Chapter 1
Sustainable Supply Chains: Recent Developments and Future Trends

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Abstract Sustainable supply chain management (SSCM) has become a highly relevant topic in scientific research as well as in managerial practice. This chapter summarizes the findings of several reviews of SSCM literature. In addition, propositions and guidelines for future SSCM research are given. Based on these insights, the structure of the book at hand and the coherence of the book chapters are outlined.

Keywords Sustainability • Supply chain management • Literature review

The rise of sustainability in corporate management increasingly leads enterprises to revisit the concepts of value and profitability that drive their operations. Actually there are mainly two critical factors by which industry networks are challenged: the compliance to social standards and the achievement of ecological targets. Together with economic criteria, these issues are synthesized to the triple bottom line (TBL) of sustainability (Elkington 1998). The interplay of these goals requires further investigation from both scientific research and managerial practice.

The practical relevance of sustainability persists since this topic has been put on the managerial agenda by international organizations such as the World Commission on Environment and Development (WCED 1987) or the United Nations (UN 2000, 2002). As a consequence, new or modified processes, practices, systems, techniques,

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and products are required to avoid or to reduce environmental and social harms and to promote benefits of sustainable management. These needs have resulted in green-growth strategies (see, e.g., papers in Vazquez-Brust and Sarkis 2012) or approaches to bridge the North-South divide by wealth transfers from richer to poorer countries (see, e.g., papers in Vazquez-Brust et al. 2014) as well as in new business models (see, e.g., papers in Azevedo et al. 2014) or innovative approaches for green logistics and transportation (see, e.g., papers in Fahimnia et al. 2015).

In parallel to the increasing practical relevance, the research on green, social, and sustainable supply chain management (SCM) has shown a strong and continuous growth over the last 10 years (see Fig. 1.1). The former area covers environmentally conscious logistics (Sarkis et al. 2011; Dekker et al. 2012), manufacturing (Ilgin and Gupta 2010), and sourcing (Bai and Sarkis 2010; Govindan et al. 2015a) as well as reverse logistics (Fleischmann et al. 1997; Govindan et al. 2015b) and closed-loop SCM (Souza 2013). In contrast, social aspects in SCM address corporate social responsibility (Mutti et al. 2012; Yakovleva and Vazquez-Brust 2012) and ethical behavior related to the environment, society, and the economy, as well as themes such as equity, health, education, or security (Hutchins and Sutherland 2008). Sustainable SCM provides an integrated perspective on economic, environmental, and social issues in a comprehensive profit-planet-people ecosystem (Tang and Zhou 2012). Scientific studies mainly focus on one of the two areas, green operations or social responsibility, but comprehensive studies that cover all three TBL dimensions are less often found. As illustrated in Fig. 1.1, the topic of green SCM

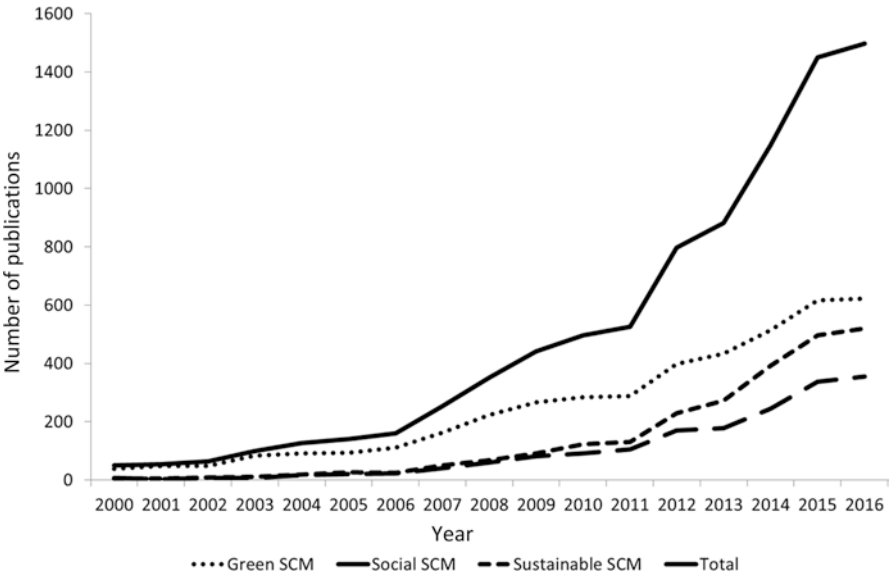

Fig. 1.1 Annual number of publications on green, social, and sustainable SCM over time (Note: Keyword-based search in Web of Science has been conducted to determine the annual number of publications. Each of the search strings (i) "green OR environmental OR ecological," (ii) "social OR societal," and (iii) "sustainab*" was combined with the search string "supply chain")

has been more prominent than social or sustainable SCM. However, in recent years, social aspects in particular and sustainability in general have also gained higher awareness in SCM research.

In order to explain sustainable SCM constructs and their relationships, numerous frameworks are developed based on reviews of related literature. Carter and Rogers (2008) conceptualize strategy, organizational culture, risk management, and transparency as facilitators and supporting facets of sustainable SCM. Moreover, the authors exemplify that environmental and social sustainability can create economic benefits for a firm and that a sustainable SCM strategy can increase the economic performance of a company. Based on a content analysis of 191 papers on sustainable SCM, Seuring and Müller (2008) design a conceptual framework that illustrates how government, customers, and other stakeholder groups trigger the sustainable management of focal firms which in turn propagate these influences to their suppliers and further upstream the supply chain. The authors observe a dominance of empirical studies, in particular, surveys and case studies, in comparison to theoretical papers that present conceptual frameworks and formal models. Furthermore, a clear focus on environmental factors is detected while social aspects and sustainable issues are less often addressed in sustainable SCM research. In addition, Seuring and Müller (2008) explain that sustainability objectives can create win-win(-win) opportunities between complementary targets but may also require trade-offs between conflictive ones or represent minimum performance levels which an organization needs to achieve. Yawar and Seuring (2017) review sustainable SCM literature with a focus on social aspects. The authors conceptualize communication, compliance, and supplier development strategies and their influences on social and economic as well as buyer and supplier performance.

Several reviews of case studies and meta-analyses summarize the empirical research on sustainable SCM. Gold et al. (2010a) analyze the content of 70 case study papers on sustainable SCM and observe strong increase of related empirical research after the millennium change. Food and textile industries are identified as main sectors of observation while automotive, chemical, and electronics industries are considered less often. The authors diagnose a high relevance of risk management for sustainability, mainly in context to environmental exposures, and a neglect of social factors in both scientific research and industrial practice. Besides, Gold et al. (2010a) advert to the high importance of communication, comprising information flows and coordination, for sustainable SCM. In another content analysis of 70 sustainable SCM case studies, Gold et al. (2010b) reveal the importance of environmental proactivity and green supply. The authors conclude that sustainable SCM has a catalytic effect on a firm's competitive advantage, which is seldom exploited on an intraorganizational or dyadic level. Furthermore, the relevance of external pressure for SSCM implementation and the dominance of environmental-economic factors compared to socio-ecological aspects were confirmed by this analysis. In a review of 80 empirical studies, Carter and Easton (2011) find that most prominent subjects of these studies include environmental issues, safety, diversity, and sustainability. In addition, a strong growth in the elaboration on holistic sustainability and its social facets corporate social responsibility (CSR) and safety is observed. Most

studies assess multiple industries or focus on the transportation sector or the consumer goods industry on a functional or firm level. The authors reveal that survey and case study are preferred methods and that a theoretical underpinning is lacking in a majority of studies. Golicic and Smith (2013) conduct a meta-analysis of 31 studies on green SCM and its performance implications. A positive and significant impact of environmental sustainability on market-based, operational-based, and accounting-based performance is detected.

Tang and Zhou (2012) evaluate developments and trends in model-based research on environmentally and socially sustainable operations based on a review of 56 related papers. The authors subdivide the environmental dimension of sustainable SCM into the consumption of natural resources and the disposal of emissions and wastes and split the social dimension to the people on customer and producers side. The authors observe lacks of operations research applications in transportation emission reduction and in product design issues that go beyond remanufacturability. Seuring (2013) analyzes the content of 36 modeling papers on sustainable SCM and finds that environmental factors, in particular the consumption of energy and natural resources and the emission of greenhouse gases and waste, dominate compared to social aspects such as employment rate, income distribution, or CSR. A majority of reviewed models aims at determining trade-offs between different sustainability parameters, while minimum performance solutions or win-win situations between the three sustainability dimensions are less often modeled. In a more comprehensive review, Brandenburg et al. (2014) reveal that sustainable SCM models most often analyze manufacturing companies while carriers, distributors, and retailers are less often focused. Technology-related sectors, consumer goods industries, or macroeconomic contexts represent preferred application areas. Descriptive models are by far more often applied than normative and preferred solution approaches include linear programming, analytic hierarchy process, and life cycle analyses. Brandenburg and Rebs (2015) detect that normative models are more often applied on the intra- and inter-organizational levels of SCM, while descriptive models are preferred for the macroscopic level of whole industries or economies.

Emerging research areas put sustainable SCM into relation to dynamic capabilities or the base of the pyramid (BoP). In a content analysis of 52 articles, Beske et al. (2014) elaborate on the coherence of sustainable SCM and dynamic capabilities in the food industry. Important dynamic capabilities include product and process development, transparency, and integration. The study illustrates that sustainability practices and dynamic capabilities improve traceability and tracking and help fulfilling customer demands. Land et al. (2015) conduct a similar analysis with a focus on the automotive industry and reveal how supply chain members adapt to changes in government regulations, customer demand trends, or competitors' behavior. Khalid et al. (2015) shed light on sustainable SCM practices in BoP context. The authors explain that the BoP should not be considered as a passive recipient of development policies. Instead, a sustainable development and win-win opportunities can be achieved by cooperation of all involved stakeholders and by co-creation of suitable solutions and approaches to overcome challenges faced by the poor. In this context, technological integration is a highly relevant success factor.

Numerous studies address opportunities for future research in sustainable SCM. These include the following propositions and guidelines:

- Sustainable SCM research needs to be broadened from a focused assessment of either green or social facets toward a comprehensive perspective that covers all three dimensions of the TBL.
- Taking comprehensive perspectives on and studying mutual interrelationships between sustainability and green SCM in sustainable and closed-loop SCM is recommended (Govindan et al. 2015b).
- Current measures for environmental and social sustainability need to be refined and new ones need to be developed (Golicic and Smith 2013).
- Models and approaches could consider uncertainties and support the management or mitigation of sustainability risks in supply chains (Brandenburg and Rebs 2015; Govindan et al. 2015b).
- Additional empirical research may employ methods such as econometric models that use actual data, behavioral research with lab experiments, longitudinal analyses, or multi-case studies to test and validate conceptual frameworks and formal models for sustainable and closed-loop SCM (Carter and Rogers 2008; Souza 2013; Brandenburg et al. 2014).
- More comprehensive studies are needed that reflect the environmental and social impacts on macroscopic levels of manufacturing sectors or whole industries as well as analyses that consider the political environment and regulatory frame conditions (Golicic and Smith 2013; Brandenburg and Rebs 2015).
- Promising research directions include in-depth analyses of social sustainability constructs as well as the role of power and information exchange or trust and commitment among supply chain stakeholders and the resulting performance impacts (Yawar and Seuring 2015).
- Theoretical and empirical research is needed to deepen the understanding of the coherence of sustainable SCM and BoP (Khalid et al. 2015).

The book at hand takes up these recommended research directions. It elaborates on the interplay of social and environmental factors in international supply chains and industry networks. The book intends to explore economic, ecological, and social performance and capabilities from various functional perspectives and different application contexts. One main question is to which extent socially responsible and environmentally conscious operations are complementary or conflictive. In total, 15 different book chapters give answers to this question. The chapters are clustered into three segments. Six chapters in Part I focus on aspects of performance management for sustainable supply chain management. Seven chapters in Part II take a closer view on sustainability in operational processes and specific applications. Two chapters in Part III particularly emphasize the social dimension of sustainability in hybrid business models and in supply chains at the BoP. In the following, a brief outline of each chapter is given that explains the approach and contribution of each study.

In Chap. 2, Campos and Rebs present the results of a review of SSCM practices based on a conceptual framework with generic practice categories. The opportunity

of combining several practices to further improve sustainability-related performance is central to this chapter. Using contingency analysis, significantly correlated categories of practice are identified. The combinations of practices are then exemplified with practices of five German automotive manufacturers. It is concluded that the integration of production and waste management with procurement and distribution practices yields opportunities for enhanced overall sustainability performance of supply chains.

Chapter 3 contains a study conducted by Zvezdov and Akhavan who elaborate on supply chain interactions that trigger the development of dynamic capabilities and, thus, result in competitive advantage through sustainable SCM. Interactions between supply chain actors are core elements of supply chain management and thereby contribute to supply chain performance. When environmental and social performance measures are taken into account in addition to conventional economic aspects, the role of collaboration between supply chain actors is amplified. Hence, the development of dynamic capabilities for sustainable SCM as a result of interactions will improve sustainability performance of supply chains.

In Chap. 4, Stohler, Rebs, and Brandenburg concentrate on the developments of the Green Supply Chain Operations Reference (SCOR) model, which extends the SCOR model by environmental besides economic performance criteria that are evaluated at a supply chain level. Since the scope of Green SCOR sustainability-related metrics is limited, the authors outline an approach to integrate further environmental metrics into the SCOR model. Besides, the integration of social sustainability metrics into and compatibility with the SCOR model is discussed.

A methodology for supply chain sustainability assessment based on qualitative and quantitative indicators is presented by Fritz, Schöggl, and Baumgartner in Chap. 5. The approach enables to select and calculate indicators related to the sustainability performance at the facility and company levels and finally aggregate indicators at the supply chain level. A comprehensive set of sustainability aspects and corresponding indicators is provided for the environmental, social, and governance dimensions of sustainability. Moreover, the authors emphasize that a software-based sustainability data exchange would support the practice applicability of this standardized approach to supply chain-wide sustainability assessment.

In Chap. 6, Fandl and Held present an approach to evaluate current and estimate future carbon emissions and costs in manufacturing. The approach is illustrated in a multi-case study from product development partnerships in German foundry supply chains. The approach is integrated into an IT tool which enables ex ante forecasts of changes in carbon emissions in cross-company casting development. Moreover, the study reveals four main factors that affect changes in carbon emissions in the iron foundry sector.

The work of Hartmann, Stehr and Struve in Chap. 7 discusses issues in sustainable supply chain management from the perspective of CSR. To this end, the authors put a special emphasis on companies in emerging markets and use interview data from consumer goods companies located in China. A checklist to support CSR implementations is developed and insights are derived with respect to the skills and

tools of CSR managers, the interface of CSR to compliance management, and global CSR implications for sustainable supply chains.

In Chap. 8, Rebs reviews 62 formal models that deal with the sustainability performance in inter-organizational supply chains. Cluster analysis is used to differentiate between groups of sustainable SCM models within the structural dimensions applied for content analysis. While environmental factors are frequently modeled, social sustainability criteria are still underrepresented. The author finds that governmental and customer pressures and incentives for sustainable SCM are operationalized by quantitative models. The representation of environmental and social risks is still scarce, thus calling for future research using stochastic models to account for uncertainties. Finally, the author suggests to move from the assessment of trade-offs to the determination of win-win(-win) situations for the interplay of the economic, environmental, and social dimensions of sustainability.

In Chap. 9, Sucky and Zitzmann examine issues in and approaches to risk management in sustainable supply chains with a specific focus on sourcing risks. The authors compare the intensity of different risk factors in conventional vs. sustainable supply chains and find that especially the quality and time dimension concerning risk differ. Investigating the applicability of classical strategies for supply chain risk management, the authors conclude that their effectiveness is limited in the context of sustainable sourcing. On the contrary, Sucky and Zitzmann see beneficial aspects of sustainable sourcing since quality and quantity risks are lower given the long-term supplier-buyer relationship. Moreover, customers are more willing to accept higher prices and longer lead times such that time and price/cost risks can be addressed more easily in sustainable supply chains.

A study on conflict minerals in the automotive industry is presented in Chap. 10. Based on a review scientific literature and company reports of five globally operating car manufacturers and on interviews conducted with three experts, Fritz and Tessmann identify major stakeholders in the area of conflict minerals in automotive supply chains. Moreover, the authors analyze current practices and challenges to build conflict-free supply chains. The study exemplifies the need to take a comprehensive perspective on the supply chain in order to manage conflict materials in the automotive industry. Moreover, the chapter points toward synergies and collaboration potentials between car manufacturers and firms from other sectors, e.g., the electronics industry.

A review of literature on the relationship between sustainable SCM and purchasing and supply management (PSM) conducted by Schulze and Bals is presented in Chap. 11. The review sheds light on the question if and how PSM knowledge and competences can promote the management of social and environmental targets in supply chains. The study emphasizes the influence of individuals on sustainable performance of firms in general and the PSM function in particular. Moreover, the authors suggest six avenues for future research.

In Chap. 12, Wensing studies the social and environmental impact of advances in economically driven transport optimization. For this purpose, the author uses a case study from automobile distribution and applies an optimization-based approach to short-term dispatch planning for car transporting companies. Comparing the results

of the optimization-based approach to a heuristic greedy algorithm, it can be found that economic, social, and environmental performance measures are improved simultaneously with the optimization-based approach even while focusing exclusively on economic objectives. The chapter also studies the implications of two different planning strategies: cost optimization given a fixed set of orders vs. profit optimization including the option to reject orders. The results indicate that a cost-based approach appears to be more beneficial from a TBL perspective since the cost drivers are more closely linked to social and environmental impacts.

In Chap. 13, Gmelin and Seuring elaborate on sustainability aspects in the development of new products. In a multi-case approach, the authors conducted 19 interviews in five car manufacturers. It is shown that success factors of product innovation are closely related to the TBL dimensions. The study reveals that, however, social factors are hardly reflected in new product development. The authors emphasize the need to closely align strategic management for sustainability with new product development processes.

A review and content analysis of 76 papers on sustainable SCM at the BoP is presented in Chap. 14. Monzer, Rebs, Khalid, and Brandenburg elaborate on economic, environmental, and social criteria of SCM in poor countries and reveal a clear dominance of social aspects and a deficit in environmental sustainability consideration in SCM. Moreover, the authors identify triggers and barriers of sustainability in supply chains at the BoP. In this context, the importance of customer and governmental influences is emphasized. The study contributes to research by analyzing the coherence of sustainability, in particular its social and societal aspects, and SCM at the BoP. Practitioners gain insights on social and societal aspects of SCM in context to poverty alleviation and making business with the poorest members of the world.

In Chap. 15, Bals and Tate elaborate on the questions how to design truly sustainable supply chains and what new practices and processes are required for such designs. The authors assess four social businesses from Haiti, a BoP country with a critical economic, environmental, and social situation, in a multi-case study. Moreover, the social resource-based view is conceptualized, and some of its key elements are identified as important capabilities that are needed to design a sustainable supply chain. In addition, the authors point toward three directions for future research on social and sustainable supply chain design.

To summarize, the book at hand comprehensively addresses economic, environmental, social, and societal dimensions of organizational and supply chain performance. It provides theoretical approaches for sustainable SCM and insights from business practices in different industrial and market contexts. Thus, scientific discourse on key developments in sustainable SCM is furthered and managerial implications as well as application opportunities are illustrated.

References

Azevedo SG, Brandenburg M, Carvalho H, Cruz-Machado V (eds) (2014) Eco-innovation and the development of business models – lessons from experience and new frontiers in theory and practice. Springer, Heidelberg

Bai C, Sarkis J (2010) Green supplier development: analytical evaluation using rough set theory. J Clean Prod 18(12):1200–1210

Beske P, Land A, Seuring S (2014) Sustainable supply chain management practices and dynamic capabilities in the food industry: a critical analysis of the literature. Int J Prod Econ 152:131–143

Brandenburg M, Rebs T (2015) Sustainable supply chain management: a modeling perspective. Ann Oper Res 229:213–252

Brandenburg M, Govindan K, Sarkis J, Seuring S (2014) Quantitative models for sustainable supply chain management: developments and directions. Eur J Oper Res 233:299–312

Carter CR, Easton PL (2011) Sustainable supply chain management: evolution and future directions. Int J Phys Distrib Logist Manag 41(1):46–62

Carter CR, Rogers DS (2008) A framework of sustainable supply chain management: moving toward new theory. Int J Phys Distrib Logist Manag 38(5):360–387

Dekker R, Bloemhof J, Mallidis J (2012) Operations research for green logistics: an overview of aspects, issues, contributions and challenges. Eur J Oper Res 219(3):671–679

Elkington J (1998) Cannibals with forks: the triple bottom line of the 21st century. New Society, Stoney Creek

Fahimnia B, Bell M, Hensher D, Sarkis J (eds) (2015) Green logistics and transportation – a sustainable supply chain perspective. Springer, Heidelberg

Fleischmann M, Bloemhof-Ruwaard JM, Dekker R, van der Laan E, van Nunen JAEE, van Wassenhove LN (1997) Quantitative models for reverse logistics: a review. Eur J Oper Res 103(1):1–17

Gold S, Seuring S, Beske P (2010a) The constructs of sustainable supply chain management – a content analysis based on published case studies. Prog Ind Ecol Int J 7(2):114–137

Gold S, Seuring S, Beske P (2010b) Sustainable supply chain management and inter-organizational resources: a literature review. Corp Soc Responsib Environ Manag 17:230–245

Golicic SA, Smith CD (2013) A meta-analysis of environmentally sustainable supply chain management practices and firm performance. J Supply Chain Manag 49(2):78–95

Govindan K, Rajendran S, Sarkis J, Murugesan P (2015a) Multi criteria decision making approaches for green supplier evaluation and selection: a literature review. J Clean Prod 98:66–83

Govindan K, Soleimani H, Kannan D (2015b) Reverse logistics and closed-loop supply chain: a comprehensive review to explore the future. Eur J Oper Res 240(3):603–626

Hutchins MJ, Sutherland JW (2008) An exploration of measures of social sustainability and their application to supply chain decisions. J Clean Prod 16:1688–1698

Ilgin MA, Gupta SM (2010) Environmentally conscious manufacturing and product recovery (ECMPRO): a review of the state of the art. J Environ Manag 91:563–591

Khalid RU, Seuring S, Beske P, Land A, Yawar SA, Wagner R (2015) Putting sustainable supply chain management into base of the pyramid research. Supply Chain Manag Int J 20(6):681–696

Land A, Nielsen H, Seuring S, Muelling Neutzling D(2015) Sustainable supply chain management practices and dynamic capabilities in the automotive industry. Acad Manage Proc January 2015 (Meeting Abstract Supplement): 13660. doi:10.5465/AMBPP.2015.13660abstract

Mutti D, Yakovleva N, Vazquez-Brust D, Di Marco MH (2012) Corporate social responsibility in the mining industry: perspectives from stakeholder groups in Argentina. Resour Policy 37(2):212–222

Sarkis J, Zhu Q, Lai KH (2011) An organizational theoretic review of green supply chain management literature. Int J Prod Econ 130(1):1–15

Seuring S (2013) A review of modeling approaches for sustainable supply chain management. Decis Support Syst 54:1513–1520

Seuring S, Müller M (2008) From a literature review to a conceptual framework for sustainable supply chain management. J Clean Prod 16:1699–1710

Souza GC (2013) Closed – loop supply chains: a critical review, and future research. Decis Sci 44(1):7–38

Tang CS, Zhou S (2012) Research advances in environmentally and socially sustainable operations. Eur J Oper Res 223:585–594

UN (2000) United Nations millennium declaration. United Nations Millennium Summit, New York

UN (2002) Agenda 21. United Nations Conference on Environment and Development. Rio de Janeiro

Vazquez-Brust DA, Sarkis J (eds) (2012) Green growth: managing the transition to a sustainable economy – learning by doing in East Asia and Europe. Springer, Heidelberg

Vazquez-Brust DA, Sarkis J, Cordeiro JJ (eds) (2014) Collaboration for sustainability and innovation: a role for sustainability driven by the global south? A cross-border, multi-stakeholder perspective. Springer, Heidelberg

WCED (1987) Our common future. Oxford University Press, New York

Yakovleva N, Vazquez-Brust D (2012) Stakeholder perspectives on CSR of mining MNCs in Argentina. J Bus Ethics 106(2):191–211

Yawar SA, Seuring S (2017) Management of social issues in supply chains: a literature review exploring social issues, actions and performance outcomes. J Bus Ethics 141(3):621–643