Biodiversity as integral to strongly sustainable supply chains: Review and exemplars in the natural resources sector

Quarshie Anne, Salmi Asta, Scott-Kennel Joanna, Kähkönen Anni-Kaisa

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Quarshie, A., Salmi, A., Scott-Kennel, J. & Kähkönen, A. K.

Cite as: Quarshie, A., Salmi, A., Scott-Kennel, J., & Kähkönen, A. K. (2018). Biodiversity as integral to strongly sustainable supply chains: Review and exemplars in the natural resources sector. In *Strongly Sustainable Societies* (pp. 192-208). Routledge.

Abstract

Biodiversity reduction is one of the most severe environmental challenges facing our planet. Yet research that connects company action with subsequent effect on biodiversity is somewhat limited, and complicated by the fact that such effects are often distanced, both spatially and temporally, from the individual actions that caused them. This chapter brings together existing research in sustainable supply chain management with empirical evidence of companies moving towards more sustainable business and supply chain practices. This chapter brings together existing research in sustainable supply chain management with empirical evidence of companies moving towards more sustainable business and supply chain practices. The chapter presents three exemplar cases in Finnish and New Zealand natural resource sectors (forestry, agriculture and fishing). Our vignettes show how companies can develop activities and practices to address biodiversity loss.

Introduction

Biodiversity reduction is one of the most severe environmental challenges that the planet currently faces (WWF, 2016). Biosphere integrity is one of four areas – the others being climate change, biogeochemical flows and land-system change – where the estimated 'safe' levels of planetary boundaries have been exceeded due to human activity and impacts on the planet (Steffen et al., 2015). Within the global business community, the response to the challenge of biodiversity loss has been limited, as it is typical for corporate responsibility and sustainability initiatives to place heavier emphasis on other, better-known sustainability challenges, such as climate change (Whiteman, Walker & Perego, 2013). Most companies have relied largely on traditional responsibility practices and activities that lessen some of the environmental and social harms that their operations are connected with instead of attempting truly transformative approaches toward sustainability (Coulter & Guenther, 2014). Hence, there remains considerable room for improvement in how firms treat biodiversity, as well as other areas of sustainability.

Similarly with regard to managerial practice, the research remains somewhat limited in its understanding of how firm activities are connected to 'emerging' challenges such as biodiversity reduction (Whiteman et al., 2013). While critical, biodiversity loss is a tricky topic to understand and address. The effects of biodiversity reduction are often distanced, both spatially and temporally, from the individual actions that caused them. In many sectors biodiversity impacts may be invisible or only manifest themselves in remote locations or at the level of sub-tier suppliers, which may hinder downstream companies' and end-customers' understanding of the true impacts of their purchasing and consumption decisions. Therefore, managers, scholars, as well as other actors need to tackle this, and other, 'wicked problems' (Churchman, 1967) armed with a long-term and broad perspective. One important area where firms can tackle biodiversity loss is

their cooperation with suppliers along supply chains and networks, where significant sustainability impacts often accrue (Seuring & Müeller, 2008; Wu & Pagell, 2011).

Supply chain management (SCM) can be defined as 'the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole' (Mentzer et al., 2001: 18). In the SCM discipline, research focusing on sustainability has grown rapidly, but very few articles have dealt with, or even touched upon, the topic of biodiversity reduction (Quarshie, Salmi, & Leuschner, 2016). To address the need for greater understanding of biodiversity loss and its connections to supply chains, this chapter brings together existing research on the topic from the SCM and related research fields, with empirical cases of exemplary sustainable SCM practices that impact biodiversity.

We first review the relevant literature on supply chain sustainability and corporate responsibility from a strong sustainability perspective (see Heikkurinen & Bonnedahl, 2013), building on our previous work in this inter-disciplinary research area (e.g., Quarshie et al., 2016; Lintukangas, Kähkönen, & Ritala, 2016). We then focus on biodiversity reduction in business and SCM research. Finally, we illustrate through empirical case examples, or vignettes, how sustainability-led companies operating in three natural resources-based sectors (fishing, forestry and agriculture) in New Zealand and Finland have sought to reduce biodiversity loss in their operations and supply chains. The two main research questions addressed in this chapter are as follows: (1) How does previous supply chain sustainability and corporate responsibility research treat the issue of biodiversity loss? (2) How can companies advance strong sustainability by incorporating biodiversity considerations into their SCM practices?

The chapter seeks to shed more light on what is already known in the literature in order to further discussion on innovative business practices related to biodiversity, and to highlight the need for more research on the topic. We contend that biodiversity is a critical element of sustainability, which should be recognised as having intrinsic or inherent value (see Ministry of the Environment, 2014), and be addressed more directly by all firms as part of strongly sustainable strategies and supply chains (see Heikkurinen & Bonnedahl, 2013).

Literature Review

Sustainable Supply Chains and Corporate Responsibility

In this section, we review previous supply chain sustainability and corporate responsibility literature from a strong sustainability perspective. We discuss key themes and assumptions that are prevalent in the literature, contrasting them to the concepts of *strong sustainability* and *a sustainable development orientation* proposed by Heikkurinen and Bonnedahl (2013). A key idea related to these concepts is that sustainability – and the natural environment – should be recognized as having intrinsic or innate value instead of being treated as a source of potential economic value. That is, activities are not pursued primarily because of their potential to generate financial advantage. Further, Heikkurinen and Bonnedahl argue that strongly sustainable companies should actively bear responsibility for furthering sustainable development rather than expecting mediating actors such as customers or stakeholders to do so.

In the SCM discipline, research on sustainability and responsibility has grown steadily during the past two decades (Carter & Rogers, 2008; Mollenkopf, Stolze, Tate, & Ueltschy, 2010). In the 1990s and early 2000s, research inquiry into sustainability concerns affecting supply chains focused largely on environmental purchasing (Min & Galle, 1997),

environmental (and reverse) logistics (Murphy, Poist, & Braunschweig, 1996), environmental management (systems) (Klassen & McLaughlin, 1996), and ethical issues in supplier relationships (Carter, 2000). Extending prior work on environmental management, Linton, Klassen and Jayaraman (2007) highlighted the interaction between sustainability and supply chains, proposing a chain-wide sustainability perspective. This perspective treats sustainability as an integrative, triple bottom line (TBL) (Elkington, 1998) concept incorporating economic, environmental and social considerations.

Carter and Rogers (2008) proposed a framework of sustainable supply chain management (SSCM) identifying factors that drive supply chains toward greater sustainability. This brought together the TBL and four supporting aspects of SSCM: strategy; organisational culture; transparency and; risk management. Building on previous definitions of SCM, Carter and Rogers (2008: 368) defined SSCM as 'the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains.' This definition emphasises environmental and social goals, alongside the notion that a firm and its supply chain should benefit through economic performance in the long term. Yet, firm activities that lie at the intersection of social, environmental, and economic performance are seen as the most sustainable (or best) because they positively affect all dimensions of the TBL.

Following these theory-building efforts and related calls to view SSCM as an integrated TBL concept, research inquiry began growing even more rapidly within the SCM and other disciplines, as scholars sought to contribute to a better understanding of supply chain sustainability. Our previous examination of the literature (see Quarshie et al., 2016) reveals prior

inquiry has resulted in a fairly comprehensive body of knowledge on how firms may seek to create more sustainable (or less harmful) supply chains. Nevertheless, relatively few studies dig deeper into an understanding of how fundamental changes in managerial mental models and behaviours, and firm-level SCM approaches and practices can be achieved. As with much of the research in corporate responsibility, where there has been significant attention on the relationship between responsibility practices and financial performance (see De Bakker, Groenewegen, & Den Hond, 2005), SCM research has focused heavily on understanding the connections between SCM practices and economic or sustainability performance (see Golicic & Smith, 2013). Amongst studies that question the assumption that firm practices and activities should – while adhering to social and environmental objectives – consider and prioritise economic goals, Wu and Pagell (2011) bring up the issue of strategic trade-offs between environmental, social and economic sustainability considerations. They explore how sustainability-led, not profit-led, firms balance the need to remain competitive in the short-term with the need to transform their supply chains toward (environmental) sustainability in the long term. Wu and Pagell contend that while their case firms generally make practical environmental decisions, sustainability offers them a new frame with which to view their operations. Further, these companies not only consider profits and the environment, but also short-term growth and long-run competitiveness simultaneously.

Pagell and Shevchenko (2014) advocate for a perspective that resembles Heikkurinen and (2013) concept of a *sustainable development orientation* in that economic value should not be the only or main priority for supply chain sustainability efforts. Rather, they argue that a true sustainability perspective will require re-thinking the meaning of value as well as the means of achieving and delivering it, which may demand radical changes in business models and SCM practices. Pagell and Shevchenko continue that a major change in researchers' viewpoints is

needed to end the separation between sustainable and 'mainstream' SCM research. Strongly and truly sustainable supply chains can be created only if firms – and researchers – can challenge existing assumptions, such as the primacy of profits. The strong sustainability perspective is not limited to the idea of going beyond profits (Heikkurinen and Bonnedahl, 2013), but also introduces the idea of ecological boundaries. That is, it is concerned about the increasing economic and other human activity in the biosphere (also Crist, Mora, & Engelman, 2017).

Montabon, Pagell and Wu (2016) present a competing logic to conventional SCM that aims at ecologically-dominant sustainability where environmental considerations come first, followed by social and financial sustainability. Practices should be optimised to minimise or eliminate harm with a long-term view, rather than to maximise profits in the short-term. Montabon et al. argue that only by adopting such a radical perspective, can companies develop truly sustainable supply chains, operating within broader social and ecological systems. By nesting or embedding the economy, including supply chains, within the social and environmental spheres (also Wu & Pagell, 2011), Montabon et al. (2016) demonstrate systems thinking, which is at the centre of strong sustainability. By challenging the instrumental logic again, the authors hint at the idea of intrinsic value, which is considered to be central to strong sustainability thinking (Heikkurinen and Bonnedahl, 2013).

While it could be argued that the vast majority of SCM research does not unambiguously fit under the sustainable development orientation as outlined by Heikkurinen and Bonnedahl (2013), some scholars have proposed alternative perspectives resembling the authors' conceptualization of strong sustainability. Heikkurinen and Bonnedahl's (2013: 196) view remains distinct, however, as they contest the idea of the focal firm being part of the current market regime, in which issues such as established economic interests and economic growth are generally not

problematized. Moreover, as supply chains reach beyond the focal firm and incorporate different types of organisations, SCM research considers other mediating actors that are absent from Heikkurinen and Bonnedahl's framework. These include suppliers and other traditional partners, but also non-traditional ones such as nongovernmental organisations, certification systems, government agencies, local communities, and civil society actors (Montabon et al., 2016; Quarshie et al., 2016). Hence, the strategies and orientations of a broad range of actors may need to target, or at least support, strong sustainability. For example, Stål and Bonnedahl (2016) conceptualise strong sustainable entrepreneurship and Upward and Jones (2016) call for business models that proactively create conditions that help resolve the underlying causes of unsustainable societies by simultaneously generating social benefits, environmental regeneration and financial rewards. If widely adopted, such strategies could help create strongly sustainable societies and businesses.

As for business research, novel research approaches and designs – where value assumptions are based on sustainability with intrinsic values rather than economic value – could support the development and further study of strongly sustainable supply chains. Next, we examine how biodiversity – a key issue in strong sustainability – has been treated in the SCM and related literatures.

Biodiversity and Sustainable Supply Chains

Biodiversity, or biological diversity, refers to the 'variability of life on Earth' (CBD, 2005), in other words the diversity within and between animal and plant species, as well as between broader ecosystems (Grigg, 2007). Biodiversity is critical not only to human activity, but also to the Earth's life-support system in general (Costanza et al., 1997). Despite its centrality to life on earth, fully valuing, acknowledging, and appreciating the instrumental as well as intrinsic value of nature and ecosystems has proven difficult (Costanza et al., 1997; Willison & Cote, 2009;

Heikkurinen & Bonnedahl, 2013; Ministry of the Environment, 2014). Nonetheless, biodiversity protection is emerging as an increasingly critical concern for individuals, organisations, governments and intergovernmental bodies alike because of the dramatic declines observed globally. Biosphere integrity (or biodiversity loss) is considered to be one of the four Earth Systems processes where the current impact levels exceed the risk levels or planetary boundaries (Steffen et al., 2015). There is increasing scientific evidence that a sixth mass extinction may have already begun due to human-induced changes and impacts on the planet. Initiatives by national governments and intergovernmental organisations (e.g. United Nations Environment Program), such as signing the Biodiversity Treaty at the 1992 Earth Summit in Rio de Janeiro, which led to the establishment of the Convention on Biological Diversity (CBD, 2005) are an attempt to respond to these developments.

Biodiversity is not evenly distributed on the planet, and most of the world's biodiversity hotspots are located in the tropics (Hanski, 2016: 60, 69). Unfortunately, many of these areas are under increasing pressure from human activity because the land is arable and productive, and hence, such areas tend to be densely-populated (Hanski, 2016: 58). Humans have already transformed a significant share of the most productive lands globally into crop lands (13% of land surface area) and grazing lands (31%). The limits of the planet's carrying capacity are becoming visible; of all the currently unfarmed land not covered by glaciers (excluding forests as well as protected and densely populated areas), only 3% is considered to be suitable for farming or grazing (Hanski, 2016: 69).

Our review of business research on biodiversity in SCM and related journals highlights it as an important issue in natural resources-based industries, and particularly in those sub-tiers of the supply chains where raw material production, extraction or harvesting takes place

(Salmi & Quarshie, 2017). Biodiversity-related issues are commonly examined in the context of sectors such as farming (Skevas, Lansink, & Stefanou, 2012), forestry and biomass production (Holma et al., 2013), fishing (Willison & Cote, 2009), and the extractive industries (Grigg, 2007). Many of these industries can have considerable (negative) impacts on biodiversity (also see Hanski, 2016; WWF, 2016). It was less common for such studies to examine downstream supply chain contexts, with some exceptions. For instance, Röös, Ekelund and Tjärnemo (2014) study consumer engagement in sustainable consumption, and Weng at al. (2015) focus on product end-of-life issues in closed landfill management.

Interestingly, while our review of biodiversity research was restricted to journals that are known to publish SCM research (that is, 30 out of the 32 journals used in Mollenkopf et al.'s (2010) study[i]), very few of the reviewed articles explicitly framed their topics as SCM studies. As for exceptions, Kobayashi, Watando and Kakimoto (2014) investigate the influences of base metal mining activities on biodiversity and in this way contribute to 'green' SCM literature. Correll, Suzuki and Martens (2014), in turn, examine buyer-supplier dyads as well as logistics-related aspects in renewable biofuels production systems. All in all, we may conclude that while biodiversity is gradually emerging in research, it is only rarely addressed as a SCM issue or related to strong sustainability.

As for managerial practice, the literature suggests that the issue of biodiversity loss brings new trade-off considerations to the firm's decision-making. For example, Battini, Agostini, Tabaglio and Amaducci (2016) note trade-offs in dairy farming between global impacts (such as greenhouse gas emissions) and local impacts (e.g. local biodiversity and eutrophication). To address biodiversity, companies may not only need to assess and understand their environmental impacts, but also learn how to mitigate them. The literature and additional resources suggest that

ecological compensation (e.g. through conservation efforts in another location) is one way for companies to mitigate harmful impacts on biodiversity (Ten Kate, Bishop, & Bayon, 2004).

Overall, extant literature suggests that while true leadership with regard to actively fighting against biodiversity loss appears rare among firms, some companies are gradually beginning to take biodiversity seriously and engage in proactive biodiversity and ecosystem management (Whiteman et al., 2013). Even if such practices alone are not enough to solve the entire 'wicked problem' (Churchman, 1967) of biodiversity reduction, they are certainly one step toward stronger sustainability, and hence worthy of further empirical inquiry.

Methodology

The three empirical illustrations in this chapter are firms from New Zealand (one) and Finland (two) that are considered to be leaders in sustainability, particularly with regard to biodiversity protection in their operations and supply chains (FIBS, 2016, December 8; Scoop Media, 2016, June 14). All companies operate in natural resource-based industries; namely fishing, forestry and farming.

To identify potential firms we searched through sustainability-related forums and government and professional associations' websites in New Zealand and Finland. In New Zealand, we reviewed details of sustainability award recipients, and contacted professionals, academics and leaders of advisory panels in the area of sustainability (e.g. the New Zealand Sustainability Dashboard Project) for names of companies whose practices included focus on biodiversity, of which Sanford, the largest holder of New Zealand fishing quota, provided the best exemplar. Sanford has won a number of awards relating to its focus and initiatives in the area of sustainability. Led by CEO, Volkner Kuntzsch, who played a role in establishing the Marine Stewardship Council

(MSC), the company takes an active stance toward community and stakeholder engagement and is an active member in environmental groups and forums locally and worldwide. This case illustrates sustainability in the (upstream) supply chain (i.e. fishers) and with collaborative partners in the industry.

In Finland, we chose the illustrative examples from among the finalists for the 'Firms and Biodiversity Competition 2016' organised by Finnish Business and Society, a leading corporate sustainability network, in collaboration with the Finnish Ministry of the Environment, Finnish Environment Institute, WWF, and other partners. Emphasising firms whose biodiversity-related practices clearly related to supply chains, we contacted both runners-up for the award. UPM, a global forestry company, bases its operations on sustainably sourced wood, while Soilfood, a medium-sized farming and agriculture supply company, utilizes by-products and residual waste streams from the forestry and bioenergy sectors as raw materials for fertilisers and soil amendments marketed to farmers.

To collect primary data, we conducted one interview per firm, the interviews lasting on average 60 minutes. All informants were involved in or managing sustainability and biodiversity-related activities. At UPM, two informants participated in the interview, while the other interviews included one informant per firm. The interviews followed a semi-structured format, which enabled respondents to discuss the issues most pertinent to their firm as well as issues relating to: how and why biodiversity protection is operationalised within the company, and with suppliers and stakeholders; exemplary practices relating to biodiversity; and industry initiatives. In addition to our interview notes, we collected and analysed relevant archival materials, such as company annual and/or sustainability reports, corporate websites including those of suppliers and partners, information in industry and professional forums, NGO and governmental

websites and reports, research publications, media articles, and press releases. Then we manually performed content analysis of the data (e.g. interview notes and recordings), especially searching for the themes of 1) biodiversity as integral to the supply chain and to the company's sustainability strategy and 2) novel biodiversity-related (SCM) practices. Finally, the resulting vignettes were supplemented with additional data that helped to understand the broader industry, country and planetary contexts for the firms' biodiversity-related efforts.

Empirical Exemplars of Moving Towards More Sustainable Supply Chain Practices

In this section, we provide the three cases of firms from natural resources-based industries that have developed novel practices for protecting biodiversity in their own operations and extended supply chains, which is integral to strongly sustainable companies.

Sanford NZ Case: Healthy Oceans through Sustainable Fishing

Nowhere are the effects of a hot and full earth less well understood than in the sea – a vast and largely unexplored 'world apart from man' (see McKibben, 1989). Yet drastic depletion of marine as well as freshwater biodiversity, due especially to overexploitation, habitat loss and degradation, climate change, invasive species and disease, and pollution, is rapidly becoming apparent (WWF, 2016). Estimates suggest that 85% of the world's fish supplies have already been fully exploited and by 2050 the stocks will be entirely exhausted – yet more than 1 billion people use fish as their primary source of protein (Fox, 2011).

New Zealand has the fourth largest exclusive economic zone (EEZ) in the world – and one of the best managed (Alder & Pauly, 2008) through the quota management system introduced 30 years ago (MfE, 2015). Ninety-six per cent of New Zealand territory is underwater

and is home to significant aquaculture resources and extraordinary biodiversity. Commercial fishing represents the sixth largest export earner (with an annual revenue of 850 million euros or NZ$1.4 billion).

The supply chain of Sanford, the largest holder of New Zealand's fishing quota (23%), consists of 474 independent sharefishers, 50 fishing vessels and seven processing sites. Sanford's biodiversity supply chain practices include evaluating suppliers on sustainability criteria to ensure commitment to sustainable development principles; zero tolerance for overfishing, underreporting and discarding catch; avoiding fishing areas with young fish stocks; electronically monitoring catch by species and size to preserve breeding capacity and diversity; prohibiting use of fish aggregation devices (tuna); and development and installation of monitoring cameras in fishing vessels (Sanford, 2016). Traditional fishing methods have been adapted to minimise accidental by-catch, particularly of protected species, such as the New Zealand sea lion and the endangered black petrel, and to reduce biodiversity loss. For example, Precision Seafood Harvesting (PSH) eliminates traditional trawl nets and allows undersize fish to swim free through 'escape portals' (Sanford, 2017; 2016: 92-93).

In line with Heikkurinen and Bonnedahl (2013) and the notion of intrinsic value, Sanford believes that biodiversity of marine resources, as part of a wider sustainability focus, has a direct impact on its ability to create, preserve or erode economic, environmental or social value not only for itself, but also its stakeholders and society at large. Sanford's sustainability manager explains that Sanford strives for healthy ocean management, so that future generations can enjoy and benefit from biologically diverse, safe, healthy and dynamic oceans (Interview, May 23, 2017). Evidence is provided by Sanford's business model which encourages less rather than more consumption (Sanford, 2016; Hunter, 2017) through transition from a traditional commodity-

driven high volume business to creation of more value for every kilogram of raw material produced (i.e. making more money from each fish sold, rather than selling more fish) and often prioritises environmental gain over economic cost (e.g. Sanford fishers cut nets to release dolphins but lost the entire catch (Interview, May 23, 2017)).

Sanford has received multiple accreditations and awards related to sustainable aquaculture practices and reporting. However, marine environments and supply chains can only be safeguarded through coordinated and cohesive action, including industry, stakeholder and government collaboration to address the various causes of biodiversity loss (also WWF, 2016). The current rate of loss demands transformation through the fishing supply chain and beyond, at both strategic and operational levels. Collaborative initiatives taken by Sanford with other firms and participants in the fishing industry aim to preserve habitat and marine mammals, remove conventional trawling methods and to proactively create conditions that help resolve the underlying causes of unsustainability (Upward & Jones, 2016) and reduce environmental impacts on aquaculture, fisheries and other marine resources (Interview, May 23, 2017). However, until such initiatives are adopted more widely and short-term gain no longer takes primacy, loss of biodiversity in fishing will remain a global issue.

UPM Case: Halting Biodiversity Reduction in Forestry

The forestry industry is one of the most important industries in Finland. In 2012, the sector accounted for 4% of Finland's GDP, and forest industry products amounted to 20% of the country's exports (Ministry of the Environment, 2014). Moreover, there are 632 000 private forest owners in the country, and the entire sector employs 160 000 employees directly or indirectly. Forests and peatlands together amount to three quarters of the land surface in Finland,

and about 90% of all forests are used commercially (Ministry of the Environment, 2014: 10, 19, 29).

UPM is a Finnish forestry company with global operations and a turnover of 9.8 billion euros (UPM, 2016). It has 55 000 suppliers across 70 countries and employs 19 300 staff in 45 countries. UPM's business is based on sustainably sourced wood and UPM has integrated sustainability into its overall strategy and supply chain (UPM, 2016). UPM's biodiversity program aims to promote sustainable forestry and to maintain and enhance biodiversity in commercial forests (UPM, 2017). The program distinguishes six main elements of forest biodiversity: 1) Native tree species, 2) Deadwood (i.e. decaying wood on the ground or standing from native tree species), 3) Valuable habitats (i.e. biotopes that are valuable for biodiversity, 4) Forest structure (i.e. 'variation in forest structure at landscape and stand level'), 5) Water resources (i.e. wetlands and open water bodies), and 6) Natural forests (i.e. forests with no human impact). Objectives include diversification of tree species and the structure of forests; increase in the amount of deadwood in forests (the most critical difference between natural and commercial forests) and the number of protected forests, and; identification and protection of valuable habitats (FIBS, 2016, December 8).

According to UPM's biodiversity program director, three groups of practices related to biodiversity protection in its own operations and the supply chain are particularly important (Interview, May 8, 2017). The first includes training and guidance (e.g. regulation, certification, and documents) at the grassroots level to ensure day-to-day forestry management and harvesting practices encourage higher biodiversity (e.g. leaving deadwood to decay); identifying valuable sites and habitats within forests that will not be touched at all; and promoting mixed forests where several tree species are grown together. UPM aims to adopt these practices not only

in its own forests, but also in forests owned by its suppliers, such as individual forest owners, through long-term contracts and certification, in particular.

The second group of practices concerns collaborative efforts to protect biodiversity through engaging, not only suppliers and forestry customers, but nongovernmental organisations, civil society groups, government officials, researchers, and the media. In particular, the firm has developed approaches to turn potential conflict situations with various local stakeholder groups into cooperation. Third, UPM – as a large land-owner in Finland – has been involved in voluntary efforts to protect large areas of forests that are unique or particularly rich in biodiversity, and will hence not be touched at all. For example, it has been involved in the establishment of Finland's Repovesi National Park.

As for its overall sustainability targets, in 2016 UPM focused on advancing supply chain sustainability, and many of these activities are inter-linked with biodiversity protection. Sustainability goals that relate to sustainable purchasing include sourcing 100% certified wood fibre by 2030 (currently 84%), sourcing 100% of raw materials from suppliers that have approved the supplier code of conduct (currently at 94% of contract value), and achieving a traceability target of 100%, a goal that has already been reached (Interview, May 8, 2017; UPM, 2016). UPM only buys controlled, legal wood, and does not utilise tropical wood from rainforests or from plantations established on converted forests.

UPM's efforts relating to biodiversity and sustainability have received both domestic and international recognition (e.g. the Carbon Disclosure Project (CDP), 2016). For example, in the 2016 Finnish 'Firms and Biodiversity Competition', the jury applauded UPM's biodiversity program for having multifaceted and extensive biodiversity impacts in Finland and internationally, and for including a range of innovative solutions and novel practices for forestry

management and wood sourcing (FIBS, 2016). Yet, the forestry industry as a whole continues to face significant challenges relating to biodiversity preservation. Commercial forestry practices put considerable pressure on biodiversity globally (Hanski, 2016: 200-201, 256-258; WWF, 2016), so identifying and adopting best sustainability practices across extended supply chains is critical for halting biodiversity reduction.

In Finland, 52% of the total forest and peatland area is owned by private forest owners, 35% by the state, and 13% by companies and communities. Sustainable forestry management by significantly larger numbers of actors, as well as sustainable wood sourcing by buyers, is therefore needed to preserve biodiversity across the country. In 2014, the Finnish government reported to the Convention on Biological Diversity that overall the 'Forest biodiversity is no longer declining as rapidly as previously, but the overall declining trend has not yet been halted …' (Ministry of the Environment, 2014: 29). It is clearly challenging to eliminate harms and achieve substantial positive biodiversity impacts in an industry which – while creating jobs, economic wellbeing and other positive sustainability impacts – depends on wood as the main raw material. This implies that in the future forestry companies, suppliers, and other partners will need to prioritize decisions around how to best preserve habitats and ecosystems (e.g. by limiting commercial activities in certain areas), as well as to develop and diffuse practices and approaches that are consistent with – and can make positive contribution toward – strong sustainability (Heikkurinen & Bonnedahl, 2013; also Ripple et al., 2017).

Soilfood Case: A Shift to a Biodiversity Paradigm in Farming

Despite the Northern climate and short growing season, there are about 51 000 farms in Finland and agriculture is an important, even if declining, industry (Natural Resources

Institute Finland, 2017). In 2016, Finland's agriculture and the food industry amounted to about 6.1 billion euros, or 4% of GNP (MTK, 2017), led by dairy (by turnover), and grain production (share of agricultural land).

Soilfood provides Finnish farmers ecologically-based farming products, as well as guidance to increase crops and profitability, while reducing production costs and environmental impact (Soilfood, 2017a). Established in 2015, by 2017 Soilfood had 15 staff and a turnover of over 4.5 million euros per year. Following circular economy principles, Soilfood utilizes by-products and residual waste streams from the forestry and bioenergy sectors as raw materials for recycled fertilisers and soil amendments to be used in farming and landscaping. As the largest recycler of nutrients in Finland, Soilfood offers its (upstream) supply chain partners an environmentally sound way of getting rid of forestry and bioenergy production by-products and scrap materials (Soilfood, 2017b). Soilfood's products and services are directly connected to enhancing biological diversity on agricultural lands, and biodiversity is at the core of the company's strategy and brand.

Modern agriculture has significant biodiversity impacts (Ministry of the Environment, 2014; WWF, 2016; Crist et al., 2017). According to a Soilfood board member, two practices are particularly important for increasing biological diversity on farmlands, both above and below ground (Interview, May 24, 2017). First, increasing organic matter in the soil, ecological fertilisers and soil amendments contribute to greater biomass and carbon fixation underground as well as a healthier soil food web. A soil food web comprises of a vast range of bacteria, algae, fungi, earthworms, insects, small vertebrates and plants (Ingham, 2017) and forms an important component of biological diversity on Earth (Hanski, 2016: 68). Soil degradation is a serious issue affecting about a quarter of all croplands and a third of grasslands globally (WWF, 2016).

Soilfood's products are hence intended to improve overall soil quality and fertility, as well as agricultural productivity in the company's downstream supply chains (Soilfood, 2017a; FIBS, 2016, December 8).

Second, providing training and guidance to farmers in the careful choice of a greater number of plant species enhances biodiversity on cropland (Interview, May 24, 2017). Soilfood supports a paradigm shift from monoculture farming – which involves farmers growing a single crop or a limited number of plants with chemical fertilisers and pesticides – to one which enhances biodiversity. The firm's founders and board members believe that the current paradigm creates the illusion of high productivity in the short term, but in the long run creates severe challenges relating to soil degradation, climate change, eutrophication and the reduction of biological diversity on farmland.

As for its overall sustainability efforts, Soilfood works also to prevent climate change and protect the Baltic Sea (Interview, May 24, 2017). The company's goal is to drive significant changes in agricultural production and supply chain practices by making ecological, recycled production inputs easy and affordable for farmers to purchase and use. This, together with ensuring that production inputs and farming techniques are effective for increasing crops and improving productivity, is essential for making ecological farming more mainstream. Significant hurdles to such a transformation include farmer preconceptions of ecological farming methods, financial challenges experienced by farms, and the localised nature of many circular supply chains.

Conclusions

The current global rate of biodiversity reduction threatens the entire planet, its systems, population, and ecosystems (Steffen et al., 2015; WWF, 2016) and should be a key

environmental concern for business scholars and practitioners alike. To advance understanding of biodiversity reduction as a critical sustainability issue in supply chains, this chapter set out to analyse how this issue (1) is treated in the academic literature, and (2) how it can be addressed through sustainable SCM practices. Our review shows that scholarly interest in sustainability and corporate responsibility is emerging and evident in investigations of sustainable supply chains, but there is little focus on biodiversity. Moreover, SCM research has only recently begun to challenge the dominance of economic value and other prevailing assumptions of supply chain management and the shift towards more sustainable supply chains is still ongoing. Evidently, much more research is needed in this area.

Biodiversity remains a difficult issue for firms to address because the effects of biodiversity reduction (and restitution) are long-term and often not easily measurable. This chapter presented initiatives taken by three firms to enhance biodiversity in their operations and supply chains. Their innovative practices and concrete actions illustrate the diversity of responses possible to address biodiversity reduction under water, in forests and on agricultural lands, as well as below ground. What is common to all cases is that supply chain biodiversity is not treated as a separate issue, but rather integrated across operations in line with the firms' philosophy of a sustainable approach to business. Each of these firms have been recognised in their efforts to further sustainability through their core business and SCM activities. Their novel practices and strategies for addressing biodiversity reduction, while maintaining overall business profitability and growth, offer an example for other firms to follow, albeit adapted to industry and location specificities. As for limitations and opportunities for improvement, companies operating in natural resources sectors need to address challenges such as habitat and ecosystem loss, defaunation and alien

species invasion, as well as to critically consider the role that they play in the global, growth-oriented economic system (Ripple et al., 2017; Crist et al., 2017).

From the strongly sustainable perspective, the market system sets limitations on what can actually be achieved in terms of (ecological) sustainability. This issue is amplified by growing the distance between producer and consumer, and by global disaggregation of supply chains, making them an ideal focal point for critical analysis. Our study provides a very preliminary step in the process of understanding how to proactively halt biodiversity loss through firm action. We concede, however, that voluntary activities by individual firms are not enough to prevent biodiversity loss on a global scale. Even if an increasing number of sustainability-led firms begin to involve their supply chain members, industry partners and stakeholders in ambitious biodiversity protection efforts, the overall scale and speed of (positive) change will not be enough to effectively slow down, let alone stop, species and ecosystem loss (Ripple et al., 2017). While we are witnessing growing attention to climate change and biodiversity reduction globally, these challenges are nevertheless proceeding at such an alarming rate that fundamental shifts in societal, business and governmental thinking and action, including further regulation and other change mechanisms, are essential to avoid irrevocable damage.

Implications for a Hot and Full Earth

Awareness of a hot and full earth is no longer the issue, rather it is complacency, inaction, and the tendency to design or adopt incremental solutions to global sustainability problems. Global response to the 'wicked problem' of biodiversity reduction on an increasingly crowded planet requires coherent action and committed engagement across governmental, non-profit and private sectors (Ministry of the Environment, 2014; Crist et al., 2017). While our study

focused specifically on novel practices undertaken by private companies, these companies are also encouraging involvement across the board from direct suppliers, sub-suppliers, customers, collaborative partners through to NGOs, industry and civil society groups, consumers, local communities and citizens, and governments, who all need to take action to halt biodiversity loss. Further, inherent to the effectiveness of organisational action is a sustainability mind-set that re-positions the intrinsic value of enhanced biodiversity at the centre of the policy-maker and practitioner agenda rather than squeezed at the margins and peripheral to more immediate concerns, such as votes and profits (also Heikkurinen & Bonnedahl, 2013). The actions and industry awareness created by these companies is a good start, but ultimately, the planet needs a fundamental shift in the current societal, commercial and cultural emphasis away from short-term return (or performance/economic output/growth) toward long-term sustainability and ecological renewal. A truly effective response would – in addition to single firm efforts – entail broader transformations in institutional and cultural systems, markets, and individual behaviours, as captured in the sobering words of the WWF's (2016: 13) Living Planet report:

> *If current trends continue, unsustainable consumption and production patterns will likely expand along with human population and economic growth. The growth of the Ecological Footprint, the violation of Planetary Boundaries and increasing pressure on biodiversity are rooted in systemic failures inherent to the current systems of production, consumption, finance and governance.*

Better understanding of the complexities and interconnections of such multi-level and cross-sector phenomena means that scholars need to engage more rigorously in addressing the

increasingly difficult research topic of biodiversity integrity. This means posing bolder research questions and engaging in systemic analyses. In addition to understanding what companies, suppliers, and other stakeholders are doing to address 'wicked' problems, business and management researchers will need to understand complex change processes that need to be set forth for the planet to survive, and how companies can act as part of the solution rather than part of the problem. Individual action by firms is an important step forward but the challenges the planet faces are amplified by the nature of the current consumer capitalism driven model, which obscures the link between individual action and subsequent ecological costs, such as biodiversity loss, occurring on a global scale (also Ripple et al., 2017). To conclude, we hope our call for urgent attention to these issues prompts more critical research on biodiversity integrity and its connections to human activity, and that our illustration of novel practices inspires other organisations and actors to adopt orientations of strong sustainability in this hot and full earth.

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[i] The original list of 32 journals appears in full in Mollenkopf et al., 2010. We excluded one journal which no longer appears and one practitioner-oriented journal.