



HOW BUSINESS VALUES NATURAL CAPITAL

Taking Stock and Looking Forward



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Status: April 2014

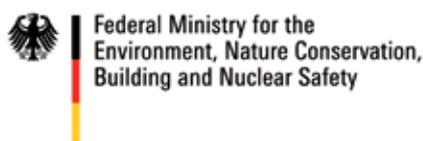
This publication has been funded under the project „Economic valuation of natural capital from a business perspective – An instrument to internalize corporate environmental impact” by the German Federal Environmental Agency and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The responsibility for the content of this publication lies with the authors.

Further Information: www.naturkapitalbilanzierung.de

Acknowledgments:

Mathieu Tolian (Veolia Environnement), Ayako Kohno (Hitachi Chemical), Eva Zabey (WBCSD), Mark Weick (Dow Chemical Company), Stuart Anstee (Rio Tinto), Sara Goulartt (EDP), Maria Norell and Karin Hallden (AkzoNobel), Andreas Streubig and Alexander Bartelt (Otto Group), Moritz Nill (Systain), Jan Michler (Stakeholder Reporting), James Spurgeon (Sustain Value), Peter Cruickshank (UNEP FI).

Special thanks to Katrina Mead



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0.0 Executive Summary

Nature is an essential economic factor. It provides a variety of renewable and non-renewable resources. We use timber as an input factor or food as a consumer good but nature also provides ecosystem services such as water filtration or erosion control that benefit society and economy at once. At the same time economic activity influences the condition and the functioning of nature through the so-called externalities. Neither benefits nor costs are adequately reflected in corporate accounting like the balance sheet or the consolidated profit and loss account.

Pilot projects such as the “The Economics of Ecosystems and Biodiversity” (*TEEB*) studies, initiated by the *European Commission*, aimed to highlight the value of ecosystem services and biodiversity for the society and provided new arguments against destruction and overuse.

Lately, the private sector has increased its efforts to measure and evaluate environmental costs, and – in the longer term – to incorporate them into accounting. At the beginning of 2011, chemicals group *Dow Chemical* and the environmental organization *The Nature Conservancy* announced plans to join forces with the aim to promote “the integration of the value of nature into business decisions.” The goal is to collect and evaluate all ecosystem services, from which the company is benefiting, and to incorporate the results into the operations of the company.¹

Furthermore, the *World Business Council for Sustainable Development (WBCSD)* has published the “Guide to Corpo-

rate Ecosystem Valuation (*CEV*)” in spring 2011. 14 companies, including *Hitachi* and *Veolia*, tested the approach presented in this guide: the economic valuation of natural capital as a possible support of decision-making processes. The focus laid on evaluating production or management options, as well as collecting experiences with the new tool.

Also in that same year, *PUMA* published the world's first environmental profit and loss account (EP&L). The calculation focused on five environmental effects: Water and land use, greenhouse gas and air emissions as well as waste production. *PUMA* took the entire supply chain – including the commodity production – into account, resulting in external environmental costs of €145 million. This corresponded to around 70 % of the company's profits in 2010.

This study aims to support this development by informing companies about the status quo of the discussions, existing approaches, methods, and case studies. The study can also serve as an initial guide to those companies who want to implement their own valuation projects. In the long term, the objective is to create a robust, general, and applicable framework for the economic valuation of natural capital in the corporate context. Further, recommendations are made on how existing methods could be improved, and on how policymakers can set incentives to accelerate the integration of this instrument into the corporate world.

¹(Dow Chemical, 2011)

THE BUSINESS CASE

Numerous reasons exist why companies should deal with the topic “natural capital“ in general and more specifically the economic valuation of natural capital, e.g.:

- **Identification of hotspots in the supply chain and risk management:** The economic valuation as part of PUMA’s environmental profit and loss account was used to identify environmental hotspots, in this case the production of leather, in the supply chain. Potential disruptions, due to environmental damages or resource-scarcities can therefore be avoided and sustainability initiatives can be targeted more efficiently to where they have the biggest impact.
- **Reputation and consumers:** In times of increasing awareness for sustainability and environmental issues, environmental damages are a reputational risk. Economic valuation permits to compare the sustainability performance of two products or companies. With this increased transparency, sustainability can become a competitive advantage.
- **Value for society:** Many companies, especially industries with a major direct impact on nature, such as extractives, use the economic valuation to highlight the benefit they are creating for society due to rehabilitation of the sites. The valuation is thus a tool to strengthen the “social license to operate”.
- **Unified metric:** Monetization allows to compare different environmental impacts such as “hectares of land use” or “tons of nitrogen emissions” as they are translated into one unit. Therefore, integration in corporate decision-making tools such as cost-benefit-analysis is possible.

CORPORATE EXAMPLES

Supply Chain application: PUMA and Otto Group

The environmental profit & loss account (EP&L) by *PUMA* should not only be understood as a financial report. Rather, it is meant to facilitate a hotspot analysis and to support *PUMA*’s decision-making process. The company proceeded in two stages: First, various environmental impacts along the entire value chain were quantified. In addition to the corporate properties, the supply chains were examined across several stages, including the production of raw materials, such as leather or cotton.

The assessment of the environmental impact for the first tier of the supply chain is partly based on primary data acquisition. For the analysis of the other sections, an econometric input-output model is used. It combines environmental data and trade flows. Through modeling, the environmental impact of the company was subsequently quantified. Five environmental indicators have been selected for the analysis: water consumption, greenhouse gas emissions, land consumption, air pollution, and land use.

As a second step, *PUMA* carried out an economic valuation and calculated the costs of the various environmental aspects. When undertaking the monetary valuation, *PUMA* relied on the benefit transfer method, where data and values are taken from existing literature and transferred to the case at hand.

Methodologically, the *Otto Group*’s procedure to calculate the environmental footprint is quite similar to *PUMA*’s approach. The external costs add up to 10% of the total sales of the group. Major external costs are caused by the emission of CO₂, water consumption, and air pollution. The calculations highlighted that the production of textiles is the main contributor to the environmental damage.

Project-based application: WBCSD Roadtester and Dow Chemical

The WBCSD's "Guide for Corporate Ecosystem Valuation" sets out five steps how companies can economically capture their positive and negative relations with the environment.

The approach differs from *PUMA's* work, because it covers very specific questions and decision problems. It is therefore not a comprehensive analysis of the company, but an assessment of a certain project or technology. For this reason, attempts are made to rely to a larger extent on local data. *Holcim* – whose example is described more detailed in the study – uses the tool to assess the value created for society after the rehabilitation of three gravel pits in the UK. *Dow Chemical* at the same time conducts an analysis of natural capital management at different production sites. Here, for example the costs of technical solutions to reduce air pollution are compared with reforestation programs, which can provide additional benefits in the form of carbon storage and the creation of habitats.

EXPERIENCE AND RECOMMENDATIONS

Recommendations for companies: project-based application

The biggest challenge is the availability of data. If companies can draw on their own data, the costs and workload decrease. However, particularly data on environmental impacts outside the corporate boundary is often unavailable and must be collected from external sources with great effort. Thus, many of the delays and increased costs experienced by the pilot companies could be traced back to this quantification of the environmental impacts.

The independent verification of the calculations and the objectivity of the data are also recurring issues. For this reason, the use of market prices has a particularly high appeal: they are tangible and comprehensible for everyone. That way, the results become less contestable. At the same time, market prices are only available for a small share of

ecosystem services. But, many aspects such as landscape beauty or potential revenue sources in the future ("option values") can hardly be covered.

Striking a balance between the precision of the results and the costs is critical and needs to be considered carefully by each company. This decision strongly depends on the audience that the company intends to target with the economic valuation. Great care must be taken, and the results should be well justified, particularly when addressing external stakeholders.

Recommendations for progression and application of the project-based approach

- **Identification of the most relevant ecosystem services:** Companies should seek a close collaboration with local NGOs and stakeholders, which can help them identify the environmental impacts and dependencies most relevant to the companies.
- **Improvement of the data basis:** Companies should begin to collect their own data concerning their impact on the local environment. Government and academia can contribute by developing a publicly accessible database with contextual information about preferences and environmental impacts.
- **Support for a unified corporate approach:** More pioneering companies are needed for the further improvement and refinement of corporate ecosystem valuation. As a first step, smaller initiatives can be started and certain environmental aspects could be considered. Building on this experience the approach could be scaled-up to a company-wide method and convention that decreases the cost and effort needed to conduct these studies and to improve comparability of results.

Recommendations for companies: Supply Chain application

The biggest challenge for the analysis of environmental costs along the supply chain is the design and selection of the underlying economic models. As a result of an expert

review it was recommended that *PUMA* increases the share of primary data in their calculations, so that local conditions and impacts are accounted for. Here as well, the availability of data for the quantification of environmental impacts is the one hurdle that has to be overcome as fast as possible in order to expedite natural capital accounting.

Moreover, there is further optimization potential within the models applied so far. Additional environmental impacts, such as water pollution, need to be integrated, and other assessments have to be refined. In addition it is sensible to look more closely at the methods of life cycle assessments, which could help to increase the robustness of the natural capital accounting methods.

Drawing a conclusion on the adaptation of the approach by other companies, the experts of the review panel consider it unlikely that many companies will follow the example, as long as an easy-to-apply and less complex method does not exist. The harmonization and standardization of approaches can also lower the entry threshold, and be an incentive for companies to try out an EP&L.

Recommendations for the development and application of the supply chain approach

- **Improvement of the data basis:** Companies should increasingly collect data on consumption, emissions, and other environmental impacts along the supply chain. For the implementation, supplier questionnaires can be introduced or expanded. It also would be conceivable to carry out “natural capital audits” in order to verify the data.
- **Development and expansion of the models:** Other environmental impacts, such as water pollution, should be integrated into the models. Also, it should be examined whether the indicators currently used, e.g. hectares of land use, are suitable to represent impacts such as the loss of biodiversity.

A comprehensive set of environmental impacts should be developed, so that companies can carry out a rough

analysis of all possible harmful effects, as a first step. As a second step, the most relevant effects should be studied in a detailed analysis.

Recommendations to policymakers

The economic valuation of natural capital should be seen as a first step towards the internalization of positive and negative environmental impacts of companies. Policymakers have to engage at different levels to push on and accelerate this development.

- **Set incentives for the application by other companies:** Currently, the economic valuation of natural capital is tested only by a few companies. Even if the topic arouses more and more interest, practical implementation lags behind. Policymakers must therefore create incentives, e.g. in the form of project funding, in order to reward companies who risk venturing forward and despite the shortcomings still present, have a try at the new methodology. On the other hand, this progress should not turn into a competitive handicap, if the company accepts to shoulder costs and effort. Therefore, even the latecomers should be encouraged to catch up with the pioneers, e.g. by introducing new regulations such as in the field of reporting.
- **Harmonization of data collection and valuation methods:** Yet, there is no standardized framework stating which environmental effects should be assessed by companies and how they should be evaluated. Currently, corporations can decide in their sole discretion which environmental aspects they deem important and what information they collect. Comparability of results is therefore only rarely given. A harmonization of frameworks should therefore be supported. As a result, conventions are necessary to make estimations reproducible such as the *German Federal Environment Agency* has done for the consequences of global warming and other specific environmental impacts. This convention can be expanded to include other environmental effects.

CONCLUSION

The great strength of an economic valuation of natural capital is that negative environmental impacts and the value of ecosystem services are translated into a language, which can be easily understood by business leaders as well as by political decision-makers. Also, this standardization helps integrating external environmental costs into corporate decision-making instruments such as cost-benefit analyses and to thus consider them on a level with financial capital. By integrating them into corporate accounting, the overall environmental performance of a company can be disclosed and compared with other companies. This way, products and their sustainability can also be quantified and compared.

By continuously improving, and standardizing the methods used to determine and value the relevant ecosystem services, and – in addition – by expanding the data basis, it will be possible to further leverage the potential.

Pioneers such as *PUMA*, *Otto Group*, *Dow Chemical*, and the *WBCSD* have sparked a dynamic which provides the opportunity to incorporate natural capital accounting and the recording of externalities in the companies. Some companies have already set out to achieve this objective, but the majority of companies still hesitate. If supported by incentives or regulatory measures, they will also address the issues discussed above. A great opportunity to transform the economy towards a “green economy” would be seized.

1.0 Introduction

Nature is an essential economic factor. It provides a variety of renewable and non-renewable resources. We use timber as an input factor or food as a consumer good but nature also provides ecosystem services such as water filtration or erosion control that benefit society and economy at once.

At the same time economic activity influences the condition and the functioning of nature through the so-called externalities. Neither of these influences are adequately reflected in corporate accounting like the balance sheet or the consolidated profit and loss account.

Above all, the economic valuation of natural capital has for some time been a part of discussions of environmental policy and comprehensive research projects such as *Externe* (external costs of energy) have been implemented in the last years and form the basis for many current applications. At the same time, the “The Economics of Ecosystems and Biodiversity” (*TEEB*) studies commissioned by the European Commission has put the topic at the center of attention. The total economic value of pollination by insects, for example, is estimated at €153 billion per year.² At the same time, in 2008 the 3,000 largest publicly listed companies were responsible for external environmental costs of \$2.15 trillion worldwide.³ A study carried out by the consultancy *Trucost* estimates the top 100 external costs to reach \$4.7 trillion per year. Coal-based power production in East Asia accounted for the largest share of these costs, closely followed by cattle breeding in South America. The dimensions are even more graphic when comparing the average profit margin before taxes without and with costs for natural capital: None of the 20 most important industries would be profitable if environmental externalities were taken into account! For the cement industry, for example, the margin would be -67%.⁴

Different approaches for different objectives

Lately, the private sector has increased its efforts to measure and value environmental costs and to make their business models more sustainable. Three triggers sparked off the development in 2011: At the beginning of the year, chemicals group *Dow Chemical* and the environmental organization *The Nature Conservancy* announced plans to join forces with the aim to promote “the integration of the value of nature into business decisions.” The goal is to collect and evaluate all ecosystem services, of which the company benefits, and to feed the results into the operations of the company.⁵

Furthermore, the *World Business Council for Sustainable Development* has published the “Guide to Corporate Ecosystem Valuation (*CEV*)” in the spring of 2011.⁶ 14 companies operating on a global scale⁷ tested the approach presented in this guide: the economic valuation of natural capital as a possible support of decision-making processes. The focus was on evaluating production or management options, as well as collecting experiences with the new tool.

In the year 2011, *PUMA* published the world’s first Environmental profit and loss account (EP&L). The calculation included five environmental effects: Water and land-use, greenhouse gas and air emissions as well as waste production. It took into account the entire supply chain including the raw material production, resulting in external environmental costs of €145 million. This would correspond to around 70 % of the company’s profits in 2010.⁸

²(TEEB, 2010a)

³(PRI Association & UNEP FI, 2011)

⁴(Trucost, 2013)

⁵(Dow Chemical, 2011)

⁶(WBCSD, 2011)

⁷The 14 business studies were conducted by: AkzoNobel, EDP, eni, Eskom, GHD, Hitachi, Holcim, Lafarge, Mondi, Rio Tinto, Syngenta, Veolia Water, Weyerhaeuser and US BSCD.

⁸(PUMA, 2011d)

These pioneering projects have sparked a variety of initiatives of different, mostly Anglo-Saxon stakeholders who pursue the goal of closing knowledge and data gaps, or of promoting the development of a common methodology for economic valuation.

Even though the number of specific business examples is currently relatively limited, two basic approaches and targets can be distinguished with respect to the commitment of the companies. Those companies that use the *WBCSD CEV Guide* apply the instrument in a narrower context, often focusing on the identification of risks and social benefits of ecosystems which are influenced by certain activities of the company. The chemicals group *AkzoNobel* for example valued and compared the environmental impact of different production technologies from a monetary point of view. The utility company *Veolia Environnement* in turn compared alternative options for the use of a plot of land. The level of

detail of such an approach is determined by the purpose of the respective study and can therefore be very high. Although not a part of the *WBCSD* pilot studies, the work by *Dow Chemical* in particular includes a detailed examination of ecosystem services and resulting benefits in selected locations.

Capturing the effects along the supply chain, however, is not or only to a limited extent part of these projects. Other companies, such as *PUMA* or the *Otto Group*, therefore employ a broader approach, in which the entire value chain is considered, all the way to the production of the raw materials. They focus on the environmental externalities, i.e. the costs (and benefits) that result from the production of goods. By identifying and comparing the main environmental impacts of the company as explained, this approach is first and foremost used for decision-making.

Environmental and social externalities

The German Federal Environment Agency defines environmental damages as impairments of health and property as well as the “extended” environmental damages, meaning the impairments of nature.⁹ The approaches presented in this study do not follow a clear definition of environmental and social externalities, but mostly emphasize the environmental damages. Impacts of environmental damage on human health are included by some companies such as *PUMA*. Social costs like bad working conditions or discrimination are however not accounted for.

Social factors will be included in this study wherever it seems useful.

Box 1: Environmental and Social Externalities

⁹(Umweltbundesamt, 2012)

The term “natural capital accounting” is today often applied to describe these two approaches. They have, despite being different in the details, in common that in the long term they both aim to integrate a natural capital in the corporate balance sheets.

The plans of the politicians

Companies that already deal with this issue at present will benefit from a competitive advantage, as the potential of economic valuation has also been recognized at the political level. The European Biodiversity Strategy notes that monetary valuation can be an important tool in raising awareness regarding ecosystem services and biodiversity.¹⁰ The EU’s “Roadmap to a resource-efficient Europe” states: “New policies should help to align the prices of resources that are not appropriately valued on the market, such as water, clean air, ecosystems, biodiversity, and marine resources.”¹¹ The economic valuation can be used to reveal external effects and increased transparency allows lawmakers and authorities to create incentives for sustainable management or to sanction environmentally harmful behavior with new policy instruments.

The most important barrier to the integration of natural capital into accounting is the lack of accepted standards for its measurement and valuation. Harmonized methods are however necessary for a consistent recording of the data which determines the comparability of the results. The effects along the supply chain, in particular, remain a major challenge.¹²

This study aims at making a contribution to supporting the development of natural capital accounting by informing

companies about the status quo of the discussions, existing approaches, methods and case studies. The study can also serve as an initial guide to those companies who want to implement their own valuation projects. In the long term, the objective is to create a robust, general and applicable framework for the economic valuation of natural capital in the corporate context. At the same time, recommendations are made on where existing methods could be improved further, and on how policymakers can set incentives to accelerate the integration of this instrument into the corporate world.

The study will first briefly explain the key concepts (chapters 1.1 and 1.2), clarify the limits of economic valuation (chapter 1.3) and illustrate why it is in the self-interest of companies to begin with measuring and valuing their natural capital (chapter 1.4). Chapters 2 and 3 contain information on how the assessment of natural capital interconnects with the existing standards of accounting and reporting.

The fourth chapter presents existing (international) initiatives which are currently active in the area of value natural capital (chapter 4.1). It also gives an overview of the results of a survey on the knowledge and attitude of German companies with regard to the subject of natural capital (chapter 4.2). Methods applied and practical experiences of companies are at the focus of chapters 4.3 and 4.4. Chapter 5 provides an outlook and recommendations to companies (chapter 5.1) as well as policymakers (chapter 5.2). Further information can be found in the annex.

¹⁰(European Commission, 2011a)

¹¹(European Commission, 2011b)

¹²(IFAC, 2013)

1.1 What is natural capital?

“Capital is defined as [...] the inventory of production equipment that can be used for the production of goods and services.”¹³ With this in mind, the current stock of biodiversity and ecosystems can be defined as natural capital. This stock can yield various dividends in the form of ecosystem services. Hence, a forest rich in species yields various forms of dividends, such as wood, medicinal plants, or drinking water. But also more abstract services, such as the regulation of the climate through the storage of CO₂ in the soil, can be seen as a dividend provided by the forest. Figure 1 gives an overview of the various ecosystem services and its relationship with business activities.

From a business point of view, natural capital can therefore be considered an (external) production factor. Thus, it is economically expedient for companies to preserve or increase the functioning and integrity of ecosystems, so that corresponding yields can be permanently secured.

In the last 50 years, due to human interventions, ecosystems have changed faster and more extensively than ever before in human history. This was in particular to meet increasing needs, such as for food, drinking water, wood,

natural fibers and fuel. Worldwide, 60% of all ecosystem services are affected by this, which means that ecosystems are no longer able to provide their original services or no longer to the full extent.¹⁴ These are the key factors for this development:

- Degradation of ecosystems and habitats
- Climate change
- Environmental pollution
- Overuse of resources
- Spread of invasive species

Against this background, the signatories of the Convention on Biological Diversity have set the target to significantly reduce the loss of biodiversity by 2020. Although some progress has been made, it will be difficult to achieve this goal. Because entrepreneurial activities contribute to the loss of biodiversity, attempts were increasingly made in recent years to motivate companies to protect biodiversity. To this end, numerous initiatives were launched, such as the *European Business and Biodiversity Campaign* or *Biodiversity in Good Company*.

What is biodiversity?

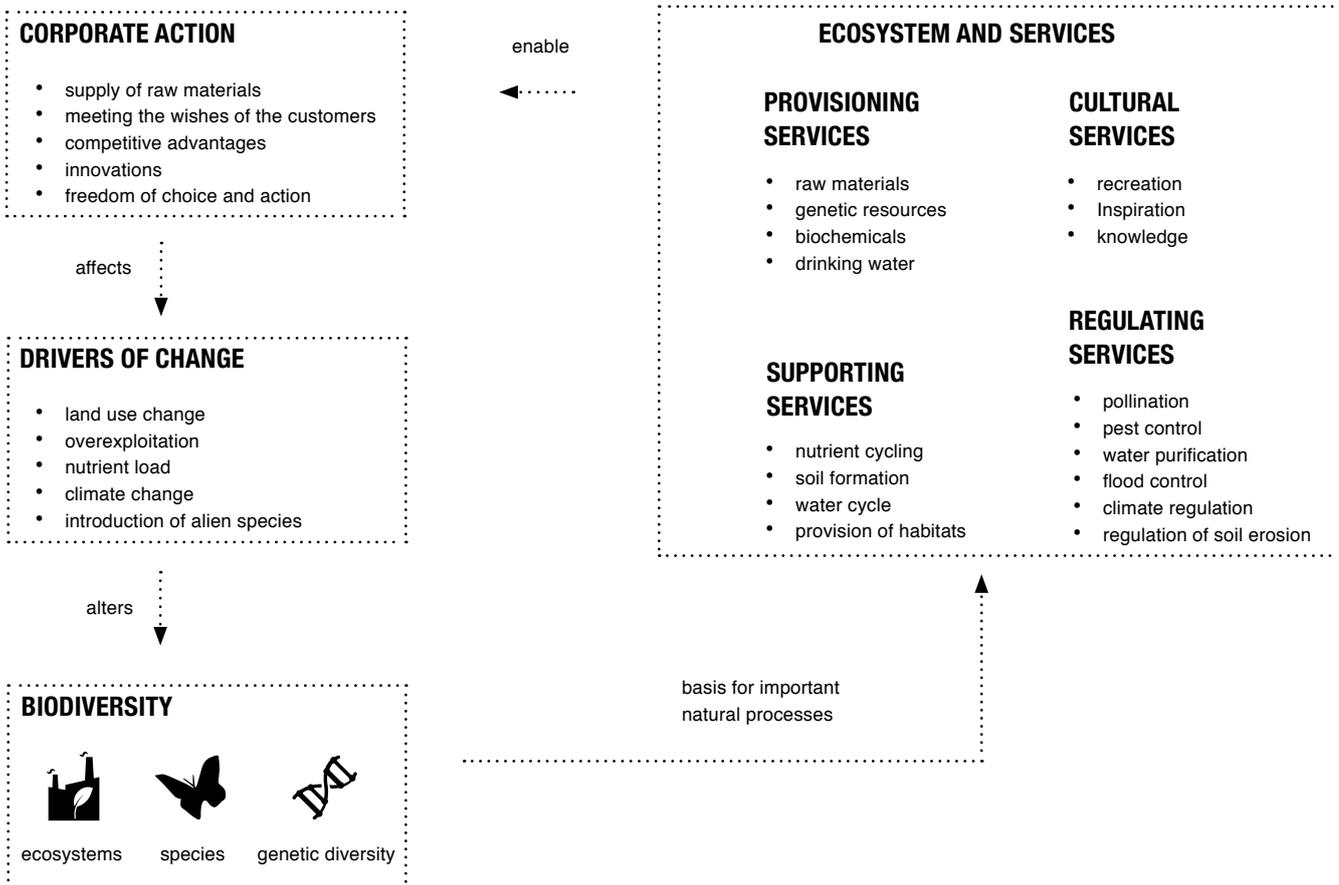
In accordance with the *UN Convention on Biological Diversity (CBD)*, biodiversity describes the diversity of life on different biological structural levels: genetic diversity, the diversity of animal and plant species (biodiversity) as well as the diversity of ecosystems. Diverse interactions take place on and between these levels. These form the basis for numerous ecosystem services, which are the fundamental basis for human well-being.

Box 2: What is biodiversity?

¹³(Gabler, 2004), p. 1638

¹⁴(Millennium Ecosystem Assessment, 2005)

Figure 1: Interaction of business activities, biodiversity and ecosystem services



Source: adapted from (Beständig & Wuczkowski, 2012)

1.2 Economic valuation of natural capital

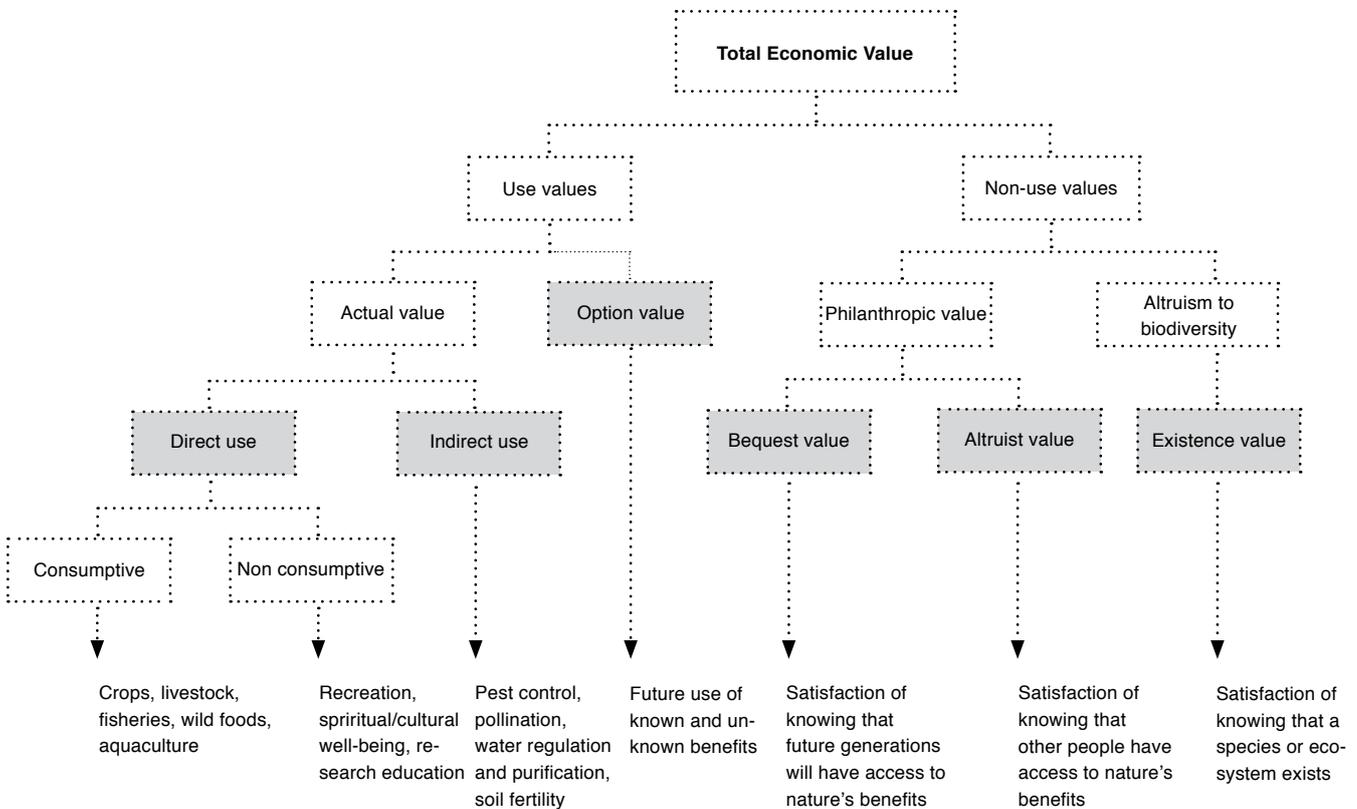
For economic valuation the different components of natural capital are important and their benefits as well as damages need to be assessed. To ensure a comprehensive assessment, the concept of choice is generally the “total economic value” (TEV), shown in Figure 2.

In order to determine the economic value of natural capital, various categories of benefits are being considered. The total value results from adding up the individual elements. Use (utility value) and non-use values are differentiated as the main categories. On the next level, use values are divided into consumptive (e.g. consumption of wood or fruit, i.e. the amount usable for other users is being dimin-

ished) and non-consumptive values (e.g. recreation, in which the consumption of one person has no influence on the consumption opportunities of another person). These direct value categories are usually the easiest to assess in monetary terms, since existing markets and market prices can be referred to.

Use values also include indirect use values. The pollination by bees as a prerequisite for the production of food, for example, is part of this category. In order to account for uncertainties about future benefits, the option value is introduced. It refers to possible advantages and benefits derived from nature in the future, which are still unknown to

Figure 2: The total economic value



Source: (TEEB, 2010b)

date. The tropical rain forest is often cited as an example. It is assumed, that there are hitherto unknown animals and plants whose economic value will only be revealed in the future (e.g. medical use). If the species is lost however, this possible value cannot be realized. These potential losses as well as the lost potential for carbon storage must therefore be accounted for when rainforest is being destroyed, for example through soy cultivation or cattle farms.

The so-called “non-use values” or non-use dependent values are another component of the total value. Many people draw benefits from knowing that certain animal or plant species exist, even if they might never set eyes on them throughout their lives. In addition, cultural and spiritual benefits can be drawn from nature and are included in the TEV as use categories.

The question arises, how natural capital components which make no known direct contribution to human well-being or to the economy can be valued economically. These

components can be captured at least partially by means of non-use values. Due to the immateriality of these value categories, the figures are difficult to compare, vague and subjective.

Methods for economic valuation

After presenting the main benefit categories of natural capital, the valuation methodology is the next subject to be considered. Table 1 gives an overview and provides a comparison of the most common procedures. These valuation techniques have different advantages and disadvantages and also differ in their suitability for the valuation of the respective ecosystem services. As mentioned, market prices are being applied in particular to direct values and provisioning services, as actual market transactions can be referred to in order to evaluate the benefits. More sophisticated methods, such as conducting interviews or more complex modeling must be used for services for which no market exists.

Table 1: Economic valuation techniques

TECHNIQUE	COMMENT/EXAMPLE	DATA REQUIRED	TIME (DURATION)	SKILLS REQUIRED
MARKET VALUATION				
Market prices	Mainly applicable to „goods“ (e.g. fish) but also to some cultural services (e.g. recreation) or regulating services (e.g. pollination)	* Market prices of ecosystem goods or services * Production and distribution costs	Days to weeks	Basic understanding or econometrician
Change in productivity	How the fertility of soils increases yields and thus the income of farmers, or how improved water quality can foster fishery	* Data on production function * Data on cause-and-effect relationship (e.g. crop losses due to reduced availability of water)	Days to weeks	Basic understanding (potentially agricultural expert or process engineer)
Replacement costs	The value of groundwater use can be estimated to be the cost of obtaining water from other sources or by using technological alternatives (replacement costs).	The cost (market price) of replacing an ecosystem good or service with a man-made equivalent (e.g., replacing flow regulation of habitat with flood defense scheme)	Days to weeks	Basic understanding
Damage costs avoided	The value of flood protection can be derived from expected damages associated with flooding.	* Data on costs incurred to property, infrastructure or production as a result of loss of ecosystem services * Damages under different scenarios, including with and without regulatory service	Weeks	Engineering knowledge and knowledge of biophysical processes
REVEALED PREFERENCES				
Hedonic pricing	Calculation of price differences, e.g. of properties that can be traced back to different ecological qualities	* Data relating to differences in property prices that can be ascribed to the different ecosystem qualities (e.g. number of bedrooms, quality of river, and distance from river)	Days to weeks	Econometric
Travel costs	Part of the recreational value of a park is represented by the time and money spent by the visitors in order to reach the park	* Average duration of visit and expenses with regard to recreational or leisure activities * Motivations for travel	Weeks to months	Designing the questionnaire, conducting interviews and econometric analysis
STATED PREFERENCES				
Contingent Valuation (CV)	Often the only way to estimate non-use values. For example, participants of a survey can be asked, how much they are willing to pay in order to improve the water quality of a lake, allowing them to swim or fish in it.	* Stated value that people place on an ecosystem good or service (e.g., water quality, wildlife in a river); demographic and biographical information on survey respondents * Obtained through survey questionnaires	Weeks to months	Questionnaire design, interviewing and econometric analysis
Choice experiments (CE)	It can be used with the help of different methods, for example comparing two options.	* As for CV above, although CE contrasts several different scenarios * An appropriate set of levels is required for the different parameters (e.g., poor, medium, good and excellent river water quality)	Weeks to months	Questionnaire design, interviewing and econometric analysis
Benefit transfer	Transfer of values or benefits from existing studies with similar context.	* Valuations from similar studies elsewhere * Data on key variables from different studies (e.g., GDP per person)	Days to weeks	Basic or econometric analysis if using bid functions

ADVANTAGES**DISADVANTAGES**

- + a readily transparent and defensible method since based on market data
- + it can reflect an individual's willingness to pay

- only applicable where a market exists for the ecosystem service and data is readily available
- market prices can be distorted, e.g. by subsidies.

- + if data is available, it is a relatively straightforward technique to apply

- necessary to recognize and understand the relationship between the ecosystem service and output of product
- can be difficult to obtain data on both change in the ecosystem service and change in productivity

- + provides surrogate measures of value for regulatory services (which are difficult to value by other means).
- + a readily transparent and defensible method when based on market data

- can overestimate values.
- does not consider social preferences for ecosystem services or behavior in the absence of the services.
- the replacement service probably only represents a proportion of the full range of services provided by the natural resource.

- + provides surrogate measures of value for regulatory services that are difficult to value by other means (e.g., storm, flood and erosion control).

- the approach is largely limited to services related to properties, assets and economic activities.
- can overestimate values.

- + readily transparent and defensible method, because based on market data and WTP.
- + property markets are generally very responsive so are good indicators of values

- approach is largely limited to benefits related to property.
- the property market is affected by a number of factors in addition to environmental attributes, so these need to be identified and discounted (e.g., number of bedrooms)
- high data requirements

- + based on actual behavior rather than a hypothetically stated willingness to pay
- + results are easy to interpret and explain

- approach is limited to the direct use recreational benefits
- difficulties in apportioning costs when trips are to multiple places or are for more than one purpose
- considering travel costs alone ignores the opportunity cost of time while traveling

- + captures both use and non-use values.
- + extremely flexible - it can be used to estimate the economic value of virtually anything.
- + gives a much more accurate outcome than benefit transfers.

- the results are hypothetical in nature and subject to numerous biases from respondents:
- e.g., respondents may express a positive WTP to promote a warm glow effect, overestimating the value;
- e.g., if the cost is perceived as a tax, respondents may express a negative WTP, underestimating the value
- it is resource intensive

- + captures both use and non-use values
- + theoretically provides more accurate values for marginal changes (e.g., values per % increase in coral cover)
- + gives a much more accurate outcome than benefit transfers

- the results are subject to bias from respondents and are hypothetical in nature
- it is resource intensive
- it can be mentally challenging for respondents to truly weigh up the alternative choices given to them in the time available

- + low cost and rapid method for estimating recreational and non-use values

- the results can be questionable unless carefully applied
- existing valuation studies may be more robust and numerous for some services than for others

Source: Adopted and extended from (WBCSD, 2013) and (TEEB, 2010 b)

The so-called “benefit transfer” method (value transfer) plays a special role. It was the basis of valuation for *PUMA*’s EP&L and many of the studies carried out by the *WBCSD* pilot companies. It is not a stand-alone method. Rather, the idea is to take advantage of existing literature and data and to transfer them to similar issues while adapting them as much as possible. For example, calculated values for the flood protection function of a lake in southern England could be transferred to a wetland in the North of England. The calculation of average values or utility functions and their subsequent use is also possible. Benefit transfer is often less expensive than carrying out a separate study, especially when dealing with aspects, for which market prices do not exist.

It is self-evident that precautionary measures need to be taken when transferring certain values. The underlying studies have been carried out in a particular context after all and the meaningfulness of the transfer must be verified. When analyzing the willingness to pay, basic socio economic conditions play an important role. The transfer to other regions must take account of these differences and the estimates have to be adjusted by for instance using purchasing power parities. Also, the methodological quality of the underlying study must be ensured, because ultimately, errors contained therein are being transferred and might be multiplied.¹⁵

Still, there is reason to believe that benefit transfer will prevail as the dominant method for the monetary valuation of environmental impacts. This is true for example when the entire supply chain is being examined and separate valuation studies cannot be carried out at each site. In doing so, it has to be ensured that the resolution of the cost and value data be as high as possible. In other words: In order to adapt specific valuations to the local context, the

underlying data has to be collected on the same or a similar level of the scale. If this is the case, the local values can be transferred to the new context.

Consulting firms such as *Trucost* or *PwC* strive to locally adapt their data and have created comprehensive databases, which should simplify more complex applications of the assessment method and increase its robustness. To that end, more data has to be collected in the long term, further studies have to be carried out and models of calculation as well as data bases have to be standardized and made publicly available in order to ensure plausibility and comparability. These attempts of harmonization will simplify the application as a whole, because they limit the uncertainties of the used values to a certain extent.

Benefit transfer is not always the ideal solution

In many cases, separate analyses cannot be avoided. While greenhouse gas emissions cause global environmental changes, there are pollutants and impacts, such as air pollution, which mostly cause locally limited damages. In the absence of local assessment data, a calculation on the basis of global average values or on the basis of calculations from other regions can easily lead to distortions.

Even if a company plans to apply the economic valuation for a specific decision or for a locally limited examination, e.g. for a production site, it is advisable not to opt for benefit transfer. This is because the actual local preferences of the population as well as the structures and functions of the ecosystem cannot be easily replicated by estimates of another study, so that reliable results cannot be calculated. It is advisable to make a greater effort, e.g. analyzing the willingness to pay and therefore achieve more reliable results.

¹⁵The methodological convention of the German Federal Environment Agency provides assistance on how to select a suitable study for benefit transfer. (Umweltbundesamt 2012)

1.3 Limits of economic valuation

While the economic and monetary valuation of natural capital offers various advantages it cannot be regarded as a panacea. Recording external environmental costs is the last step in a process that begins with a quantitative analysis of entrepreneurial effects on natural capital as well as its dependencies from it. Such analyses can be the basis for responsible biodiversity management. Companies must therefore ask what added value the monetary valuation of natural capital holds in stock for them.

While there is a number of procedures and indicators for the capturing of natural capital, trying to value natural capital and impacts on natural capital comprehensively is highly complex. The following aspects are to exemplify how difficult it is to “properly” assess the benefits that ecosystems generate.

- **Allocating the impacts:** How can negative environmental impacts be assigned to the responsible agent? This problem of causality can be illustrated by the example leather: Starting point of the production of leather is the skin of an animal, which often accrues as a by-product of the production of meat and is subsequently processed. A certain percentage of the environmental damage caused in the meat production would therefore have to be allocated to the leather producers. The environmental costs caused by cattle farms would, as an example, thus have to be apportioned based on the value added. This example also illustrates another difficulty. The conversion of a forest goes through three phases: initially, the forest is being cleared, then the area is being converted into agricultural land on which, for example, soy is grown. Finally, the same land is being depleted by agriculture and used for cattle breeding. The massive impact on nature, i.e. the clearing of the trees, would therefore have been carried out for the cultivation of soy, not for the farming of livestock. This would have to be taken into account when apportioning the environmental costs to the polluters.
- **Spatial valuation differences:** Biodiversity and ecosystems are valued differently if the respondent is directly dependent on them, or if they are only present on a

different continent. Impacts and valuations vary on local, regional and international levels. One example is the preservation of forests. Forests generate income for the local population, for example, by harvesting forest fruits. In addition, they provide ecosystem services such as erosion control and thus benefit the regional population. Assuming the forest is also a habitat for rare species, whose conservation is a concern to part of the world's population, the ecosystem also generates global benefits.

- **Temporary valuation differences:** Even temporal effects play a role. An overuse of natural resources, such as fish stocks, beyond their ability to regenerate, has a strong impact on the availability of these stocks in the future, meaning that the external effects are being passed onto subsequent generations.

Similar to the case of investment decisions, it is possible to compensate temporary valuation differences by discounting future benefits. Putting a discount rate greater than zero means that the benefit of future generations is being rated lower than today's benefit. The choice of the discount rate can quickly lead to ethical discussions.

- **Thresholds, tipping points, and irreversibility:** Nonlinear dynamics become apparent in the degradation of ecosystems: if certain impacts are too massive, thresholds may suddenly be overstepped, which cannot be undone or only with great effort. Within certain levels of concentration, lakes for example can absorb nutrients without their self-cleaning function being significantly affected. The closer the system gets to its pollution load capacity, the more the self-cleaning power of water is affected. Once set in motion, these dynamics cannot be stopped anymore and the system “collapses”. In the case of a eutrophying lake, any costs for the introduction of a nutrient unit would therefore have to gradually rise according to their damaging impact and tend to infinity just before reaching thresholds.

1.4 The business case for economic valuation of natural capital

For companies, there is a variety of reasons to deal with the subject of natural capital in general and with economic valuation in particular. Table 2 gives a brief overview.

Firstly, the economic assessment of natural capital can lead to improving internal processes and decisions. Generally, it can be said that improvements of corporate transparency can be achieved and optimization potentials can be revealed. With a cost-benefit analysis, the environmental impacts and the accompanying (external) costs of different production technologies can be evaluated. The Japanese company *Hitachi*¹⁶ did this for the CO₂ emissions of selected technologies for the manufacturing of electronic components. The company calculated, which costs the company might be facing and how, if necessary, environmental taxes could be saved. In addition, possible

savings can be pointed out, for example when comparing ecological approaches to erosion control through reforestation with an alternative technological solution.¹⁷ Similarly, companies can use their funds more precisely to address the identified damaging impacts at ecological hotspots. Accordingly, *PUMA* has decided to seek alternatives to leather, as the leather production is responsible for the bulk of the company's impact on the environment.¹⁸ One special value added by economic valuation is the fact that the value of natural capital is expressed in a comparable unit. These examples show that integrating natural capital in corporate management tools, such as cost benefit assessments, provides companies with a basis for decisions that can make a significant contribution to improving the environmental performance of companies.

Table 2: Reasons for the economic valuation of natural capital

PROCESS OPTIMIZATION	+ Decision making: ecological advantages and drawbacks of alternative production techniques can be assessed.
	+ Potential savings can be identified and expenses for environmental taxes can be reduced.
	+ Investment decisions can be targeted more accurately.
	+ Increased transparency through increased knowledge.
RISK MANAGEMENT	+ Allows companies to respond to new laws at an early stage.
	+ Liability and compensation costs can be estimated more easily.
	+ Potential risks in the supply chain can be diagnosed and solved more easily.
REPUTATION	+ The environmental performance of a company can be demonstrated and compared with competitors.
	+ Companies can position themselves with respect to competitors.
	+ A positive image can induce increased demand by consumers.
	+ Employees identify more closely with their company.
BUSINESS OPPORTUNITIES	+ Potential new business opportunities such as eco-tourism and biodiversity offsets can be evaluated and applied.

Source: Own illustration

Risk management

In the field of risk management, the economic valuation of natural capital can help companies to better assess the economic dimension of possible events of damage. Particularly in the context of compensation payments, the economic valuation of environmental damages has been used widely. The *ExxonValdez* disaster is perhaps the best-known example.¹⁹

By the same token, risks can be analyzed along the supply chain and for the procurement of raw materials. The example of a recent study by *Trucost* on global externalities shows firstly, which industry sectors have a particularly high environmental impact in different regions and secondly, in which region resource shortages can occur. That way, the

costs of water consumption can be weighed against local water shortages²⁰ and act as an indicator of future risks for the stability of the supply chain.

An interesting study by Lenzen et al. (2012) for the first time chalks out the ecological impact of imports and was able to demonstrate correlations between the loss of certain plant and animal species and the German economy. (See Box 3)

The subject of natural capital is becoming more and more important in the financial industry. Companies such as oil corporations or mining companies, who are especially dependent on natural capital or are affected by extensive environmental regulation, could in the future face more restrictive lending criteria.²¹

Loss of species due to the supply chain

In a much-acclaimed study by Lenzen et al. (2012), the researchers point out that the loss of species is being fueled by world trade and argue that its cause and effect are very much geographically separated.

In their model, they evaluated 5 billion supply chains and were able to show the connection between 25,000 threats to plant and animal species and 15,000 goods produced in 187 countries. An input-output model traced goods along their supply chains from the production to the place of consumption. For example, the spider monkey is threatened due to the loss of its habitat. Above all, this is due to the expansion of coffee and cocoa plantations in Mexico and Central America, which is driven by the demand in Europe and the United States.

30% of the threats to species can therefore be attributed to international trade. This is true in particular for trade in products such as coffee, tea or textiles. Because of the production of goods, the biodiversity footprint of developed countries is much higher abroad than at home. For Germany, the scientists show that imports are in different ways connected with 395 species threats. As an example, the production of steel in Finland for German automotive manufacturers is connected with negative impacts in Ghana or Congo, where the mineral resources are mined. Figure 3 (next page) shows a diagram of the trade flows and their impact.

¹⁶(Hitachi Chemical Co., 2011)

¹⁷(WBCSD, 2009), p. 25

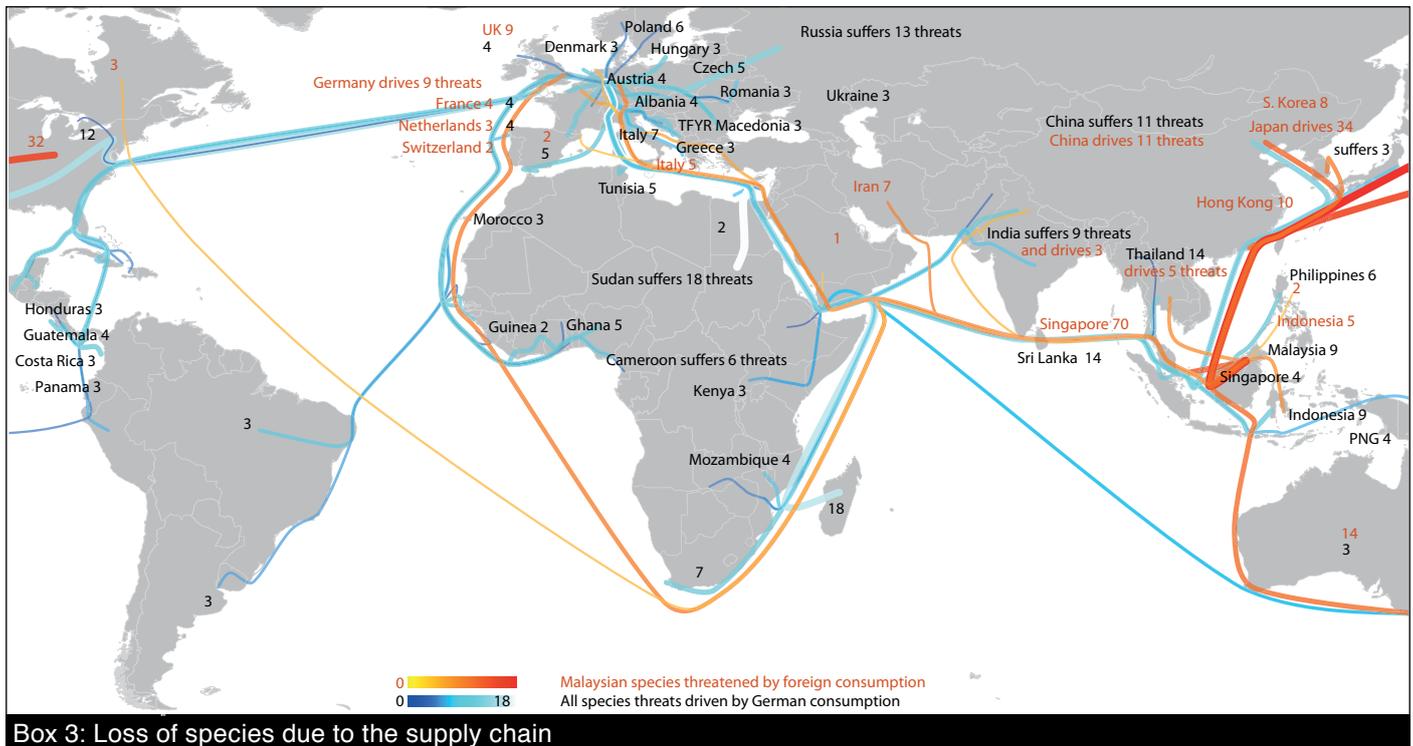
¹⁸(Financial Times Germany, 2012)

¹⁹(Carson, Mitchell, Hanemann, Presser, & Rudd, 2003)

²⁰(Trucost, 2013)

²¹(UNEP FI, 2010)

Figure 3: Flow sheet for threatened species



Box 3: Loss of species due to the supply chain

Source: (Lenzen, Moran, Kanemoto, Foran, Lobefaro, & Geschke, 2012)

Reputation and consumers

The reputation of a company is an important motive for the economic valuation of natural capital. This can be beneficial on many levels. Companies for example position themselves as sustainability pioneers or reinforce the identification of their own employees through the (social) commitment of the company. In addition, the instrument can be used to measure the corporate sustainability performance and to draw comparisons with the competitors. It may be equally revealing to break down the sustainability performance to the product level, as *PUMA* did subsequently to its environmental profit and loss account. According to this calculation, the environmental costs of a conventionally produced shoe were €4.29 and around 31% higher than those of the biodegradable version.²² This is even more important when considering that consumers pay more and

more attention to environmental and social aspects when shopping. A low negative environmental impact can result in a competitive advantage.

Another field of application is the potential analysis of new business areas. For instance, the South African utility company *Eskom* has calculated whether it is worthwhile to open up for eco-tourism the area around a pumped-storage power plant operated by the company, which is also a habitat for a variety of bird species.

This example is also directly connected to the incentive for companies. The “true” value of company-owned natural assets, e.g. a forest area, can be uncovered through economic valuation.²³ Find out more about the influence on corporate accounting in the following chapter 2.

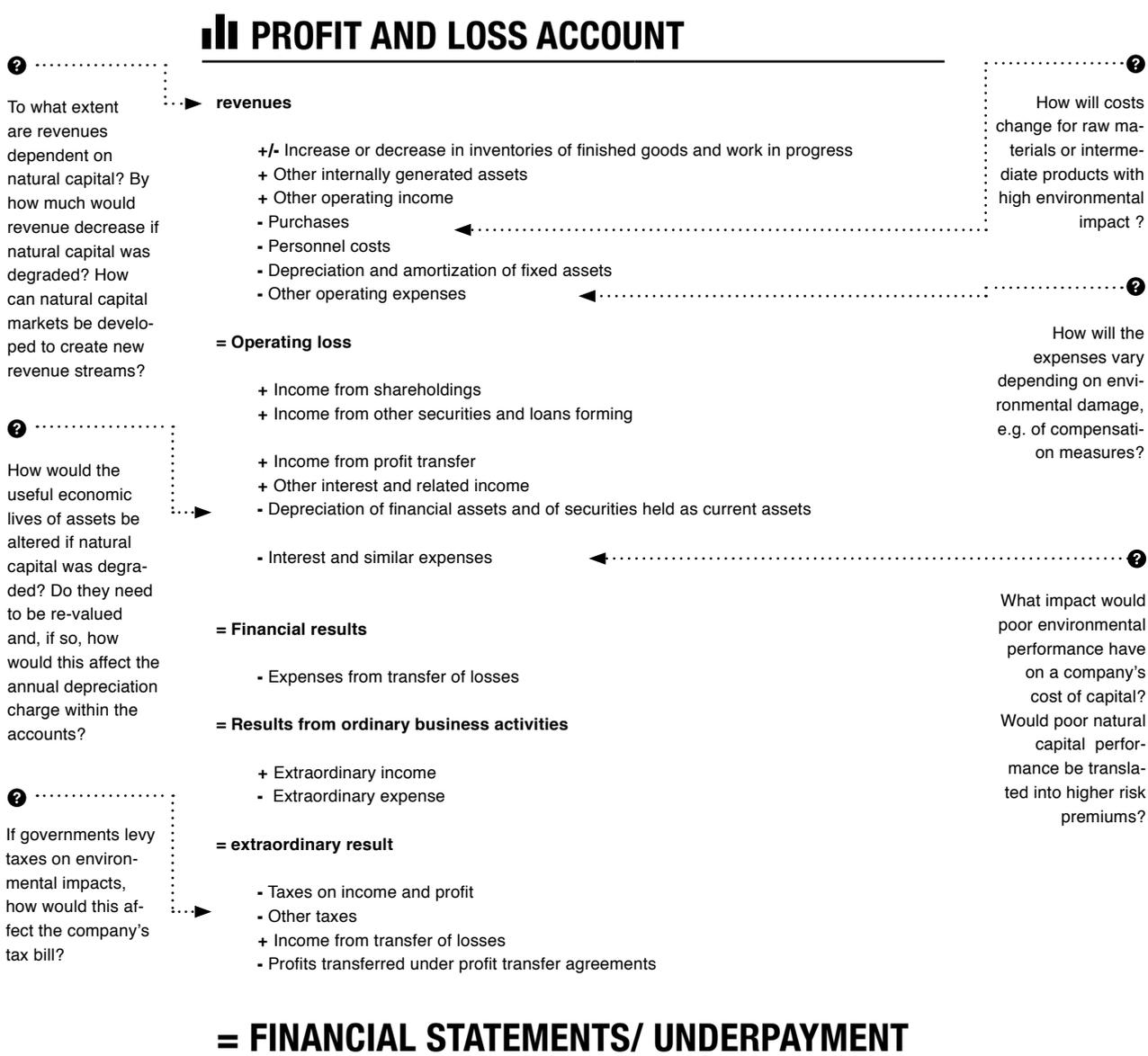
²²(PUMA, 2012b)

²³(WBCSD, 2011), p. 22

2.0 Links to existing accounting standards and laws

Even if at the moment natural capital does not have to be reflected in financial accounting, there are many items in the profit and loss account and balance sheet, where a link to natural capital can be established. Figure 4 and Figure 5 provide a first overview:

Figure 4: Natural capital and profit and loss account



Source: Adapted and extended from (ACCA, FFI, & KPMG, 2012)

Figure 5: Natural capital in the balance sheet



Source: Adapted and extended from (ACCA, FFI, & KPMG, 2012)

These links can also be pointed out in international and national accounting standards. Table 3 gives an overview of the requirements of international accounting standards and its overlap with the debate on natural capital.

Table 3: Natural capital and existing requirements in annual accounting

STANDARD	EQUIVALENT COMMERCIAL CODE (HGB)	OBJECTIVE (IAS)	LINKS TO NATURAL CAPITAL
IAS 37: Provisions, Contingent Liabilities and Contingent Assets	§ 249 Provisions	Rules for the treatment of provisions, contingent liabilities and contingent assets. For an obligation according to IAS 37, a legal or contractual obligation is not necessary, the existence of a constructive obligation is sufficient. For this reason, a larger group of stakeholders may assert claims against the company.	IAS 37 is connected to natural capital in two ways: 1) A company can be legally obligated to restore a utilized area to its original (ecological) state. An estimate of the restoration costs must be made at the beginning of the project and disclosed as a provision in the accounting. 2) The legislation is becoming more and more complex and companies could, in the future, increasingly face lawsuits for bad environmental performance or damages. Accordingly, a company would have to recognize provisions for possible penalties and damages. This also raises the question of assessing the damage.
IAS 16: Property, Plant and Equipment	Property, plant and equipment are not defined in the commercial code, according to §266 II HGB, they are part of the fixed assets	Refers to the accounting treatments for most types of property, plant and equipment. The most important aspects are the recognition of the assets, the determination of their book values as well as the depreciation charges that would have to be recognized.	1) After an intervention in nature, restoration is necessary (see above) and in Germany required by law. Restoration costs must be estimated accordingly. 2) What is the "true" value of land? Forests or natural areas provide many ecosystem services. Should this value be included in the valuation of property, plant and equipment? If so, how should it be depreciated? How does an ecosystem diminish in value due to its use? Can ecological enhancement produce an increase in value?
IAS 36: Impairment of Assets	§ 253 Valuation of assets and liabilities	Ensures that assets are not carried at more than their recoverable amount in the balance sheet. Also, stipulates how this recoverable amount can be determined.	Developments in the field of natural capital can change the value of assets carried in the balance sheet of a company. IAS 36 stipulates that the assets of a company cannot be carried at more than their recoverable amount in the balance sheet (i.e. the higher of an asset's fair value less costs of disposal and its value in use). If the cost for the use of an asset increases (e.g. increased water scarcity leads to higher water prices), the value of the asset or its resale value is reduced, resulting in a decline in value.
IAS 41: Agriculture		Accounting rules for agricultural activity	As described in IAS 36, changes in the condition of the natural capital can affect the balance sheet. As an example: The value of an orchard can sharply drop when the number of existing pollinating insects declines. This has been observed increasingly in recent years. The decline of the populations leads to loss of productivity and a decrease in value of the asset.

STANDARD	EQUIVALENT COMMERCIAL CODE (HGB)	OBJECTIVE (IAS)	LINKS TO NATURAL CAPITAL
IAS 38: Intangible Assets	Intangible assets are not defined in the commercial code, according to §266 II HGB, they are part of the fixed assets	Rules for the accounting of intangible assets	With the EU emissions trading scheme, a market for ecosystem services does already exist. The emission rights are accounted for as intangible assets. In addition to the market for CO ₂ , efforts are being made internationally to build more markets for biodiversity and ecosystem services, such as “eco-accounts” (“Ökokonten”) for impacts on nature or biodiversity offsets.
IFRS 3: Company Mergers		Rules of accounting for transactions in which one business obtains control of another.	<p>Goodwill is measured as the difference between the purchase price of a company and the aggregate value of its assets. It refers to things like brand equity or expected future developments.</p> <p>In view of the increasing demand for sustainable goods, companies who bear this in mind can expect excellent growth opportunities. Companies that show good management practice of natural capital would accordingly have a higher value.</p> <p>Both of these factors would positively affect the amount of goodwill.</p>
IASB guidance on reporting		This is non-mandatory guidance on the preparation and presentation of the management commentary that accompanies financial statements.	Although the directive does not contain any explicit reference to natural capital, companies are encouraged to identify their main risk potentials and to present plans to reduce the risks.

Source: adapted from (ACCA, FFI, & KPMG, 2012), (Deloitte & Touche GmbH Auditing Company, 2013)

Based on this list, a number of challenges can be shown which companies face when integrating natural capital into the balance sheet. The “correct” economic valuation specifically is a difficult challenge. Provisions are one example: At what level should a damage be set? Interestingly, the *Exxon-Valdez* accident in 1989 was one of the first cases where environmental-economic methods were applied in order to quantify the ecological damage. The same would have to be applied to other industries with high risk potential. The ex-ante assessment of possible events of damage must rely on estimates. In addition, the reversal of provisions (HGB § 249 III) is another aspect, which would be influenced by the increasing recording of natural capital.

When does the reason for the provision cease to apply? In particular, due to their complexity it will be difficult to establish causality between damages and long-term consequences in ecosystems.

The difficulties to calculate a realistic economic value for natural capital do also become manifested when accounting for property, plant and equipment. The natural capital value of properties would have to be assessed. Consequently, their book value would decrease, if the functioning of the associated ecosystem and its potential for the generation of ecosystem services were affected. One example is the clear-cutting of forest areas, which promises

high short-term profits whilst accepting long-term productivity losses of various non-monetary services of the forest. But also external factors, such as climate change can be influential. However, is it possible to write off ecosystems just like a machine?

On the other hand, by taking stock of natural capital, an incentive would be created for companies to sustainably cultivate the land. However, the problem goes beyond properties. This is shown by the example above, according to which the cost for the use of an asset increases due to a change in condition and functioning of the natural capital. For example, if climate change or desertification leads to increased water scarcity, this can affect water prices and thus the production costs.

Intangible assets and goodwill

According to HGB § 266, intangible assets include concessions and rights. The EU emissions trading scheme created a market for trading rights to pollute the atmosphere. These emission rights can be included in the balance sheet as intangible assets and will be valued at acquisition cost in case of acquisition against payment.²⁴ Interestingly, even in this case, the correct valuation could be a matter of discussion, as many existing studies on the economic valuation of corporate natural capital do not use the market price

but the “social costs” of climate change. This also includes the damages arising from climate change. It is not entirely surprising that these costs are much higher than the current market prices²⁵ of the European emissions trading scheme.

At the same time, it is currently being discussed at various levels to also establish market-based systems such as emissions trading for other ecosystem services. In Germany, for example, there are guidelines on “eco-accounts” (“Ökokonten”) aimed at making the impact compensation scheme more flexible. According to this, companies damaging nature, e.g. during a construction project, can compensate for this by buying “eco-points”, which have been generated elsewhere. Owning these eco-points therefore entitles companies to a (future) intervention in nature.

In the event of the acquisition of companies, there are often payments, which are referred to as goodwill in the commercial code. Its value results from the difference between the purchase price of a company and the aggregate value of its assets. Among others, this value relates to the value of the brand or also to the future potential of the company. Nowadays, the total value of companies is also determined on the basis of sustainability criteria. Good natural capital management could therefore positively affect the goodwill.

²⁴(Beyer, 2006)

²⁵The current price in February 2014 is €6/tCO₂

3.0 Links to corporate reporting

Corporate reporting will be a key driver for the integration of natural capital into corporate accounting. This is true although corporate reporting might not necessarily include monetization. It will however cover the qualitative and quantitative recording of the environmental impact of the company.

Currently only around 3,500 of a total 80,000 multinational companies report on their sustainability performance. This corresponds to a proportion of just 5%.²⁶ In some countries there are already approaches, to make mandatory the disclosure of social and environmental indicators in addition to the reporting of financial data. Back in 2011, the European Commission published its corporate social responsibility strategy, stating that integrated financial and non-financial reporting is an important objective in the medium and long term.²⁷ By submitting an amendment to the accounting directives in April 2013, the Commission also demonstrated that it intends to put this goal into practice. The amendment is to achieve more transparency in the social and environmental performance of major companies: “Companies concerned will need to disclose information on policies, risks and results as regards environmental matters, social and employee-related aspects, respect for human rights, anti-corruption and bribery issues, and diversity on the boards of directors.”²⁸ However, the Commission recognizes that the regulation does not call for a comprehensive sustainability report, but rather for the provision of brief information. Companies can decide on their own, which aspects they

view as most relevant, so that they would want to report to that effect.²⁹

Some European countries have advanced more than this. In France, a new law was adopted in 2001, requiring listed companies to disclose their environmental performance. In Denmark, there is a similar law, which obliges companies above a certain size to report on their responsibility towards society.³⁰

Especially with regard to the practical implementation of these guidelines, there is a lot happening internationally. The *Global Reporting Initiative (GRI)* has recently published its revised guidelines GRI4. But also new initiatives like the *International Integrated Reporting Council (IIRC)* dealing with integrated reporting or the *Sustainability Accounting Standards Board (SASB)* which pursues a sector-specific approach, have recently entered the market. (See Table 4)

The aspect of “materiality” is of particular importance in connection with the reporting. Reporting guidelines urge companies to capture the aspects essential to them. However, there is still no generally accepted methodology to determine how this requirement can be put into practice and companies approach this question differently, depending on their industry and available resources. Based on internal considerations as well as in dialogue with external stakeholders companies weigh their sustainability issues and design a materiality matrix in which certain aspects are

²⁶(Thurm, 9/6/2013)

²⁷(European Commission, 2011)

²⁸(European Commission, 2013)

²⁹(European Commission, 2013)

³⁰(ACCA, FFI, & KPMG, 2012)

Table 4: Initiatives in sustainability reporting and links to natural capital accounting

INITIATIVE	WEBSITE	OBJECTIVE/COMMENT	LINKS TO NATURAL CAPITAL ACCOUNTING
International Integrated Reporting Council (IIRC)	www.theiirc.org/the-iirc	<ul style="list-style-type: none"> - Development of guidelines for the integrated reporting. - Integrated report to include parts of financial and sustainability report. 	<ul style="list-style-type: none"> - Broad concept of capital. Natural capital is the basis for all other types of capital. - Companies to show how they use and impair capital.
Global Reporting Initiative (GRI)	www.globalreporting.org	<ul style="list-style-type: none"> - Development of a framework for sustainability reporting. - Latest guidelines were published in May of 2013: <ul style="list-style-type: none"> • Companies are to place increased focus on determining the main impacts. • The value chain is also included and companies are to report on it. 	<ul style="list-style-type: none"> - Economic valuation can be an instrument for the materiality analysis. - Transparency in the supply chain and the collection of data facilitates the implementation of economic valuation and the identification of natural capital risks.
Sustainability Accounting Standards Board	www.sasb.org	<ul style="list-style-type: none"> - Development of industry-specific standards for the disclosure and accounting of key sustainability topics. - Integration of sustainability reports into existing standardized forms like the "Form 10-K" for annual reporting to the U.S. Securities and Exchange Commission (SEC). 	<ul style="list-style-type: none"> - Explicit reference to natural capital. - As a second step, the Board intends to examine how the main aspects can be accounted for.

Source: Own illustration

plotted in a coordinate system, according to their relative importance for the company and its stakeholders. However, these matrixes do not necessarily show how stakeholders would weigh individual aspects or which the industry benchmarks are that can be used to compare companies. They do not include a future orientation either, meaning the question how risks can be influenced by unforeseen events or what happens when the stakeholder preferences change.³¹

A new proposal is to remedy these shortcomings. The new *GRI4* guidelines contain a guide to the implementation of a

materiality analysis. The *Sustainability Accounting Standards Board* has developed industry-specific "materiality maps". However, it has yet to be seen which improvements these proposals provide in practice. The corporate collection of environmental externalities in the form of a hotspot analysis can be an instrument for the implementation of the materiality analysis. With the hotspot analysis, different harmful effects can be monetarily valued and compared subsequently. This way, different environmental effects can be reduced to a common denominator, making it easy to compare them.

³¹(AccountAbility, 2013)

4.0 Valuation of natural capital in practice

4.1 Overview of (international) initiatives

A variety of initiatives currently deals with aspects of the recording and accounting of natural capital. Table 5 provides an abridged overview (the detailed table can be found on our website www.naturkapitalbilanzierung.de). Also, a wide variety of approaches and objectives is associated with the large number of actors. Many of these initiatives are however still in early stages and it seems that they have not always found their final orientation.

Since its establishment the *Natural Capital Coalition* (formerly *TEEB for Business Coalition*) has become an important player. The Coalition is promoting the development of methods as well as acting as a coordinator, bringing together many of the other initiatives. Coalition members include the *World Business Council for Sustainable Development (WBCSD)*, the *Corporate EcoForum* and the *Prince's Accounting for Sustainability Project*. The *Natural Capital Coalition* emerged from the international *TEEB* process. The director of studies *Pavan Sukhdev* is a principal consultant for the organization. The *Coalition* is working with its partners to develop standardized methods for the valuation of natural capital. It has adopted a transparent approach and wants to disclose all information as well as collating them in an open source database. Amongst others, the consulting company *Trucost* provides methodological support.

WBCSD, which has published a seminal publication in this field, the "Guide for Corporate Ecosystem Valuation", is a pioneer in the field and in the practical application of natural capital valuation. *WBCSD* also works to capture the value of natural capital and has drafted a report on the valuation of water, among other things.

The *Cambridge Natural Capital Leaders Platform* also works to improve and develop the methods for the economic valuation of natural capital. However, its focus is on the ability to operationalize the approaches and on providing practical assistance for the application. It also asks which data a company needs to conduct a valuation. The platform has currently 12 member companies including the supermarket chain *Asda* or the brewery group *SAB Miller*. They will implement evaluation studies and draw conclusions from their experiences on how to practically improve the approaches. Recently they published a tool to assess externalities in agriculture.

The *B-Team*, an initiative launched by the founder of *Virgin*, *Sir Richard Branson* and the former CEO of *PUMA*, *Jochen Zeitz* is still surrounded by rumors. The *B-Team's* main topics are a more sustainable economy including the calculation of the true costs of products and business activities.

Apparently, 10 more environmental profit and loss accounts are to be carried out on the basis of the *PUMA* model in the framework of the project. *Virgin*, *Wal-Mart* or *Unilever* amongst others have been mentioned as interested candidates. The auditing company *PwC* as well as *Trucost* are supporting the initiative.

The Dutch initiative *True Price Foundation* also aims to develop the underlying methods. It is supported by companies such as the chemicals groups *AkzoNobel* and *DSM*, but also by development institutions and workers associations. The initiative differs from others by explicitly wanting to include social externalities and particularly aiming at the product level. This way, the *Foundation* intends to directly appeal to the consumers and to disclose the “real” price of products.

The association of US enterprises *Corporate EcoForum* (CEF) does not aim to develop methods, but to facilitate and promote their use. It wants to encourage companies’ commitment for the preservation of natural capital and instill the responsibility for this preservation at the management level of enterprises. In 2012 *CEF* released a report named “The New Business Imperative-Valuing Natural Capital”. In it, 24 American companies, among them *Alcoa* and *Xerox*, commit to reducing their environmental impact and to record and preserve the value of natural capital for

their company. Based on this study, the *Forum* is currently working on establishing a platform, the “Natural Capital Business Hub” which is to serve as a point of contact and a source of information for companies who are interested in valuating natural capital.

The “Natural Capital Declaration” is specifically geared towards the financial sector. It was initiated by the *UNEP Finance Initiative* and the environmental NGO *Global Canopy Programme*. On the one hand, it aims at ensuring that the great importance of natural capital be increasingly reflected in the financing and investment decisions of banks and insurers. On the other hand, its objective is for financial institutions to integrate their impact on the natural capital into the corporate balance sheets.

This overview suggests that there is a lot of development at different levels, and efforts are made to improve the usability and dissemination of natural capital valuation. But there is clearly an imbalance: While activities are mainly undertaken by Anglo-Saxon initiatives, other countries lag far behind. Therefore, companies in Germany should actively engage with the topic of natural capital and its valuation and accounting and discuss how they can integrate this aspect in their operations. Only then will they be able to shape the ongoing developments and can prepare for future legislation and regulations.

Table 5: Overview of the most important initiatives for the valuation of natural capital

INITIATIVE	WEBSITE	OBJECTIVE/COMMENT	BACKGROUND	PARTNER COMPANIES
Natural Capital Coalition (formerly TEEB for Business Coalition)	www.naturalcapital-coalition.org	Platform of initiatives. Development of methods for the evaluation of natural and social capital. Development of open-source database	Not-for-profit, includes many environmental organizations and scientific institutes but also accounting firms and service providers	Kingfisher, consulting firms such as Ernst & Young, Trucost
World Business Council for Sustainable Development (WBCSD)	www.wbcسد.org	Development of the "Guide for Corporate Ecosystem Valuation", a framework for integrating natural capital into business operations	Association of companies for sustainable development	14 companies have tested the guide.
B-TEAM	www.bteam.org	More sustainable economy in general, including accounting for the "real" costs in particular.	Nonprofit, founded by business executives, including Sir Richard Branson and Jochen Zeitz.	Kering/PUMAVision, Virgin amongst others
Dow Chemical Company und The Nature Conservancy	www.nature.org/about-us/working-with-companies/companies-we-work-with/dow/working-with-dow-chemical-company.xml	Development of tools, methods and models that aim at helping companies to integrate the economic value of nature in their strategies, goals and decision making. Very site-specific and decision-oriented approach.	Part of the company's sustainability strategy	-
Corporate EcoForum	www.naturalcapitalhub.org	Building an open-source enterprise platform to exchange experience and best practices.	Association of companies from the US	The platform is backed by 24 companies, such as Enterprise, Coca Cola
Cambridge Natural Capital Leaders Platform	www.cpsl.cam.ac.uk/Business-Platforms/Natural-Capital-Leaders-Platform.aspx	Development of a framework for the assessment of externalities. Centers on support for the practical implementation. Recently published guidelines for the agriculture.	Project of the University of Cambridge and its Programme for Sustainable Leadership	12 companies, including SAB Miller, Mars, Nestlé
The True Price Foundation	www.thetrueprice.org	<ul style="list-style-type: none"> - Development and testing of a methodology for the detection of social and environmental costs - Supporting companies in calculating these costs - Awareness-raising among the population 	Nonprofit with partners from the Dutch industry and economic development aid	Several Dutch companies: AkzoNobel, DSM, Rabobank
EU B@B Platform	http://ec.europa.eu/environment/biodiversity/business/index_en.html	to build on existing initiatives to develop methodologies establishing good practice principles in natural capital accounting, with a particular focus on biodiversity and ecosystems	Initiative of the Directorate General Environment of the European Commission	Companies can apply
Natural Capital Declaration (UNEP FI)	www.naturalcapital-declaration.org	Initiative of the financial industry with the aim of more consistently taking into account natural capital in financial products and services and to integrate them into accounting, disclosure and reporting.	The declaration is a project of UNEP FI and the NGO Global Canopy Programme	39 financial institutions are members

COMMERCIAL PROVIDERS				
INITIATIVE	WEBSITE	OBJECTIVE/COMMENT	BACKGROUND	PARTNER COMPANIES
Trucost	www.trucost.com	Trucost has developed its own method and database for the collection and evaluation of companies' externalities and is offering corresponding services.	International consulting company	Among other things contributing to PUMA's environmental profit and loss account
PwC	www.pwc.com	The company has its own methods for the collection and evaluation of externalities.	International accounting and consulting firm	Among other things contributing to PUMA's environmental profit and loss account
Systain	www.systain.com	The company has developed a tool to assess environmental and social externalities in the supply chain	International consultancy	Methodological partner in calculating the ecological footprint of the Otto Group
Sustain Value	www.sustainvalue.co.uk	Sustain Value advises companies on natural capital issues and helps implement related decision-support tools.	International natural capital consultancy firm	Worked with WBCSD on CEV Guide and with Antofagasta Minerals to develop EROVA tool.
Climate Earth	www.climateearth.com	Climate Earth has developed a „Natural Capital Management System“ to assess corporate externalities	Consultancy	Application of the tool with Webcor Builders for a construction project.

Source: Own research

4.2 Attitude of business towards the valuation of natural capital

The publication of the environmental profit and loss account by *PUMA* has also attracted attention in Germany, fueling a debate about the value of natural capital and external costs. As a matter of fact, interest in and demand for these instruments are increasing. However, many companies are still hesitant and attempt economic valuation (if at all) for internal purposes and decisions.

In the summer of 2013, an online survey was carried out by the *Global Nature Fund* to examine the awareness with respect to natural capital accounting in Germany. Although the results are not representative, they provide a good initial impression about the current state of knowledge.³² The feedback shows the importance of *PUMA*'s efforts – many respondents associate the issue with the approach of the sports equipment manufacturer. Many companies have demonstrated interest to follow *PUMA*'s example, but there are a number of obstacles. On the one hand, the cost of such an endeavor has a deterrent effect on companies, especially when considering scarce capacities and resources. This is directly associated with the impression that the current methods are still too complex and, above all, that there

is still no unified and approved procedure for the process of economic valuation. In addition, the reliability of the data and its availability are major problems, in particular, when dealing with companies with complex supply chains. Still, the survey shows that the approach of natural capital accounting is also of interest for companies from the service sector. The survey however points out the lack of methods that exist, for example, for the financial industry, in order to describe indirect effects of financial products.

The survey conducted at the conference “How Business Values Nature” that was held in Bonn, Germany on January 21st provided similar insights. Data and quality of methods are seen as major barriers. In addition the difficulty and necessity to gain executive support was highlighted – to achieve this, the business case for natural capital accounting has to be very clear.

Just as the participants of the online survey, a majority of participants of the conference would welcome an initiative to make the publication of a natural capital profit and loss account mandatory.

³²The survey was answered by 33 companies.

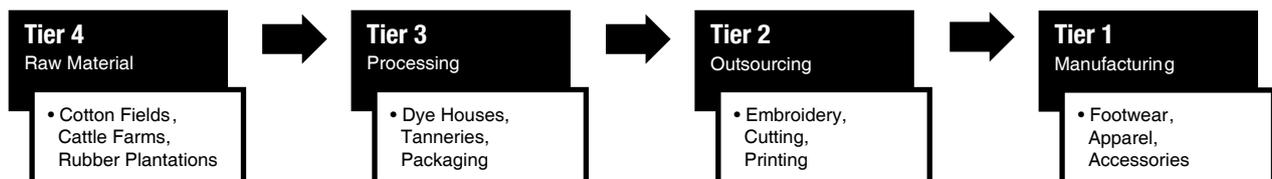
4.3 Company examples to date

4.3.1 PUMA's Environmental Profit and Loss Account³³

The Environmental Profit and Loss Account (EP&L) by *PUMA* should not only be understood as a financial report. Rather, it is meant to facilitate a hotspot analysis and support *PUMA*'s internal decision-making.

For the creation of the EP&L, the company received support by the consultancy firms *PwC* and *Trucost*. It proceeded in two stages: First, various environmental impacts along the entire value chain were quantified. In addition to the corporate properties, supply chains were examined across several stages, including the production of the raw materials, such as leather or cotton (see Figure 6).

Figure 6: PUMA's value chain



Source: (PUMA, 2011f)

The recording of the environmental impact for the first stage of value creation is partly based on primary data collected. For the analysis of the other tiers, econometric input-output models are used. They combine environmental data and trade flows. With the help of modeling, the environmental impact of the company was subsequently quantified. Five environmental indicators have been selected for the analysis: water consumption, greenhouse gas emissions, land consumption, air pollution and land use.

As a second step, *PUMA* carried out an economic valuation and calculated the cost of the various environmental aspects. When undertaking the monetary valuation, *PUMA* relied on the benefit transfer method. The underlying assumptions regarding the respective environmental costs are summarized in Table 6. In the following, they will be considered in detail in order to facilitate practical understanding.

³³This section is mainly based on (PUMA, 2012c)

Table 6: Environmental indicators and cost estimates

ENVIROMENTAL IMPACT	UNIT	COST ESTIMATE
Climate change	Tons of greenhouse gas emissions	€66/t CO2e
Water scarcity	Volume of water consumption	Ø: €0.81/m³ ↔: €0.03 – €18.45/m³
Loss of biodiversity and eco-system services	Converted area	Ø: €347 / ha ↔: €63 – €18,653/ha
Smog and acid rain	Tons of ammonia (NH3), particulate matter (PM10), sulfur dioxide (SO2), nitrogen oxides (NOX), volatile organic compounds (VOCs) and carbon monoxide (CO)	<p>Ammonia</p> <p>Ø: €1,673/t ↔: €1,133 – €5,670/t</p> <p>Particulate matter</p> <p>Ø: €14,983/t ↔: €1,285 – €191,743/t</p> <p>Sulfur dioxide</p> <p>Ø: €2,077/t ↔: €783 – €6,422/t</p> <p>Nitrogen oxide</p> <p>Ø: €1,186/t ↔: €664 – €3,179/t</p> <p>VOCs:</p> <p>Ø: €836/t ↔: €425 – €1,998/t</p>
Landfill leachate and on-site disruptive factors due to landfills and waste incineration	Tons of waste	<p>Landfill:</p> <p>Ø: €73/t ↔: €36 – €87/t</p> <p>Incineration:</p> <p>Ø: €51/t ↔: €35 – €63/t</p> <p>Recycling</p> <p>0€/t</p>

Source: Adapted from (PUMA, 2012 c)

Input-output modeling to capture externalities along the entire value chain

PUMA's environmental profit and loss account is based on primary data collected for the top stages of the sports equipment manufacturer's value chain as well as modeled data on the effects of commodity production and processing. For this modeling, the company uses an input-output model expanded to include environmental impacts.

These input-output models have been in use for quite some time now to calculate external costs. The *ExternE* project for example was developed to assess the externalities caused by energy production and the *EXIOPOL* project that covers the trade flows and their environmental impacts for 139 industries.

The basic idea of these models is fairly simple. The industries in an economy are interconnected and the increase in demand for one product results in increased demand for the upstream products as well. These models now assume that every production or processing step is associated with a certain environmental impact, such as the emission of carbon per manufactured good. Input-Output models moreover allow for geographic differentiation of impacts by assuming variations in impact factors depending on regions or countries. By adding these impacts up it is possible to calculate the environmental load of a product. With monetary valuation as the last step these impacts can furthermore be represented in Euros or Dollars.

Up to now most of the models have been applied for macro-economic analyses. As *PUMA* or the *Otto Group* show, they can be used for corporate decision-making processes as well.

Box 4: Input-output modeling

Water consumption

The price of water is the obvious choice for the monetary valuation of water use. Because water prices can be distorted, e.g. by subsidies, they do not represent the indirect use values, which *PUMA* focuses on. The environmental costs calculated by *PUMA* are the losses of indirect use values for third parties on the basis of water consumption along *PUMA's* entire supply chain, such as groundwater recharge (ecosystem preservation, nutrient cycling). The direct impact due to the reduced amount of available water for its own use was not considered, because it is assumed that this is already included in the prices, which the company and its suppliers pay. In addition, the costs have been adjusted to reflect the local water shortage. Ultimately, a weighted average of €0.81/m³ was calculated.³⁴

With a proportion of 33% of the total costs, water consumption is the biggest item in the EP&L.

Greenhouse gases

For greenhouse gas emissions *PUMA* uses Richard Tol's³⁵ concept of the social costs of CO₂: "These estimates attempt to value the damage (as a result of current and future climate change) attributable to each ton of carbon dioxide released in a given year [...]."³⁶ The social costs of CO₂ vary greatly and depend on various assumptions and factors. These factors include for example the choice of the discount rate for future damages or the expected inflation rate. By incorporating all these aspects *PUMA* calculated a price of €66 per ton of CO₂. Just as for the water consumption, the supply chain of the *PUMA* group accounts for the major part of the environmental costs. Some major factors are the production of raw materials (such as leather) or the use of fertilizers in agriculture.

³⁴(PUMA, 2012c)

³⁵(Tol, 2009)

³⁶(PUMA, 2011c)

Land use

Land use effects are generated almost exclusively at the level of raw material production. A total of €37 million was calculated. By including the land use, *PUMA* values the “environmental externality represented by the loss of biodiversity and ecosystem services associated with the conversion of natural ecosystems to provide land for buildings and agriculture in *PUMA*’s operations and supply chain.”³⁷ The main sources of environmental damage are the production of leather and cotton. Existing data by authorities has been used to calculate the land use for a country, which is necessary for the production of specific raw materials. Subsequently, *PUMA*’s share of the total production was calculated.³⁸ The monetary values for ecosystems vary greatly, between €63 and €18,653 per hectare, depending on the region and other characteristics. Ultimately, these specific values were multiplied by the land use in each country.

Air pollution

Six air-polluting substances were analyzed: ammonia (NH₃), particulate matter (PM₁₀), sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs) and carbon monoxide (CO). Based on a literature review, the average effect on the environment was identified.

The impacts on tradable goods, such as the decrease of crop yields, were evaluated on the basis of market prices. For the other effects such as the deterioration of health, average values from studies on willingness to pay were consulted. Those were adapted to the local conditions on a case-by-case basis.

The link between emissions and imissions is often not clearly understood and costs vary spatially. The range of costs and the uncertainties of the calculations are therefore considerable.³⁹

Waste production

As the last aspect, *PUMA* assessed the effects of waste production. Three disposal options were evaluated using

different methods: landfill, incineration and recycling. Waste disposal on landfills causes methane emissions, landfill leachate, and impaired quality of life (disamenity effects). The methane emissions were recorded in the same way as the calculation of greenhouse gas emissions mentioned above. Quantity and potential damage of landfill leachates depend on aspects such as the quality of the waste management in the respective countries, in particular the quality or the presence of a base sealing. The costs therefore differ from country to country. The evaluation of the disamenity effects was based on hedonic pricing studies.⁴⁰ These three aspects were evaluated together. The average costs caused by a ton of discarded waste on a landfill were estimated at €73.

Waste incineration, however, causes two different effects: air pollution and disamenity effects. On the other hand, one advantage of waste incineration is that energy can be produced and fossil fuels can be replaced. As described above, the air pollution was assessed and the greenhouse gas savings due to the incineration were subtracted. On average, this resulted in a value of €51/t of waste.

Recycling also has positive and negative effects, but even though *PUMA* assumes that the benefits exceed the costs, the value was set at €0/t.

In total, *PUMA* calculated environmental costs amounting to €145 million (see Table 7). 91% of these costs are accounted for by water consumption, greenhouse gas emissions, and land use, while the two other aspects, namely waste production and air pollution, have a relatively low impact. It is also interesting that about half of the cost is caused at the lowest level of the value chain, i.e. at the production of the raw materials. This is also reflected in the geographical distribution of the costs: 67% incur in Asia.⁴¹ Table 7 presents the results of the EP&L.

³⁷(PUMA, 2011h)

³⁸The total environmental costs of the conversion were added up for cotton and rubber, while for leather only 15 percent of the land use was attributed to PUMA, as animal skin is a by-product of the production of meat. The company’s share of a country’s livestock is therefore included in the calculation.

³⁹The cost per ton of sulfur dioxide, for example, ranges from €783 to €6.422

⁴⁰See Table 1

⁴¹(PUMA, 2012c)

Table 7: Results of PUMA's EP&L

	Water use	GHGs	Land use	Other air pollution	Waste	TOTAL	
	EUR million	EUR million	EUR million	EUR million	EUR million	EUR million	% of total
	33%	32%	26%	7%	2%	100%	
TOTAL	47	47	37	11	3	145	100%
PUMA operations	<1	7	<1	1	<1	8	6%
Tier 1	1	9	<1	1	2	13	9%
Tier 2	4	7	<1	2	1	14	10%
Tier 3	17	7	<1	3	<1	27	19%
Tier 4	25	17	37	4	<1	83	57%
EMEA	4	8	1	1	<1	14	10%
Americas	2	10	20	3	<1	35	24%
Asia / Pacific	41	29	16	7	3	96	66%
Footwear	25	28	34	7	2	96	66%
Apparel	18	14	3	3	1	39	27%
Accessories	4	5	<1	1	<1	10	7%

Source: (PUMA, 2011e)

PUMA's environmental profit and loss account for products

The EP&L already showed that the production of footwear, in particular due to the production of leather, accounts for 2/3 of the total environmental cost. In October 2012, PUMA published a product EP&L based on these calculations. It compared the environmental impacts of a "sustainable" shoe and t-shirt with the effects of their conventional equivalents. It was also important that the valuation not only capture the production but also the costs of usage and disposal.

The analysis revealed that the environmental costs of the sustainable alternatives are lower by 31%. The externalities of the conventional shoe were calculated at €4.29 per pair, while the sustainable shoes cause external costs of €2.95. For comparison: the costs of the materials of a comparable shoe are estimated to be €8.⁴² The difference between the conventional and the "sustainable" shoe can be attributed mainly to the substitution of leather by cotton as the material and the resulting lower greenhouse gas emissions and the lower water and land use.⁴³

The results provide clear evidence that the reduction of the environmental costs can be substantial, if a company adopts a more sustainable production. At the same time PUMA shows that it is possible to calculate the environmental cost of a product and therefore contribute to an increased transparency of prices of consumer goods.

Box 5: PUMA's environmental profit and loss account for products

⁴²(Landesarbeitsgemeinschaft Agenda 21 NRW e.V., 2010)

⁴³(PUMA, 2012a)

Evaluation of PUMA's approach

In this important pioneering work, *PUMA* always made clear that it saw the EP&L as a first test and that the methods used are still underdeveloped. The calculations should therefore be interpreted with caution. A solid basis for future progress has nevertheless been established. In the drafting of the report, the company was able to make use of the models and data of the service providers *PwC* and *Trucost* – a possibility not always available to other companies. It is thus all the more important for the future to develop a uniform and above all publicly accessible model, which can be used and, if necessary, adapted by all companies. Given this harmonized procedure, the comparability and transparency of environmental cost calculation would be made possible and an important milestone on the way towards natural capital accounting would have been reached.

With respect to sustainability reporting, *PUMA's* calculation demonstrates that reporting without the consideration of the supply chain is clearly inadequate. Without the supply chain, only the top two stages of the value chain of the company are captured, representing only 15% of the calculated environmental costs. A major part of the environmental impact is often ignored in reporting. This is why an adjustment of reporting requirements is desirable.

At the same time, even *PUMA* is still far from integrating the results into its profit and loss account. As these costs are not real costs that actually incur, the company could create a fictional integrated profit and loss account and account for the environmental costs under "other operating expenditure". This way, the company could show what its "true" profit would be.

4.3.2 Ecological footprint of the Otto Group

In the sustainability report 2013 of the *Otto Group*, the company for the first time calculates and economically values its ecological footprint. The external costs reach 10% of the total sales of the group. The biggest costs are caused by the emission of CO₂, water consumption and air pollution. The calculations pointed out the production of textiles as the main contributor to the environmental damage.⁴⁴

For the *Otto Group* too, the economic valuation of environmental impacts is initially an instrument for the internal sustainability management. One reason for its use is that

the main environmental impacts can be identified and compared and targeted initiatives can be geared towards the greatest effect. The calculation of monetary values also facilitates the internal and external communication, because the results are simple and more understandable for the different stakeholders.

It is expected that particularly the new guidelines on sustainability reporting of the *Global Reporting Initiative* and the specifications for the materiality analysis contained therein will provide an impulse for further progress in this area. This

⁴⁴(Otto Group, 2013)

is because the identification of significant environmental impacts on the basis of economic valuation could be carried out in an objective and comparable manner.⁴⁵

Methodologically, the procedure is similar to *PUMA*'s approach. The *Otto Group* uses a special modeling tool developed by the consultancy *Systain* that is based on an

input-output model. It can be used to quantify the environmental impact along the supply chain. Just as *PUMA*, the *Otto Group* views itself to be at the beginning of the process as well as the development of the methodology. The accuracy of the results must be further improved and additional damaging effects such as biodiversity should be included in the future.⁴⁶

4.3.3 14 road testers of the WBCSD guide

The “Guide for Corporate Ecosystem Valuation” sets out five steps how companies can economically capture their positive and negative relations with the environment. Among others, these include scoping environmental impacts as well as embedding the results in the business processes.⁴⁷

The approach differs from the work done by *PUMA* and others, in that the assessment covers very specific questions and decision problems. It is therefore not a comprehensive analysis of the company, but an assessment of a certain project, site or technology. For this reason, attempts are made to rely to a larger extent on local data. Table 8 provides a brief overview of the case studies.

It is also interesting to note the industries the individual road testers operate in. Both the utility companies and the commodity producers have a very direct relationship with natural capital. For them, economic valuation is also a way to demonstrate which benefits they produce for the environment (after usage), e.g. through rehabilitating a mining site. In doing so, they want to show their sense of responsibility for the impacts they cause and secure their operating license for the future. At the same time, these are companies who do not only focus on the risks but also on the opportunities which can be revealed by the evaluation. These include eco-tourism as in the case of *Eskom* or different land use options as in the case of *Veolia*.

⁴⁵Interview with Andreas Streubig, Head of Environmental and Social Policy, Otto Group

⁴⁶(Otto Group, 2013)

⁴⁷Additional application examples of the CEV method which focus on the ecosystem services of water can be found in the “Business Guide to Water Valuation” published in September 2013.

Table 8: Overview of the CEV road testers

COMPANY	APPLICATION	TECHNIQUE	INDUSTRY
 AkzoNobel	Comparison of social costs of air pollution caused by three chemicals used in paper production.	Benefit transfer	Chemicals, paints, coatings
 Syngenta	Value of pollination services by wild bees to blueberry farms	The conclusion was reached that computer-based models (such as Aries, InVest...) were not suitable and that the benefit transfer method provided only rough estimates.	Agro-chemicals
 US BCSD/Cook Composites and Polymers	Financial and ecological benefits by substituting a (technical) storm water management system with a “constructed wetland”.	Replacement costs and Ecological Lifecycle Assessment Tool (Eco-LCA)	Chemicals
 EDP	Costs/benefits resulting from the management of a 7,200-hectare water shed used for hydro power.	Different methods for different services, primarily market-based methods, but also travel cost method for cultural services.	Energy industry (Portugal)
 Eskom	Cultural services associated with tourism at the conservation area associated with their Ingula pumped storage scheme	Conditional evaluation, benefit transfer (no results)	Energy
 SA Water	Value of ecosystem services under various management options for a water catchment area.	Benefit transfer, market values	Water management
 Veolia Environnement	Prioritization of water use and land management options	Contingent valuation/CVM	Water/waste water /disposal/energy services/transport
 Eni	Ecosystem services impacts and dependencies relating to an existing oil operation, and to a new development in a sensitive area	Benefit transfer	Oil and gas
 Rio Tinto	Financial and social costs and benefits of conserving areas of rain forest as part of the company’s policy of Net Positive Impact (NPI) on biodiversity.	Benefit transfer	Mining
 Holcim	Value of ecosystem services for local communities under several alternative restoration scenarios	Benefit transfer	Building materials/ cement
 Lafarge	Value of ecosystem services to improve land management planning for the future reclamation of a quarry	InVest, Habitat Benefits Toolkit	Building materials
 Weyerhaeuser	Economic value of ecosystem services produced under different management scenarios for forested land	Market price	Wood products/ forestry
 Hitachi	Costs associated with carbon emissions for alternative manufacturing processes for multi-layer CCL	Market prices	Electronics/machine construction
 US BCSD Houston By-Products Synergy Project	Quantification of physical ecosystem benefits realized through the process of matching undervalued or waste materials from one company with the needs of another.	Eco-LCA	Efficient use of raw materials/recycling

 **CHEMICALS**
 **UTILITY COMPANIES**
 **RAW MATERIALS**
 **OTHER**

Source: adapted from (WBCSD, 2011)

There are only brief summaries for many of the studies, which is why the CEV approach will be presented through the well-documented case of Holcim as an example, before also including the other case studies in the analysis of the approach.

4.3.3.1 Holcim⁴⁸

Holcim is a supplier of cement and building materials. With the road test, the company aims to “quantify in monetary terms the impacts that the quarrying and restoration operations will have on biodiversity and the ecosystem services provided to local communities and regionally.”⁴⁹

The company plans to expand a sand and gravel quarry in the United Kingdom. At an extraction site already in operation, three new, adjacent areas will be used and subsequently restored. Among other things, an artificial lake will be created.

The challenge was to calculate the costs and benefits resulting from the conversion of agricultural land into wetlands with limited economic use. In order to do this, the benefit transfer method was selected. Results of other studies were therefore evaluated and adapted to the local conditions.

Initially, the costs of the restoration/conversion were calculated. Opportunity costs arise from lost agricultural production, as the land can no longer be used in this form.

The gross profits of the former owners were used for the calculation. Furthermore, costs originate from the restoration itself and the follow-up costs of conservation. On the benefit side, six aspects were considered: flood protection, carbon storage, biodiversity, recreation, landscape aesthetics and the financial profits from the extraction of sand and gravel.

For the storage of CO₂, different aspects were correlated by substituting agriculture with an (artificially created) wetland. Integrating data from a comparable area, the study assumed a carbon storage rate of 0.16 t/ha/year and a price of £27/t CO₂e. The price results from the recommendations of the British Environment Department *DEFRA* and also includes the costs incurred by the (future) damage due to the climate change.

For the underlying study assessing biodiversity, interviews were conducted to evaluate the willingness to pay for the stopping or slowing of the loss of species. Two areas with different biodiversity characteristics were compared. The willingness to pay was £62.50 per household for the next

⁴⁸This section is largely based on the work of (Olsen & Shannon, 2010)
⁴⁹(Olsen & Shannon, 2010), p. 5.

five years in the area with low biodiversity and £53.40 in the area with high biodiversity. The authors of the *Holcim* study use the value of £53.40.

The restoration also ensures the improvement of the recreational offers. Another study provides data from surveys on visitors' willingness to pay for possible types of boating in the event a new lake was created. The value calculated is £4.93 per inhabitant per year and is applied as recreational

value resulting from the restoration of the mining site. In order to summarize benefits and costs, the net present value (NPV) was calculated for a period of 50 years. The calculation shows that the NPV is only negative for one of the three areas. (If it involves the profits from the extraction of sand and gravel, it is positive too.) For the other two areas, the main costs originate from the loss of agricultural yields, while the main benefits result from the preservation of biodiversity and the ecosystem (Table 9).

Table 9: Calculation of the Holcim CEV case study

		TOTAL IN GBP	BRIDGE FIELD	CANAL FIELD	NEWBY GRAVEL BEDS
COSTS	Restoration	58,819	4,942	42,042	11,835
	Recurring costs	117,598	-	84,600	32,998
	Opportunity costs	721,761	43,718	570,591	107,452
	Subtotal costs	898,177	48,659	697,233	152,285
BENEFITS	Retention function	224,079	8,024	-	216,054
	Carbon storage	4,702	-	3,263	1,439
	Biodiversity	1,415,917	-	982,655	433,262
	Recreation	356,330	-	-	356,330
	Subtotal benefits	2,001,028	8,024	985,919	1,007,085
Net benefit		1,102,850	-40,635	288,686	854,800
	Sand and gravel*	1,737,490	460,562	371,196	905,732
Net benefit with sand and gravel		2,840,341	419,928	659,882	1,760,532

Source: taken from (Olsen & Shannon, 2010): present value by category (£2009, discount rate of 3%, 50 years). * The profits from the extraction of sand and gravel are economical. The assumed discount rate is 8%. Bridge Field, Canal Field and Newby Gravel Beds are the names of the areas in which sand and gravel will be extracted.

4.3.4 Dow Chemical Company and The Nature Conservancy

In the year 2011, *Dow Chemical* began its collaboration with the environmental organization *The Nature Conservancy* with the objective to develop instruments, methods and models to help companies integrate the economic value of nature in their strategies, goals and decision making.⁵⁰

As a first step, the company has identified two pilot locations selected on the basis of their relevance with respect to operational and ecological criteria: firstly, the industrial complex in *Freeport, Texas*, where more than 20% of all of *Dow Chemical* products are being manufactured and secondly, a cane factory in *Santa Vitória* in Brazil.

Based on the selection of production sites, the company analyzed which ecosystem services are particularly critical at the respective site and what the options are for the preservation of these services. In order to record and assess the consequences of these alternatives, *Dow Chemical* uses existing models, which are customized and expanded for its purposes. For example, the costs of technical solutions to reduce air pollution are compared with reforestation programs that can provide additional benefits in the form of carbon storage and the creation of habitats. A similar comparison is made for the plant in *Freeport*, taking into account different options for the coastal protection and the preservation of the fresh water supply.

In that respect *Dow Chemical's* approach differs from the one adopted by *PUMA*. The aim is to compare concrete courses of action and to evaluate costs and benefits of

natural and technological solutions as well as estimating the added social benefit provided by the ecological alternatives. This requires accurate data – global averages are not suitable for the analysis.

In the long-term, the developed models shall also be transferred and adapted to other sites. Initial results of the first pilot study are expected for next year.

Evaluation of the project-based/CEV approach

The *Guide for Corporate Ecosystem Valuation* has established itself as a blueprint for action for the economic valuation and corporate management of natural capital.

The approach of *WBCSD* is very similar to that of *Dow Chemical*. It is a bottom-up approach, which in the long term can be expanded to include all sites of a company. In contrast to *PUMA* or *Otto Group* the supply chain is only considered in a few cases. However, it is possible to address the respective site contexts in a more detailed manner and to consider different ecosystem services on a case-by-case basis. Precisely because decisions are intended to be taken with geographically limited impacts, it is beneficial to specifically collect information on willingness to pay and valuation, rather than relying on benefit transfer.

It should be noted that the CEV approach only makes a recommendation for the different steps of the economic valuation. Companies need to develop their own proce-

⁵⁰(The Nature Conservancy & Dow Chemical Company, 2013)

dures for data collection and monetization and will therefore utilize different assumptions. Thus, companies cover a wide range of possibilities to carry out an economic valuation.

The availability of data was identified as a major challenge by the pilot companies. On the one hand, this refers to data on environmental impact, on the other hand to data used to assess this impact. A second hurdle is the integration of the findings into the company and their dissemination. For many companies, the question is how to proceed with the results and the instrument after having completed the pilot test. Some companies develop their own procedures based on the road test. This is to facilitate the replication of the method at different business locations and its integration into the company. Adjustments to local conditions are still necessary but the efforts would be greatly reduced. As the results are based on a standardized method an (internal) comparability is given as well. For the wider application of

economic valuation of natural capital a harmonization of approaches and assumptions is indispensable. Even as it is positive that companies start to replicate their own work, this should delay the overall harmonization of frameworks and methods.

Supply chain effects are one issue that the *WBCSD* pilot companies have not sufficiently considered in the application of the project-based approach. *PUMA*'s EP&L was a first step and the underlying models need to be revised, expanded, and refined. Its course of action can however be a blueprint for the recording of environmental costs across the entire company. In the long term, both approaches should be combined. The location-based CEV approach should be expanded by *PUMA*'s global approach, in order to achieve a comprehensive corporate natural capital accounting.

4.4 Experiences and suggestions for improvement

The economic valuation of natural capital and externalities is still new for many companies and the examples shown are pioneering work in the truest sense. For some of the *WBCSD* road testers, it was actually a priority to learn how the instruments work, and how to utilize them for themselves. Nevertheless, it makes sense to evaluate, what experiences the companies have made with the instruments, how they continue to work with them and what challenges

and opportunities for improvement were identified by them. This is all the more interesting, since the studies were based on different objectives and each company provides a new perspective. In order to record the different experiences, interviews were conducted with a total of 12 company representatives in the framework of this project. The results of the interviews and of the further research will be presented below.

4.4.1 Project-based application as a decision-making tool

In addition to the WBCSD pilot companies, *Dow Chemical* uses economic valuation as an instrument in a project-specific context. Even if the approach of *Dow Chemical* includes a deeper and broader consideration, these examples will be discussed together.

The biggest challenge is the availability of data. If companies can make use of their own data, the cost and the workload decrease. However, particularly data on environmental impacts outside the corporate boundary is often unavailable and must be collected from external sources at great effort. This is why many of the delays and increased costs experienced by the pilot companies could be traced back to the quantification of the environmental impacts. Alternatively, some companies refrain from collecting primary data, but have to pay the price in terms of uncertainties and inaccuracies in the calculation. This applies in particular to the monetary valuation. When it comes to the benefit transfer method, the difficulty lies in identifying appropriate studies which can be transferred to one's own research question.

Non-use values like recreational benefits are particularly challenging. To achieve robust results, it is vital to collect own data and to undertake own surveys instead of using benefit transfer. *Veolia Environnement* has done this to a limited extent, for example for its case study in Berlin. The company now benefits from this fact, since it can explain the results better than by using benefit transfer. In its CEV study, *Rio Tinto* argues along similar lines. The values of biodiversity depend on a variety of factors and regional averages may not be able to represent the peculiarities of a given area.⁵¹ At the same time, it should be made clear that these calculations will always be subject to an element of uncertainty. This poses even more of a problem insofar

as non-use values can account for a major proportion of the economic value of ecosystem services.⁵² To increase the accuracy of the calculations, it may also be useful to assess the same effect using two or more methods and to compare the results.⁵³

The independent verification of the calculations and the objectivity of the data are also recurring issues. For this reason, the use of market prices has a particularly high appeal: they are tangible and comprehensible for everyone. That way, the results become less contestable. In addition, companies do not want to risk being accused of glossing over the calculations for their own purposes.

Striking a balance between the precision of the results and the costs is critical and needs to be considered carefully by each company. This decision strongly depends on the audience that the company intends to target with the economic valuation. Great care must be taken and the results should be well justified, particularly when addressing external stakeholders. Moving from a quantitative assessment of environmental impacts to their monetary valuation does rarely change the results and decisions significantly. At the same time however, there are reasons to take this additional step. On the one hand, it will be easier to (internally) communicate the results, to provide arguments in favor of sustainable behavior or to support the decision for the ecological alternative. On the other hand, and this is the objective of many of the pilot companies, natural capital can feed into business models or corporate instruments such as cost-benefit analyses in the same manner as other production factors. This allows companies to make better-informed decisions.

⁵¹(Olsen, Bishop, & Anstee, 2011)

⁵²(Ninan, 2011)

⁵³(WBCSD, 2013)

Recommendations for the further development and application of the project-based approach:

- **Identification of the most relevant ecosystem services:** Companies should seek a close collaboration with local NGOs and stakeholders, which can help them identify the environmental impacts and dependencies most relevant to the companies.
- **Improvement of the data basis:** Companies should begin to collect data on their own impact on the local environment. To be independent of the inaccuracies of benefit transfer, these should include socio-economic data and willingness to pay. Government and academia can contribute by developing a publicly accessible database with contextual information about preferences and environmental impacts.
- **Support for a unified corporate approach:** As economic valuation of natural capital is still in the early stages pilot projects are needed. In a first step, companies can for example address single aspects and can use this analysis as a basis for an internal template that can help to reduce the needed resources to conduct a an assessment and to compare the results.

Box 6: Recommendations for the further development and application of the project-based approach

4.4.2 Supply chain application

After the release of the EP&L, *PUMA* requested experts to provide feedback on the chosen approach. On the whole, the expert panel assesses *PUMA*'s approach as being very positive and innovative. The discussion focuses in particular on the input-output model used by *PUMA*, which calculates the environmental impact. To improve the results and to develop the EP&L methodology, the panel proposes to increase the proportion of primary data on the effects along the supply chain. Thus, it would no longer be necessary to use aggregate information, which cannot describe

the local situation with sufficient precision. However, the experts also point out that the supply chains are often too complex and that the commodity markets change quickly, making it unrealistic to hold an all-encompassing dataset. Therefore also in the future, companies will have to rely on primary and modeled data at the same time.⁵⁴

PUMA integrates these recommendations in the further development of its procedures. Compared to the first EP&L, the company intends to collect primary data not only for

⁵⁴(PPR, 2012)

its own offices and ware-houses and the highest stage of production, but to also capture the next lower level like tailors or embroideries.⁵⁵ In sum: here too, it is true that the availability of data for the quantification of environmental impacts is the one hurdle that has to be overcome as fast as possible in order to expedite natural capital accounting. In order to be able to apply methods such as the EP&L in the future, companies need to start gathering information on the environmental impact from their suppliers today.

Moreover, there is further optimization potential within the models applied so far, for example with respect to the presentation of economies and the individual trade relations between one another (see also Box 4, p.37), as well as the modeling of regional differences in production technologies and environmental impact. This is especially true for local damages such as air pollution. Also, it will have to be considered whether the indicators of environmental impact that are currently being used, can be expanded. For example, *PUMA* utilizes land use as a proxy for the loss of biodiversity. Land use is however only one driver of many that contributes to the degradation of biodiversity. As described in Box 3 (p.21), *Lenzen et al.* on the other hand

use the threats to species as an indicator. A combination of these two approaches could describe the loss of biodiversity in greater depth. It would also be beneficial to expand the existing set of environmental impacts by other effects, such as water pollution. As a first step, companies could carry out a rough analysis of all damaging effects and later on evaluate the main effects in detail.

Furthermore, it is useful to align and complement the methods with the approaches of life-cycle assessments and thus increasing the robustness of the methods. Things are also on the move here: the *Fraunhofer Institute for Building Physics*, for example, is working on integrating the effects on biological diversity into the LCA-methodology.

Further efforts are also necessary with respect to the improvement of valuation procedures. The uncertainty about calculations could be reduced by increasing the number of variables used to transfer values from one study to different regions. It is also being proposed to not just transfer single values, but rather to use a utility function.⁵⁶

Recommendations for the development and application of the supply chain approach:

- **Improvement of the data basis:** Companies should increasingly collect data on consumption, emissions and other environmental impacts along the supply chain. To do this, supplier questionnaires can be expanded. Also, it would be conceivable to carry out “natural capital audits” in order to verify the data.
- **Development and expansion of the models:** Other environmental impacts, such as water pollution should be integrated into the models. Also, it should be examined, whether the indicators currently used, e.g. hectares of land use, are suitable to represent impacts such as the loss of biodiversity. A comprehensive set of environmental impacts should be developed so that companies can carry out a rough analysis of all possible harmful effects as a first step. As a second step, the most relevant effects should be studied in a detailed analysis.
- **Harmonization of assumptions and cost estimates:** In order to compare calculations stemming from two companies or projects, it is essential that both are based on the same assumptions. To achieve this, a methodological convention including a range of possible monetary values should be developed, just as the *German Federal Environment Agency* did in 2012 for the consequences of global warming and other specific environmental impacts.

Box 7: Recommendations for the development and application of the supply chain approach

⁵⁵Conversation with Stefan Seidel, Deputy Head PUMA.Safe Global
⁵⁶(PPR, 2012)

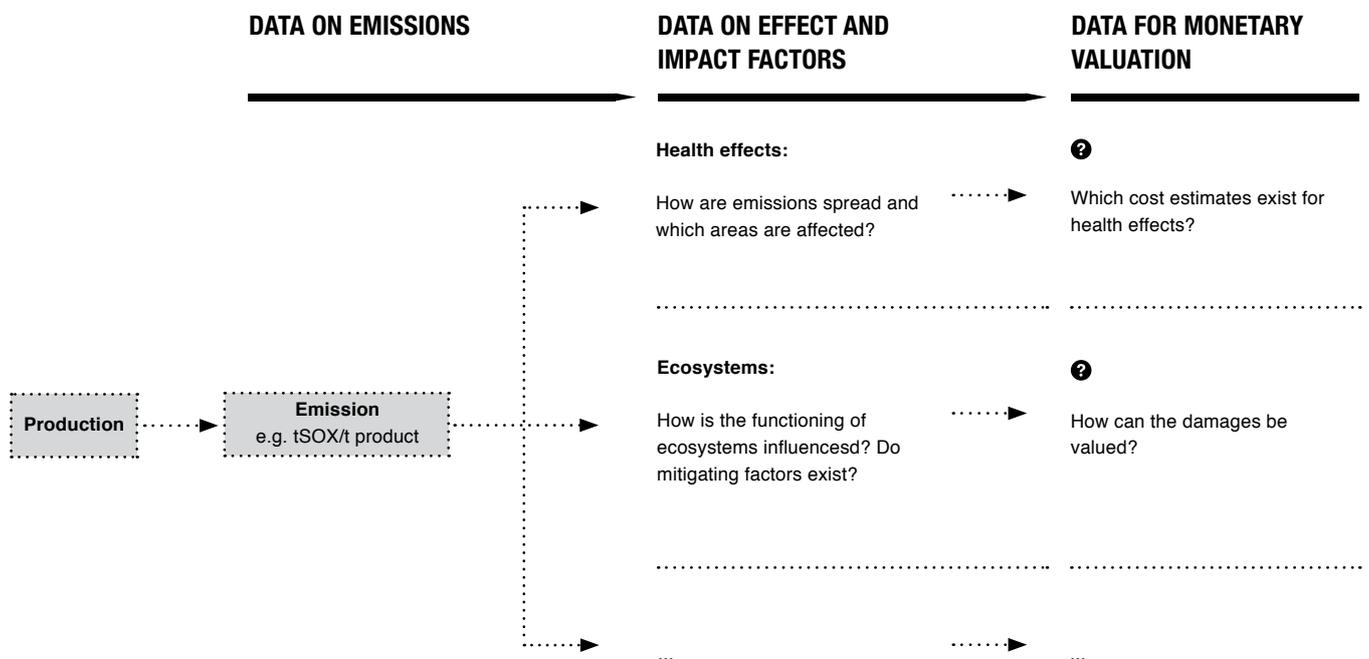
5.0 The way forward

Data – What Data?

The question of data availability appears often as it is the basis for the application of economic valuation of natural capital. But which data is actually needed?

For an on-site application these are mainly the information on the stock and status of the surrounding nature and possible changes due to impacts and emissions.

To assess externalities along the supply chain the answer becomes more complex. The following graph shows exemplary what information can be considered for the economic valuation of impacts of air pollution. In the first step the coefficient that represents the emissions embedded in one product. The “produced” emissions then need to be put into context. For air pollution this could mean for example the size of the population affected or the dispersion of the particles. The last step is the monetary valuation for which the methods depicted in chapter 1.2 can be applied.



Box 8: The Data question

5.1 Recommendations to companies

Even though many initiatives aim at valuing natural capital, and more than 20 companies have carried out studies on the economic valuation, we are still in the test and trial phase. Therefore, the most urgent recommendation for companies is to carry out their own studies. By using economic valuation, companies can better manage possible risks in their supply chain and expand their decision-making processes to include the consideration of environmental effects. Alternatively, companies can participate in pilot projects of current initiatives such as the *Natural Capital Coalition* (see Table 5, p.32). This way, they can contribute to the international development of methods and help shape the next steps. This commitment can also help with internal preparations, so that companies can adequately respond to possible new regulations.

As a positive side effect, companies contribute to improving and refining the methods, and to expanding the data pool. Companies should specifically aim at increasing the transparency of the supply chain in order to minimize the proportion of modeled data on environmental impact along the value chains.

An important incentive for the development of the economic valuation is the comparability of companies with regard to their sustainability performance or environmental dam-

age caused. Of course, the focus is on the comparison of companies in the same industries. As different sectors of the economy differ in their significant environmental impacts, it must be asked whether the modeling of the impacts, particularly along the supply chain, should not be industry-specific. For a cement manufacturer with a mostly regional production, CO₂ emissions will be the most important environmental aspect. It therefore differs from a textile company with a global supply chain, for whom the expansion of agriculturally used land produces the greatest environmental impact. A “one size fits all” approach is therefore not suitable. Individual companies from one industry could therefore join forces and together develop additional industry-specific modules for the existing methods and models.

The social side of sustainability will be an important topic for the future.⁵⁷ Some approaches to assess these issues already exist. The *True Price Foundation* for example has developed a method for economic valuation of social externalities. However, the integration of social aspects opens up entirely new discussions and a lot of work will be done in this area in the next years.

Box 9 shows what businesses can do today to prepare for economic valuation and natural capital accounting.

⁵⁷(EY, 2014)

What you can do: preparatory steps towards natural capital accounting

Starting to deal with natural capital accounting today will give companies a competitive advantage for the future. Even if the methods are still underdeveloped, it is advisable in terms of sustainability and risk management, that companies already deal with the subject matter and evaluate which data on environmental impacts they are already collecting and which they can record without much effort. The revision of supplier questionnaires in order to obtain a more accurate picture of the supply chain can be an initial step. The following discussion briefly presents how businesses can prepare for natural capital accounting.

1. **Identify the ecosystem services relevant to you and their associated risks:** What components of natural capital are most important for you? Can you quickly shift your supply chain to substitutes, if climate change or droughts reduce the supply of the raw materials you rely on? What would happen if the Chinese government responded with new regulations on air pollution and the factories in China faced higher environmental costs? Ask yourself these questions and identify the risks that you can address with natural capital management.

There are a variety of tools to identify the ecosystem services most relevant to you. The biodiversity check developed by the *Global Nature Fund*, for example, can help you recognize dependencies from and impacts on biodiversity. More information: www.business-biodiversity.eu

2. **Develop your own key indicators:** The most relevant environmental impacts vary from industry to industry. Therefore, not every company needs the same environmental indicators. If you know what damaging effects and ecosystem services are most important to you, you should start measuring them and their status respectively and collect your own data. This way you can set comparable goals and monitor progress.

Also, footprint methods, such as the *Carbon Disclosure Project* or the *Water Footprint* as well as other approaches of ecological assessment can be consulted.

3. **Carry out stakeholder dialogues:** NGOs and other stakeholders often have special knowledge, from which you can benefit. This includes for example the environmental impact of the cultivation and extraction of raw materials or environmental impacts along the supply chain. In dialogue with these groups, you can gain new insights and pro-actively respond to potential reputational risks.

4. **Use natural capital accounting in sustainability and integrated reporting:** A systematic corporate valuation of natural capital enhances the quality of your sustainability reporting or integrated reporting. Economic valuation can help you identify and compare the most relevant environmental aspects, uncover risks and make your commitment to sustainability measurable.

5. **Start small:** test economic valuation for sites/measure footprint for individual products:
You do not have to start right away with an environmental profit and loss account across the company. As a first step, you can use economic valuation in one location, for a particular decision, or to measure the

footprint of a single product along your supply chain. Start with the environmental impacts for which the data and methods are available. These are mostly water consumption or greenhouse gas emissions. If possible, try to evaluate additional environmental effects such as land use and water pollution right from the beginning, in order to obtain a comprehensive picture. You should follow these steps:

- a. **Clearly define, for which purpose you intend to use economic valuation:** The entire approach depends on the following question: Using a project-based or group-wide approach respectively will have implications for the question of what information you will need, what models you can apply and so on. In line with this decision, you should also set the boundaries of the study.
 - b. **Determine the ecosystem services important for the decision:** Instruments such as the *Ecosystem Services Review* can help to identify the most relevant aspects of natural capital at your location or for your value chain. However, it is also possible that you encounter new areas during your investigation, which you had not previously considered.
 - c. **Collect specific data and information:** Comprehensive data on environmental impacts is the basis for recording and assessment. Collect data from your suppliers (e.g. using online surveys) as well as data on the ecosystems around your sites or create ecological balance sheets for your products. When attempting monetary valuation, socio economic data are essential. In areas in which you cannot collect primary data, you have to rely on modeled data.
 - d. **Calculate the environmental impacts and evaluate these economically:** This is the hardest step of all. Although there are a variety of models suitable for this purpose, these are often complex and not applicable offhandedly. Many companies therefore obtain assistance from experienced environmental economists or consulting firms. There are currently a number of initiatives that try to facilitate this application (see Table 5, p. 32).
6. **Identify new business opportunities:** Economic valuation does not only serve to identify potential risks such as new taxes or costs that result from resource depletion. It can also be used to identify new sources of income. For example, own estates and properties can be used for eco-tourism.
 7. **Participate in existing initiatives:** There are a number of international initiatives dealing with the topic of natural capital accounting. Through active participation you can benefit from the experience of pilot testers and help shape the development of methods and instruments. You will find an overview of these initiatives in Table 5, p.32.
 8. **Train your staff:** The reasons why you deal with the topic of natural capital should be understood in the entire company. Inform your employees about the value of natural capital for the company. *WBCSD*, for example, has developed a training course on biodiversity and ecosystem services.

5.2 Recommendations to policymakers

From the political perspective the economic valuation of natural capital should be seen as a first step towards the internalization of positive and negative environmental impacts of companies. To help accelerate this development, policy makers have to engage at different levels.

1) Set incentives for the application by other companies

Currently, the economic valuation of natural capital is tested only by a few companies. Even if the topic gets more and more interest, practical implementation lags behind. Policymakers must therefore create incentives, e.g. in the form of project funding, in order to reward companies who risk venturing forward and, despite the shortcomings still present, have a try at the new methodology. On the other hand, this progress should not turn into a competitive handicap, if the company accepts to shoulder costs and effort. Therefore, even the latecomers should be encouraged to catch up with the pioneers, e.g. by introducing new regulations or incentives such as in the field of reporting (see below).

In order not to set the bar too high for the use of economic valuation, it has to be considered how the instrument can be integrated into existing management systems such as EMAS. Then, it would not be a different approach, but the extension of a system that the companies already use. This could keep the overhead minimal. The assessment can also be included in other procedures which are mandatory for companies, e.g. environmental impact assessments.

The availability of data is one challenge for the future. The evolution of carbon accounting can be insightful in this respect. With the introduction of the *GHG Protocol* a methodological standard was set that is now the basis for the *ISO* norm. With this development it was achieved that the data availability was drastically increased. A similar development would be desirable for natural capital as well.

2) Harmonization of data collection and valuation methods

Currently, there isn't any uniform framework yet which could stipulate the environmental effects to be recorded by companies and how to evaluate them. Currently, corporations can decide at their sole discretion, which environmental aspects they deem important and what information they collect. In order to facilitate the comparison of the environmental performance of companies in a quantitative manner, industry-specific guidelines should be developed.

It is also true that there is still a multitude of values and procedures that companies use for economic valuation. The comparison of certain results is rarely possible. The standardization of the valuation procedures should therefore be promoted, and a methodological convention is needed to render concrete valuation results comprehensible. As a first step, companies should be supported in the practical implementation of natural capital accounting. Even if a company is interested in the subject matter, it will be overwhelmed by the variety of approaches and options. There is need for an information platform with case studies and practical guidance. If a company wants to evaluate its externalities for example, it has to be told what data it needs, which databases it can access and which values can be applied. In 2012, the *German Federal Environment Agency* developed instructions for the valuation of external costs and for the possible values applicable to the consequences of global warming as well as other specific environmental impacts. This convention can be expanded to include other environmental effects.⁵⁸

Still, it must be examined how economic valuation can be expanded by existing approaches in order to evolve into environmental accounting. In the EU, there are currently attempts to develop and test methods for the calculation of an ecological organizational and product footprint.⁵⁹ If pos-

⁵⁸(German Federal Environmental Agency, 2012)

⁵⁹(European Commission, 2013)

sible, these procedures should be aligned and combined with the methods of economic valuation.

For enterprises, especially SMEs, the great expenditure of resources required plays a crucial role. Not every company can hire a consultancy for an environmental profit and loss account and use the models developed by them. A publicly accessible and easily applicable model, as well as access to the relevant data should therefore be promoted and developed. The *European Commission* intends to make a contribution in the context of the continuation of the *Business & Biodiversity Platform*. Germany should get involved in these processes, be it only for reasons of compatibility and to not develop competing methods. With the *BMBF's* tender on "sustainable business" or also in the framework of the *BMUB* program "*Business and Biodiversity 2020*" (UBI2020), projects are promoted which seek a close interaction with the Platform and other existing initiatives.

3) Corporate Reporting

Sustainability reporting is seen as a major driver for the recording of the impact on natural capital. As demonstrated by the *PUMA* case, it can only cover a fraction of the total environmental effects. Also, only a fraction of companies publishes sustainability reports. Policymakers are thus being called upon in two ways: on the one hand, the obligation to carry out sustainability reporting should at least be introduced for publicly traded companies. It should be based on common reporting standards, in order to minimize the overhead. In the long term, the merging of financial and sustainability reporting should be addressed, so that the overall performance of a company will be reflected comprehensively in one report. On the other hand, reporting limits should be expanded, and companies should start to cover the effects along the supply chain.

4) Accounting

A long-term goal of current efforts should also be to integrate natural capital in corporate accounting. Accounting is based on rules and principles, which have yet to be defined and adapted for natural capital. To achieve this, a process of coordination and standardization is necessary.

5) Consumers

Natural capital accounting will affect the behavior of consumers. As *PUMA* has done, product footprints can be calculated based on accounting and consumers can be educated on the external / environmental cost of the products they purchase. This would be more readily understandable then specifying the environmental load in other metrics such as tons of carbon, which the consumer cannot put into context. In the medium term, it may be conceivable to feature external costs on price tags. In the short term, a traffic light scheme could be used. It could specify whether the environmental costs are high, medium or low. Another option would be natural capital efficiency eco-labeling as already in place for electronics. A particularly sustainable product could then be rated A+++. Based on this, and as a first step towards internalization, companies could allow voluntary payments by consumers, which would be used to promote the protection of the environment or to support development cooperation projects. While this would not entail compensation for the real environmental impact of the purchased product, it can nevertheless make a contribution to reducing the negative consequences of consumption until a compensation mechanism is established in the long term.

In the meantime, sustainability certificates or procurement rules, which already include climate change, can be extended to other environmental aspects. Economic valuation is in turn useful to achieve comparability of environmental impacts and can be promoted based on this fact.

6.0 Conclusion

The strength of the economic valuation of natural capital is that negative environmental impacts and the value of ecosystem services are translated into a language, which can be easily understood by business leaders and political decision makers and that the different impacts resulting from land use or water pollution etc. are made comparable. Also, this standardization helps integrating external environmental costs into corporate decision-making instruments such as cost-benefit analyses and to thus consider them on a level with financial capital. By integrating them into corporate accounting, the overall environmental performance of a company can be disclosed and compared with other companies. This way, products and their sustainability can also be quantified and compared. Also, consumers can easily align their consumption decisions in order to achieve lower environmental impacts.

In addition, environmental impact analysis can help detect and manage potential risks. On the one hand, a company can identify critical points in the supply chain, e.g. what impact climate change or drought can have on the availability of certain raw materials. Accordingly, the company can

adjust its supply chain structure to minimize these risks. Once these hot spots are identified, the company can also better control its sustainability management and specifically act where the maximum effect can be achieved.

But there is still a long road ahead, and so far, only the first steps have been taken. By continuously improving and standardizing the methods used to determine and value the relevant ecosystem services and, in addition, by expanding the data basis, it will be possible to further leverage the potential.

Pioneers such as *PUMA*, *Dow Chemical* and the *WBCSD* have sparked a dynamic which provides the opportunity to incorporate natural capital accounting and the recording of externalities in the companies. Some companies have already set out to achieve this objective, but the majority of companies still hesitate. Supported by incentives or regulatory measures, they will also address the issues discussed above. A great opportunity to transform the economy towards a “green economy” would be seized.

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8.0 Annex I: Further resources

Platforms and initiatives for corporate natural capital management:

- European Business and Biodiversity Campaign: www.business-biodiversity.eu
- Markets for Biodiversity: www.naturalcapitalmarkets.org
- Unternehmen Biologische Vielfalt 2020: http://www.biologischevielfalt.de/ubi_2020.html
- Biodiversity in Good Company: www.business-and-biodiversity.de
- Naturkapital Deutschland – TEEB DE: www.naturkapitalteeb.de
- Natural Capital Coalition: www.naturalcapitalcoalition.org

Literature on natural capital accounting and economic valuation:

- The Guide to Corporate Ecosystem Valuation
<http://www.wbcsd.org/pages/adm/download.aspx?id=253&objectypeid=7>
- The website of WBCSD, including summaries of the pilot studies:
<http://www.wbcsd.org/work-program/ecosystems/cev.aspx>
- Study on the top 100 externalities of Business
 - Natural Capital at Risk: The Top 100 Externalities of Business
http://www.teebforbusiness.org/js/plugins/filemanager/files/TEEB_Final_Report_v5.pdf
- Practical guide to assess externalities in agriculture
 - Natural Capital Leaders Platform of Cambridge University
<http://www.cpsl.cam.ac.uk/Business-Platforms/Natural-Capital-Leaders-Platform.aspx>
- German Federal Environment Agency: Method Convention on estimating environmental costs (German)
 - http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/uba_methodenkonvention_2.0_-_2012.pdf

9.0 Glossary

Supporting ecosystem services: A category of ecosystem services. They are a prerequisite for the provision of all other ecosystem services.

Benefit transfer method: Economic valuation method. Benefit transfer is used to estimate the economic value of ecosystem services by transferring information of already completed studies to other places/contexts.

Biodiversity (biological diversity): Includes the diversity of life on earth. These include three levels: The diversity of species, genetic diversity, the diversity of ecosystems.

Convention on Biological Diversity; CBD: International treaty for the conservation of biological diversity.

CEV: Corporate Ecosystem Valuation

eKPI: Environmental Key Performance Indicator

External effects: Effects of activities (e.g. by production or consumption) on uninvolved third parties which are not being compensated.

HGB: German Commercial Code

IFRS: International Financial Reporting Standards

Internalization: Attribution of external effects to the responsible party. The internalization of environmental costs can reveal the true cost of production including environmentally harmful practices.

Cultural ecosystem services: A category of ecosystem services. Include non-material use of ecosystems, such as recreation, aesthetic perception, or spiritual values.

Natural capital: Economic metaphor for the (limited) stock of physical and biological resources on earth.

Public goods: Goods and services which are used by different people at the same time, because nobody can or should be excluded from their use.

Ecosystem: An ecosystem is a dynamic complex of different species and their inanimate environment including the interactions taking place between these system components.

Ecosystem services: Ecosystem services are the direct and indirect contributions of ecosystems to human well-being and include material and non-material goods and services. There are supporting, provisioning, regulating, and cultural services.

Opportunity costs: Costs of lost profits, resulting from the fact that existing opportunities for the use of a resource (e.g. of land) are not being seized.

EP&L: Environmental Profit and Loss Account

PES: Payments for ecosystem services

Regulating ecosystem services: A category of ecosystem services. These include in particular ecosystem processes that are important for the human well-being.

TEEB: The Economics of Ecosystems and Biodiversity.

Social cost: Costs, which in addition to the cost of production also include the external costs to society, for example the pollution caused/increased by the production.

Provisioning ecosystem services: A category of ecosystem services that includes the large number of goods that ecosystems provide, such as fish or timber.

WBCSD: World Business Council for Sustainable Development



Federal Ministry for the
Environment, Nature Conservation,
Building and Nuclear Safety

This publication has been funded under the project „Economic valuation of natural capital from a business perspective – An instrument to internalize corporate environmental impact” by the German Federal Environmental Agency and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The responsibility for the content of this publication lies with the authors.

Further Information: www.naturkapitalbilanzierung.de