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Publisher: Taylor & Francis

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Scandinavian Journal of Forest Research

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/sfor20>

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Accepted author version posted online: 07 May 2014. Published online: 04 Jun 2014.

To cite this article: Daniela Kleinschmit, Berit Hauger Lindstad, Bo Jellesmark Thorsen, Anne Toppinen, Anders Roos & Sjur Baardsen (2014) Shades of green: a social scientific view on bioeconomy in the forest sector, Scandinavian Journal of Forest Research, 29:4, 402-410, DOI: [10.1080/02827581.2014.921722](https://doi.org/10.1080/02827581.2014.921722)

To link to this article: <http://dx.doi.org/10.1080/02827581.2014.921722>

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RESEARCH ARTICLE

Shades of green: a social scientific view on bioeconomy in the forest sector

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(Received 5 December 2013; accepted 2 May 2014)

Politics increasingly introduces initiatives supporting a shift toward a bioeconomy aiming at a society relying strongly on renewable biological sources while achieving economic growth efficiently and sustainably. However, the agenda of bioeconomy comprises different “shades of green,” in the sense that different actors stress different aspects of the concept, when embracing it in communication. This conceptual paper aims to present policy and socioeconomic theoretical frameworks and research areas relevant for a more holistic understanding of the bioeconomy concept applied to the forest sector, and identify a core set of potential contributions from social sciences for enhancing the bioeconomy in the forest sector. The paper focuses on studies within policy analysis, economics, and business administration disciplines. Thus it presents diverse disciplinary perspectives on the forest sector in a bioeconomy. Furthermore, innovation and sustainability have been identified as issues relevant to be approached across these disciplines.

Keywords: economics; political science; business management research; future directions

1. Introduction

Politics increasingly highlights the importance of strengthening a bioeconomy. The major aim of political bioeconomy strategies is the call for a shift toward a society relying strongly on renewable biological sources while achieving economic growth. Knowledge, innovation, and sustainable management are identified as core factors contributing to achieve this aim (EU Commission 2012a). Forests and the forest sector are expected to provide a significant contribution to a bioeconomy (EU Commission 2012a).

So far, the majority of bioeconomy studies are within natural science and engineering perspectives, such as biotechnology or genetic engineering. However, it has been acknowledged that the road toward a bioeconomy involves economic and policy challenges, e.g. in order to implement appropriate regulations, foster information exchange, get incentives right, and support knowledge development (Najam & Selin 2011). Furthermore, innovations are needed on greener products and in developing new greener businesses. In accordance with these challenges, the Organisation for Economic Co-operation and Development (OECD) states that social analysis is necessary in order to guide policy-making (OECD 2009). Some scholars dealing with transition management and coevolution already marked that a shift from fossil economy toward bioeconomy means a

comprehensive systemic change affecting and being affected by among others economic, business, and other social systems (Foxon 2011; Loorbach & Wijsman 2013). To gain a deeper understanding on how policies and market forces interact and shape conditions for the bioeconomy, social scientific research is required. This paper concentrates on political, economic, and business administration sciences being aware that other social scientific areas as well can contribute to the understanding of the conditions of the bioeconomy.

The bioeconomy concept has developed to include a great variety of agendas and ambitions implying challenges and opportunities for the forest sector to a degree that the borders of the traditional forest sector might become blurred, although still integrated in a bioeconomy sector. However, previous reviews done on the evolving bioeconomy (e.g. McCormick & Kautto 2013) have not analyzed it from the perspective of the forest sector. Therefore, this conceptual paper aims to (1) present socioeconomic theoretical frameworks and research areas relevant for a more holistic understanding of the bioeconomy concept applied to the forest sector and (2) identify a core set of potential contributions from socioeconomic and policy research for enhancing the bioeconomy in the forest sector.

In the second section, the paper starts with shedding light on the different perspectives inherent in the

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bioeconomy concept. In the third section, the paper presents selected theoretical frameworks and examples of studies within policy, economic, and business administration disciplines relevant for understanding bioeconomy in the forest sector. In the fourth section, arising research questions and possible contributions for future socioeconomic research are discussed. Finally, conclusions are drawn in Section 5.

2. The bioeconomy concept

Bioeconomy can be delineated from the broader concept of a green economy which follows the definition of United Nations Environment Programme (UNEP), namely one “that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (UNEP 2010). This paper focuses on the concept of bioeconomy which can be understood as part of the green economy, but emphasizing various aspects differently. In this section, we want to point to the different “shades of green” covered by the bioeconomy concept rather than listing the different definitions available for the bioeconomy. An overview of definitions and political concepts of bioeconomy used in the last decade, discovering synergies and inconsistencies has been provided by Schmid et al. (2012).

There is evidence that the bioeconomy concept has become increasingly popular in the last decade (Staffas et al. 2013). The concept starts from the premises that natural resources are limited and thus need to be used efficiently. It has its roots in the discourse of ecological modernization arguing that economic growth and development can be aligned with environmental protection (Arts et al. 2010). Following the ecological modernization discourse, the bioeconomy concept as well facilitates an enhanced role for the private sector (Arts et al. 2010). The dominant paradigm of technological progress in a liberal market is mirrored in the bioeconomy concept by stressing the role of biotechnology and innovative products.

The scope of the political bioeconomy concept differs, depending on those using it. OECD and the US focus on the process converting raw material into value added products using biotechnology and life sciences (Staffas et al. 2013). The EU and some of its member states focus on an economy which is based on the use of biomass resources (Staffas et al. 2013), comprising “[...] biological resources from the land and sea, as well as waste, as inputs to food and feed, industrial and energy production [...]” (EU Commission, 2012b). Simplifying one could state that “bio” refers in the former perception to biotechnology and in the latter perception to the use of bioresources. Furthermore, the bioeconomy concept is framed in a way drawing attention to sustainability and planetary boundaries, when embraced by green non-governmental organizations or scholars of this area

(e.g. Asveld et al. 2011). We understand these different perspectives as the “shades of green” of the bioeconomy concept. This “shadiness” of the concept has been criticized elsewhere as “the ‘fetishization’ of all things ‘bio’” (Birch & Tyfield 2012).

The role of forests and the forest sector in the bioeconomy depends on which perception is taken. In general, the bioeconomy is regarded as cross-sectoral making it relevant for actors associated with diverse sectors (Hilgartner 2007). Major forest sector stakeholders align with the concept of bioeconomy (Finnish Ministry of Agriculture and Forestry 2010; Swedish Forest Industry 2012; Forest-based Sector Technology Platform 2013) and emphasize their role in contributing to a bioeconomy. This can be regarded as an indicator that the benefits of being integral part of the bioeconomy are well perceived.

3. Policy, economic, and business administration subfields relevant for bioeconomy in the forest sector

Because the bioeconomy concept covers a range of policy agendas in varying shades of green, it presents a large variety of demands, expectations, and challenges for the forest sector. Several of these imply a call for social-science contributions. In this section, we outline relevant subfields of the three disciplines, policy science, economics, and business administration as these areas can be regarded as essential to understand how policies and market forces interact and shape conditions for the bioeconomy. The areas are linked to the general kind of research questions they may address, using examples from the literature.

3.1. Policy theories and related research

Policy analysis being part of political science builds on a multitude of theories that can be grouped into different “families.” In the following, central research areas are described within the different theoretical families of forest policy research following Arts (2012) and examples of existing bioeconomy relevant studies are given.

Rational policy analysis characterizes a “classical” theoretical family closely linked with classical economic theories. It highlights rational and strategic decisions taken by individuals or by a collective based on the highest benefits net of costs. Research on forest policy supports this theory by revealing benefits as the driving force for forest owners to manage their forests in a specific way (Krott 2005). These benefits are not limited to economic benefits. This may represent a challenge for the forest sector in the bioeconomy as private forest owners maximize their utility rather than their profit, implying some reduction in the delivery of biomass to the industry (cf. Krott 2012, p. 39).

Institutional/neo-institutional policy analysis is based on the assumption that behavior of actors can be explained by the appropriateness of a certain institutional setting resulting from rules, norms, and beliefs (Schlager & Ostrom 1992). These policy studies have become popular among scientists focusing on the forest sector (Kleinschmit et al. 2012). Norms, e.g. represented in form of public acceptance, have been identified as one of the key factors pushing or hindering a shift toward the bioeconomy (Benner & Löfgren 2007), in particular concerning contested practices like genetic modification of trees (Moon Chapotin & Wolt 2013).

Advocacy Coalition Framework (ACF) is a theoretical framework popular in forest policy research focusing on coalitions between actors based on belief systems that might result in policy change through learning (Sabatier & Weible 2007). Innovation as a core element of the bioeconomy can be a result of these learning processes. Rametsteiner and Weiss (2006) identified that innovation in the forest sector is limited due to traditional coalitions of actors and limited exchange with actors facilitating learning, e.g. research institutions and policy institutions.

Critical policy analysis comprises different approaches linked by understanding that the world exists independently of our knowledge, and highlighting the role of power in general and the influence of scientists in particular (Arts 2012). Studies based on discourse theory revealed among others an increased role for markets, the private sector, and voluntary regulations in (international) forest policy (e.g. Humphreys 2009), in line with the concept of bioeconomy.

Furthermore, *governance studies* using different of the aforementioned theoretical approaches highlight and explain the multi-level, cross-sectoral, and multiple actor characteristics of forest policy-making, e.g. as adaptive co-management. However, in the forest sector strong sectoral boundaries have been identified. These result not only in limited market opportunities, but also hinder innovation (Rametsteiner & Weiss 2006).

3.2. Economic theories and related research

Economics has evolved to a broad science with no all-encompassing definition. Classical definitions focus on the allocation of scarce resource, while the behavioral aspect is more prominent in recent definitions (Backhouse & Medema 2009). In the following, five subfields relevant for the analysis of the bioeconomy are introduced.

Resource economics focuses on the optimal management of natural resources, as seen from a private as well as a social point of view. Classical contributions include the optimal rotation age problem (Faustmann 1849), the extraction of nonrenewable resources (Hotelling 1931), and extensions acknowledging forest externalities (Hartman 1976). This latter aspect has received enormous

attention with the focus on carbon sequestration (van Kooten et al. 1995; Stavins 1999).

Very few peer reviewed articles dealing with economic aspects of natural resource use or link their analyses to the bioeconomy concept. Most are assessments of specific technologies, e.g. Low and Isserman (2009), O'Keefe et al. (2012), or slightly broader multi-criteria assessments of competing technology designs (Sultana & Kumar 2012).

Environmental valuation is concerned with estimating the values of externalities. In the greener shades of the wide bioeconomy fan of agendas, we find policy goals like management of natural ecosystems for sustained ecosystem services and protection of biodiversity (Kumar 2010; Bateman et al. 2013). Knowledge about the values of forest ecosystem services and biodiversity protection is fundamental to assess policy measures. Numerous applications can be found in forest economics targeting recreational use aspects (e.g. Lindhjem 2007; Zandersen et al. 2007), as well as biodiversity protection, amenity values, water protection (Campbell et al. 2013), and many other environmental issues.

Public Economics is concerned with aspects of market failures, including those arising from externalities, welfare effects (cost-benefit analysis), equity and distributional aspects, and policy design. In relation to forestry and the bioeconomy, the aspects of regulation targeting externalities are of clear relevance. So public policies are to enhance innovation and knowledge on new technologies. The literature contains many examples of analyses investigating policy designs targeting forest activities, and options for designing and applying market-based instruments for optimal provision of ecosystem services (Engel et al. 2008), including the role of forests in climate change mitigation (see e.g. van Kooten et al. 1995; Delacote et al. 2014).

Behavioral economics attempts to merge insights from in particular psychology (e.g. Kahneman & Tversky 1979) into the neoclassic economic theory to ameliorate shortcomings of the latter in explaining human behavior. In the forest sciences, related studies exist investigating forest owner decision-making, motivations, and objectives. An early study is Kuuluvainen et al. (1996), but many others exist (Lönnstedt 1997; Boon et al. 2004; Størdal et al. 2008; Broch & Vedel 2012; Blennow et al. 2012). The understanding of forest owner motivations and decision-making is crucial for appropriate policy design.

Ecological economics is a transdisciplinary subfield with a strong focus upon the natural systems, capital, dynamics and boundaries, and the implications of these for sustainable economic uses and development. A hallmark publication in this field (Costanza et al. 1997) has been quite influential in paving the way for the current focus on ecosystem services (de Groot et al. 2002) and the Payment for Ecosystem Services (PES)

agenda (Engel et al. 2008). Concerns about planetary boundaries and sustainable global growth and the bioeconomy concept itself may be inspired by aspects of ecological economics (Lehtonen 2004), but is also likely to be challenged from this field.

3.3. Business administration theories and related research

From the business administration point of view, four main research areas are identified as relevant in the context of the forest sector in a bioeconomy. First, the central role of business has extended from the traditional economic actor to a political and social actor via concept of *Corporate Social Responsibility* (CSR). CSR is often used in conjunction with other terms such as “corporate responsibility,” “corporate sustainability,” or “corporate citizenship,” or as a synonym of other concepts such as triple-bottom line (economic, environmental, and social) and the three Ps (profits, planet, and people). According to dominant management theory behind CSR, a company is responsible not only for its shareholders, but also for a wide range of other stakeholder groups, including the natural environment (Freeman 1984; Hart 1995). In Crifo and Forget (2014), forces driving CSR are identified to be based on three types of market imperfections: the existence of externalities and public goods, consumer heterogeneity and imperfect market competition, and existence of imperfect contracts with key stakeholders. Empirical research under CSR in forest sector has gained momentum in recent decades, focusing on adoption of CSR practices, standardized sustainability reporting, and defining what constitutes eco-efficiency (see e.g. Mikkilä & Toppinen 2008; Vidal & Kozak 2008; Koskela & Vehmas 2012).

Second, studies on *green customer practices* (green consumerism for end-consumers and green purchasing in business to business relations) could have an impact on the development toward a bioeconomy, although clear-cut answers cannot always be expected on criteria, means, and ends (Moisander 2007). Several empirical studies have analyzed customer preferences for eco-labeled, or certified, forest products. These segmentation or willingness to pay-studies have delivered ambiguous results, based on “socially desired responses” and simplistic views customer behavior (Forsyth et al. 1999; Cai & Aguilar 2013). However, further enquiry has turned the focus to the role of values, and experiences (Hansmann et al. 2006) information content of eco-labels (Aguilar & Cai 2010; Heikkonen 2012). It is a paradox that, despite thin evidence on its effect on customer demand, green marketing and eco-labeling are still being applied and even growing.

Third, *sustainable supply chain management* (SSCM) integrating supply chain profitability and sustainability (Srivastava 2007; Chopra & Meindl 2013)

apply management science with environmental research. The field is prompted by various regulations and an insight that reduced environmental impact, efficiency gains, and market success often are compatible goals. Studies to date focus on management tools and exchanges between actors in the supply chain (von Geibler et al. 2010). SSCM has also been applied for sections of forest supply chains (Tikina et al. 2008; Rätty et al. 2012). Life Cycle Assessment (LCA) approaches provide input for the mapping of environmental effects and sustainable operation of forest-based supply chains (Upton et al. 2008; Lindner et al. 2010). Combining LCA procedures with economic analyses, Dwivedi et al. (2012) found that the internalization of the value of carbon balances could increase the land expectation value of forest land.

Fourth, *green innovations* (or eco-innovations), driven by technology push (R&D) or market pull, are aiming at reducing environmental impacts (e.g. Rennings 2000). However, limited interest is shown toward green innovations (e.g. Hansen et al. 2006; Hansen 2010), which is mainly occurring in the Nordic pulp and paper industry as incremental process innovations (Rushton 2008). Studies identify factors limiting innovation, e.g. available resources and workplace culture (Stendahl & Roos 2008), the small size of operators (Kubeczko et al. 2006), and limited changes in market demand (Kivimaa & Kautto 2010). In addition, some EU policies, such as the Lead Market Initiative, do not even include traditional volume-based forest products (pulp, paper, and wood; Toppinen & Siljama 2011). According to Hetemäki (2010), diffusion of forest biorefinery technology is the most important concept toward the bioeconomy, but forest industry’s low willingness to take investment risks has been perceived as a barrier for diffusion (Näyhä & Pesonen 2012). The potential impact through material substitution in, e.g., wooden multi-story construction is another important avenue for progressing green innovations. This is, however, according to Brege et al. (2014) calling for a fundamental change of business models in the construction industry value-chains.

4. Missing shades of green: possible contributions of social science

This section builds on the theories and existing research introduced in Section 3, and aims to enhance future contributions from social sciences in the developments of the forest sector in the emerging bioeconomy. It might be used as a starting point for discussing a research agenda on bioeconomy in the forest sector.

4.1. Possible policy research contributions

Policy studies deal only selectively with very specific problems of the forest sector in a bioeconomy (see some

examples in Section 3). However, the political demand for a shift toward a bioeconomy deserves a political scientific investigation in the design of the political framework supporting this shift. In particular, governance research offers to understand and explain the problems at hand, long-term societal trends and needs across sectors and across multiple actors. It approaches the creation and exploitation of opportunities by systematically paying attention to institutional settings (Kooiman & Bavinck 2005). The identification of opportunities for vertical and horizontal integration of forest and bioeconomy policies is central to support effective and efficient policies and can be approached by governance research. Under the umbrella of governance research the different theoretical approaches can contribute to shed light on specific policy problems and situations of the forest sector in the bioeconomy. The identification of options of cross-sectoral coalitions supporting innovation in and across the forest sector can be supported among others by the ACF. Research on vertical integration can contribute to identify those institutional bodies and instruments able to drive a shift toward a bioeconomy.

Applying the rational choice approach can support identifying those actors benefiting from a shift toward a bioeconomy and those with conflicting interests. This might serve as a basis for balancing different demands on forests, minimizing trade-offs and conflicts. Critical policy analysis can be used to reconstruct prevailing ideas, concepts, and narratives in the discussion on bioeconomy. Starting from this, it can reveal power situations that are reproduced in discourses and the role of research and researchers in a bioeconomy. In post-structuralism scientific discourses, the institutions producing them are central in producing “truth” and thus can be regarded as co-creators of the future.

The opportunity for social innovation in a bioeconomy can be addressed by different approaches, the (neo-) institutional approach, e.g. under the umbrella of governance research but as well by applying rational choice approaches asking for the individual contribution to social innovation.

4.2. Challenges with a clear role for economic research

R&D in new technology is a core focus of the bioeconomy. R&D-efforts are likely to be sub-optimal due to problems of intellectual property rights protection and losses. Classic questions thus arise: how much should the public support and subsidize innovation and diffusion in the bio-based sectors? and how much should be handled by markets themselves?

New advanced technologies may have profound impacts on markets for forest products. How will this affect forest management? In particular, the development of the biorefinery concept may fundamentally shift the understanding of wood quality.

Climate policies and sector development are linked and forest products prices are heavily influenced by the European Trading Scheme price on carbon, as it induces an increase in the use of biomass in the energy sector. Thus flows but not stocks of carbon in the forest have value, and still incentives need balancing. Many questions require research, e.g. how far into the solid wood sector incentives should be carried? How should the issue of joint production (production processes which by nature results in several simultaneous outputs, e.g. timber produced alongside bioenergy and biodiversity protection) be handled? What are equilibrium effects on energy markets and timber markets, and what are climate effects? What about indirect land use changes?

Biodiversity protection and non marketed forest ecosystem services will remain in focus as the pursuit of more efficient, advanced valuable uses of bio-based products are likely to have significant environmental impacts. It is of paramount importance that these are included in assessments of technologies and forest management methods, to ensure that progress is indeed welfare enhancing and gains in marketed values not outweighed by non marketed environmental impacts. A particular research challenge here is a better understanding of international cross-boundary transcendence of environmental benefits as well as costs.

4.3. Key future challenges from a business administration research perspective

The majority of previous studies on sustainability strategies, practices, and implementation of CSR in the forest industry have focused on large companies. Given the vast number of small- and medium-sized companies, and the recognized small-scale potential in the de-centralized bioeconomy (e.g. SITRA 2011), better understanding is needed for supporting the *implementation of CSR among small and medium enterprises (SMEs)* both in the traditional forest industries and in the production of emerging new bio-based products. Also analyses of outcomes from implementing CSR in the form of “frontrunner practices,” “improved business case,” or as any other relevant economic or social benefits would be fruitful. Addressing the question how “greenness” can be used as a competitive advantage for a firm’s overall (or marketing) strategy is also warranted (Li and Toppinen 2011).

The use of LCA-based approaches in research is currently broadening toward the use of *social life-cycle assessment (SLCA)* and *environmental life-cycle costing (ELCC)*. Methodologically, the approaches could move on toward more rigorous estimations of joint sustainability/economic aspects of green supply chains and on prescriptive analyses. More innovative studies of how consumer choices are developed dynamically and how they depend on experiences, values, and norms

are needed, as is research that explicitly addresses the consumers' roles for a bioeconomy (regarding new products such as nano-products, composites, bio-chemicals, and bio-fuels). There could be also "blind spots" at the intersection of public policies and private sector business, where the development potential of small-scale, local-level business opportunities is yet neglected. Since, innovations for the forest-based economy range from incremental improvements for cost/environmental efficiency gains and share gains in existing markets, to more radical innovations for emerging "new" markets, new skills, and resources are required. Finally, an area which warrants more research, is cross-industry collaborations over innovations, e.g. with the automotive industry.

5. Conclusion: hot spots of future policy and economic research on bioeconomy

Politics increasingly introduces initiatives supporting a shift toward a bioeconomy aiming at a society relying strongly on renewable biological sources while achieving sustainable economic growth efficiently. Supporting these initiatives requires disciplinary interaction and integrated approaches of social sciences. Focusing on policy research, economics, and business administration,

different theoretical frameworks and research areas relevant for understanding the bioeconomy concept applied to the forest sector as well as a core set of potential contributions have been presented in Table 1.

The different disciplines of social sciences contribute to a better understanding and explanation of a great diversity of factors driving and hindering a shift toward bioeconomy starting from specific disciplinary perspectives. Some issues with high relevance for the forest sector in a bioeconomy attract greater attention across all three disciplines. Two of these cross-disciplinary issues identified in this paper are innovation and (the management of) sustainability at global, national, and local levels.

Innovation becomes substantial in a bioeconomy as new technologies and products are aimed for. It demands a specific policy setting allowing learning across sectors, balancing public support, technology push, and market pull, e.g. by environmental standardization and labeling or via green public procurement. Integrated forest and environmental management becomes relevant in the bioeconomy when striving not only for efficient but also at the same time sustainable resource use and environmental protection taking into account the provision of diverse ecosystem services from forests. This integration might be accompanied by diminishing the traditionally strong actor coalitions of the forest sector.

Table 1. Potential contributions of socioeconomic and policy research perspectives on the bioeconomy in the forest sector.

<i>Policy research</i>	
Governance	<ul style="list-style-type: none"> • Trends/needs across sectors and across multiple actors • Opportunities for vertical and horizontal integration • Social innovation
Rational choice	<ul style="list-style-type: none"> • Identifying actors benefiting and those in conflict
Neo-institutionalism	<ul style="list-style-type: none"> • Institutional settings of a bioeconomy
ACF	<ul style="list-style-type: none"> • Identifying changing actor coalitions
Critical theory	<ul style="list-style-type: none"> • Reconstruct prevailing ideas, concepts, and narratives • Revealing power situations reproduced in discourse • Observing the role of research and researchers
<i>Economics</i>	
Resource economics	<ul style="list-style-type: none"> • Assessing impacts for management of end-use innovations • Handling joint production incl. ecosystem services
Environmental valuation	<ul style="list-style-type: none"> • Obtaining spatially explicit values and cost of ecosystem services
Public economics	<ul style="list-style-type: none"> • Setting the right tax (price) for CO₂ emissions and stocks
Behavioral economics	<ul style="list-style-type: none"> • Implications of changing land owner population and objectives
Ecological economics	<ul style="list-style-type: none"> • New instruments for rewarding ecosystem service provision
<i>Business administration</i>	
CSR	<ul style="list-style-type: none"> • Implementing CSR among SMEs • Assessing outcomes from implementing CSR • Understanding the link between greenness and competitive advantage
Green customer practices	<ul style="list-style-type: none"> • New approaches for understanding green customer behavior • Linking attitudes toward green purchasing with learning and values
SSCM	<ul style="list-style-type: none"> • Developing SLCA and ELCC • Developing integrated models for optimal supply chain management for competitiveness and sustainability
Green innovations	<ul style="list-style-type: none"> • Public-private partnerships for innovation among forest-based SMEs • Finding models for cross-sector alliances for innovation

Identifying political and economic trade-offs and conflicting interests of stakeholders in using forests, assessing the economic values of forest ecosystem services and biodiversity protection, and providing incentives for CSR and green consumerism are core challenges in the context of integrated forest management in the bioeconomy. One example of political and economic trade-offs is the choice between short-rotation forests and fast growing species where biodiversity protection and increased productivity interests might be in conflict.

Innovation and sustainability are examples of cross-disciplinary research issues referring to different “shades of green” in the concept of bioeconomy. Biotechnology driven perspectives, highlighting innovation, deserve different theoretical and analytical starting points and approaches than do perspectives focusing on the sustainable use of biological resources or the pursuit of the right provision of ecosystem services. However, all shades of green and the related objectives, interests, and challenges must be considered in the future research on the role and potentials of the forest sector in the bioeconomy, the aim being to provide a holistic understanding of these potentials, and to avoid negligence of others.

References

- Aguilar FX, Cai Z. 2010. Conjoint effect of environmental labeling, disclosure of forest of origin and price on consumer preferences for wood products in the US and UK. *Ecol Econ*. 70:308–316.
- Arts B. 2012. Forests policy analysis and theory use: overview and trends. *For Policy Econ*. 16:7–13.
- Arts B, Appelstrand M, Kleinschmit D, Pülzl H, Visseren-Hamakers I, Eba’a Atyi R, Enters T, McGinley K, Yasmi Y. 2010. Discourses, actors and instruments in international forest governance. In: Rayner J, Buck A, Katila P, editors. *Embracing complexity: meeting the challenges of international forest governance*. Vienna: IUFRO World Series; p. 57–73.
- Asveld L, van Est R, Stemerding D, editors. 2011. *Getting to the core of the bio-economy: a perspective on the sustainable promise of biomass*. The Hague: Rathenau Instituut.
- Backhouse RE, Medema SG. 2009. Retrospectives: on the definition of economics. *J Econ Perspect*. 23:221–233.
- Bateman IJ, Harwood AR, Mace GM, Watson RT, Abson DJ, Andrews B, Binner A, Crowe A, Day BH, Dugdale S, et al. 2013. Bringing ecosystem services into economic decision-making: land use in the United Kingdom. *Science*. 341:45–50.
- Benner M, Löfgren H. 2007. The bio-economy and the competition state: transcending the dichotomy between coordinated and liberal market economies. *New Political Sci*. 29:77–95.
- Birch K, Tyfield D. 2012. Theorizing the bioeconomy: biovalue, biocapital, bioeconomics or ... what? *Sci Technol Hum Values*. 38:299–327.
- Blennow K, Persson J, Tomé M, Hanewinckel M. 2012. Climate change: believing and seeing implies adapting. *PLOS One*. 7:e50182.
- Boon TE, Meilby H, Thorsen BJ. 2004. An empirically based typology of forest owners in Denmark – improving the communication between authorities and owners. *Scand J For Res*. 19:45–55.
- Brege S, Stehn L, Nord T. 2014. Business models in industrialized building of multi-storey houses. *Constr Manage Econ*. 32:208–226.
- Broch SW, Vedel SE. 2012. Using choice experiments to investigate the policy relevance of heterogeneity in farmer agri-environmental contract preferences. *Environ Resour Econ*. 51:561–581.
- Cai Z, Aguilar FX. 2013. Meta-analysis of consumer’s willingness-to-pay premiums for certified wood products. *J For Econ*. 19:15–31.
- Campbell D, Vedel SE, Thorsen BJ, Jacobsen JB. 2013. Heterogeneity in the demand for recreational access – distributional aspects. *J Environ Plann Manage*. [Forthcoming]. Available from: <http://www.tandfonline.com/doi/full/10.1080/09640568.2013.793173>
- Chopra S, Meindl P. 2013. *Supply chain management – strategy, planning, and operation*. 5th ed. Essex: Pearson Education.
- Costanza R, d’Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O’Neill RV, Paruelo J, et al. 1997. The value of the world’s ecosystem services and natural capital. *Nature*. 387:253–260.
- Crifo P, Forget V. 2014. The economics of corporate social responsibility: a firm-level perspective survey. *J Econ Surveys*.
- de Groot RS, Wilson MA, Boumans RMJ. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecol Econ*. 41:393–408.
- Delacote P, Palmer C, Bakkegaard RK, Thorsen BJ. 2014. Unveiling information on opportunity costs in REDD: who obtains the surplus when policy objectives differ? *Resour Energy Econ*. 36:508–527.
- Dwivedi P, Bailis R, Stainback A, Carter DR. 2012. Impact of payments for carbon sequestered in wood products and avoided carbon emissions on the profitability of NIPF landowners in the US South. *Ecol Econ*. 78:63–69.
- Engel S, Pagiola S, Wunder S. 2008. Designing payments for environmental services in theory and practice: an overview of the issues. *Ecol Econ*. 65:663–674.
- EU Commission. 2012a. *Innovating for sustainable growth: a bioeconomy for Europe*. Brussels: Communication from the commission to the European Parliament, the Council, the European economic and Social Committee and the Committee of the regions.
- EU Commission. 2012b. *Commission adopts its strategy for a sustainable bioeconomy to ensure smart growth in Europe*. Press release, February, Memo/12/97. [cited 2014 May 19]. Available from: http://ec.europa.eu/research/bioeconomy/news-events/news/20120213_en.htm
- Faustmann M. 1849/1995. Calculation of the value which forest land and immature stands possess for forestry. *J For Econ*. 1:7–44.
- Finnish Ministry of Agriculture and Forestry. 2010. *Finland’s National Forest Programme 2015: Turning the Finnish forest sector into a responsible pioneer in bioeconomy*. Finland: Finnish Ministry of Agriculture and Forestry.
- Forest-based Sector Technology Platform. 2013. *Horizons – vision 2030 – for the European forest-based sector*. Brussels: Forest-based Sector Technology Platform.
- Forsyth K, Haley D, Kozak RA. 1999. Will consumers pay more for certified wood products? *J For*. 97:18–22.
- Foxon TJ. 2011. A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecol Econ*. 70:2258–2267.

- Freeman E. 1984. Strategic management: a stakeholder approach. Boston (MA): Pitman.
- Hansen E. 2010. The role of innovation in the forest products industry. *J For*. 108:348–353.
- Hansen E, Korhonen S, Rametsteiner E, Shook S. 2006. Current state of knowledge: innovation research in the global forest sector. *J For Prod Bus Res*. 3:1–27.
- Hansmann R, Koellner T, Scholz RW. 2006. Influence of consumers' socioecological and economic orientations on preferences for wood products with sustainability labels. *For Policy Econ*. 8:239–250.
- Hart SL. 1995. A natural-resource-based view of the firm. *Acad Manage Rev*. 20:986–1014.
- Hartman R. 1976. The harvesting decision when a standing forest has value. *Econ Inquiry*. 14:52–58.
- Heikkonen H-L. 2012. Developing guidelines for an ideal eco-label for wood and paper products in the U.S. Master's Thesis for the examination of Master of Science (Agr. & For.) Forest Economics. Helsinki: Helsinki University.
- Hetemäki L. 2010. Forest biorefinery: an example of policy driven technology. In: Mery G, Katila P, Galloway G, Alfaro RI, Kanninen M, Lobovikov M and Varjo J, editors. *Forest and society – responding to global drivers of change*. Vienna: IUFRO-WFSE; p. 160–161.
- Hilgartner S. 2007. Making the bioeconomy measurable: politics and an emerging anticipatory machinery. *BioSocieties*. 2:382–386.
- Hotelling H. 1931. The economics of exhaustible resources. *J Pol Econ*. 39:137–175.
- Humphreys D. 2009. Discourse as ideology: neoliberalism and the limits of international forest policy. *For Policy Econ*. 11:319–325.
- Kahneman D, Tversky A. 1979. Prospect theory: an analysis of decision under risk. *Econometrica*. 47:263–291.
- Kivimaa P, Kautto P. 2010. Making or breaking environmental innovation?: technological change and innovation markets in the pulp and paper industry. *Manage Res Rev*. 33:289–305.
- Kleinschmit D, Ingemarson F, Holmgren S. 2012. Research on forest policy in Sweden. *Scand J For Res*. 27:120–129.
- Kooiman J, Bavinck M. 2005. The governance perspective. In: Kooiman J, Bavinck M, Jentoft S, Pullin R, editors. *Fish for life. Interactive governance for Fisheries* Mare Publication Series 3. Amsterdam: Amsterdam University Press; p. 11–24.
- Kumar P. 2010. *The Economics of ecosystems and biodiversity: ecological and economic foundations*. London: Hardback.
- Koskela M, Vehmas J. 2012. Defining eco-efficiency: a case study on the Finnish forest industry. *Bus Strategy Environ*. 21:546–566.
- Krott, M. 2005. *Forest policy analysis*. Dordrecht: Springer.
- Krott M. 2012. Value and risks of the use of analytical theory in science for forest policy. *For Policy Econ*. 16:35–42.
- Kubeczko K, Rametsteiner E, Weiss G. 2006. The role of sectoral and regional innovation systems in supporting innovations in forestry. *For Policy Econ*. 8:704–715.
- Kuuluvainen J, Karppinen H, Ovaskainen V. 1996. Landowner objectives and nonindustrial private timber supply. *For Sci*. 42:300–309.
- Lehtonen M. 2004. The environmental – social interface of sustainable development capabilities, social capital, institutions. *Ecol Econ*. 49:199–214.
- Li N, Toppinen A. 2011. Corporate responsibility and sustainable competitive advantage in the forest-based industry: complementary or conflicting goals? *For Policy Econ*. 13:113–123.
- Lindhjem H. 2007. 20 years of stated preference valuation of non-timber benefits from Fennoscandian forests: a meta-analysis. *J For Econ*. 12:251–277.
- Lindner M, Suominen T, Palosuo T, Garcia-Gonzalo J, Verweij P, Zudin S, Päivinen R. 2010. ToSIA – a tool for sustainability impact assessment of forest-wood-chains. *Ecol Modell*. 221:2197–2205.
- Lönnstedt L. 1997. Non-industrial private forest owners' decision process: a qualitative study about goals, time perspective, opportunities and alternatives. *Scand J For Res*. 12:302–310.
- Loorbach D, Wijsman K. 2013. Business transition management: exploring a new role for business in sustainability transitions. *J Cleaner Prod*. 45:20–28.
- Low SA, Isserman AM. 2009. Ethanol and the local economy: industry trends, location factors, economic impacts, and risks. *Econ Dev Q*. 23:71–88.
- McCormick K, Kautto N. 2013. The bioeconomy in Europe: an overview. *Sustainability*. 5:2589–2608.
- Mikkilä M, Toppinen A. 2008. Corporate responsibility reporting by large pulp and paper companies. *For Policy Econ*. 10:500–506.
- Moisander J. 2007. Motivational complexity of green consumerism. *Int J Consum Stud*. 31:404–409.
- Moon Chapotin S, Wolt JD. 2013. Genetically modified crops for the bioeconomy: meeting public and regulatory expectations. *Transgenic Res*. 16:382–386.
- Najam A, Selin H. 2011. Institutions for a green economy. *Rev Policy Res*. 28:451–457.
- Näyhä A, Pesonen H-L. 2012. Diffusion of forest biorefineries in Scandinavia and North America. *Technol Forecasting Social Change*. 79, 1111–1120.
- OECD. 2009. *The bioeconomy to 2030: designing a policy agenda*. OECD.
- O'Keefe SR, Schulte PO, Sanders JPM, Struik PC. 2012. II Economic assessment for first generation green biorefinery (GBR): scenarios for an Irish GBR blueprint. *Biomass Bioenergy*. 41:1–13.
- Rametsteiner E, Weiss G. 2006. Innovation and innovation policy in forestry: linking innovation process with systems models. *For Policy Econ*. 8:691–703.
- Räty T, Lindqvist D, Nuutinen T, Nyrud AQ, Perttula S, Riala M, Roos A, Tellnes LGF, Toppinen A, Wang L. 2012. Communicating the environmental performance of wood products. Working Papers of the Finnish Forest Research Institute 230, Vantaa, Finland.
- Rennings K. 2000. Redefining innovation – eco-innovation research and the contribution from ecological economics. *Ecol Econ*. 32:319–332.
- Rushton M. 2008. Nordic innovation: innovations in pulp and paper is alive and kicking and living in the Nordic countries. *Pulp Pap Int*. 15–19.
- Sabatier P, Weible C. 2007. The advocacy coalition: innovations and clarifications. *Theories policy process*. 2:189–220.
- Schlager E, Ostrom E. 1992. Property-rights regimes and natural resources: a conceptual analysis. *Land Econ*. 68:249–262.
- Schmid O, Padel S, Levidw L. 2012. The bioeconomy concept and knowledge base in a public goods and farmer perspective. *Bio-based Appl Econ*. 1:47–63.
- SITRA. 2011. Sustainable bioeconomy: potential, challenges and opportunities in Finland. SITRA studies 51. [cited 2013 Oct 1]. Available from: <http://www.sitra.fi/julkaisut/Selviytyksi%C3%A4-sarja/Selviytyksi%C3%A4%2051.pdf>

- Srivastava SK. 2007. Green supply-chain management: a state-of-the-art literature review. *Int J Manage Rev.* 9:53–80.
- Staffas L, Gustavsson M, McCormick K. 2013. Strategies and policies for the bioeconomy and bio-based economy: an analysis of official national approaches. *Sustainability.* 5:2751–2769.
- Stavins RN. 1999. The costs of carbon sequestration: a revealed-preference approach. *Am Econ Rev.* 89:994–1009.
- Stendahl M, Roos A. 2008. Antecedents and barriers to product innovation – a comparison between innovating and non-innovating strategic business units in the wood industry. *Silva Fennica.* 42:659–684.
- Størdal S, Lien G, Baardsen S. 2008. Analyzing determinants of forest owners' decision-making using a sample selection framework. *J For Econ.* 14:159–176.
- Sultana A, Kumar A. 2012. Ranking of biomass pellets by integration of economic, environmental and technical factors. *Biomass Bioenergy.* 39:344–355.
- Swedish Forest Industry. 2012. The forest industry – the driver for a sustainable bioeconomy. Stockholm: Swedish Forest Industry.
- Tikina A, Kozak R, Larson B. 2008. What factors influence obtaining forest certification in the U.S. Pacific Northwest. *For Policy Econ.* 10:240–247.
- Toppinen A, Siljama M. 2011. Challenges and opportunities embedded in the European Union lead market initiative: case bio-based products. *J Bus Chem.* 8:65–74.
- UNEP. 2010. Driving a green economy through public finance and fiscal policy reform. [cited 2014 May 19]. Available from: http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_Working_Paper_Public_Finance.pdf
- Upton B, Miner R, Spinney M, Heath LS. 2008. The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. *Biomass Bioenergy.* 32:1–10.
- Van Kooten GC, Binkley CS, Delcourt G. 1995. Effect of carbon taxes and subsidies on optimal forest rotation age and supply of carbon services. *Am J Agric Econ.* 77:365–374.
- Vidal NG, Kozak RA. 2008. Corporate responsibility practices in the forestry sector: definitions and the role of context. *J Corporate Citizenship.* 31:49–59.
- von Geibler J, Kristof K, Bienge K. 2010. Sustainability assessment of entire forest value chains: integrating stakeholder perspectives and indicators in decision support tools. *Ecol Modell.* 221:2206–2214.
- Zandersen M, Termansen M, Jensen FS. 2007. Evaluating approaches to predict recreation values of new forest sites. *J For Econ.* 13:103–128.