



Methodological and Ideological Options

Natural Capital Accounts and Public Policy Decisions: Findings From a Survey

Laura Recuero Virto^{a,*}, Jean-Louis Weber^b, Mathilde Jeantil^c^a Sciences Po Paris and French Ministry of Foreign Affairs and International Development, 27 rue de la Convention, 75015 Paris, France^b Member of the European Environment Agency's Scientific Committee, University of Nottingham, Nottingham NG7 2RD, United Kingdom^c Ecole Normale Supérieure de Cachan, 61 Avenue du Président Wilson, 94230 Cachan, France

ARTICLE INFO

JEL Classification:

Q0
Q28
Q38
Q58

Keywords:

Natural capital accounts
Public policy

ABSTRACT

There have been many initiatives and policy commitments in natural capital accounting in the recent years. Based on a survey for statistical offices, ministries and independent experts worldwide, we provide some preliminary evidence that there is very little use of natural capital accounts for public policy decisions and, more so, in developing countries. The most relevant obstacles are the lack of political support by key people and institutional leadership unable to promote policy use by other ministries. Concerning developing countries, the factor which is considered as the most relevant in preventing the use of natural capital accounts for policy making is the stage of development of the country. In addition, respondents from statistical institutes and developing countries are firstly, concerned about institutional obstacles and secondly, about data availability and cooperation. Respondents from ministries and independent experts are particularly concerned about design obstacles. Not many accounts may be available to be used in the policy-making process due to data gaps, design challenges and the required investment, the problem being more acute in developing countries. A key result of the survey is the need to evaluate the added value of natural capital accounts with respect to statistics.

1. Introduction

The concept of natural capital can be described as the components of the natural environment that can be used to generate income, goods or services (Barbier, 2011). It underlines the role of nature in supporting the economy and human well-being (Pearce et al., 1989). Natural capital can be categorised as geophysical capital (abiotic goods and services) and ecosystem capital (biotic goods and ecosystem services) (Milligan et al., 2014; Petersen and Gocheva, 2015).¹ Ecosystem services, in particular, can be defined as the outcome of biological, geochemical and physical processes and components that take place within an ecosystem and that are accessible to people (Weber, 2011; Maynard et al., 2015).² According to the Common International Classification of Ecosystem Services (CICES), three broad categories of ecosystem services can be identified, namely: provisioning, regulation and maintenance, and cultural services (MA, 2005; Weber, 2011).³

There is no single agreed-upon definition of natural capital or

(economic-)environmental accounting (Hecht, 2000; Weber, 2014a). We can nevertheless identify some common elements that usually characterise this concept (Hecht, 2000). Firstly, these accounts provide tools to link environmental and economic data which enables joint analyses. Secondly, they have a comprehensive coverage and can be used for macroeconomic and sectoral policy-making, rather than for decisions at the local level. Third, the accounts have time series data produced on a regular basis which enables analyses of trends over time. In this paper, we broadly define natural capital accounts as ‘the (economic-)environmental accounts that refer to the statistics that can be integrated with national economic accounts which enable to have joint analyses’.

Since the 1970s with some initiatives in Canada, Denmark, France, the Netherlands, Norway and Spain, we have witnessed substantial efforts to develop natural capital accounting (Laurans et al., 2013; Edens, 2013; Weber, 2014a).⁴ In the recent years, the international natural capital accounting standards have evolved, and many capacity-

* Corresponding author.

E-mail addresses: laura.recuero-virto@diplomatie.gouv.fr (L. Recuero Virto), mathilde.jeantil@ens-cachan.fr (M. Jeantil).¹ Some key features of natural capital goods and services are their depletability (or not) and their capacity (or not) to renew or self-maintain. In neoclassical economic theory, goods and services overlap since the value of the good or asset stock is derived from the net present value of expected future benefits (monetary terms) (Weber, 2014a).² Ecosystem services have not yet been given an exact definition (Weber, 2014b).³ There is no clear-cut boundary between natural capital nor ecosystem services categories (see Milligan et al., 2014 and Petersen and Gocheva, 2015 for more details).⁴ See Edens (2013) and Weber (2015) for a summary of initiatives on natural capital accounting since the 1970s.

building partnerships and research programs have been developed.⁵ Concerning international capital accounting, the United Nations System of Environmental–Economic Accounting Central Framework (SEEA CF) has become, in 2012, an international statistical standard that describes stocks and changes in stocks of environmental assets.

The 2012 SEEA Experimental Ecosystem Accounting (EEA) provides the conceptual framework for ecosystem accounting, but does not include an integrated set of accounting tables and provides little guidance on how to implement these accounts (Weber, 2014a). The SEEA EEA defines ecosystem accounting as a coherent and integrated approach to the assessment of the environment through the measurement of ecosystems, and of the flows of services from ecosystems into economic and other human activity. The 2011 EU Framework for Ecosystem Capital Accounting in Europe enables to implement simplified ecosystem capital accounts based on the use of existing data.

The term natural capital accounting is broadly used throughout these initiatives, but not always in an unambiguous way (Weber, 2014a). The usual sense (for instance, its use by the World Bank) relates natural capital both to non-renewable resources of the subsoil and to renewable resources, as well as to the associated services. While proposing no precise definition of natural capital, the SEEA EEA suggests similar coverage for natural assets and services.⁶ In the biodiversity strategy of the European Union (EU), natural capital is equivalent to ecosystem capital only. This is the terminology also used in the UNSD/UNEP/CBD project on Advancing Natural Capital Accounting (ANCA) for ecosystem capital. Natural capital can be also understood as an economic production factor or, in a broader sense, covering non-marketed ecosystem services. Capital can refer implicitly or explicitly to the standard economic theory where capital is equal to the value of discounted future benefits; or capital can be defined as physical systems with capacities and resilience.

The SEEA CF and the SEEA EEA encompass measurement in both physical and monetary terms, and this is also the scope of this paper.⁷ The monetary valuation in the SEEA CF is limited in scope, since generally only goods that have a market price are included (Weber, 2014a; Petersen and Gocheva, 2015). Physical accounts are considered the basis of the framework in the SEEA EEA (Weber, 2011). Because ecosystem accounts are deeply rooted into monitoring databases, implementation presently focuses on physical accounts. Measurement in monetary terms for ecosystem accounting is generally dependent on the availability of information in physical terms since there are few observable market values for ecosystems and their services (Weber, 2014a). According to a review of national ecosystem service assessments across the EU Member States, most provisioning services are, or will be, valued using market prices. Most regulating services using methodologies based on costs, are possible. Cultural ecosystem services, which are mainly valued using stated valuation methods, are subject to methodological challenges and lack of data (Brouwer et al., 2013).

There are many challenges related to monetary valuation in natural capital accounting. Adding together supporting services and ecosystem services represents a double counting of the contribution of supporting

⁵ Some capacity building programs include the 2008 'United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries' (UN-REDD), the 2010 'Partnership for Wealth Accounting and the Valuation of Ecosystem Services' (WAVES) coordinated by the World Bank and the Convention on Biological Diversity 'Quick Start Package' on 'Ecosystem Natural Capital Accounts' (ENCA). Some research programs include the 2005 Millennium Ecosystem Assessment, the 2008 Commission on Measuring Economic Performance and Social Progress and the 2010 Economics of Ecosystems and Biodiversity Initiative. See Milligan et al. (2014) and Petersen (2015) for a detailed review of accounting standards, capacity-building partnerships and research programs on natural capital accounting.

⁶ The SEEA CF defines environmental assets as the naturally occurring living and non-living components of the Earth that may provide benefits to humanity. The SEEA EEA proposes accounts which describe the supply of ecosystem services as well as asset accounts for ecosystems (Edens, 2013).

⁷ See Petersen and Gocheva (2015) for details on the units of measurement for the different components of the accounts in the SEEA CF and the SEEA EEA.

services.⁸ To avoid double counting, CICES classification assists in identifying the 'final outputs' of ecosystems (Haines-Young and Potschin, 2010). In addition, because there is often lack of resources and time to do monetary valuation studies, the benefit transfer approach extends value estimates for ecosystem services or ecosystem assets to other areas (Pascual et al., 2010). However, the values provided by ecosystem services are often strongly dependent on the local context and on the proximity of other ecosystems (Petersen and Gocheva, 2015). According to the SEEA EEA, the limited data for certain ecosystem services, the variability in methodologies and the lack of common functional variables across studies, limit the use of this approach.

Concerning the monetary valuation of natural capital, the choice of the discount rate, which attributes more relevance to costs and benefits in the present than in the future, is one of the most disputed subjects in economic theory (Russi and ten Brink, 2013). According to the SEEA CF, it is necessary to select marginal, private, market-based discount rates for environmental assets in net present value calculations, to align SEEA values with the system of national accounts. However, lower discount rates are more appropriate to account for intergenerational equity and ethical responsibilities to the world's poorest that depend directly on natural capital (Gowdy et al., 2009). Although experts agree on the principle of discounting and the formula to be used, they do not agree on the discount rate to be used for the valuation of natural capital (ten Brink et al., 2015).

Another problem related to the monetary valuation of natural capital, is the estimation of exchange values for non-market ecosystem capital, such as many regulation and cultural services.⁹ The SEEA CF and SEEA EEA refer in principle to exchange values, not welfare values, similarly to the system of national accounts.¹⁰ Accordingly, there is a need to value the quantity of ecosystem services at the market prices that would have prevailed if the services had been freely traded and exchanged. Weber (2011) states that in the case of ecosystem degradation, monetary valuation should be carried out on the basis of restoration costs rather than stated or revealed preferences as the latter are based on subjective evaluations, which make up-scaling and aggregation disputable.¹¹

Besides, in general, the methods based on revealed and stated preferences are based on the measurement of changes in individual welfare, and hence prices should be generated through simulated exchanged value or price function approaches (Day, 2013; ten Brink et al., 2015). In addition, if different methodologies are used for monetary valuation, the values obtained for different ecosystem services are not directly comparable and hence difficult to aggregate (Petersen and Gocheva, 2015). Despite these caveats, the use of monetary valuation is often considered useful for communication purposes (Pascual, 2014).¹²

Regarding the areas covered by natural capital accounts, at least 33 developed (high-income) countries have experiences, out of which 26

⁸ The SEEA EEA argues that peat soils and cultivated biological resources can also be subject to double counting.

⁹ It is also difficult to give a market value to biodiversity since it is challenging to evaluate the benefits it provides to humans associated, among other features, with social and cultural, ethical and aesthetic values, as well as unexplored or unknown values (Lavorel, 2014).

¹⁰ In contrast with exchange values, welfare values include the consumer surplus, that is, the difference between the price consumers are willing to pay for a good or service and the market price. Exchange values do not capture the full benefits derived by the agents participating in a transaction. Natural capital accounts using exchange values are not attempting welfare valuation, and do not replace the need for cost-benefit analyses appraisal of policy changes (ten Brink et al., 2015).

¹¹ Others argue that restoration costs reflect technological ability rather than the value of ecosystem capital (ten Brink et al., 2015).

¹² Accounts in physical units are generally given priority to consider the capacity of ecosystems to deliver services, their resilience and, ultimately, the measurement of ecosystem degradation and enhancement (Weber, 2014a). In current approaches, physical accounts are sitting alongside economic information as a set of satellite accounts (Petersen and Gocheva, 2015).

regularly compile at least one account (Edens, 2014).¹³ The accounts that are most frequently compiled are physical flows in the input and output in production and consumption, namely air emissions, energy and material flow accounts. They also cover quite often environmental transactions in monetary units, mainly taxes and environmental protection expenditure accounts, and natural capital assets in physical and monetary units, mainly energy, timber and land accounts. Ecosystem services are rarely compiled, with exceptions such as non-timber forest resources in physical units.

There are a large number of pilot projects in developed countries concerning environmental protection expenditure, air emissions and non-timber forest resources accounts which suggest that these areas should be covered in the coming years by more countries. In developing (non-high-income) countries, there are fewer natural capital accounting experiences.¹⁴ According to Edens (2014), out of 39 developing countries, 11 have some accounts while 21 have pilot projects. These countries usually develop natural capital asset accounts in physical and monetary units (minerals, energy, fish, ...) and, to a lesser extent, physical flows such as water flows. Given these premises, ecosystem services accounts are those with most data gaps both for developed and developing countries. While monitoring databases can enable physical valuation, monetary valuation demands robust primary valuation studies that cover ecosystem services relevant to the decision context which can be very expensive (Hölzinger et al., 2013).

Since setting up natural capital accounts is very demanding in terms of human and financial resources, a relevant question is to which extent and how they are used. Worldwide policy makers were asked, among other things, whether or not they had made use of their natural capital accounts for economic and policy analysis through a survey developed by the UN for the SEEA programme (UN, 2006). Specific components of natural capital accounts were used by some developed countries' line ministries and agencies for planning and policy analysis such as Norway and Sweden (integration of natural capital accounting data with macroeconomic planning tools), Australia (water Act) and the United Kingdom (carbon footprint and sustainable consumption) (Delos Angeles, 2011). The reported uses of natural capital accounting by developing countries are much scarcer.¹⁵

There are currently international efforts to support financially and to accompany, from a technical standpoint, some developing countries in the development of natural capital accounts, including ecosystem capital accounts. There is however, no scientific consensus neither on the definition of natural capital, nor on its conceptual relationship with ecosystem services. There are also theoretical and empirical questions about what should be appropriate analytical scales in ecosystem services accounting (EFESE, 2013). The process of creating of ecosystem services accounts has been characterised by tensions between statistics and modelling efforts, and between initiatives that modify the boundaries of the system of national accounts framework and the emergence of multiple systems analyses (Weber, 2015).

Significant progress in the implementation of natural capital accounts is expected given international commitments. In 2010, Parties to the Convention on Biological Diversity (CBD) decided to integrate biodiversity values in national accounting systems by 2020, under Aichi Target 2 (CBD, 2014). The EU committed to the same goal under the EU Biodiversity Strategy, has given a significant push to natural capital accounting and, in particular, to ecosystem capital accounting (EU, 2011). Under the UN General Assembly 2015 agreement, the Sustainable Development Goals (SDG) target 15.9 requires countries to integrate ecosystem capital values into national and local planning,

¹³ Developed countries are those with high-income level according to the World Bank classification.

¹⁴ Developing countries are those with non-high-income level according to the World Bank classification.

¹⁵ See Hecht (2000), Edens (2014) and Milligan et al. (2014) for some additional examples in developed and developing countries.

development processes, poverty reduction strategies and accounts by 2020.

These commitments on natural capital accounts are made in a context of accelerated degradation of ecosystem capital (GRET/CIRAD/CDC Biodiversité, 2014). They seek to foster better management decisions, and are often closely linked to defining financing needs and mechanisms (NRC, 2005; TEEB, 2008). In this context, we propose to explore whether or not natural capital accounting has been used so far to inform public policy decisions, and to identify the obstacles that prevent such usage, if any. We explore the specificities of developed and developing countries. We aim at extending UN (2006) survey's sample beyond statistical offices since the latter may not be well informed of policy uses (Smith, 2015a). A survey conducted recently on 21 countries identified the (lack of) political awareness and will, enabling laws, policies and institutions, and technical knowledge and capacity as the challenges to the advancement and implementation of natural capital accounting (Milligan et al., 2014).

The remainder of this paper is structured as follows. In the second section of the paper, we describe the existing evidence on the obstacles for the use of natural capital accounts for policy decisions. We find six major obstacles: political, structural, institutional, design, data availability and cooperation. We elaborate a survey that we describe in Section 3. In Section 4, we provide the data description. In Section 5, we describe the results and in Section 6 we conclude. The survey, some details about the sample, and the results of the survey can be found in the Appendices (Tables A.1–A.2 and A.3–A.5, and A.6–A.13, respectively).

2. What Do We Know About the Obstacles for the Use of Natural Capital Accounts for Policy Decisions?

Most of the literature on natural capital accounting and its policy uses comes from practitioners and international organisations aiming at better informing the design of these initiatives. Given this literature, we can define six main obstacles for the use of natural capital accounts for policy decisions: structural, political, institutional, design, data availability and (absence of) cooperation. Regarding structural obstacles, the country's level of development can affect its' capacity to undertake natural capital accounts and to continue them in the long term. In some developing countries fail to develop natural capital accounts in a sustainable manner because of resource constraints and lack sufficient data (Edens, 2013). Because national accounts data is weak they may already devote much of their statistical efforts to improving such accounts at the request of international financial institutions (Hecht et al., 2007).

Concerning political obstacles, the United States, for instance, developed a natural capital accounting program in the mineral sector in the early 1990s under the Clinton administration. This politically controversial program was abandoned in 1994 following the first publication of natural capital accounts (Edens, 2013). There was strong opposition from the mineral resource industry (Hecht, 1999). Although Nordhaus and Kokkelenberg (1999) concluded at the importance of taking the assets and productive activities related to natural capital into account, little progress has been made. Chile also abandoned one of its natural capital accounting programs for political reasons (Hecht, 2000). In the early 1990s, the Chilean Central Bank started to implement natural capital accounts focusing on forests and minerals. This program concluded that the development strategy of forestry-based countries was not sustainable. This result, contrary to the policy pursued by the government, seems to be at the origin of the significant slowdown in the country's efforts on natural capital accounting (Hecht, 1997).

At the institutional level, there may be lack of sufficient collaboration between conventional natural capital statisticians and natural capital accountants to ensure data compatibility implement accounts. While in developing countries there may be no distinction between statisticians and accountants, in some developed countries this problem

can be relevant, particularly when they work at different institutions.¹⁶ The collaboration is essential to deal with technical problems that may arise to best reflect the interactions between the economy and the environment (Hecht, 2000).¹⁷ Besides, it is important to choose the appropriate leader in natural capital accounting to promote policy uses by other line ministries (UN, 2005; Edens, 2014). In most cases, the establishment of natural capital accounts is under the responsibility of the national statistical office or the minister of environment. When the country creates natural capital accounts for a particular resource, for instance, forests or water, the project may be entrusted to the ministry that has such competence. Central banks may also be associated with the implementation of natural capital accounts in Latin America (Edens, 2013).

In terms of the design of accounts, a number of international institutions including the UN, the European Commission, the IMF and the World Bank, have worked together to establish a framework for natural capital accounting. The SEEA was created in 1993 and was regularly modified to better fit the needs of countries. However, this framework is not always appropriate in practice. For instance, Japan decided to measure environmental pressures only in physical units (Edens, 2013). Moreover, the development of ecosystem accounts is still at an experimental stage. Besides, countries often lack data and funding to all the accounts recommended by the SEEA CF (Hecht et al., 2007). A country with established natural capital accounts should also have additional information not to underestimate its' impact on the environment which further increases program costs (Lange, 2003).

The availability and quality of data is a prerequisite for the use of natural capital accounts for public policy decision-making. In most cases, natural capital accounts uses data already collected for other reasons (Hecht, 2000). This secondary data must be treated to match the different concepts in natural capital accounts. Primary data is collected to establish natural capital accounts in very few countries such as Canada. There is low investment in the production natural capital primary data. Developing countries may request external funding to develop natural capital accounts and to collect data. The funding source has an impact on how the work is performed since donors may change their priorities and often work with 3 to 5 year time horizons (Hecht, 2000).

Regular and effective cooperation between countries can contribute to the standardisation of practices. Since the early 1990s, the UNSD, the EU, the OECD, the World Bank, and national statistical offices, among other organisations, are working together to propose a standardised framework to implement natural capital accounts (Lange, 2003). According to the UN (2007), there should be more cooperation and coordination between national statistical offices and the different ministers in charge of natural capital data and information. Data should be shared between and within countries prior to the implementation of frameworks. There are no tools however, to compare the management of resources across similar countries. Cooperation is particularly necessary when environmental problems are trans boundary such as the case of water management in sub-Saharan Africa.

3. Survey

The survey was conducted by the French Ministry of Foreign Affairs and International Development in a joint effort with the WAVES

¹⁶ For instance, carbon accounts are often primarily developed by meteorological offices. In France, statisticians and accountants work at different institutions (the National Institute of Statistics and Economic Studies, INSEE and the Ministry of Ecology, Sustainable Development and Energy, respectively).

¹⁷ Technically, the key issue is how to integrate data into national accounts, while ensuring compatibility with the data structures used by international groups such as the Intergovernmental Panel on Climate Change. This is adequately addressed in some cases, such as the Norwegian air emissions data, but in general terms there is still much work to be done to effectively link natural capital statistics with natural capital accounting (Edens, 2014).

program from the World Bank and with technical support from the EEA. The first part of survey deals with the strategies and commitments on natural capital accounting (see Table A.1 in the Appendix). The second part of the survey tackles the policy uses of natural capital accounting (see Table A.2 in the Appendix). In the first part of the survey, there are 4 questions on integration of natural capital accounts in national strategies, and 9 questions on the commitments that the country has made on natural capital accounting. The respondent could answer yes, no or non-applicable. This first part of the survey recalls the potential uses of natural capital accounting, as well as the ongoing international and national processes. This part of the survey was designed with the support of the European Environmental Agency (EEA).

In the second part of the survey, the respondent was asked whether the country compiles or has compiled natural capital accounts. The respondent could answer yes, no or non-applicable. If the answer is positive, the respondent was asked whether or not, to his/her knowledge, natural capital accounts have been used as input for public policy decisions in the country. The respondent could answer to a great extent, somewhat, very little, not at all, very difficult to know or non-applicable. This question relates to the uses of natural capital accounts as input for policy decisions, and does not refer to other potential uses such as 'derivation of indicators', 'input in national accounts', 'input in research and modelling', 'basis for reporting to international organisations' (UNCEEA, 2007). Moreover, we understand public policy as 'an officially expressed intention backed by a sanction, which can be a reward or a punishment'. As a course of action (or inaction), a public policy can take the form of a law, a rule, a statute, an edict, a regulation or an order (Fischer et al., 2007). While it is not the research question of this paper, we acknowledge the prominent use of natural capital accounts as input for research and modelling (Hoekstra, 2010; Smith, 2015b).

The second part of the survey then deals with the reasons for not having used natural capital accounts as input for policy decisions, or for not having used them more intensively. Building over the enabling conditions and obstacles highlighted by Edens (2014) and complementing this information with exchanges with experts from the World Bank and the EEA, we have pre-identified a set of indicators that can be aggregated in the six following obstacles previous detailed in the literature review: political, structural, institutional, design, data availability and cooperation (see Table A.2 in the Appendix). For each of the indicators, the respondent could answer not relevant, slightly relevant, very relevant, extremely relevant or non-applicable.¹⁸ The respondent could identify additional indicators beyond the ones included in the question.

The second part of the survey ends with three additional questions to characterise the type of natural capital accounts developed in the country. Firstly, the respondent was requested to share the data of creation of natural capital accounts. Secondly, the respondent was requested to highlight the type of methodology that is used for the development of the accounts: developed by the country, SEEA, the World Bank, other or non-applicable. Thirdly, the respondent was requested to share the level(s) at which the accounts are developed: local, regional, national or non-applicable. Finally, the respondent was invited to share any additional relevant information.

4. Data

The survey was sent to about 100 experts from statistical offices and relevant ministries, as well as to some independent experts, between the 24th June and the 15th August 2014 (see Tables A.3 and A.4 in the Appendix). Experts were identified among the focal points of natural capital initiatives such as the SEEA, WAVES and the EU Mapping and

¹⁸ Note there can be interactions between the different obstacles, which may not be independent.

Table 1
Respondents.

Statistical office experts	Ministry and independent experts
Afghanistan (*)	Afghanistan (*)
Australia (**)	Austria (2)
Bangladesh (*)	Brazil (*)
Bosnia and Herzegovina	Belgium
Central African Republic	Burkina Faso
Denmark (**)	Colombia
Finland	Comores (*)
Guatemala	Côte d'Ivoire (**)
Guinea-Bissau (*)	Estonia
Jamaica (*)	France (3)
Kenya (*)	Ghana (*)
Liberia (**)	Iran, Islamic R. (*)
Mauritania (*)	Korea, Rep.
Mauritius (*)	Republica Dominicana (*)
Mexico (**)	Myanmar (*)
Nepal (*)	Nepal (*)
Netherlands (2)	Sri Lanka
South Africa	Uganda
Sweden	United Kingdom

Note. (*): The country does not have natural capital accounts. (**): The survey is incomplete.

Table 2
Strategies and commitments.

	Strategies	Commitments	Total
Country mean	2.8	6.1	9.0
High-income country mean	3.0	6.1	9.1
Non-high-income country mean	2.7	6.2	8.9
Statistical office mean	2.3	5.9	8.1
Ministry/independent mean	3.3	6.3	9.7

Note. The values are obtained through a non-weighted sum of questions 1–2 (column 'strategies') and 3–7 (column 'commitments'). The maximum value is 4 for strategies and 9 for commitments. The values in the column 'total' are the sum of the values in the columns 'strategies' and 'commitments'.

Assessment of Ecosystems and their Services (MAES). There were 42 respondents, of which 16 did not yet have natural capital accounts and 5 completed only some of the answers. There are many countries that have yet to develop natural capital accounts, especially non-high-income countries (UNCED, 2015). Besides, some respondents declined the request arguing that policy uses were not under their mandate, or that they did not share the narrow definition of policy uses described in Section 3. 21 surveys could be exploited, a total of 17 countries (see Table 1).¹⁹ There were multiple respondents from Austria (2), France (3) and the Netherlands (2). There were 8 respondents from statistical offices and 13 respondents from relevant ministries and also independent experts. There were 9 respondents from high-income countries and 8 from non-high-income countries.

The natural capital intensity of a country's economy could be a confounding factor. The dependence on natural capital measured through variables such as 'natural resource rents as a percentage of the gross domestic product' or 'natural capital as a percentage of total

¹⁹ That is, we have attained the desirable sample size for a normal distribution with a 90% confidence level and 16% margin of error, given our initial sample size (Krejcie and Morgan, 1970). This confidence interval refers to the sample size and hence to the reliability of the data used in the analysis. When performing a survey, the objective is to obtain representative data about a number of variables within a certain target group or population, in our case about 100 experts from statistical offices and relevant ministries. It is very important to use a correct sample size, since if it is too small, the results will not be statistically significant and we will not have reliable conclusions.

Table 3
Uses of natural capital accounts for public policy decisions.

	Have natural capital accounts been used as input for public policy decisions in your country?
Mean	1.7
High-income mean	1.3
Non-high-income country mean	2.5
Statistical office mean	1.9
Ministry/independent mean	1.6

Note. The respondent could answer to a great extent (0), somewhat (1), very little (2), not at all (3), very difficult to know (4) or non-applicable (5).

wealth' has often been analysed in the framework of economic growth. According to Gylfason (2001), developed countries have a lower dependence on natural capital as they have diversified their economies by investing in other forms of capital, particularly in intangible capital, while developing countries have a higher dependence on natural capital. In Table A.5 in the Appendix, we can see that we find similar results with our sample of countries. Natural capital as a percentage of total wealth is 2% for high-income countries, while 41% for non-high-income countries. We may hence infer that separating our sample in developed and developing countries enables us to take into account the natural capital intensity of a country's economy.

5. Results

We have analysed the results of the survey for the whole sample, and according to the income level of the country (high-income versus non-high-income), and to the type of respondent (statistical offices versus ministries and independent experts). We present the results of the survey in Tables 2–6 and in Fig. 1. Detailed information can be found in Tables A.6–A.13 in the Appendix.

In Table 2 and in Tables A.6–A.8 in the Appendix, we can see the results of the first part of the survey. Concerning the strategies and the commitments, the maximum values per respondent are 4 (strategies) and 9 (commitments). There is a fairly high integration of natural capital accounts in country strategies and a relatively high endorsement of commitments, independently of the level of income of the country. Any differences between high-income and non-high-income countries in the second part of the survey should not be related to significant differences in their engagements. If we analyse the samples according to the type of respondent, the differences are neither very strong.

In Tables 3–6 and A.9–A.13 in the Appendix, and in Fig. 1, we can see the results of the second part of the survey. We first asked whether or not, according to the respondent, natural capital accounts have been used as input for public policy decisions in the country. In Table 3, we can appreciate that respondents consider that natural capital accounts are used between sometimes and very little. 4 respondents signalled that it is very difficult to know whether or not natural capital accounts are used for public policy decisions. If we disaggregate results according to the income level of the country, in high-income countries the accounts have been used sometimes, while in non-high-income countries the accounts are used between very little and not at all. If we disaggregate results according to the type of respondent, there are no major differences between statistical offices, and ministries and experts.

In Table 4, we can see the obstacles for the use of natural capital accounts for public policy decisions. The punctuation is generally quite low. Given that in Table 3 we can see that accounts are not used very frequently for policy decisions, we explain this low score because of the active involvement of most respondents in the creation, development and/or upgrading of natural capital accounts. Many respondents directly expressed their concerns to us regarding this question, which could eventually undermine the financial and political support to this

Table 4
Obstacles for the use of natural accounts for public policy decisions by country income level.

	Total	High-income	Non-high-income
Political			
Strong opposition to a public policy decision from groups of interest	0.62	0.77	0.38
Lack of political support by key people	1.33	1.15	1.63
Concern that natural capital accounts deliver 'bad news'	0.57	0.54	0.63
Lack of ownership by the country	0.52	0.23	1.00
Structural			
Absence of a serious public good problem and of irreversibility risks	0.43	0.46	0.38
Inadequate stage of development of the country	1.05	0.54	1.88
Exogenous shocks have changed priorities in the country	0.62	0.69	0.50
Institutional			
Insufficiently broad engagement of stakeholders	1.14	0.92	1.50
Lack of a clear lead agency	0.90	0.77	1.13
Institutional leadership unable to promote policy use by other ministries	1.33	1.23	1.50
Design			
Difficulty to draw a link between natural capital accounts and policy decisions	1.05	1.00	1.13
Unclear guidelines	0.86	0.77	1.00
Classifications that are not very relevant to environmental policies	0.43	0.54	0.25
Lack of an 'umbrella framework' combining natural c. accounts and statistics	1.05	0.92	1.25
Data availability			
It is too early to use natural capital accounts for a fundamental policy use	0.71	0.69	0.75
Decreasing data availability	0.86	0.46	1.50
Insufficient data because of lack of staff and financial resources	1.00	0.54	1.75
Cooperation			
Lack of strong endorsement and mainstreaming by international agencies	1.10	0.77	1.63
Concerns by developing countries donors might impose 'conditionalities'	0.62	0.38	1.00
Lack of an international forum for training and exchange	0.90	0.62	1.38

Note. The respondent could answer not relevant (0), slightly relevant (1), very relevant (2), extremely relevant (3) or non-applicable (4). The values in the columns 'total', 'high-income' and 'non-high-income' are the mean of the total, high-income country and non-high-income country individual respondent values, respectively.

Table 5
Obstacles for the use of natural capital accounts for public policy decisions by respondent type.

	Total	Statistical office	Ministry/indepen.
Political			
Strong opposition to a public policy decision from groups of interest	0.62	0.44	0.75
Lack of political support by key people	1.33	1.33	1.33
Concern that natural capital accounts deliver 'bad news'	0.57	0.44	0.67
Lack of ownership by the country	0.52	0.78	0.33
Structural			
Absence of a serious public good problem and of irreversibility risks	0.43	0.22	0.58
Inadequate stage of development of the country	1.05	1.11	1.00
Exogenous shocks have changed priorities in the country	0.62	0.67	0.58
Institutional			
Insufficiently broad engagement of stakeholders	1.14	1.33	1.00
Lack of a clear lead agency	0.90	1.22	0.67
Institutional leadership unable to promote policy use by other ministries	1.33	1.11	1.50
Design			
Difficulty to draw a link between natural capital accounts and policy decisions	1.05	0.78	1.25
Unclear guidelines	0.86	0.33	1.25
Classifications that are not very relevant to environmental policies	0.43	0.22	0.58
Lack of an 'umbrella framework' combining natural c. accounts and statistics	1.05	1.22	0.92
Data availability			
It is too early to use natural capital accounts for a fundamental policy use	0.71	0.67	0.75
Decreasing data availability	0.86	1.11	0.67
Insufficient data because of lack of staff and financial resources	1.00	1.22	0.83
Cooperation			
Lack of strong endorsement and mainstreaming by international agencies	1.10	1.22	1.00
Concerns by developing countries donors might impose 'conditionalities'	0.62	0.89	0.42
Lack of an international forum for training and exchange	0.90	1.22	0.67

Note. The respondent could answer not relevant (0), slightly relevant (1), very relevant (2), extremely relevant (3) or non-applicable (4). The values in the columns 'total', 'statistical office' and 'ministry/independent' are the mean of the total, statistical office and ministry/independent expert individual respondent values, respectively.

Table 6
Obstacles for the use of natural capital accounts for public policy decisions: Aggregated values.

	Total	High-income	Non-high-income	Statistical office	Ministry/independent
Political	0.76	0.67	0.90	0.75	0.77
Structural	0.70	0.56	0.91	0.66	0.72
Institutional	1.13	0.97	1.38	1.22	1.06
Design	0.85	0.81	0.91	0.64	1.00
Data availability	0.86	0.56	1.33	1.00	0.75
Cooperation	0.87	0.59	1.33	1.11	0.69

Note. The respondent could answer not relevant (0), slightly relevant (1), very relevant (2), extremely relevant (3) or non-applicable (4). The values in the columns 'total', 'high-income', 'non-high-income', 'statistical office' and 'ministry/independent' are the mean of the total, high-income country, non-high-income country, statistical office and ministry/independent individual respondent values, respectively.

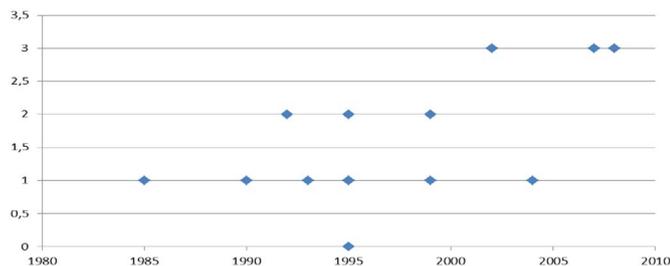


Fig. 1. Correlation between the date of creation of the natural capital accounts and their use for policy decisions.

Note. The horizontal-axis represents the answers to the question 8.3 in the survey ('When were natural capital accounts first available in your country?') and the vertical-axis represents the answers to the question 8.1 in the survey ('Have natural capital accounts been used as input for public policy decisions in your country?'). In 8.1, higher scores indicate lower use.

type of accounts.²⁰ Despite the overall low score, we can see in Table 4 (first column) that there are two main obstacles: the lack of political support by key people such as politicians or the head of a government agency (political obstacle), and the institutional leadership being unable to promote policy use by other ministries (institutional obstacle). These two obstacles are among the most important, independently of the income level of the country (second and third columns).

In addition, the design, data availability and cooperation obstacles are also slightly relevant obstacles for the sample on non-high-income countries. That is, the inadequate stage of development of the country (structural obstacle), the insufficient broad engagement of stakeholders (institutional obstacle), the difficulty to draw a link between natural capital accounts and policy decisions and the lack of an 'umbrella framework' combining natural capital accounts and statistics (design obstacles), the decreasing data availability and insufficient data because of lack of staff and financial resources (data availability obstacle), and the lack of strong endorsement and mainstreaming by international agencies and the lack of an international forum for training and exchange (cooperation obstacles). Being at an inadequate stage of development in the country is the obstacle with the highest score in the sample on non-high-income countries.

We can compare results between statistical offices, and ministries and independent experts. In Table 5 (third column), we can see the results for ministries and independent experts where besides the lack of

²⁰ Given the low scores, we do not seem to have strong sample selection or strategic bias. A sample selection bias could occur as a result of using samples from a non-randomly selected data. It could arise if some surveyed individuals are more prone to reply to the survey when the information they convey is relatively positive. The results could be also subject to strategic bias, if the respondents intentionally answer the survey questions in a misleading way. The respondent, for instance, may believe that a higher value would favour future investments on these accounts.

political support by key people (political obstacle) and the institutional leadership being unable to promote policy use by other ministries (institutional obstacle), we find that the design obstacles are also slightly relevant. In particular, the difficulty to draw a link between natural capital accounts and policy decisions and unclear guidelines, for example, guidance is not (yet) available for ecosystem accounting.

Regarding statistical offices, in Table 5 (second column), we can see that the institutional, data availability and cooperation obstacles are slightly relevant. In particular, the insufficient broad engagement of stakeholders and the lack of a clear lead agency (institutional obstacles), the decreasing data availability and the insufficient data because of lack of staff and financial resources (data availability obstacles), and the lack of strong endorsement and mainstreaming by international agencies and the lack of an international forum for training and exchange (cooperation obstacles). In terms of the design obstacles, the lack of an 'umbrella framework' that combines natural capital accounts and statistics is relatively important for statistical offices, but not for ministries and independent experts. The differences between results reported by statistical offices, and ministries and independent experts, support the choice have a sample that not only includes statistical offices.

Respondents have signalled other obstacles for the use of natural capital accounts for public policy decisions beyond those in the survey. Lack of awareness has been pointed out by respondents from Finland, France, the Netherlands, and Uganda. In Finland, policy makers only use their traditional sectoral data on forest and energy. In France, there is a need to develop dissemination and communication tools and strategies. In Uganda, there is a lack of clear understanding and appreciation of the importance of natural capital accounting in guiding policy.

In South Africa, the statistical office relies on other government departments to obtain natural capital data. In the United Kingdom, the value-added of accounts compared to existing environmental statistics is not straight forward. Concerning the greenhouse gas emissions accounts, the lack of use by the policy department was mostly because it was seen as a distraction from the Kyoto commitment; in terms of the energy accounts, energy balances have been analysed and used for policy purposes for decades already; in terms of the material flow accounts, the lack of a link to products and to within economy flows has inhibited their use.

Moreover, concerning the environmental protection expenditure accounts, the definition of spending and the lack of information on impact are a problem; in terms of the environmental taxes, the structure of the tax which has more environmental impact than the amounts raised; in terms of oil and gas accounts, some issues related to valuation approaches still need to be resolved; in terms of the water accounts, water balances and other statistics have already developed; idem for the forestry/timber accounts. Most interest may lay in the green economy/resource efficiency policies, but the weakness of material flow accounts significantly limits their use.

In Table 6, we aggregate the obstacles for the use of natural capital accounts for public policy decisions. The institutional obstacles are the most relevant, independently of the sub-sample. In addition, in non-high-income countries, the data availability and cooperation are slightly significant obstacles. For ministries and independent experts the design obstacles stand out, while for statistical offices the data availability and cooperation obstacles are slightly relevant. Respondents from non-high-income countries and from statistical offices give relatively high scores to the institutional obstacles.

The second part of the survey provides some additional information. In Fig. 1, we can see there is a positive correlation of 0.64% between the use of natural capital accounts for policy decisions and the date of creation of such accounts. That is, accounts are used for policy decisions with a higher probability, the longer the time elapsed since they were

created. This is not always be the case since some accounts that were created decades ago are yet to be exploited and used for policy decisions.

The second part of the survey has two additional questions (see Tables A.12–A.13 in the Appendix). In terms of the methodology used for the development of natural capital accounts, countries are mostly using SEEA (12 respondents) and, to a lesser extent, their own methodology (6 respondents). The accounts are mainly developed at the national level (18 respondents) and, to a lesser extent, at the regional level (6 respondents).

In our sample of developed countries, the accounts that are most frequently compiled are physical flows, mainly air emissions, energy and material flow accounts, and environmental transactions in monetary units, mainly taxes and environmental protection expenditure accounts. Natural capital asset accounts in physical and monetary units, mainly energy, timber and land accounts, are developed much less frequently. Ecosystem services in physical units are rarely compiled. In terms of future developments, there are a large number of pilot projects for subsidies and water emissions accounts. There are also several pilot projects for timber resources and non-timber forest resources accounts.

In terms of uses for policy decisions, in the Netherlands, the water and energy physical flow accounts, and the environmental goods and services sector transactions accounts have been used for specific policies. The National Accounts Matrix including Environmental Accounts (NAMEA) in physical units has been used to set policy targets for the country's environmental performance on climate change, acid rain and eutrophication. In the United Kingdom, natural capital accounts mainly cover physical flows, natural capital assets in physical and monetary units, and some transactions accounts in monetary units. Accounts are used to feed in resource efficiency and sustainable procurement policies. In Austria, natural capital accounts influence environmental politics in the area of climate policy through the efficient use of resources, and also by driving more investments into the environment.

In Estonia, natural capital accounts are used to set restrictions on economic activities. For example, there is a limitation to preserve 10% of the forest land from economic activities, and there are also limitations on the use of shale-oil mining to ensure sustainability. In Finland, natural capital accounts are used to estimate environmental taxes. In the Republic of Korea, natural capital accounts are used to decide on the total government environmental budget. Except for Estonia, in developed countries, insufficient data is a major obstacle for the use of natural capital accounts for policy decisions, in contrast with design. For instance, the difficulty to draw a link between natural capital accounts and policy decisions is considered a major constraint in Estonia, France and the United Kingdom.

The developing countries in our sample usually have natural capital asset accounts in physical and monetary units, primarily timber, fisheries and land and, to a lesser extent, energy and minerals. They also have physical flow accounts mainly water flows. Few policy uses have been reported by respondents from developing countries. In Guatemala, natural capital accounts are used for the prioritization of national strategies, and used as input for the attribution of the country's general budget. They were also used for the Law on Vulnerability Reduction and for the legal framework on Adaptation to Climate Change and Mitigation of Greenhouse Gases Emissions. In South Africa, there is lack of ownership, lack of institutional leadership and insufficient data for natural capital accounts to be used for policy decisions. Natural capital accounts are mainly supply-driven and have a low profile (Edens, 2014).

In Burkina Faso, the Central African Republic and Guatemala there is also insufficient data to use natural capital accounts for policy decisions, and in Uganda, it is too early for any fundamental policy use. Design is also a major obstacle for the use of natural capital accounts for

policy decisions. In Bosnia and Herzegovina, South Africa and Sri Lanka, the design obstacles are mainly due to the lack of an 'umbrella framework' combining natural capital accounts and environmental statistics. In Colombia, the 2010 Natural Capital Strategy was developed with the support of Conservation International to integrate natural capital accounting into decision-making processes (Milligan et al., 2014). There are, however, unclear guidelines for the development of accounts, and there is insufficient engagement from the different institutional stakeholders.

6. Conclusion

There have been many initiatives and policy commitments in natural capital accounting in the recent years. Based on a survey for statistical offices, ministries and independent experts worldwide, we provide some preliminary evidence on the use of natural capital accounts for public policy decisions. Prior to concluding, we highlight that there is probably no 'best practice' comprehensive approach to integrate natural capital accounts on policy decisions, needing to customise solutions.²¹ In addition, further research would be needed to confirm the preliminary evidence reported in this paper.

We find that, independently of the income level of the country, countries are equally engaged in the integration of natural capital accounts in terms of their commitments and strategies. And yet, there is very little use of natural capital accounts for public policy decisions and more so in developing countries. The most relevant obstacles for the use of accounts in the policy-making process are the lack of political support by key people and the institutional leadership being unable to promote policy use by other ministries.²² In terms of the political support, there has been a long debate for years between demand-driven and supply-driven natural capital accounts.

Field experience suggests that demand-driven projects are more likely to succeed in influencing public policies. Independently of political support, our respondents suggest that there is still a need to raise awareness on the existence and potential uses of such accounts at different levels of the administration. Local authorities can remain largely ignorant if there is no targeted strategy to raise awareness (Labarraque and Tardieu, 2014). Raising awareness at the regional level on the potential of natural capital accounts for key EU policy areas such as the water framework and the flood directives, the biodiversity strategy and the cohesion policy, can be helpful to enhance usage (Petersen and Gocheva, 2015).

Regarding the institutional setting, the choice of the leading agency to be in charge of the accounts is key, as this agency should be strong enough to promote the use of accounts by third parties. The Ministry of Finance may be privileged as leading agency for the coordination of the development of natural capital accounts. In order to ensure the independence of data production and uses, the accounts may be developed in another ministry or in the statistical office. Adapting existing laws or policies concerning natural capital data as in Costa Rica, Japan, Peru and the United Kingdom, is not a sufficient condition for the development and upgrading of natural capital accounts (Milligan et al., 2014).

In addition to these results, respondents from statistical institutes and developing countries reported to be particularly concerned firstly, about institutional obstacles and secondly, about data availability (insufficient data because of lack of staff and financial resources) and

²¹ Milligan et al. (2014) find there is no unique 'best practice' approach for legal and policy reform for natural capital accounting. In several national contexts, there is considerable interest from senior politicians to work towards decision-making informed by natural capital accounting, but a reluctance to take action in absence of clear options for what to do (what legislation should be changed and how, what policies and incentives should be put in place, ...).

²² The WAVES program found that once there is political support from key people, support from middle management can still represent a significant obstacle.

cooperation (lack of strong endorsement and mainstreaming by international agencies and lack of an international forum for training and exchange). Respondents from ministries and independent experts are particularly concerned about design obstacles such as the difficulty to draw a link between natural capital accounts and policy decisions, and unclear guidelines for the creation of the accounts. These results suggest that it is useful to integrate respondents beyond statistical offices and from countries at different stages of development.

Concerning developing countries, the most important obstacle for the use of natural capital accounts for policy making is the country's stage of development. This obstacle, together with the very little use of accounts in these countries for decision-making, may be relevant information for donors. At the same time, developing countries often rely heavily on natural capital for income and therefore, they can benefit most from the development of natural capital accounts. In such countries, engaging first with the ministries of finance and planning to be sure that accounts are relevant for policy-making may be key prior to the development of accounts. Finally, natural capital accounts are used for policy decisions with a certain lag with respect to their creation and hence, no rapid action may be expected following initial investments on the accounts.

In our sample of developed countries, the accounts that are most frequently compiled are physical flows, mainly air emissions, energy and material flow accounts, and environmental transactions in monetary units, mainly taxes and environmental protection expenditure accounts. In terms of future developments, there are a large number of pilot projects for subsidies and water emissions. There are also several pilot projects for timber resources and non-timber forest resource accounts. The developing countries in our sample usually have natural capital asset accounts in physical and monetary units, primarily timber, fisheries and land and, to a lesser extent, energy and minerals. They have also physical flow accounts, mainly water flows. Both in developed and developing countries, ecosystem services accounts in physical units are rarely compiled. While monitoring databases can enable physical valuation of ecosystem services, monetary valuation demands robust primary valuation studies that cover ecosystem services relevant to the decision context which can be very expensive (Hölzinger et al., 2013).

In developed countries, insufficient data is generally not considered a major obstacle for the use of natural capital accounts for policy decisions, in contrast with design. For instance, the absence of clear guidelines for the development of accounts is a major obstacle in Estonia and France. The difficulty to draw a link between natural capital accounts and policy decisions is a major constraint in Estonia, France and the United Kingdom. In developing countries, there is insufficient data to use natural capital accounts for policy decisions. Design is also an obstacle for the use of natural capital accounts for policy decisions, particularly the lack of an 'umbrella framework' combining natural capital accounts and environmental statistics. Not many accounts may be available to be used in the policy-making process due to data gaps, design challenges and the required investment, the problem being much more acute in developing countries.

A key result of the survey is the need to evaluate the added value of natural capital accounts with respect to statistics, prior to the development of accounts. Some developed countries have already developed a significant amount of environmental statistics, and accounts may not provide substantial additional information. Even in countries with few environmental statistics, the question remains relevant. Local problems might be better addressed through cost-benefit analyses and by investing in statistics. Many environmental problems are local in nature and cannot be easily addressed through natural capital accounts because accounting is mainly applicable at the national and regional levels. Besides, in the absence of an unequivocal connection between

ecosystem services and economic activities, ecosystem accounts conventions and rules may distort complex processes within and between ecosystems (Tichit, 2014; Bartelmus, 2015).

It is interesting to draw a parallel with respect to the development of national income accounts, including the gross domestic product (GDP). There is evidence that the investment in data production may increase in times of crisis, for instance, during the energy crisis in the 1970s. The fast decisions required by the situations of crisis provide incentives to managers to develop the information to improve decision-making (Hecht, 2000). National accounts were in created on the 1930s to understand whether or not the economic mobilisation program could be met for World War II and, if so, at what costs (Marcuss and Kane, 2007). It then took over a decade in some countries to have a nation-wide economy indicator that would be regularly revised with obstacles that are very similar to the ones currently associated with the creation of natural capital accounts (Ekins, 2015). It is important for natural capital accounts to be considered as relevant from a policy standpoint to attain maturity both in their development and in their integration within the decision-making process.²³

There are two ways of using the economic and natural capital accounts in the policy process, ex-ante and ex-post, and both are important. In this paper, we have focused on the ex-ante use of natural capital accounts. When the economic accounts are used ex-ante to shape policy, their use is mainly in economic analysis done by technical experts. That kind of analysis usually occurs early in the policy process and some argue that its influence may be diluted by the time the final decision is made by senior officials and politicians who take much more into consideration than empirical studies. Under such a hypothesis, our results on the limited ex-ante use of natural capital accounts for policy decisions may not be surprising.

If we focus on the ex-post use of economic accounts, there are many examples of policies that target the variables such as economic growth, inflation control and employment measured in the economic accounts. The success of policies is measured by economic accounts, not informed by them. We can make a comparison between the ex-post use of economic and natural capital accounts. Since governments make far fewer policies that relate directly to natural capital than to economic activities, there are far fewer opportunities for the ex-post use of natural capital accounts than there are for economic accounts. The comparison of natural capital accounts with economic accounts in terms of the importance in the policy process may not be fair. Further research could be undertaken to understand the relative importance of ex-ante and ex-post uses of economic accounts for policy decisions and hence, to make inferences about the role of ex-ante and ex-post uses of natural capital accounts in the policy-making process.²⁴

Acknowledgements

The views expressed in this paper are our own and do not necessarily reflect those of the French Ministry of Foreign Affairs and International Development. We would like to thank two anonymous reviewers for very useful comments. We would also like to thank Philippe Puydarrieux and Ophélie Darses from the Ministry of Ecology, Sustainable Development and Energy, and Glenn-Marie Lange and Sofia Ahlroth from the World Bank for their suggestions. A preliminary version of this paper was presented at the weekly 'inter' seminar at the Museum National d'Histoire Naturelle in Paris on the 4th December 2014, we thank Anne-Caroline Prevot and Clément Feger for their comments. The paper was also presented at the International Workshop

²³ We recall that, for the time being, Hicksian income is not even reflected in SEEA publications. According to Hicks, income in a given period of time is the maximum amount that can be consumed in that period while keeping real wealth unchanged (Hicks, 1939).

²⁴ The authors would like to thank Robert Smith of Midsummer Analytics for this insight.

on Opportunities and Obstacles for Natural Capital Accounting organised by the French Ministry of Foreign Affairs and International Development and the WWF in Brussels on the 27th January 2015, we

also thank participants for their comments. In particular, we would like to thank Ben Milligan, Günter Mitlacher Jan-Erik Petersen and Robert Smith.

Appendix A. Appendices

A.1. Survey

The survey constructed for this study contains the following questions reported in Tables 1–2.

Table A.1

Natural capital accounts: Strategies and commitments (*).

Strategies

1) Is there a sustainable development strategy in your country?

1.1) If yes, is the use of natural capital accounts being considered to provide input?

2) Is there a sectorial sustainable development strategy in your country?

2.1) If yes for one or several sectors, is the use of natural capital accounts being considered to provide input?

Commitments

3) Has your country signed the Kyoto protocol on climate change and on the reduction of greenhouse gases?

3.1) If yes, is your country reporting to UNFCCC following GIEC/IPCC guidelines?

4) Is your country participating to a REDD + action on reforestation?

5) Is your country putting in place actions related to the implementation of the Convention on biological diversity? (**)

6) Is your country participating in an action of the World Bank Waves partnership on natural capital accounting?

6.1) If yes, are there projects ongoing or foreseen on ecosystems services accounting (forests or coasts)?

7) Is your country participating in an action of the UNEP or OECD programmes on green economy and green growth?

7.1) If yes, is the SEEA methodology being considered to participate to those programmes?

7.2) If yes, are there projects ongoing or foreseen on ecosystems services accounting?

Note. (*): The (economic-)environmental accounts refer to the statistics that can be integrated with national economic accounts which enables to have joint analyses, while indicators are usually isolated and are more difficult to interpret. (**): Note that according to the Aichi-Nagoya 2010 objectives biological diversity values should be integrated on national accounts by 2020 (Strategy A, Target 2). For questions 1 to 7, the respondent could select yes (1), no (0), or non-applicable (2). We acknowledge that some questions are not dissociated.

Table A.2

Natural capital accounts: Their uses for public policies (*).

8) Does your country compile (or has it compiled) natural capital accounts?

8.1) If yes, have natural capital accounts been used as input for public policy decisions in your country? (**)

8.2) If yes, please explain the reasons for not having used natural capital accounts as input public policy decisions in your country or for not having used them more intensively.

Political

Strong opposition to a public policy decision from groups of interest.

Lack of political support by key people (e.g., politicians or head of a governmental agency).

Concern that natural capital accounts deliver ‘bad news’.

Lack of ownership by the country in the development and uses of natural capital accounts.

Structural

Absence of a serious public good problem and of irreversibility risks.

Inadequate stage of development of the country (other priorities considered more important).

Exogenous shocks have changed priorities in the country (for instance, 2008 global crisis, 1973 oil crisis).

Institutional

Insufficiently broad engagement of stakeholders.

Lack of a clear lead agency (or clear implementation structure among collaborating agencies).

Institutional leadership unable to promote policy use by other ministries.

Design

Difficulty to draw a link between natural capital accounts and policy decisions.

Unclear guidelines, e.g., guidance are not (yet) available in case of ecosystem accounting.

Classifications (***) that are not very relevant to environmental policies.

Lack of an ‘umbrella framework’ combining natural capital accounts and environmental statistics.

Data availability

It is too early to use natural capital accounts for a fundamental policy use.

Decreasing data availability (confidentiality of data, weaker administrative burden placed on companies).

Insufficient data to use it for policy decisions because of lack of staff and financial resources.

Cooperation

Lack of strong endorsement and mainstreaming by international agencies in their programs.

Concerns by developing countries that additional ‘conditionalities’ may be imposed by international organi.

Lack of an international forum for training and the exchange of experiences for policy analysis.

Other (please specify)

8.3) If yes, when were natural capital accounts first available in your country?

8.4) If yes, following which methodology? Developed by your own country, SEEA, World Bank, other, nonapplicable.

8.5) If yes, at which level(s)? Local, regional, national, non-applicable

Do you have any comments you would like to share with us?

Note. (*): The (economic-)environmental accounts refer to the statistics that can be integrated with national economic accounts which enables to have joint analyses, while indicators are usually isolated and are more difficult to interpret. (**): Note that this question does not refer to other uses such as 'derivation of indicators', 'input in national accounts', 'input in research and modelling', 'basis for reporting to international organisations'. We understand public policy as "an officially expressed intention backed by a sanction, which can be a reward or a punishment." As a course of action (or inaction), a public policy can take the form of "a law, a rule, a statute, an edict, a regulation or an order" (Fischer et al., 2007). (***) For instance, see the classification on the production of manufactured goods (PRODCOM) or the classification of individual consumption by purpose (COICOP). For question 8, the respondent could select yes (1), no (0), or non-applicable (2). For question 8.1, the respondent could select to a great extent (0), somewhat (1), very little (2), not at all (3), very difficult to know (4) or non-applicable (5). For question 8.2, the respondent could select not relevant (0), slightly relevant (1), very relevant (2), extremely relevant (3) or non-applicable (4). For questions 8.4–8.5, the respondent could select yes (1), or no (0).

A.2. Respondents

Table A.3

Respondents: Statistical offices experts.

Country	Statistical office	Income level (+)
Afghanistan (*)	Central Statistics Organisation	LI
Australia (**)	Australian Bureau of Statistics	HI
Bangladesh (*)	Bangladesh Bureau of Statistics	LI
Bosnia and Herzegovina	Agency for Statistics of Bosnia and Herzegovina	UMI
Central African Republic	Institut Centrafricain de la Statistique et des Etudes Eco. et Sociales	LI
Denmark (**)	Statistics Denmark	HI
Finland	Statistics Finland	HI
Guatemala	Instituto Nacional de Estadística	LMI
Guinea-Bissau (*)	Instituto Nacional de Estatística	LI
Jamaica (*)	Statistical Institute of Jamaica	UMI
Kenya (*)	Kenya National Bureau of Statistics	LI
Liberia (**)	Liberia Institute of Statistics & Geo-Information Services (LISGIS)	LI
Mauritania (*)	Office National de la Statistique	LMI
Mauritius (*)	Statistics Mauritius	UMI
Mexico (**)	Statistics Office of Mexico	UMI
Nepal (*)	Central Bureau of Statistics	LI
Netherlands (2)	Statistics Netherlands	HI
South Africa	Statistics South Africa	UMI
Sweden	Statistics Sweden	HI

Note. (*): The country does not have environmental accounts. (**): The survey file is incomplete. (+): World Bank country income level classification: Low-income (LI), lower-middle-income (LMI), upper-middle-income (UMI), high-income (HI).

Table A.4

Respondents: Ministry and independent experts.

Country	Ministry/independent	Income level (+)
Afghanistan (*)	National Environmental Protection Agency	LI
Austria (2)	Austrian Institute of Economic Research Federal Institute for Less Favoured and Mountainous Areas	HI
Brazil (*)	Universidade Estadual de Campinas, IPBES Multidisciplinary Expert Panel (MEP)	UMI
Belgium	Bureau fédéral du Plan	HI
Burkina Faso	Ministère de l'Environnement et du Développement Durable	LI
Colombia	Departamento Nacional de Planeación	UMI
Comores (*)	Direction Générale de l'Environnement et des Forêts	LI
Côte d'Ivoire (**)	Ministère de l'Environnement; de la Salubrité et du Développement Durable	LMI
Estonia	Estonian Environment Agency	HI
France (3)	Ministère de l'écologie, du développement durable, et de l'énergie Le Centre de coopération internationale en recherche agronomique pour le développement Muséum national d'Histoire naturelle	HI
Ghana (*)	University of Ghana, Member, Board of the Millennium Ecosystem Assessment (MA), Chair, Subsidiary Body on Scientific Technical and Technological Advice (SBSTTA) of the UN Convention on Biological Diversity	LMI
Iran, Islamic R. (*)	University of Tehran, expert for the UN Convention on Biological Diversity	UMI

Korea, Rep.	Ministry of Environment	HI
Dominican R. (*)	Ministerio de Medio Ambiente y Recursos Naturales	UMI
Myanmar (*)	Ministry of Envi. Conservation and Forestry Forest, University of forestry	LI
Nepal (*)	Ministry of Science, Technology and Environment	LI
Sri Lanka	Board of Investment of SL	LMI
Uganda	National Environment Management Authority	LI
United Kingdom	Department for Environment, Food and Rural Affairs	HI

Note. (*): The country does not have environmental accounts. (**): The survey file is incomplete. (+): World Bank country income level classification: Low-income (LI), lower-middle-income (LMI), upper-middle-income (UMI), high-income (HI).

Table A.5
Natural capital in total wealth.

	Intangible capital (% total wealth)	Produced capital (% total wealth)	Natural capital (% total wealth)
Austria	0.80	0.20	0.02
Belgium	0.79	0.18	0.01
Estonia	NA	NA	NA
Finland	0.80	0.19	0.05
France	0.82	0.16	0.02
Korea, Rep.	0.75	0.24	0.01
Netherlands	0.80	0.19	0.03
Sweden	0.83	0.16	0.03
United Kingdom	0.86	0.13	0.01
High-income country mean	0.81	0.18	0.02
Bosnia and Herzegovina	NA	NA	NA
Burkina Faso	0.57	0.12	0.33
Central African Republic	– 0.09	0.08	1.04
Colombia	0.71	0.13	0.17
Guatemala	0.56	0.12	0.33
South Africa	0.74	0.15	0.12
Sri Lanka	0.71	0.16	0.16
Uganda	0.24	0.08	0.70
Non-high-income country mean	0.49	0.12	0.41

Note. According to the World Bank data on the wealth of nations (1995–2005 mean value). Natural capital is sum of crop, pasture land, timber, non timber forest, protected areas, oil, natural gas, coal, and minerals. NA: Absence of data.

A.3. Results

Table A.6
Strategies and commitments.

	Strategies	Commitments	Total
Austria	2	6	8
Belgium	4	5	9
Bosnia and Herzegovina	3	4	7
Colombia	4	8	12
Central African Republic	4	4	8
Estonia	2	3	5
Finland	4	6	10
France	4	9	13
Guatemala	0	9	9
Korea, Rep.	4	5	9
Netherlands	3	8	11
South Africa	2	2	4
Sri Lanka	2	9	11
Sweden	0	8	8
Uganda	4	7	11
United Kingdom	4	5	9
Country mean	2.8	6.1	9.0

Note. The values are obtained through a non-weighted non-rounded sum of questions 1–2 (column ‘strategies’) and 3–7 (column ‘commitments’). The maximum value is 4 for strategies and 9 for commitments. The values in the column ‘total’ are the sum of the values in columns ‘strategies’ and ‘commitments’.

Table A.7
Strategies and commitments by country income levels.

	Strategies	Commitments	Total
Austria	2	6	8
Belgium	4	5	9
Estonia	2	3	5
Finland	4	6	10
France	4	9	13
Korea, Rep.	4	5	9
Netherlands	3	8	11
Sweden	0	8	8
United Kingdom	4	5	9
High-income country mean	3.0	6.1	9.1
Bosnia and Herzegovina	3	4	7
Colombia	4	8	12
Central African Republic	4	4	8
Guatemala	0	9	9
South Africa	2	2	4
Sri Lanka	2	9	11
Uganda	4	7	11
Non-high-income country mean	2.7	6.2	8.9

Note. The values are obtained through a non-weighted sum of questions 1–2 (column ‘strategies’) and 3–7 (column ‘commitments’). The maximum value is 4 for strategies and 9 for commitments. The values in the column ‘total’ are the sum of the values in columns ‘strategies’ and ‘commitments’.

Table A.8
Strategies and commitments by type of respondent.

	Strategies	Commitments	Total
Bosnia and Herzegovina	3	4	7
Central African Republic	4	4	8
Finland	4	6	10
Guatemala	0	9	9
Netherlands	3	8	11
South Africa	2	2	4
Sweden	0	8	8
Statistical office mean	2.3	5.9	8.1
Austria	2	6	8
Belgium	4	5	9
Colombia	4	8	12
Estonia	2	3	5
France	4	9	13
Korea, Rep.	4	5	9
Sri Lanka	2	9	11
Uganda	4	7	11
United Kingdom	4	5	9
Ministry/independent mean	3.3	6.3	9.7

Note. The values are obtained through a non-weighted sum of questions 1–2 (column ‘strategies’) and 3–7 (column ‘commitments’). The maximum value is 4 for strategies and 9 for commitments. The values in the column ‘total’ are the sum of the values in columns ‘strategies’ and ‘commitments’.

Table A.9
Use of natural capital accounts for public policy decisions.

	Have natural capital accounts been used as input for public policy decisions in your country?
Austria	1
Austria	0
Belgium	2
Bosnia and Herzegovina	3
Burkina Faso	NA (*)
Colombia	2
Central African Republic	NA (*)
Estonia	1
Finland	2

France	3
France	NA (*)
France	NA (*)
Guatemala	2
Korea, Rep.	1
Netherlands	1
Netherlands	1
South Africa	3
Sri Lanka	2
Sweden	1
Uganda	3
United Kingdom	1
Mean	1.7

Note. The respondent could answer to a great extent (0), somewhat (1), very little (2), not at all (3) and difficult to know (NA).

Table A.10

Use of natural capital accounts for public policy decisions according to country income levels.

	Have natural capital accounts been used as input for public policy decisions in your country?
Austria	1
Austria	0
Belgium	2
Estonia	1
Finland	2
France	3
France	NA (*)
France	NA (*)
Korea, Rep.	1
Netherlands	1
Netherlands	1
Sweden	1
United Kingdom	1
High-income country mean	1.3
Bosnia and Herzegovina	3
Burkina Faso	NA (*)
Colombia	2
Central African Republic	NA (*)
Guatemala	2
South Africa	3
Sri Lanka	2
Uganda	3
Non-high-income country mean	2.5

Note. The respondent could answer to a great extent (0), somewhat (1), very little (2), not at all (3) and difficult to know (NA).

Table A.11

Use of natural capital accounts for public policy decisions according the respondent type.

	Have natural capital accounts been used as input for public policy decisions in your country?
Bosnia and Herzegovina	3
Burkina Faso	NA (*)
Central African Republic	NA (*)
Finland	2
Guatemala	2
Netherlands	1
Netherlands	1
South Africa	3
Sweden	1
Statistical office mean	1.9
Austria	1
Austria	0
Belgium	2
Colombia	2
Estonia	1

France	3
France	NA (*)
France	NA (*)
Korea, Rep.	1
Sri Lanka	2
Uganda	3
United Kingdom	1
Ministry/independent mean	1.6

Note. The respondent could answer to a great extent (0), somewhat (1), very little (2), not at all (3) and difficult to know (NA).

Table A.12

Methodology used for natural capital accounts.

	If natural capital accounts been used as input for public policy decisions in your country, following which methodology?			
	Own methodology	SEEA	World Bank	Other
Austria	0	1	0	0
Belgium	1	1	0	1
Bosnia and Herzegovina	0	1	0	0
Burkina Faso	0	1	0	0
Colombia	0	1	0	0
Finland	0	1	0	0
France	1	0	0	0
Guatemala	0	1	0	0
Korea, Rep.	0	1	0	0
Netherlands	1	1	0	0
South Africa	0	1	0	0
Sweden	1	1	0	0
United Kingdom	0	1	0	0
Mean	4	12	0	1

Table A.13

Scale used for natural capital accounts.

	If natural capital accounts been used as input for public policy decisions in your country, at which level(s)?		
	Local	Regional	National
Austria	0	0	1
Belgium	0	1	1
Bosnia and Herzegovina	0	0	1
Burkina Faso	0	0	1
Colombia	0	0	1
Estonia	0	0	1
Finland	0	0	1
France	0	0	1
Guatemala	0	0	1
Korea, Rep.	0	0	1
Nepal	0	0	1
Netherlands	0	1	1
South Africa	0	0	1
Sweden	0	0	1
United Kingdom	0	0	1
Mean	0	2	15

References

- Barbier, E.B., 2011. *Capitalizing on Nature: Ecosystems as Natural Assets*. Cambridge University Press, Cambridge, New York.
- Bartelmus, P., 2015. Do we need ecosystem accounts? *Ecol. Econ.* 118, 292–298.
- ten Brink, P., Russi, D., Tinch, R., Schoumacher, C., Agarwala, M., Bateman, I., 2015. The Use of (Economic & Social) Values of NC/ES in National Accounting. D3.4 Discussion Paper. European Commission (OPERA project).
- Brouwer, R., Brander, R., Kuik, O., Papyrakis, E., Bateman, I., 2013. A Synthesis of Approaches to Assess and Value Ecosystem Services in the EU in the Context of TEEB. Report to the European Commission, 15 May 2013, Brussels, Belgium.
- Convention on Biological Diversity (CBD), 2014. Strategic Plan for Biodiversity 2011–2020, Including Aichi Biodiversity Targets. Convention on Biological Diversity, Montreal, Canada.
- Day, B., 2013. An Overview of Valuation Techniques for Ecosystem Accounting. University of East Anglia. Produced for The Department for Environment, Food and Rural Affairs (DEFRA) and The Office for National Statistics (ONS) Valuation for Natural Capital Accounting Seminar, United Kingdom.

- Delos Angeles, M., 2011. Lessons Learned From Country Experiences With Environmental Accounting. World Bank Presentation at the First Annual Meeting of the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Partnership, Washington D.C., United States.
- Edens, B., 2013. Reconciling Theory and Practice in Environmental Accounting. Statistics Netherlands, The Hague, Netherlands.
- Edens, B., 2014. Lessons Learned From Environmental Accounting. The World Bank, Washington D.C., United States.
- Ekins, P., 2015. Building Policy Support for Natural Capital Accounting. Presentation at the French Ministry of Foreign Affairs and International Development-World Wide Fund (WWF) International Workshop on Opportunities and Obstacles for Natural Capital Accounting, Brussels, Belgium.
- European Union (EU), 2011. The EU Biodiversity Strategy to 2020. European Commission, Belgium.
- Evaluation Française des Écosystèmes et Services Écosystémiques (EFESE), 2013. L'évaluation française des écosystèmes et des services écosystémiques: Méthodologie et premiers résultats. In: Séminaire du 20 décembre 2013 au Ministère de l'Écologie, du Développement durable et de l'Énergie, Paris, France.
- Fischer, F., Miller, G.J., Sidney, M.S. (Eds.), 2007. Handbook of Public Policy Analysis: Theory, Politics, and Methods. Taylor & Francis Group, LLC, New York: CRC Press.
- Gowdy, J.M., Howarth, R.B., Tisdell, C., 2009. Discounting, ethics and options for maintaining biodiversity and ecosystem integrity. In: Kumar, P. (Ed.), The Economics of Ecosystems and Biodiversity (TEEB): Ecological and Economic Foundations. Routledge, Abingdon.
- GRET/CIRAD/CDC Biodiversité, 2014. Innovative Financing Mechanism for Biodiversity and the Identification of Mechanisms With Strong Potential. The French Ministry of Foreign Affairs and International Development, Paris, France.
- Gylfason, T., 2001. Natural resources, education, and economic development. *Eur. Econ. Rev.* 45, 847–859.
- Haines-Young, R.H., Potschin, M., 2010. Proposal for a Common International Classification of Ecosystem Goods and Services (CICES) for Integrated Environmental and Economic Accounting. European Environment Agency, Copenhagen, Denmark.
- Hecht, J.E., 1997. Environmental Accounting: What's it All About? The International Union for Conservation of Nature (IUCN), Green Accounting Initiative 8, Washington D.C., United States.
- Hecht, J.E., 1999. Environmental accounting. Where we are now, where we are heading. *Resources* 135, 14–17.
- Hecht, J.E., 2000. Lessons Learned From Environmental Accounting: Findings From Nine Case Studies. The International Union for Conservation of Nature (IUCN)/The World Conservation Union, Washington D.C., United States.
- Hecht, J.E., Johnstone, N., Bishop, J., Swanson, T., 2007. National environmental accounting: a practical introduction. *Int. Rev. Environ. Resour. Econ.* 1 (1), 3–66.
- Hicks, J.R., 1939. Value and Capital: An Inquiry into some Fundamental Principles of Economic Theory. Clarendon Press, United Kingdom, Oxford.
- Hoekstra, R., 2010. (Towards) A Complete Database of Peer-reviewed Articles on Environmentally Extended Input-output Analysis. Paper Prepared for the 18th International Input-Output Conference, June 20–25th, Sydney, Australia.
- Hölzinger, O., Sunderland, T., Kenter, J., Cowap, C., von Essen, E., Corstanje, R., Davies, A., 2013. Valuation tools: a literature review. In: TABLES Project 2012–2013, the National Ecosystem Approach Toolkit. United Kingdom National Ecosystem Assessment Follow-On (NEAFO) research, United Kingdom.
- Krejcie, R.V., Morgan, D.W., 1970. Determining sample size for research activities. *Educ. Psychol. Meas.* 30, 607–610.
- Labarraque, D., Tardieu, L., 2014. Des bouquets de services pour étudier l'impact sur les écosystèmes de variantes de projets d'infrastructures. In: 2ème Séminaire sur l'Évaluation Française des Écosystèmes et Services Écosystémiques (EFESE), 9 décembre 2014, Paris, France.
- Lange, G.M., 2003. Policy applications of environmental accounting. In: World Bank Environment Department, Environmental Economics Series Paper 88 The World Bank, Washington D.C., United States.
- Laurans, Y., Rankovic, A., Billé, R., Pirard, R., Mermet, L., 2013. Use of ecosystem services economic valuation for decision making: questioning a literature blindspot. *J. Environ. Manag.* 119.
- Lavorel, S., 2014. Évaluer et cartographier les écosystèmes et les services écosystémiques: Questions posées à la recherche et avancées scientifiques. In: 2ème Séminaire sur l'Évaluation Française des Écosystèmes et Services Écosystémiques (EFESE), 9 décembre 2014, Paris, France.
- Marcuss, R.D., Kane, R.E., 2007. U.S. national income and product statistics: born of the great depression and world war II. *Surv. Curr. Bus.* 87 (February), 32–46.
- Maynard, S., James, D., Davidson, A., 2015. Determining the value of multiple ecosystem services in terms of community wellbeing: who should be the valuing agent? *Ecol. Econ.* 115, 22–28.
- Millennium Ecosystem Assessment (MA), 2005. Ecosystems and Human Well-being: General Synthesis. Island Press, Washington D.C., United States.
- Milligan, B., Terama, E., Jiménez-Aybar, R., Ekins, E., 2014. GLOBE Natural Capital Accounting Study, 2nd Edition. GLOBE International and University College London, London, United Kingdom.
- Natural Resources Commission (NRC), 2005. Standard for Quality Natural Resource Management. Document D05/5274, Australia.
- Nordhaus, W.D., Kokkelenberg, E.C. (Eds.), 1999. Nature's Numbers: Expanding the National Economic Accounts to Include the Environment. National Academies Press, Washington D.C., United States.
- Pascal, N., 2014. Bouquets de services écosystémiques rendus par les récifs coralliens: Synthèse des recherches de l'Ifreco. In: 2ème Séminaire sur l'Évaluation Française des Écosystèmes et Services Écosystémiques (EFESE), 9 décembre 2014, Paris, France.
- Pascual, U., Gómez-Baggethun, E., Brander, L., Martín-López, B., Muradian, R., Verma, M., 2010. The economics of valuing ecosystem services and biodiversity. In: Kumar, P. (Ed.), TEEB (2010). The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Earthscan, London, United Kingdom.
- Pearce, D.W., Markandya, A., Barbier, E., 1989. Blueprint for a Green Economy. Earthscan, London, United Kingdom.
- Petersen, J.E., 2015. Natural Capital Accounting – Current Progress in Relation to the MAES Pilot. Presentation at the French Ministry of Foreign Affairs and International Development-World Wide Fund (WWF) International Workshop on Opportunities and Obstacles for Natural Capital Accounting, Brussels, Belgium.
- Petersen, J.E., Gocheva, K., 2015. EU Reference Document on Natural Capital Accounting. Prepared as Part of the European Union Mapping and Assessment of Ecosystems and Their Services (MAES) Process, Revised Draft for Consultation, 6 January 2015.
- Russi, D., ten Brink, P., 2013. Natural Capital Accounting and Water Quality: Commitments, Benefits, Needs and Progress. A Briefing Note. The Economics of Ecosystems and Biodiversity (TEEB).
- Smith, R., 2015a. Users and Uses of Environmental Accounts. The World Bank, Washington D.C., United States.
- Smith, R., 2015b. Natural Capital Accounting in Canada. Presentation at the French Ministry of Foreign Affairs and International Development-World Wide Fund (WWF) International Workshop on Opportunities and Obstacles for Natural Capital Accounting, Brussels, Belgium.
- The Economics of Ecosystems and Biodiversity (TEEB), 2008. An Interim Report. European Communities, Brussels, Belgium.
- Tichit, M., 2014. La problématique des services écosystémiques dans le cas des agro-écosystèmes. In: 2ème Séminaire sur l'Évaluation Française des Écosystèmes et Services Écosystémiques (EFESE), 9 décembre 2014, Paris, France.
- United Nations (UN), 2005. Implementation of Environmental-Economic Accounts (Strategy Paper). Preliminary Meeting of the United Nations Committee on Environmental-Economic Accounting, New York, 29–31 August 2005, United States.
- United Nations (UN), 2006. The Global Assessment of Environment Statistics and Environmental-Economic Accounting (Phase 1). New York, United States.
- United Nations (UN), 2007. Workshop on Environment Statistics, 16–20 July, Addis Ababa, Ethiopia.
- United Nations Committee of Experts on Environmental-Economic Accounting (UNCCEA), 2007. Global Assessment of Environmental-economic Accounting and Supporting Statistics 2007. Prepared by the Committee of Experts on Environmental-Economic Accounting, Statistical Commission, 38th session, 27 February–2 March 2007.
- United Nations Committee of Experts on Environmental-Economic Accounting (UNCCEA), 2015. Global Assessment of Environmental-Economic Accounting and Supporting Statistics 2014. Prepared by the Committee of Experts on Environmental-Economic Accounting, Statistical Commission, 46th session, 3–6 March 2015.
- Weber, J.L., 2011. An experimental framework for ecosystem capital accounting in Europe. In: European Environmental Agency (EEA) Technical Report 13, Copenhagen, Denmark.
- Weber, J.L., 2014a. Ecosystem natural capital accounts: a quick start package. In: Technical Series 77. Secretariat of the Convention on Biological Diversity (CDB), Montreal, Canada.
- Weber, J.L., 2014b. Experimental Ecosystems Natural Capital Accounts. Mauritius Case Study. Methodology and Preliminary Results 2000–2010. India Ocean Commission.
- Weber, J.L., 2015. From Environmental to Ecosystem Accounting, What Is Our Experience? Presentation at the French Ministry of Foreign Affairs and International Development-World Wide Fund (WWF) International Workshop on Opportunities and Obstacles for Natural Capital Accounting, Brussels, Belgium.