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Review

How Could Companies Engage in Sustainable Landscape Management? An Exploratory Perspective

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Abstract: Current concepts that aim to align economic development with sustainability, such as the circular and green economy, often consider natural systems as externalities. We extend the green economy concept by including the landscape as the provider of social, economic and environmental values. Our aim is to explore how companies could engage in creating landscape-inclusive solutions for sustainable landscapes. We propose a conceptual model of the relationship between companies and landscape services based on a demand for landscape benefits by companies, implications for wider society. We present a short overview of how scientists addressed the role of companies in landscape-inclusive solutions. We also give some examples taken from the World Wide Web to illustrate the variety of ways in which companies already invest in landscape services. Our findings suggest that the relationship between companies and landscapes is not yet strongly recognized in sustainability science. However, examples from practice show that some companies do recognize the added values of landscape services, to the extent that they invest in landscape management. We conclude that future research should provide information on the added value of landscape-inclusive solutions to companies, and increase their capacity to engage in regional social–ecological networks.

Keywords: landscape governance; landscape services; landscape-inclusive solutions; nature-based solutions; business engagement; green economy; supply chain

1. Introduction

The rise of sustainability as an overarching concept to embrace economic, sociocultural and life-support systems has generated new economic paradigms. One of these, the *circular economy*, was explained by Schulte [1] as restructuring linear supply chains into a circular system of using consumed materials as nutrients in interlinked usage cycles. The circular economy is becoming mainstream, as is illustrated by the European Union circular economy strategy (aiming to "**closing the loop of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy**") [2]. Another example is the Chinese Circular Economy Program run by the government since 2002 (reviewed by Su et al. [3]), which aims for reduction of use, and reuse and recycling of energy, water and materials in both production and consumption.

Whereas in a *circular economy* the emphasis is on technical innovations to reuse waste products, in a *green economy* "natural capital" is supposed to be a critical economic asset and source of public benefits. In the green economy as it was conceptualized by UNEP [4], growth in income and employment is assumed to be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services. This view implies that ecosystems need protection, that impacts on ecosystems are minimized, and that

ecosystem services need to be economically valued to create a financial basis for compensation of impacts [1,5]. For example, when Havas et al. [6] proposed involving industries in the ecosystem services management framework, their assumption was that this could help industries to reduce their impact on ecosystems, but not that ecosystem services could produce corporate value. The green economy has been criticized for economizing nature as an externality; critics argue that instead the economy is totally dependent on the natural system [7]. Another criticism challenges the green economy for its emphasis on technological solutions [8]. In a more recent report, UNEP [9] takes a step towards including ecosystem services into the economic system. The report calls for us to "internalize environmental and social externalities in order to provide the right market signals". It also calls for collaboration among all tiers of society: governments, businesses, communities and citizens.

In this explorative review we are interested in how (big) companies, as influential players in supply chains and in the economic arena in general, could internalize services provided by the landscape and how this would connect them to landscape governance in the region. We build on the conclusions by Whiteman et al. [10] that business management literature on corporate sustainability remains focused on social, organizational and institutional implications, thus neglecting ecosystem functioning and with little integration of theory from the natural sciences. However, as pointed out by Houdet et al. [5], businesses become more interested in what nature has to offer as biodiversity becomes progressively associated with raw materials, products and sources of new technologies. We take this conceptual thinking a step further and consider how the natural processes in landscapes may provide benefits to companies and how these benefits may involve companies in the management of landscapes. We see the landscape as the physical outcome of the mutual interaction between nature and people in a particular area. The landscape can also be considered as the physical environment of the people who live and work in that area. We will use the concept of landscape services [11] throughout this paper to denote the connection of the functioning of landscapes to the benefits valued by society. This term is based on the ecosystem services concept but with a strong and explicit emphasis on the benefits associated with human-altered spatial patterns and locally perceived values [12]. We recognize that our focus is related to the idea of nature-based solutions [13,14], defined as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits" [15] (p. 1). By using the term landscape-inclusive, we want to emphasize the importance of a landscape approach [16], in which the landscape is a local to regional social–ecological system. Our assumption is that sustainable solutions benefit from the learning capacity, creativity and collaboration of local communities in a local landscape area [17].

Our first aim is to explore how landscape services can be integrated in supply chains and production cycles and at the same time add value to society by enriching the level of well-being of the human population in the region. Our second aim is to find out whether and how the idea of companies investing in landscape services has been the subject of scientific research. Our third aim is to explore the variety of ways in which companies have been engaged in enhancing landscape services thus far. We emphasize that this paper is meant to be an exploration of a potentially new field of research rather than a review of the state of the art. We propose that landscape-inclusive thinking in companies has not often been subject to scientific research, whereas practical examples suggest that some companies have started experiments. We also propose that landscape scientists and scholars in sustainability science and the green economy work together on a research agenda that calls for a joined-up approach to this challenging topic. In the next section we define the idea of landscape-inclusive solutions and propose a model based on the theory of planned behaviour to hypothesize the mechanisms behind a company's decision to get engaged with the landscape and its services. Subsequently, we present three ways of considering the company–landscape interaction: by way of a conceptual model (Section 3), by the way science has thus far approached the subject (Section 4), and by way of examples of company–landscape interactions that we take from practice (Section 5). In the perspective section (Section 6) we speculate about motives that a company may have to get involved in landscape governance networks, and we end with a proposed research agenda.

2. Approach

2.1. Landscape-Inclusive Solutions

We deviate from the [4] definition of the green economy in considering nature as a constitutive part rather than an externality. This implies that an ecologically resilient landscape is insurance for the provision of a range of economic, social and ecological benefits. Seen in this way, we define landscape systems as social–ecological networks [18]. This term highlights the interdependence of social and ecological system components, as in social ecological systems [19]. The term network refers to the spatially explicit nature of the interactions between the landscape and human societies. For example, in the social network neighbouring farmers may exchange knowledge more frequently than distant farmers [20], which would increase the exchange of knowledge and experience. In the ecological network distance between sites is also of importance as it affects the spatial distribution of species in the cultural landscape [21] and thereby the efficient and reliable delivery of landscape services [22]. We will use the term landscape-inclusive solutions for planned physical adaptations in the ecological network that aim for improved landscape services. The term well-being will be used in a broad sense to cover social, economic and ecological values of landscape services, encompassing for example health, safety and security, living standards and social cohesion [12].

2.2. Involvement of Companies in Landscape-Inclusive Solutions

As we are particularly interested in the contribution of companies to landscape-inclusive solutions, we need a specification of what such a contribution could be. Our assumption is that landscape-inclusive thinking is not part of mainstream business strategies, and that such thinking needs to be developed over time. To characterize this development, we distinguish three phases of increasing engagement with landscape-inclusive solutions, based on the theory of planned behaviour [23], as adapted by Mulatu et al. [24] (Figure 1). The initial phase of involvement is expressed as a positive attitude towards landscape-inclusive solutions, for example identified by a company's *awareness* that landscape-inclusive investments may produce corporate value. The second phase, *intention*, is interpreted as an (intended or actual) willingness to pay for landscape improvements that provide increased benefits. In the third phase, the company is actually *engaged* in landscape governance by being active in a social–ecological network. A company in the first phase may show that it is aware of the potential corporate value of landscape services (or biodiversity) by supporting nature conservation projects or supplying funds without further implications for its strategy or activities. In the second phase, the company actually finances landscape-inclusive solutions, for example through paying individual farmers for the development of flowery strips along field margins providing natural pest control or pollination. In the third phase, the company takes part in a landscape governance network with other beneficiaries and land owners to create a future landscape that will provide the wished-for collective benefits. For example, the company may take the lead in a project involving water management in a catchment. Whether a company moves to the next phase will depend upon such factors as their level of control over the change process, uncertainties in the product chain or business cases that might emerge, or their view on corporate social responsibility.

This view on three levels of involvement overlaps with the business sustainability typology proposed by Dyllick and Muff [25]. They distinguish the following three levels of involvement: broadening the business concern towards sustainability issues, a shift from a focus on shareholder value to creating value for the common good, and a shift in organizational perspective from inside–out to outside–in, with a focus on the sustainability challenges society is facing. In the remainder of the paper we will distinguish three levels of engagement by reference to: (1) awareness of landscape services, (2) paying for landscape services, and (3) involvement in social–ecological governance networks.

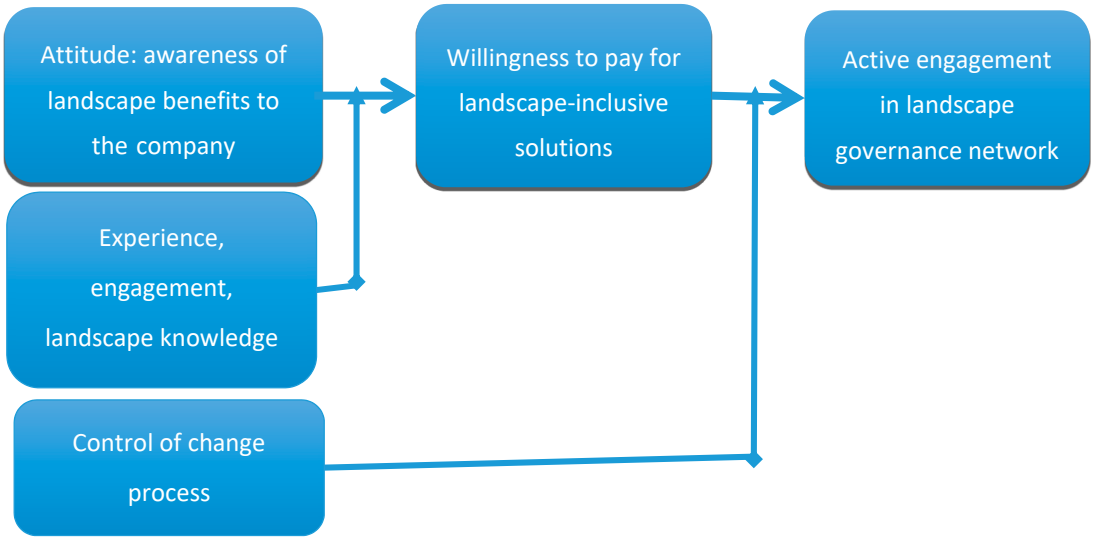

Figure 1. Three phases in the level of involvement of companies in creating landscape-inclusive solutions. The transitions between the phases are affected by subjective terms (experience, knowledge) and by the perceived control of the implementation of the solution. Based on the theory of planned behaviour [23,24].

2.3. Selection of Examples

We failed to identify combinations of keywords that produced more than a few relevant research papers, probably because our focus is new and at the interface of landscape ecology and planning, economy and governance. We had the same experience when searching on the World Wide Web for examples of companies that had invested in landscape services to create landscape-inclusive solutions. Therefore, our overview cannot be regarded as giving the state of the art in science and practice. Our aim is to explore the different ways scientists have been dealing with landscape services in connection to companies and the different ways companies have been experimenting with landscape-inclusive solutions. This will help us to ask research questions.

We excluded farms as companies in our search. Obviously, farms are part of the landscape, and by definition they engage with landscape services. There is extensive literature on multifunctional farming, including the use of landscape services for food production or for social benefits. See, for example, [26,27].

3. Conceptual Model

The relationship a company may develop with its landscape depends on the type of landscape and business. For example, food industries may incorporate regulating landscape services such as natural pest control or crop pollination into food supply chains. To achieve this they could stimulate farmers to create green infrastructure. However, a software firm in an urban landscape has no obvious food chain in which landscape services may be incorporated. However, they may be interested to foster social services perceived as beneficial by their employees, or to build a good relationship with people in the neighbourhood of the office. Also, the type of landscape matters, because different landscapes provide different services, and geographical locations may differ in the demand for services, depending upon the level of urbanisation, industrialisation and prosperity.

As an illustration of the position a company may develop within a social-ecological network, we discuss a conceptual model of a food industry interacting with a landscape and its users. This example (Figure 2) is for a company entering level 3 of social–ecological network involvement. The design of this conceptual model was inspired by the Dutch Green Circles programme (www.greencircles.nl), in which the Heineken brewery in Zoeterwoude, next to the city of Leiden in the province of South Holland in The Netherlands, plays a central role. The Green Circles programme is essentially based on the

concept of low carbon emissions and closing circles of water and materials (circular economy), but with the important addition of considering nature as a 'partner' in creating corporate and societal value. The conceptual model in Figure 2 (most of which is a plan rather than reality) depicts two bundles of cycles: a physical and a social bundle. The physical cycle includes the food chain, the production of raw material and bioenergy, and the water cycle. In the case of Heineken, for example, natural pest control and water purification (regulation services) need to be integrated with the production of barley (production service) for brewing beer. Waste water from the brewery is planned to be purified in ditches and wetlands in the landscape adjacent to the brewery and subsequently added to the strategic water buffer in the area. Green infrastructure that would provide these landscape services also has the potential to produce social services or benefits to human communities in the neighbourhood. To achieve these potential benefits, the company needs to influence the management of the landscape by land owners and managers, such as farmers and water managers. This demand for a transition in the social–ecological network closes the social cycle. In this cycle, citizens and other companies as well as governmental bodies, including environmental groups and health organizations, may demand for benefits of social services. Also regional and local governments may join on the demand side. As a result, both the landscape and the governance network evolve.

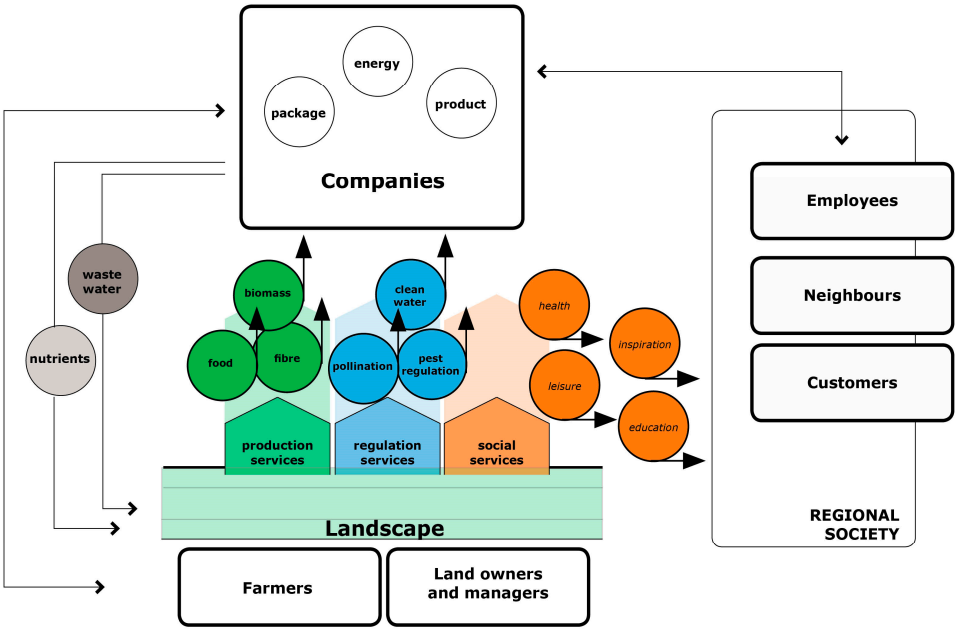

Figure 2. Conceptual model of the interaction between a food company and its landscape. Two bundles of cycles are distinguished. In the first one (left side) the company interacts with the landscape. In this bundle we see waste water and nutrient flows from the production process flowing through the landscape where they are treated by regulation services (i.e., water purification). The company uses this cleaned surface water. Furthermore, the landscape (with green infrastructure and soil compartments) provides production and regulation services in the production of food products and fibres for package, whereas biomass is used for energy production. However, the same landscape also produces social benefits to the wider society, giving rise to the second bundle of cycles. The implication is that if the company invests in the landscape for better services in the first bundle the bundle of social services are simultaneously enhanced, adding well-being value to the regional society. For these improvements of landscape services, the company depends on activities by land owners in the area, who are partly the same people that profit from the social services as well.

Obviously, the application of this model depends on the type of industry. In non-food industries part of the physical cycle may not apply, but companies may still be interested in social services for the well-being of their employees or to improve the relationship with the neighbourhood.

4. Examples from the Scientific Literature

Overall, the scientific literature on the relationship between companies and landscape-inclusive solutions we found is mostly focused on reducing the footprint of economic activity. For example, Golicic and Smith [28], in their extensive review of sustainable supply chain management, limited the meaning of this concept to "activities or actions taken to reduce or eliminate the environmental impact of supply chain management–related functions or processes". This is consistent with regarding nature as an externality. Considering the major economic and humanitarian implications of climate change, we expected that scientists would publish cases in which firms were engaged in making urban and agricultural landscapes less susceptible to climate-related impacts that would affect them directly. Although worldwide climate-related investments were estimated at 364 billion in 2011, 21% of which was from corporate actors, most of it was spent on mitigation measures [29]. Pauw and Pegels [30] found that businesses were engaged in almost half of the National Adaptation Programmes (to climate change) in developing countries. Activities did include measures to make the landscape more climate-proof, but these measures entailed technical innovations, whereas the potential of the landscape to contribute to climate adaptation, for example by adapting the water system, was neglected.

Recently, the ecosystem services concept has appeared in several companies' sustainability strategies [31], and there is emerging interest in the willingness of firms to pay for benefits provided by natural systems. We found examples of the willingness to pay for ecosystem services from tropical forests. Koellner et al. [32] found a demand for carbon sequestration among international firms, whereas Costa Rican firms were interested in watershed protection, biodiversity conservation, carbon sequestration and scenic beauty (in this order of preference). Mulatu et al. [24] investigated the willingness to invest in a water fund for managing the landscape for ecosystem services, as an alternative governance arrangement to direct payments. Companies differed in the interest they expressed for landscape services: for example, carbon sequestration was mainly of interest to energy companies, while improving water quality and landscape beauty were prioritized by large-scale farms. An interesting outcome of this study is that the company's cost–benefit expectations for investing in a water fund were highest for non-financial cost-benefits, i.e., securing natural resources, improving human welfare and ecologically responsible management.

Potentially promising developments in which companies could play an active role in landscape transformations are the so-called *integrated landscape initiatives* that promote multifunctional and multi-objective management of rural landscapes. Systematic assessment studies were published for 104 cases in 21 Latin American countries [33], 87 cases in 33 African countries [34], 166 cases in South and Southeast Asia [35], and 71 European cases [36]. In the most comprehensive examples, "multi-sector governance, coordination and adaptive management functions become the hub for linking stakeholders activities and policies" [34]. Although multi-functionality and multi-stakeholder planning were common assets of these initiatives, one of the challenges reported was the difficulty of engaging private business actors. Agribusiness and industries were engaged in 14% of the African and European cases, in Asia less than 20%, whereas in the Latin American overview this percentage varied between 7% and 20% for different categories of private actors. From the specifications of investments provided by these overviews, we could not identify any case of investing in landscape services other than improving the land for higher food productivity (for example, by irrigation). As a possible explanation for the low degree of business participation, it is suggested that private actors may be reluctant to engage in a complex multi-stakeholder process with uncertain outcomes and low financial revenue. Research on the acceptance of the natural-resource-based view among the Scottish agri-food sector [37] revealed that companies are more often inclined to incorporate pollution prevention than product stewardship into the supply chain. Product stewardship is associated with product certification, not with landscape services.

Under the payments for the ecosystem services concept [38], which is meant to internalize environmental externalities through the creation of (quasi-)markets [39], one could expect companies

to pay for landscape benefits. However, in the majority of PES cases, it is the government that pays [39]. Muňoz Escobar et al. [40] described two cases of water catchment management in which companies pay farmers upstream for adapting the use of their land, either in kind by providing social development programmes, or in cash, as a compensation for a change from conventional to organic farming. The downstream companies were sugar cane producers (Colombia) and a drinking water company providing the city of Munich, Germany. Other similar examples for water catchments are reviewed by Schomers and Matzdorf [39]. Because firms are often settled in urban landscapes, it is in these landscapes that they may encounter the potential benefits of green infrastructure for their personnel and the neighbourhood. Based on an analysis of benefits of ecosystem services in 25 urban areas in the USA, Canada and China, Elmqvist et al. [41] concluded that investing in ecological infrastructure in cities, and the ecological restoration and rehabilitation of ecosystems such as rivers, lakes, and woodlands occurring in urban areas may not only be ecologically and socially desirable, but also quite often economically advantageous. However, this does not mean that companies know. Snep et al. [42] found that contributing to a larger ecological network by creating stepping stones or ecological corridors were the two preferred scenarios among companies for greening the office park. In a choice experiment measuring willingness to pay, companies associated themselves with such benefits as their environmental status, external appearance of the office park and positive effects on health and well-being of their employees. However, when it comes to translating such thinking into concrete investments [43], exploring the enhancement of urban landscape services by tree planting, only one of 58 interviewees considered the private sector as an important actor in the governance of urban landscapes. Interviewees saw the mayor as the prime actor, and if the mayor does not take the lead, they considered the non-profit sector as the strongest actor in tree-planting initiatives.

In summary, in the scientific literature about the engagement of companies in landscape-inclusive solutions to sustainability, there is an emphasis on the willingness to pay for landscape benefits. Direct involvement in investments in landscape functioning to improve corporate value has rarely been investigated. Although we found companies interested in engaging in landscape management, there is little knowledge about why and how firms would engage in regional social–ecological networks to create added value (either to the firm or to society) by landscape-inclusive solutions.

5. Examples from Practice

We present 14 practical cases, found on the World Wide Web, in which companies were involved in adapting landscapes to enhance the benefits of landscape services, and/or were involved in landscape governance networks to generate value of interest to a wider society (Table 1).

The examples were found under a wide variety of keywords, sometimes hidden in reports on corporate sustainability that were dominated by typical cases of recycling water or minimizing the use of water or energy in the manufacturing chain or production process. We found many more examples of companies involved in programmes of empowering farmers to develop a more efficient farming practice, but without recognition of the benefits obtained by landscape-scale management of natural habitats. For example, the Danone Ecosystem Fund website reports financial support to 59 projects across the world, mostly fostering a more prudent use of resources by education or social learning. Of these cases, only one involved physical measures in the landscape. Examples of "integrated management of fruit orchards" in which industries (e.g., Bayer) are involved aim to reduce the frequency of chemical pest application by more sophisticated methods of monitoring populations of pest organisms, rather than converting the orchard to bring in natural habitats for more effective natural pest control. Such examples do not meet the criteria of landscape-inclusive solutions.

Table 1. Examples of companies investing in landscapes services found on the World Wide Web. Two roles have been distinguished: paying and active engagement in landscape governance (including payments).

	Company	Country of Case	Company Type	Willingness to Pay	Active Engagement in Social–Ecological Networks	Landscape Services	Network Partners
1	General Mills	USA	Food and beverage	US$2 million over five years for restoring 40,000 ha farmland by developing hedgerows and other landscape elements		Pollination	Cofounding by Xerces Society for Invertebrate conservation, US department of Agriculture, Organization by Xerces
2	Heineken brewery	Zoeterwoude Netherlands	Food and beverage	Reconstruction of plant area to become a pollinator habitat as part of a larger social–ecological network for pollinators		Pollination, scenic beauty, inspiration to staff	None. The reconstruction inspired a range of public and private actors to create a pollinator network
3	Union Carbide Corporation (Dow chemical)	Seadrift, Texas, USA	Chemical industry	US$1.2 million for 45 ha wastewater treatment wetlands on the plant area		waste water purification, biodiversity, recreation	none
4	Diageo	River Spey management plan Scotland	Food and beverage	donation of 10,000 GBP toward a pond for river restoration		water purification	Cairngorm NP Authority, Forestry Commission Scotland, Highland & Moray Councils, Scottish Natural Heritage, the Scottish Environmental Protection Agency, Spey Fishery Board.
5	Veracel-Stora Enso	Brazil, South Bahia	Paper, biomass	5695 ha restored rainforest in production forests as ecological corridors to connect 65,000 ha fragments to large rainforest area		Connectivity for biodiversity	None mentioned (owns large areas of forest)
6	Ladish Malting (Cargill)	South Dakota, USA	Food and beverage		Conversion of 75 ha farmland into wetland, Ladish Malting paid 60% of construction costs	Water purification, ecological connectivity, irrigation water for 1000 ha farmland	Local farmers, Ducks Unlimited, US Fish and Wildlife service, Boy Scouts
7	Volkswagen group Mexico	Mexico	Car industry		Secure reliable water supply for plant and local communities by reforestation of 750 ha mountain slope with native trees	Water storage	Secretary of the environment Mexico, Drinking water agency, local communities,

Table 1. *Cont.*

	Company	Country of Case	Company Type	Willingness to Pay	Active Engagement in Social–Ecological Networks	Landscape Services	Network Partners
8	Reseau de Transport d'Electricité	France, Ardennes	electricity transmission network		Restoration of peatlands under power lines, creating wildlife corridors and reducing vegetation management costs	Biodiversity, unspecified services to adjacent farmland	National Forestry Office (ONF), Nature Park of Ardennes, Municipalities of Sécheval and Hargnies, local land managers
9	Lafarge Holcim Ambujanagar cement plant	Gujarat, India	cement industry		Converting closed quarries into artificial lakes and wetlands (330 ha), and improving water conservation by reforestation,	rain water storage, biofuel growth, biodiversity	Gujarat Ecology Commission, local communities,
10	Danone Ecosystem Fund, Danone Waters China	Jiaquan Watershed, Guangdon Province, S-China	Food and beverage		Restore 43 ha woodland to ensure availability of drinking water, water training school for water management	Water retention	Local communities, IUCN
11	Perrier Vittel SA	Contrexéville and Vittel, France	Food and beverage		Construction of embankments, reintroduction of trees and hedgy bushes	Regulating rain water run-off	Municipalities of Contrexeville and Vittel, forest office
12	Toyota Motor Europe, Cofinimmo Rockspring, Thon	Woluwe, Brussels, Belgium	Car industry, Real estate providers, hotel		Social–ecological network of companies and local and regional authorities	Biodiversity, human health, leisure, education, storm water regulation	Flemish Land Agency, municipalities, regional government
13	South West Water	UK	Drinking Water company		Peatland restoration, ditches blocked up, buffer strips along streams grassland restoration	Water storage, Water purification, CO_2 sequestration, biodiversity	Wildlife trust, River trust, Farmers, Exmoor national Park authority, governments
14	Mondi	South Africa	Paper industry		9000 ha wetland and 15,000 forest buffer zone added to wildlife reserve	Water resource, wood harvesting, wildlife	Black economy empowerment partners, governments, local communities

1—https://www.generalmills.com/en/News/NewsReleases/Library/2016/November/pollinator-habitat; 2—http://www.greencircles.nl; 3—http://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2015/11/DOWUCC_NI4BizCaseStudy_Constructedwetlands.pdf; DiMuro et al., 2014; 4—http://www.diageo.com/en-us/Pages/default.aspx; 5—http://www.storaenso.com/sustainability/stories/replanting-a-rainforest; 6—WBCSD 1998. Industry, fresh water and sustainable development. WBCSD Conches-Geneva and UNEP Nairobi; 7—http://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2015/11/Volkswagen_NI4BizCaseStudy_Itza-Popo.pdf; 8—http://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2015/11/RTENI4BizCaseStudy_Peatlands.pdf; 9—http://www.holcim.com/sustainable/environment/biodiversity/india-ecosystem-management.html; 10—http://ecosysteme.danone.com/projects/; 11—WBCSD 1998. Industry, fresh water and sustainable development. WBCSD Conches-Geneva and UNEP Nairobi; 12—Van Tichelen, K. (ed.) 2015. GIFT-T! Business Plan Woluweveld. Flemish Land Agency (in Dutch), Brussels; 13—https://www.southwestwater.co.uk/environment/upstream-thinking/; 14—http://www.siyaqhubeka.co.za/page/new-generation-plantation.

Most examples were from recent years, but Union Carbide, Veracel, Ladish Malting and Perrier Vittel (cases 3, 5, 6 and 11) started before the turn of the century. They include a variety of industries, e.g., food industries interacting with agricultural landscapes, chemical and car industries, as well as energy-providing companies. In two cases (cases 1 and 2), landscape conditions for pollinators were improved. General Mills (Minneapolis, MN, USA) pays an NGO to organize land improvements by collaborating with farmers, but the company itself is not actively involved in the social–ecological network. In the other example, the Heineken brewery (South Holland, The Netherlands) conversed half of the 100-ha plant area into a pollinator habitat. Although this initiative fostered the creation of a social–ecological network to ensure pollinator populations in the wider region, Heineken did not actively engage in the social network process. The electricity transmission network RTE (case 8) in France is converting the management of the strips of land below the power lines to create corridors for biodiversity across the landscapes. They report that the potential of these strips of natural vegetation to provide benefits to adjacent farms is being investigated. In case 13 we have a drinking water company restoring the capacity of peat bogs and upstream agricultural landscape to store and purify water, with co-benefits for biodiversity. The wood processing company Veracel, in exploiting the Brazilian rainforest, developed a system of ecological corridors to connect rainforest fragments to a large area, apparently on land owned by the company (case 5). A somewhat similar case 14 is the Mundi paper industry in South Africa, which (in collaboration with other land owners) expanded a nature reserve with a 24,000-ha buffer area where sustainable wood harvesting was combined with water resource management and big mammal population restoration.

Most other examples pertain to physical adaptations in the landscape to improve water management. They include the construction of waste water purification wetlands (cases 3, 6 and 9) as well as measures to protect drinking water resources (cases 4, 7, 10 and 11). In the wetland cases additional services are mentioned as spin-offs, for example connectivity for wildlife migration. We found some more examples in which companies were engaged in water regulation services, maybe because companies are more familiar with these services than with other regulation services, or because water is more often a key resource. We did not include measures for carbon sequestration since these are often taken outside the landscape area in which the company is located.

From our own practice, we knew of one example in which industries improved the green infrastructure in the urban landscape (case 12). In this case several industries formed a social–ecological network together with local municipalities, an initiative organized by the Flemish Land Agency. A more frequently encountered investment in urban landscapes is in green roofs for the benefit of storm water regulation. However, due to the small spatial scale we did not consider this an example of investment in the landscape.

Summarizing, as we have searched for companies engaged in landscape-inclusive solutions, all examples pertain to companies that are beyond the basic awareness stage and actually invest in landscape services. Heineken, Union Carbide and Veracel invest in parts of the landscape that they own, and do so without taking part in landscape governance processes in the region at large. Mills pays farmers for physical adaptations in the landscape to provide pollination services, but does so through the mediation of an NGO. Other companies not only invest but are also part of a regional social–ecological network and cooperate in landscape governance. Companies may take the lead in organizing an area-based cooperation to create more sustainable conditions, for example to ensure long-term water supply.

6. Perspectives

We have explored how the landscape and its services can become an integral part of a green economy in which companies integrate landscape services into their supply chain or social responsibility programme. Many companies have started to support sustainability and sustainable supply chain management [28]. Ecosystem services are becoming part of business strategies [44,45].

We found examples of companies going beyond awareness by actually investing in landscape services, sometimes as a partner in a governance network (levels 2 and 3 of the business sustainability typology proposed by Dyllick and Muff [25]). The engagement of companies in landscape governance could, however, be inhibited by the belief that the landscape and its natural benefits are a common good and therefore the responsibility of the government, rather than of business [30]. However, such engagement by companies with landscape governance has not been the subject of scientific research thus far.

All our examples pertain to large companies, maybe because large firms have put more effort into communicating their sustainability achievements or maybe because they are more often members of international business networks for sustainability. We do not know whether small firms differ from large companies in terms of their sustainability goals or their capacity to engage with local social–ecological networks.

6.1. Motives for Engagement

Companies may have different aims when engaging in landscape-inclusive solutions. For example, they may be interested in making the supply chain more sustainable by integrating regulating services. Also, they may be interested in investing in social services to improve the well-being of societies they are a part of. For example, a food industry may pay farmers for extending green infrastructure to provide more reliable pollination because they attribute value to more sustainable crops. Also, a car industry may pay landowners for sustainable river catchment management. By synergistic relations, such investments may also produce social landscape services, and thereby contribute to human well-being. Based on Figure 2, at least four categories of motives can be imagined. A first type of motive, related to closing cycles of water and material (e.g., nutrients), is associated with the long-term availability of resources. A second type of motive may be that the use of landscape services is cheaper. The case of Union Carbide was analysed for its financial and environmental return on investment [46], showing that the particular green infrastructure solution saved US$282 million over 30 years compared to technical purification of waste water. That is because the constructed wetland took less time and capital to build and required lower operational and maintenance costs. A third type of motive is associated with making supply chains more sustainable, for example by fostering pest regulation and pollination services. Food industries may be interested in those services because they expect that their customers increasingly prefer sustainable, healthy food. Also, the crops themselves may increase in market value, as was illustrated by Klatt et al. [47], who demonstrated that strawberries pollinated by wild bees produced a higher market value than wind-pollinated and self-pollinated strawberries. A fourth type of motive is associated with the provisioning of social–cultural services to the wider public in the region, for example as a synergistic yield from the development of green infrastructure for regulation services. To companies this could be valuable if the enhancement of social services improves their relationship with communities and the government in their region. In this respect, it is of interest that studies on willingness to pay (e.g., [24]) revealed that companies would not invest in a water fund primarily for reasons of financial benefits, but rather were motivated to contribute to the common good. This suggests that a purely financial model may not be appropriate to fully explain decision-making by firms interacting with landscapes.

6.2. The Involvement of Science

While companies have been experimenting with using landscape services and engagement in landscape governance, we see little of that reflected in the scientific literature. An explanation for that lack of interest could be that our focus is in the middle of three scientific domains: economy, landscape ecology and landscape governance/planning. We hope that our contribution might foster an interdisciplinary scientific focus on the role of companies in landscape sustainability. Other explanations may be the values and beliefs of scientists. For example, the idea of nature as an externality is deeply rooted in neoclassical economic theory. Although this paradigm is being challenged in ecological

economics, Wam [48] concluded that the gap between ecological economists and ecologists appears hard to bridge. A similar road block might be found in the dominant frame of the human–nature relationship: nature needs our respect and protection because it has inherent value. Advocates of this point of view consider the economic frame of the human–nature relationship as implicated in the concept of ecosystem (or landscape) services as unethical: nature should not be commercially exploited [49]. Thus, our perspective might not align with the dominant economic and conservation discourses.

Overall, our findings suggest that the relationship between firms and landscapes is not recognized in science due to a separation of scientific domains. A similar conclusion was proposed by Winn and Pogutz [50] with respect to sustainability management. These authors plead for "incorporating the complexity of and interconnectedness between ecosystems and organizations" into sustainability management theories, opening up managerial decision-making to include the potential of natural capital in a more proactive approach. In the terms of this perspective paper, this plea can be reframed as the need for landscape-inclusive solutions to become an integrated part of corporate sustainability.

6.3. Conclusions and Research Outlook

To further sustain the engagement of companies with landscape sustainability, several fundamental challenges have to be faced. The first obvious one is that landscape system theories and data should be integrated with social and economic theories, for example based on the concept of social–ecological systems. A second challenge comes from the need for creative rather than analytical scientific approaches. Landscape ecology and sustainability science are dominated by impact and assessment studies [51]. While Whiteman et al. [10] have highlighted the importance of scientific impact assessment studies to inform corporate sustainability decision-making, we advocate a more iterative, design-oriented approach in which scientists, companies and other actors in a landscape area collaborate to create place-based solutions [12,52].

We have argued that incorporating companies in landscape governance requires fundamental changes in thinking. Lambin [53] proposed that the development of such transformations depends on three categories of factors: information, motivation and capacity-building. Below we use these categories to structure a landscape science research agenda.

6.4. Information

Which advantages and difficulties are associated with landscape-inclusive solutions, in comparison to technical solutions? Are landscape-based solutions more sustainable than technical solutions (as in the case of Dow Chemical [46])?

Business models for landscape-inclusive solutions for companies. Recent studies show that business models based on sustainability have higher returns on investment and are more resistant to stock price volatility [54]. We suggest extending such studies with the costs and benefits to companies of investments in landscape services. This requires a place-based, well-being-oriented valuation approach fundamentally different from current practice in ecosystem services accounting [12,32].

6.5. Motivation

Understanding motives. Why would companies be interested in including landscape services in the supply chain or in contributing to the well-being of the region? How can awareness of the potential corporate value of landscape services be developed? Why do companies invest in landscape systems; what return on investment do they expect in the short and long term? How does increased awareness of corporate responsibility affect decision-making? We suggest that research should distinguish between motives for investing in more sustainable nutrient and water cycles, more sustainable food supply chains and increased societal value in the region.

Case studies for inspiration. Case studies can be sources of inspiration to make companies aware of landscape benefits, demonstrate how they can be involved, and how they can take the lead in regional change processes. For example, such cases may demonstrate the contribution of soil and green

infrastructure to a sustainable supply chain, cost–benefit quantifications of companies' investments in the landscape, or returns on investment in a social, economic and environmental sense.

6.6. Capacity Building

Building a knowledge framework that supports design of landscape-inclusive solutions. For example, rules of thumb to design green infrastructure for (multiple bundles of) landscape services in agricultural and urban landscapes that are open for deliberation and adaptation by the social–ecological network in the area in which the company is involved. How can the role of species diversity with respect to an efficient and reliable delivery of landscape services be incorporated in such design rules? Also required are frameworks and practical tools for assessment of landscape services that specify social corporate value.

The role of companies in the governance of landscape services. The governance of landscape services in a social–ecological network depends on complex interactions in networks of demanders for services and suppliers, on multiple spatial scales. What are the roles companies can play in such networks, and what is their impact on the dynamics of such networks? How does their role replace or compete with the classic role of the government? How do companies deal with bottom–up collaborative governance processes?

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