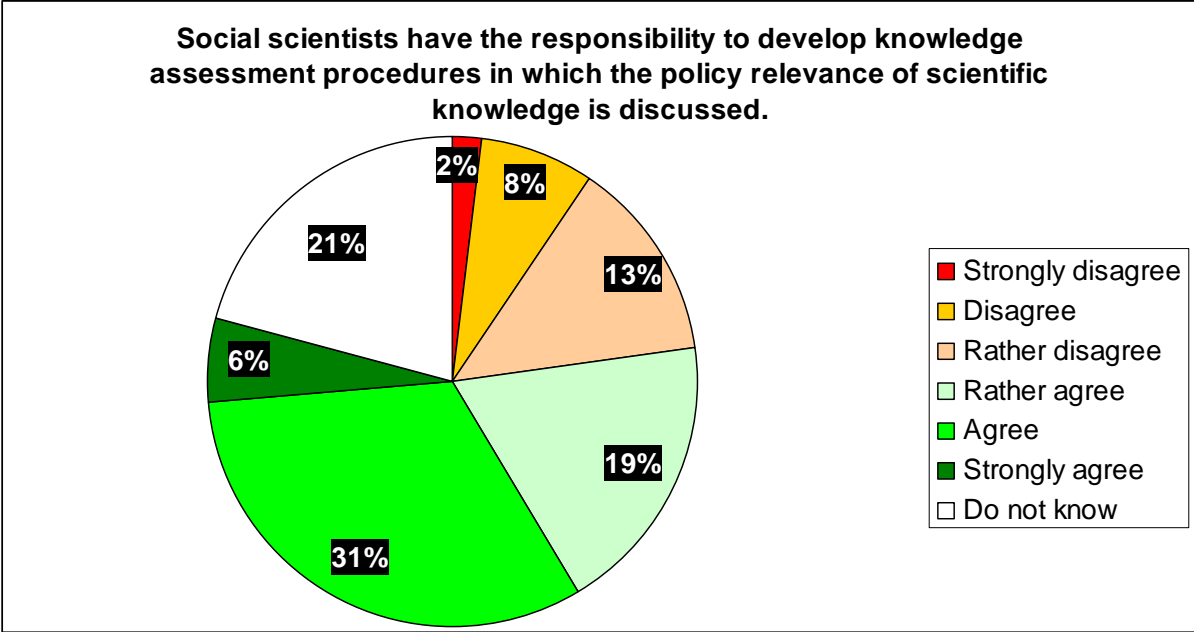
Figure 62 Social science and knowledge assessment – Institutional background

Social scientists have the responsibility to develop knowledge assessment procedures in which the policy relevance of scientific knowledge is discussed.
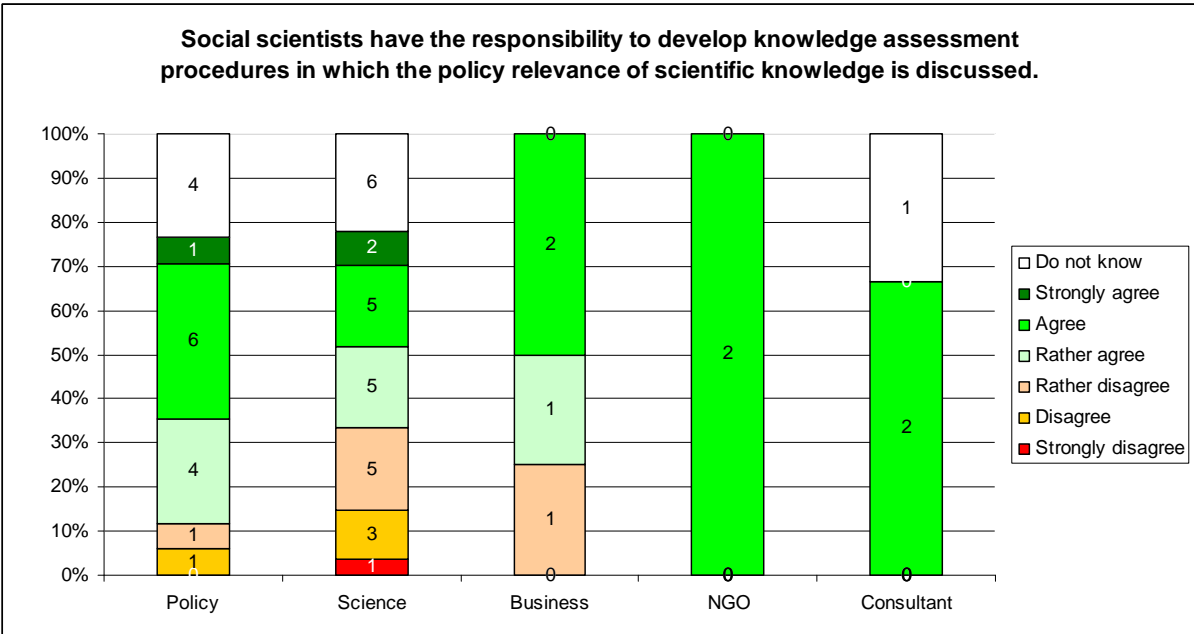
Figure 63 Social science and knowledge assessment – Educational background

Social scientists have the responsibility to develop knowledge assessment procedures in which the policy relevance of scientific knowledge is discussed.
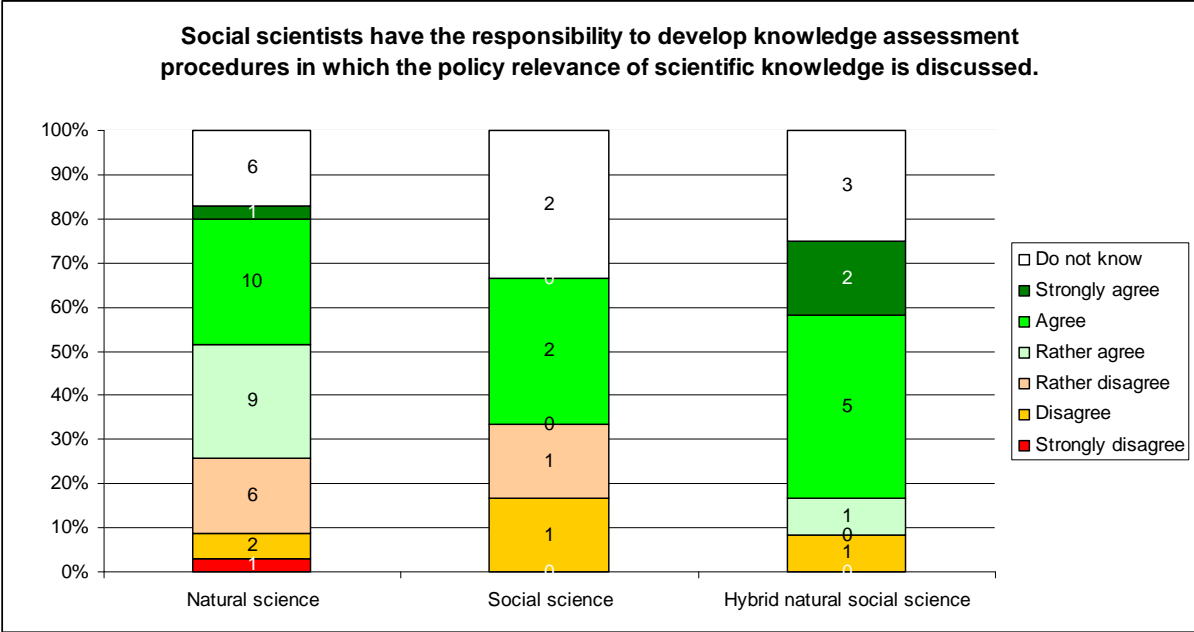
Figure 64 Social science and decision making procedures

Social scientists have the responsibility to develop decision making procedures for translating science into policy options.
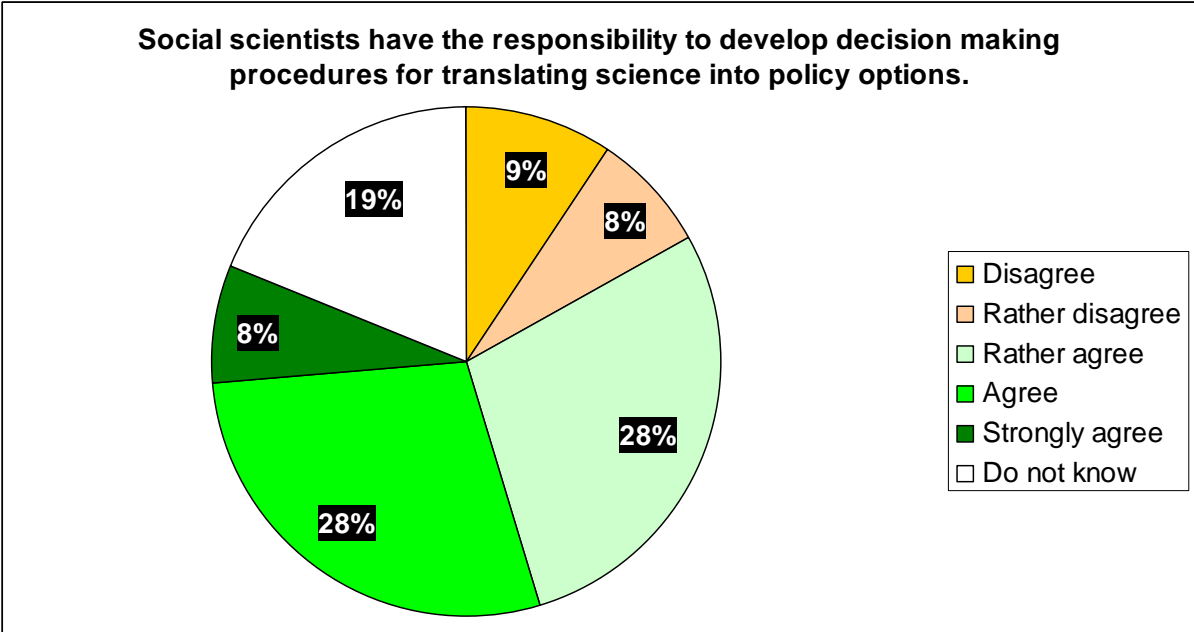
Figure 65 Social science and decision making procedures – Institutional background

Social scientists have the responsibility to develop decision making procedures for translating science into policy options.
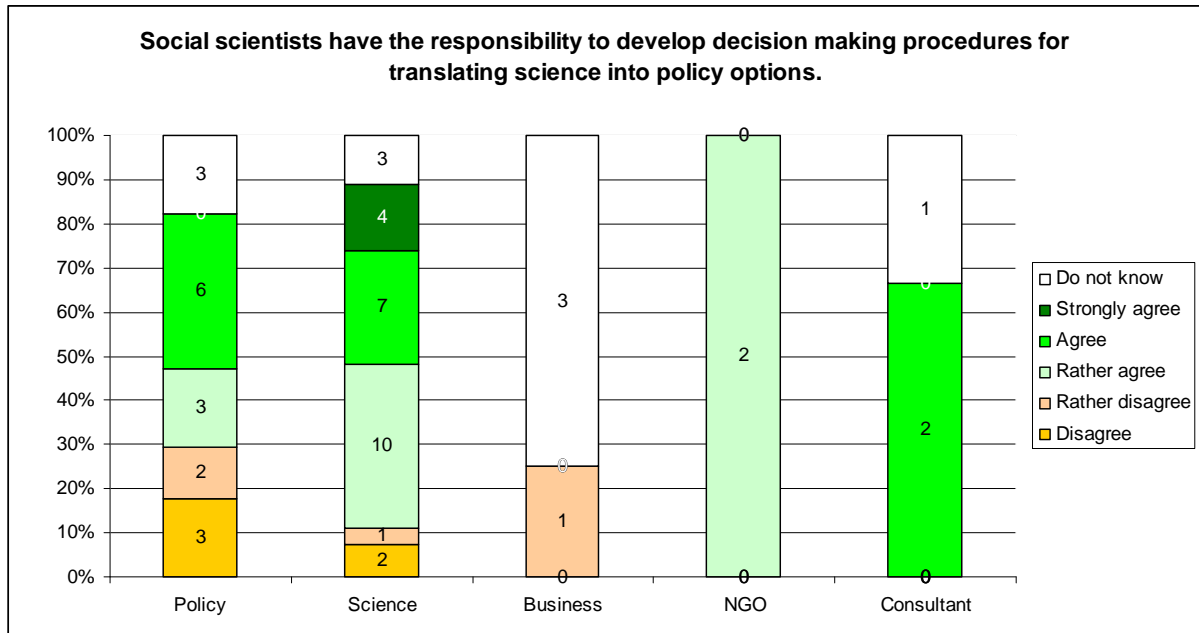
Figure 66 Social science and decision making procedures – Educational background

Social scientists have the responsibility to develop decision making procedures for translating science into policy options.

Figure 67 Limited value of a handbook on ecosystems services approaches due to need for methodological expertise

A handbook on ecosystem services tools and approaches is of limited value as context specifics will always be in demand of thorough methodological expertise.

Figure 68 Limited value of a handbook on ecosystems services approaches due to need for methodological expertise – Institutional background

A handbook on ecosystem services tools and approaches is of limited value as context specifics will always be in demand of thorough methodological expertise.
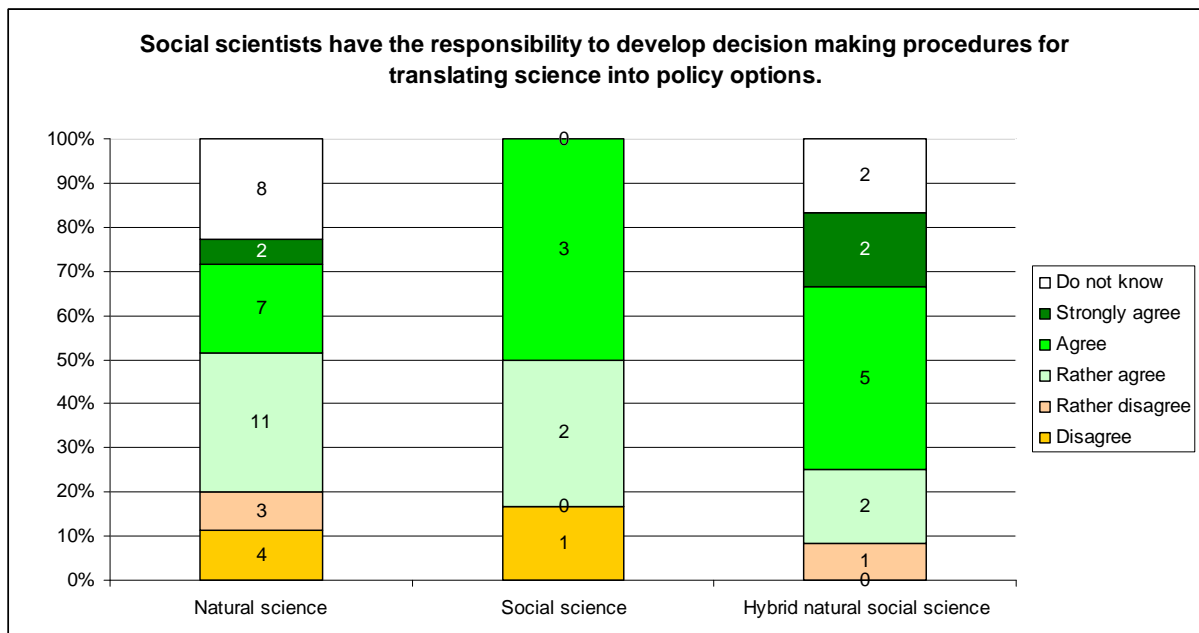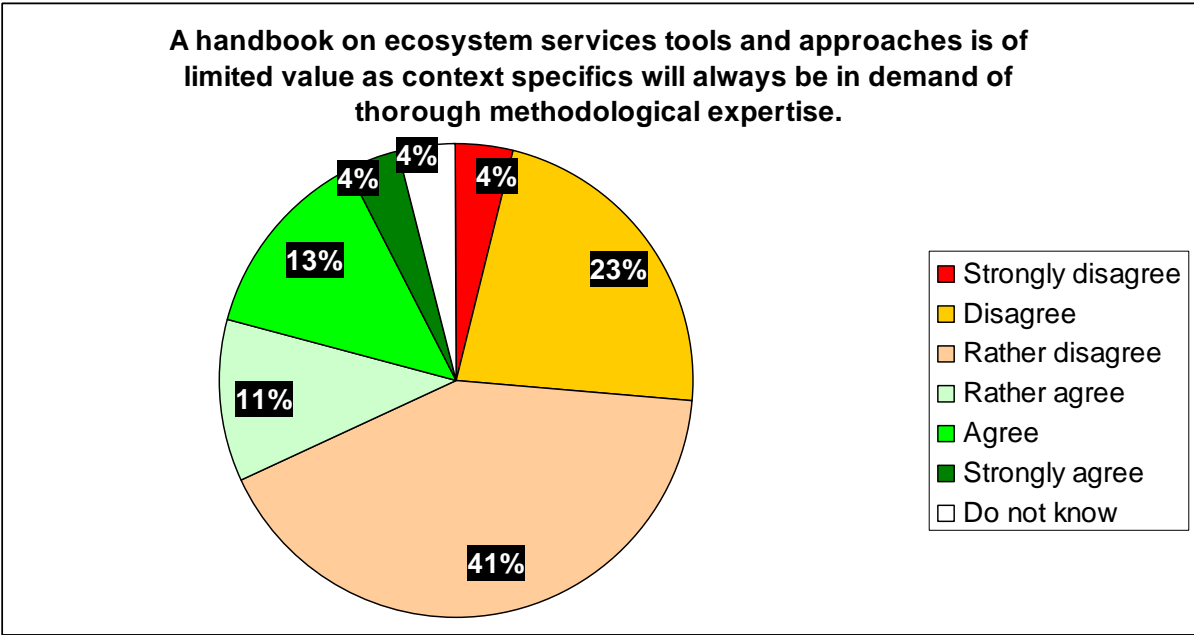
Figure 69 Limited value of a handbook on ecosystems services approaches due to need for methodological expertise – Educational background
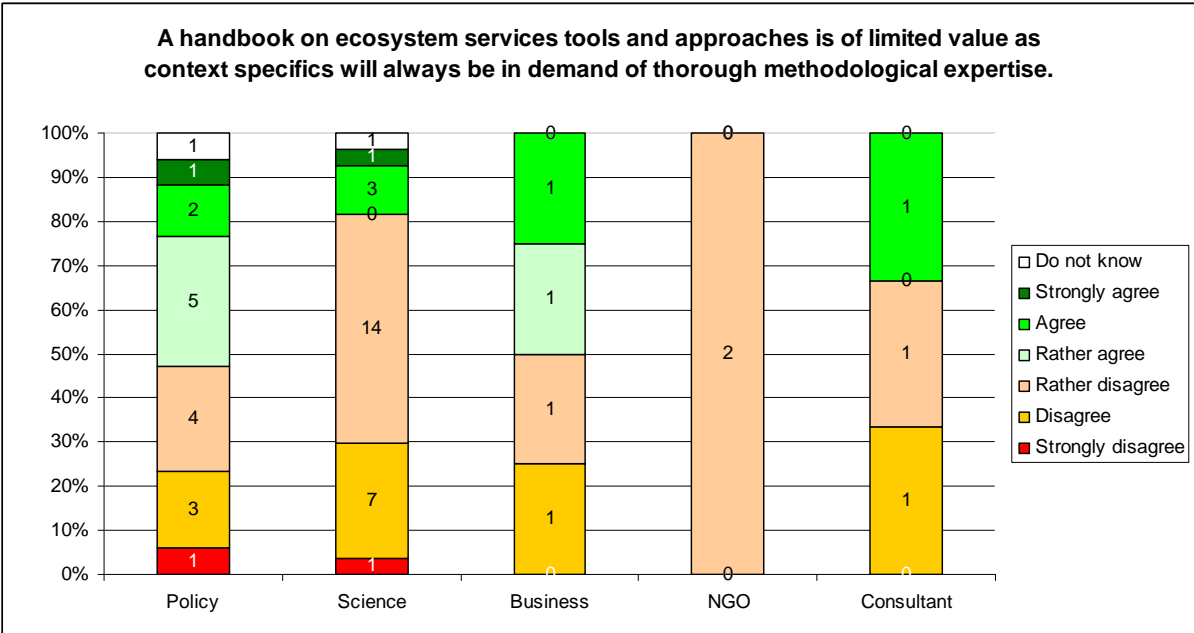

A handbook on ecosystem services tools and approaches is of limited value as context specifics will always be in demand of thorough methodological expertise.

Figure 70 Limited value of a handbook on ecosystems services approaches due to need for methodological negotiation

A handbook on ecosystem services tools and approaches is of limited value as choices of tools and approaches are dependent of negotiation amongst actors responsible for the organization of ecosystem services assessments.

Figure 71 Limited value of a handbook on ecosystems services approaches due to need for methodological negotiation – Institutional background

A handbook on ecosystem services tools and approaches is of limited value as choices of tools and approaches are dependent of negotiation amongst actors responsible for the organization of ecosystem services assessments.

Figure 72 Limited value of a handbook on ecosystems services approaches due to need for methodological negotiation – Educational background
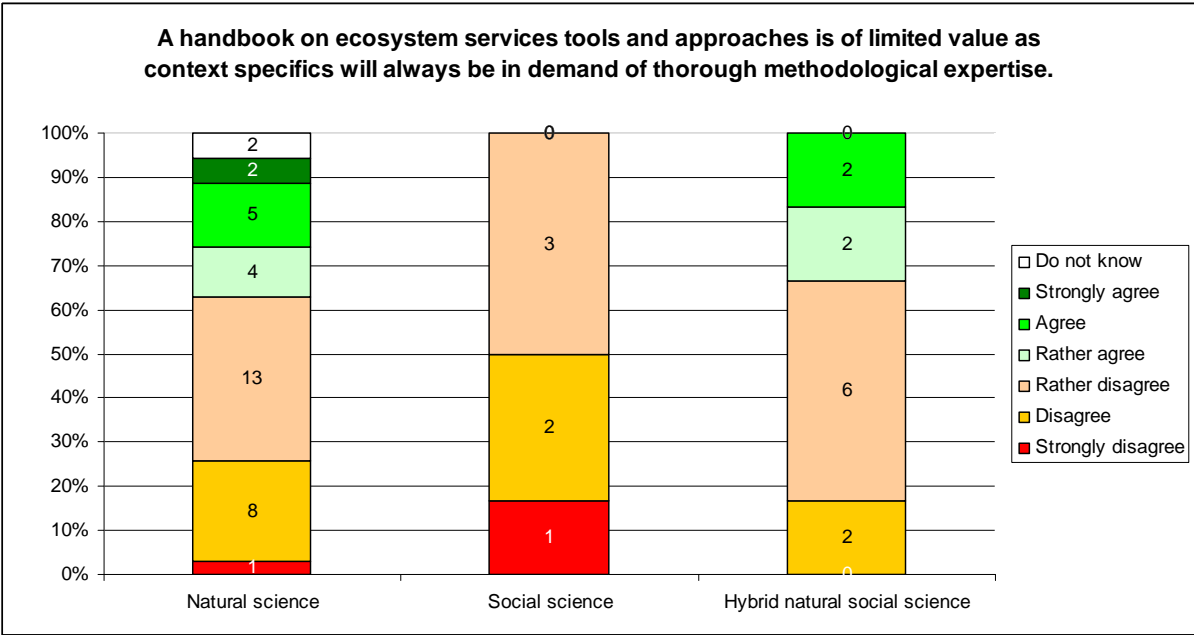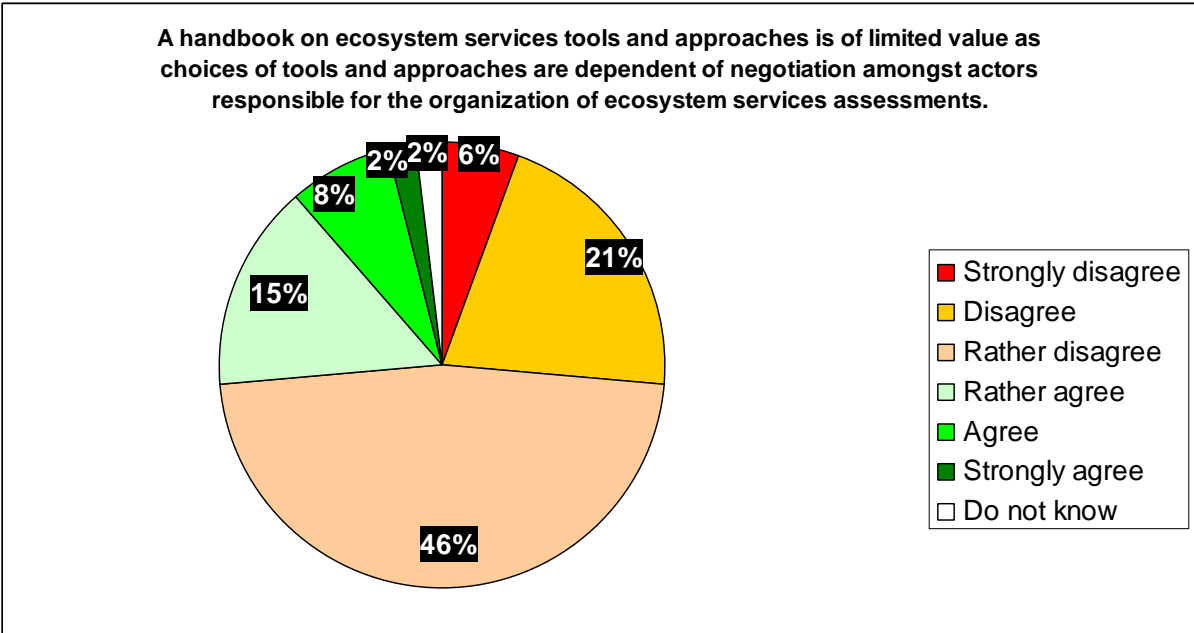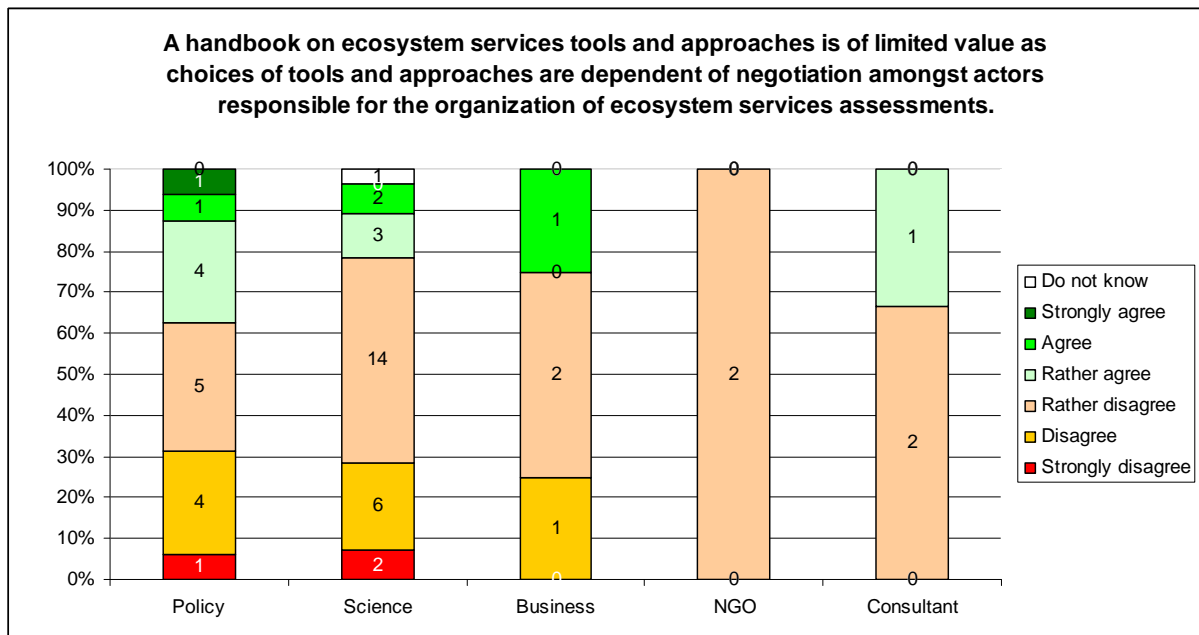

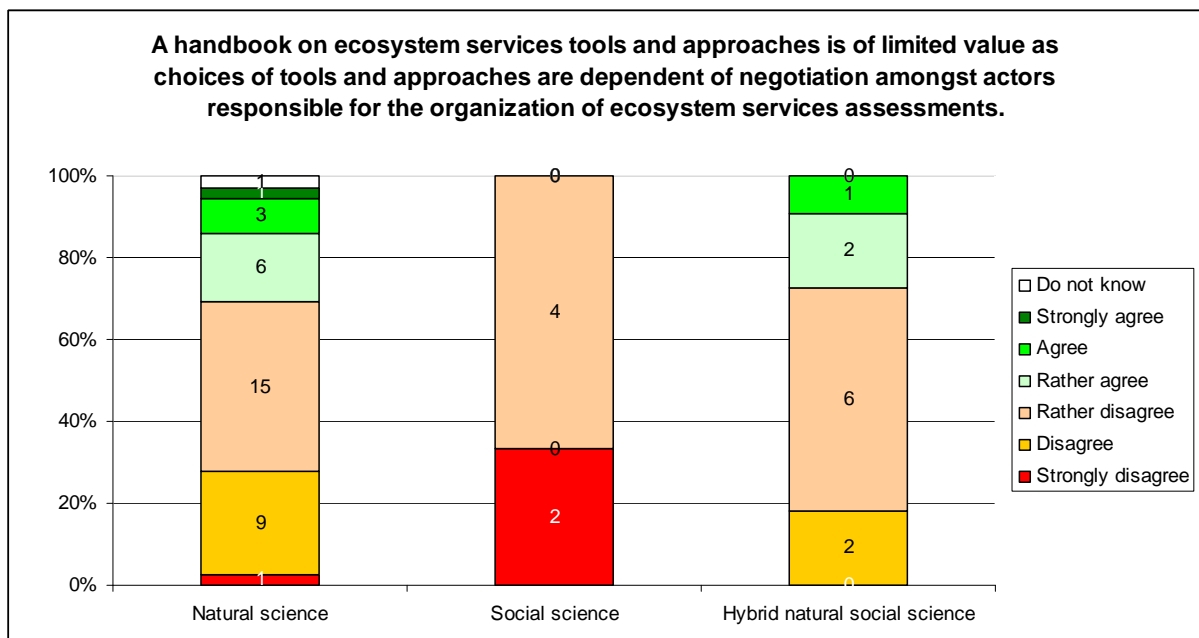**A handbook on ecosystem services tools and approaches is of limited value as choices of tools and approaches are dependent of negotiation amongst actors responsible for the organization of ecosystem services assessments.**

Figure 73 Knowledge ability of policy makers

Policy representatives* have the responsibility to be knowledgeable on the scientific ecosystem services debate and developments in order to be qualified to discuss with scientists the policy relevance of the ecosystem services knowledge to be produced.

- Disagree
- Rather disagree
- Rather agree
- Agree
- Strongly agree
- Do not know

4% 4% 16% 39% 25% 12%
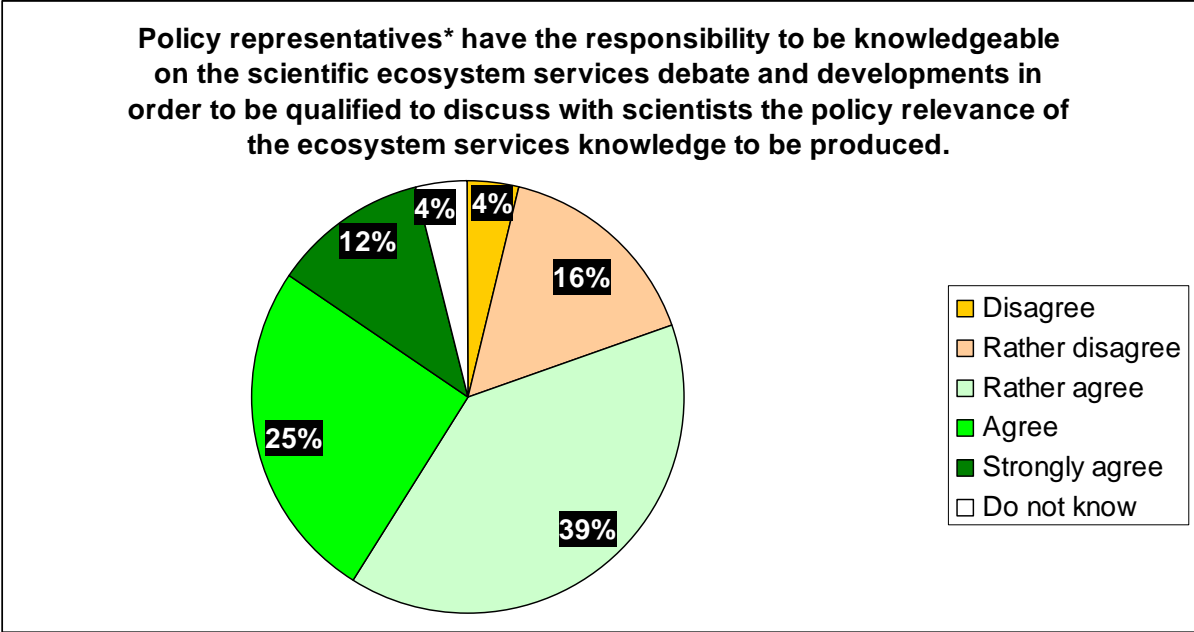
Figure 74 Knowledge ability of policy makers – Institutional background

Policy representatives* have the responsibility to be knowledgeable on the scientific ecosystem services debate and developments

- Do not know
- Strongly agree
- Agree
- Rather agree
- Rather disagree
- Disagree
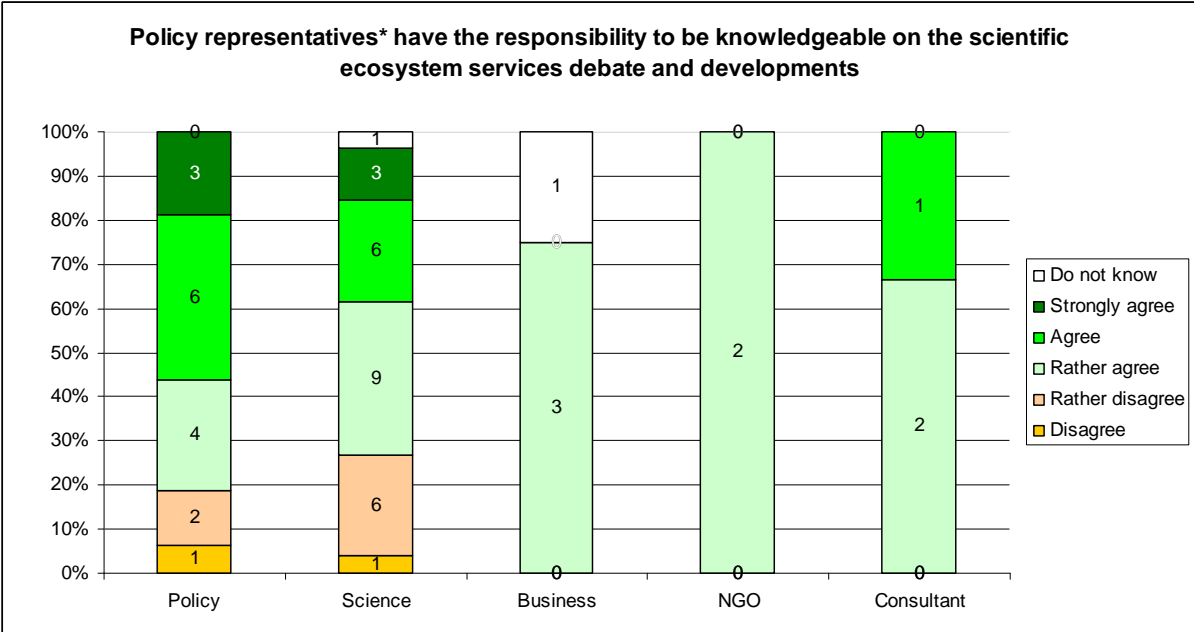
Figure 75 Knowledge ability of policy makers – Educational background

Policy representatives* have the responsibility to be knowledgeable on the scientific ecosystem services debate and developments
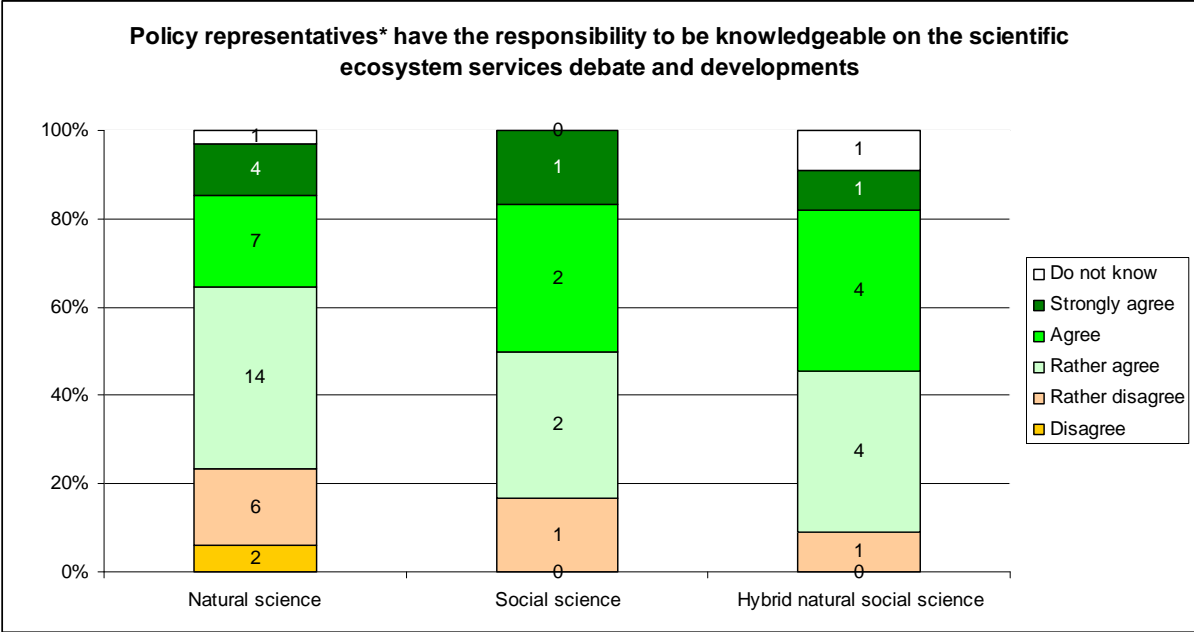
Figure 76 Knowledge ability of scientists

Scientists have the responsibility to be knowledgeable on ecosystem services-relevant policies, developments and policy potential.
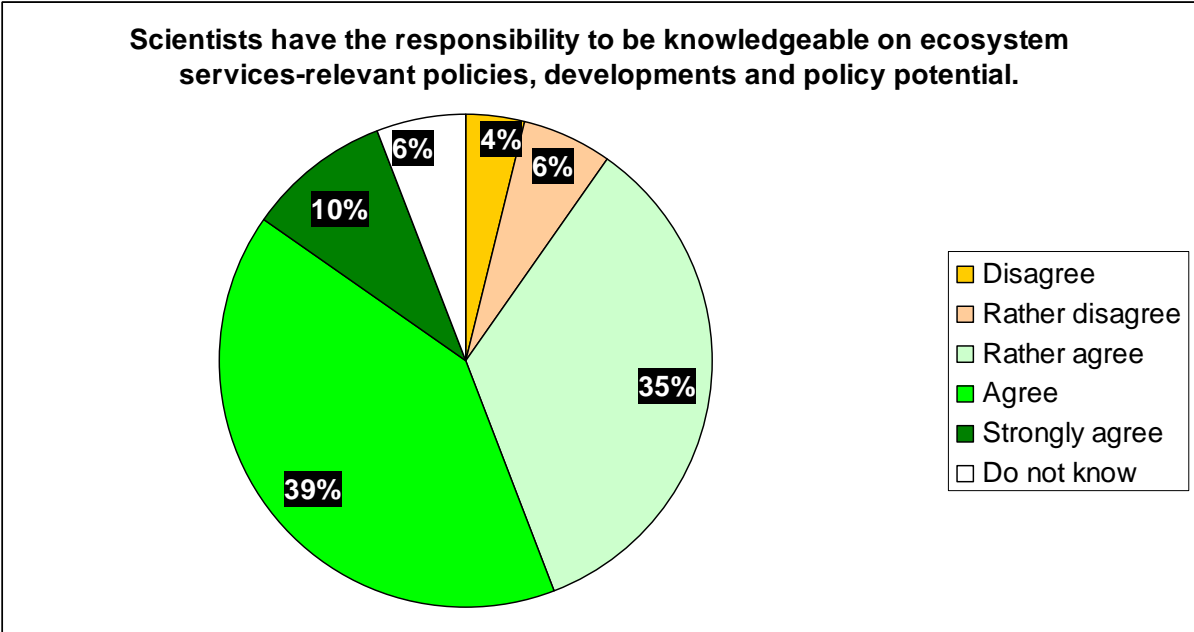
Figure 77 Knowledge ability of scientists – Institutional background

Scientists have the responsibility to be knowledgeable on ecosystem services-relevant policies, developments and policy potential
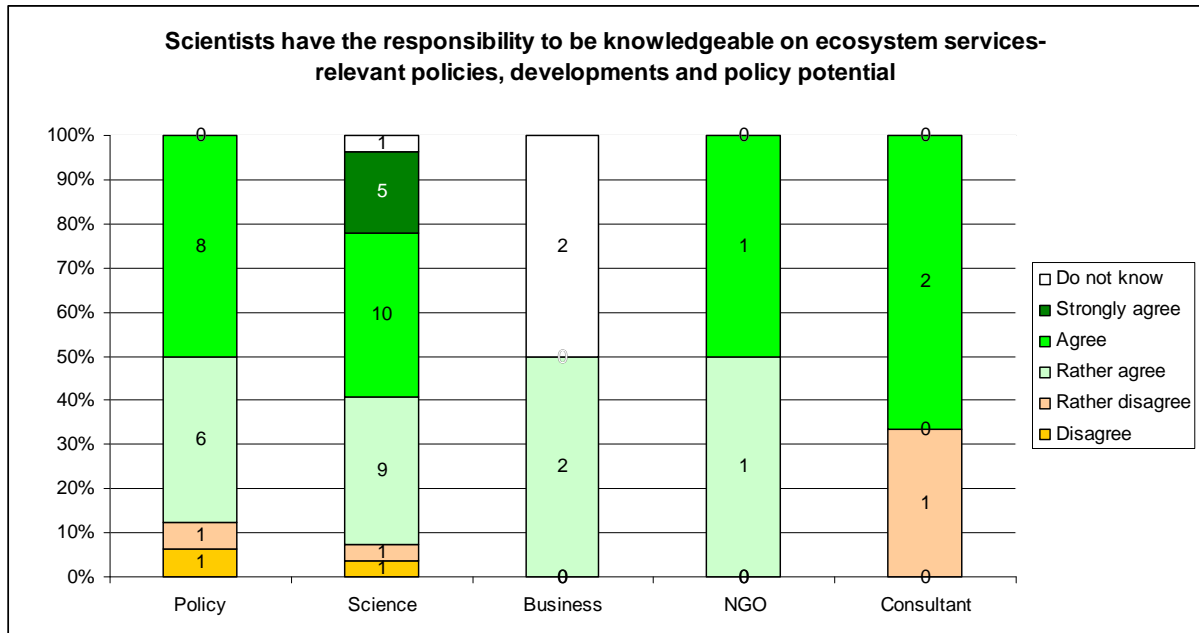
Figure 78 Knowledge ability of scientists – Educational background

Scientists have the responsibility to be knowledgeable on ecosystem services-relevant policies, developments and policy potential
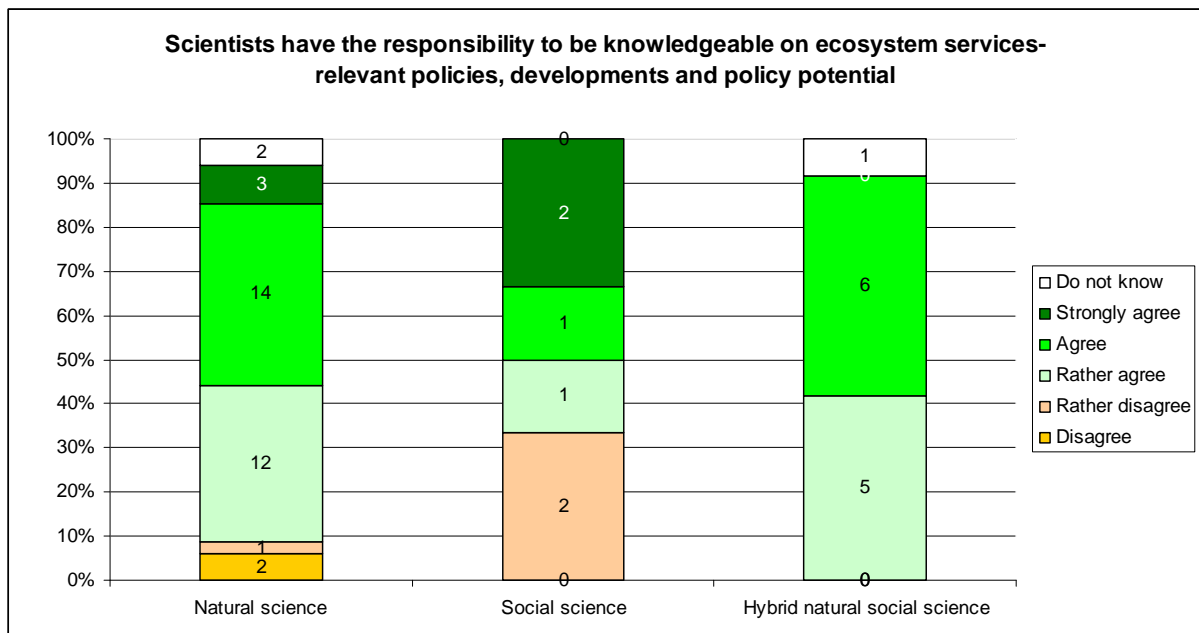
Figure 79 Science – policy collaboration instead of knowledge ability

Scientists and policy representatives not necessarily need to be knowledgeable about each other's ecosystem services related expertise and practices, but have to work together.

Legend:
- Strongly disagree
- Disagree
- Rather disagree
- Rather agree
- Agree
- Strongly agree
- Do not know

Values shown: 2%, 6%, 13%, 23%, 33%, 17%, 6%
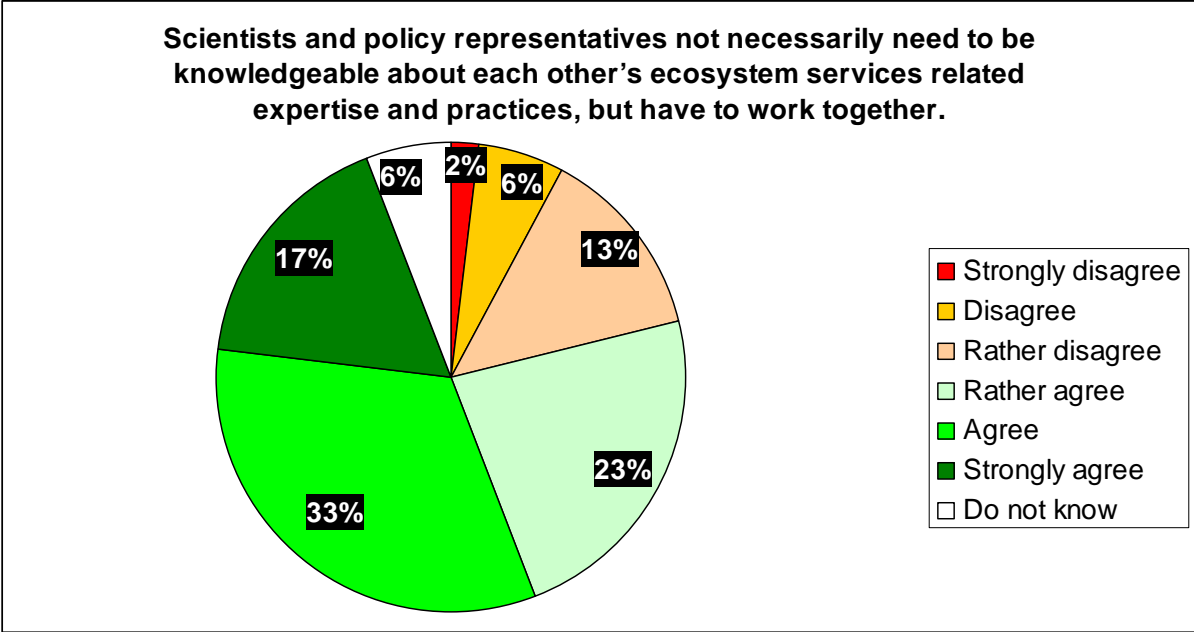
Figure 80 Science – policy collaboration instead of knowledge ability – Institutional background

Scientists and policy representatives not necessarily need to be knowledgeable about each other's ecosystem services related expertise and practices, but have to work together
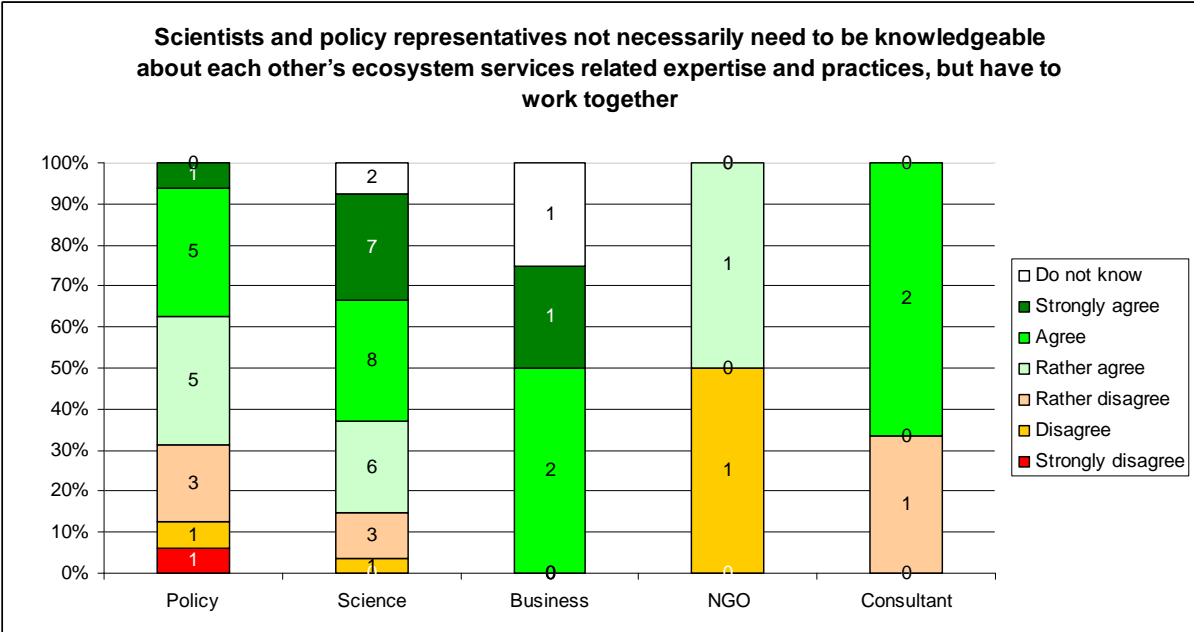
Figure 81 Science – policy collaboration instead of knowledge ability – Institutional background

Scientists and policy representatives not necessarily need to be knowledgeable about each other's ecosystem services related expertise and practices, but have to work together