Where sector and society meet:

Empirical research to tailor the communication of the forest-based sector to the general public

Doctoral Thesis to obtain the degree of:

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Study Program:

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Vienna, April 2017

Acknowledgements

Many thanks to my supervisor Tobias Stern for providing inspiration and advice whenever needed. Thanks to Peter Schwarzbauer and Ika Darnhofer for helpful comments on how to improve my work. Furthermore, I thank all co-authors for the good collaboration. Special thanks to all my colleagues from “Team MAIF” and BOKU for always being fun and supportive the last three years. Last but not least, many thanks to Ingomar, my family, and friends for being there for me.

List of figures

Figure 1: Schematic figure depicting the communication of the forest-based sector and the perception of the general public, as well as areas of congruence between the two groups (own illustration)……..3

Figure 2: The Unified Model of public relations evaluation (Watson and Noble 2007, p93)……..9

Figure 3: Framework of the thesis and position of the articles I-VI (own illustration)……10

Figure 4: Overview of methods and materials used for articles I-VI (own illustration)……..11

List of abbreviations

CSR Corporate Social Responsibility

CR Corporate Responsibility

e.g. example given

ES ecosystem services

i.e. id est

SLO Social License to Operate

Abstracts

English

Communication is considered an important tool to maintain the legitimacy of the forest-based sector within society. Especially the communication of sustainability related issues can influence the public perception of the forest-based sector. In this context, there is only little research on how the sustainability of the forest-based sector is communicated and how it is perceived by the general public. This dissertation investigates the content of forest-based sector communication and the public perception regarding selected sustainability topics. It uses the methods of qualitative content analysis, quantitative and qualitative surveys, and systematic literature review. The results indicate a need for more targeted communication to the general public. Furthermore, there is skepticism among the general public towards the environmental claims made regarding the responsible use of forest resources and climate mitigation benefits gained from using wood products. Audience segmentation based on recognized forest ecosystem services was found to be promising for communication on the environmental impact of the forest-based sector. Tailored communication increased the public acceptance of tree harvests. The results provide practical input for the communication to the general public as well as a conceptual framework which can be expanded to future research on forest-based sector communication.

Deutsch

Kommunikation ist ein wichtiges Instrument, um die gesellschaftliche Legitimität des Forst-Holz-Sektors zu erhalten. Besonders die Kommunikation von Nachhaltigkeitsthemen kann die öffentliche Wahrnehmung des Forst-Holz-Sektors beeinflussen. Es gibt jedoch nur wenig Forschung darüber, wie der Forst-Holz-Sektor Nachhaltigkeit kommuniziert und wie diese von der Öffentlichkeit wahrgenommen wird. Die vorliegende Dissertation untersucht daher die Kommunikationsinhalte des Forst-Holz-Sektors und die öffentliche Wahrnehmung ausgewählter Nachhaltigkeitsthemen. Dafür werden die Methoden der qualitativen Inhaltsanalyse, quantitativen und qualitativen Befragung und systematischer Literaturrecherche verwendet. Die Ergebnisse zeigen auf, dass es einer gezielteren Kommunikation bedarf, um die Öffentlichkeit zu erreichen. Die Öffentlichkeit steht zudem den Behauptungen des Sektors hinsichtlich der verantwortungsvollen Nutzung des Waldes und des Beitrags von Holz zum Klimaschutz skeptisch gegenüber. Um die Umweltauswirkungen des Forst-Holz-Sektors zu kommunizieren, ist es vielversprechend die unterschiedliche Wahrnehmung von Waldökosystemleistungen zu berücksichtigen. Maßgeschneiderte Kommunikation konnte die gesellschaftliche Akzeptanz der Holzernte erhöhen. Die Ergebnisse liefern einen praktischen Beitrag für die Kommunikation des Forst-Holz-Sektors, sowie einen konzeptuellen Rahmen, der für die zukünftige Kommunikationsforschung des Forst-Holz-Sektors erweitert werden kann.

List of original articles

The doctoral thesis consists of six papers, which are referred to as Articles I-VI[1]. Article I, II, and IV are published in peer-reviewed journals. Articles III, V, and VI are manuscripts in submission to peer-reviewed journals. If applicable, the impact factor[2] (IF) is provided.

The thesis is based on the results of the international research project "What We Wood Believe – Societal Perceptions of the Forest-based Sector" (Website: http://www.wood-w3b.eu/en/) funded by the Wood Wisdom ERA-NET. The selection of the case countries Austria, Germany, Finland, and Slovenia was determined by the research partners of the project.

I Korhonen, E., Toppinen, A., Lähtinen, K., Ranacher, L., Werner, A., Stern, T., Kutnar, A., (2016) Communicating Forest Sector Sustainability: Results from Four European Countries. *Forest Products Journal* 66, 362-370. [**IF 2015: 0.481]**

II Ranacher, L., Stern, T., (2016) Are your messages being heard? Evaluation of the forest-based sector's communication on sustainable forest management in Austria. *Journal of the Austrian Society of Agricultural Economics* 25, 159-168. **[double blind review]**

III Ranacher, L ., Stern, T., Schwarzbauer, P., (submitted Manuscript) Perceiving the wood but not the trees? Public perception of the forest-based sector's contribution to climate change mitigation. *Austrian Journal Forest Sciences*. **[IF 2015: 0.25]**

IV Ranacher, L., Lähtinen, K., Järvinen, E., Toppinen, A., (2017) Perceptions of the general public on forest sector responsibility: A survey related to ecosystem services and forest sector business impacts in four European countries. *Forest Policy and Economics* 78, 180-189. [**IF 2015: 1.552]**

V Lähtinen, K., Toppinen, A., Suojanen, H., Stern, T., Ranacher, L., Burnard, M., Kitek Kuzman, M., (submitted Manuscript) Forest sector sustainability communication in Europe: A systematic review on the contents and gaps. *Journal of Current Forestry Reports.* **[double blind review]**

VI Huber, J., Ranacher, L., Stern, T., Schwarzbauer, P. (submitted Manuscript) Forest management or greed of gain? – An information experiment on peri-urban forest visitors' attitudes regarding harvesting operations. *Journal of Urban Forestry and Urban Greening*. **[IF 2015: 2.006]**

[1] The articles use the terms forest sector and forest-based sector. Throughout the thesis the term forest-based sector is used and includes woodworking industries, pulp and paper industries and printing industries, as well as forest owners (FTP 2017).

[2] Impact factor referring to 2015 Journal Citation Reports® (Thomson Reuters 2015)

Contribution in co-authored articles

	I	II	III	IV	V	VI
Conception & design	EK,AT, KL, TS, AK	**LR**, TS	**LR**, TS, PS	**LR**, AT, KL, EJ	KL, AT,HS, TS, **LR**, MB, MK	**LR**, TS, JH, PS
Planning & implementation	EK, **LR**, AW	**LR**	**LR**	**LR**	KL, AT, HS	JH
Data collection	EK, **LR**, AW, AK	**LR**	**LR**	**LR**	KL, AT, HS	JH
Analysis and interpretation	EK, **LR**, AW, AK	**LR**	**LR**	**LR**	KL, AT, HS	JH
Writing the article	EK, **LR**, KL AW, AK, TS, AK	**LR**, TS	**LR**, TS, PS	**LR**, AT, KL, EJ	KL, AT,HS, TS, **LR**, MB, MK	JH, **LR**, TS, PS
Overall responsibility	EK, AT	**LR**	**LR**	**LR**	KL	JH, **LR**

LR = Lea Ranacher, TS = Tobias Stern, AT = Anne Toppinen, KL = Katja Lähtinen, PS = Peter Schwarzbauer, EK = Elina Korhonen, AW = Andrea Werner, AK = Andreja Kutnar, EJ = Erno Järvinen, MB = Michael Burnard, MK = Manja Kitek Kuzman, HS = Hannele Suojanen

Table of Contents

1. Introduction 1
2. Theoretical Background 3
2.1 Sustainability in the forest-based sector 3
2.2 Communication of sustainability 5
2.3 Influence of communication 6
2.4 Measuring communication 7
3. Research design 10
3.1 Framework of the study 10
3.2 Material and methods 11
4. Summary of Articles 14
4.1 Article I: Communicating forest sector responsibility: results from four European countries 14
4.2 Article II: Are your messages being heard? Evaluation of the forest-based sector's communication on sustainable forest management in Austria 15
4.3 Article III: Perceiving the wood but not the trees? Public perception of the forest-based sector's contribution to climate change mitigation 16
4.4 Article IV: Perceptions of the general public on forest sector responsibility: A survey related to ecosystem services and forest sector business impacts in four European countries 16
4.5 Article V: Forest sector sustainability communication in Europe: A systematic review on the contents and gaps 18
4.6 Article VI: Forest management or greed of gain? – An information experiment on peri-urban forest visitors' attitudes regarding harvesting operations 18
5. Discussion 19
5.1 Contribution and discussion of results 19
5.2 Limitations 23
5.3 Future research 25
6. Conclusion 27
References 28

1. Introduction

The forest-based sector is under public surveillance due to its dependence on natural resources and increasing environmental awareness among the public (Bowyer, 2008). Sustainability assessment across the value chain has become an important topic among researchers and practitioners alike. Therefore, the development of criteria and indicators is growing (e.g. Näyhä and Horn, 2012; Päivinen et al., 2010; Ševčík et al., 2014). However, several surveys indicate skepticism among the general public regarding the forest-based sector's environmental impact. For example, European citizens were found to have a lack of understanding about the activities of the forest-based sector (European Commission, 2002) and consider cutting trees and forest management a threat to biodiversity (Fabra-Crespo et al., 2014). Furthermore, wood is perceived as a renewable material but there is ambiguity whether the tree harvest has a negative impact on the climate, even when trees are replanted (Lovell and O'Brian, 2009; Rametsteiner et al., 2007). Moreover, the protection of the forests and the prevention of deforestation was a central topic among European citizens when asked about forests in their country (Rametsteiner et al., 2009).

Political agenda setting at an international level aims to transform society towards a bioeconomy, in which the forest-based sector is considered as a key player in delivering raw material for bio-based products and energy (European Commission, 2012; UNECE/FAO, 2016). Furthermore, the transition towards a bioeconomy represents a chance for the forest-based sector to be competitive in the future by renewing its products and service portfolio (Hetemäki et al., 2014; Ollikainen, 2014). However, the increasing demand for raw material that comes with the vision of a forest-based bioeconomy, is likely to lead to societal conflicts between forestry production and forest conservation which requires adequate policy measures (Roos and Stendahl, 2016). As a result, the forest-based sector's contribution to a bioeconomy is considered to be dependent on how society accepts forest-based products and the activities carried out to produce them. Therefore, public perception of the environmental impact of the forest-based sector and its contribution towards sustainability are crucial. One central issue regarding forest-based sector sustainability is the impact on forest ecosystems. In this context, research on the public perception on forest ecosystem services (ES) can help to specify the information demand of the public regarding the forest-based sector's environmental impact.

Communication is an important tool to increase the public acceptance of the forest-based sector. Companies usually emphasize their contribution to sustainability in their communication. Regarding corporate communication on sustainability issues, it is necessary to know the

information demand of the stakeholders to be successful (Schmeltz, 2012). However, as different stakeholders have different expectations and information needs regarding sustainability, a clear strategy with messages tailored to different stakeholder groups is required (Dawkins, 2005). For example, target group oriented communication is essential to reduce skepticism among consumers (Pratt et al., 2013). In the forest-based sector, there are many different stakeholders next to the general public, such as consumers or the government to name only a few. Furthermore, the forest-based sector encompasses different organizations along the value chain which may have different communication goals. As a result, target-group oriented communication to the general public is considered a challenge for the forest-based sector.

There is a growing body of research on selected aspects regarding the communication of the forest-based sector (Aasetre, 2006; Fabra-Crespo and Rojas-Briales, 2015b; Janse, 2008; Räty et al., 2014; Vidal and Kozak, 2008), its public perception (European Commission, 2002; Fabra-Crespo et al., 2012; Fabra-Crespo et al., 2014; Hemström et al., 2014; Lovell and O'Brian, 2009; Mynttinen, 2009; Rametsteiner et al., 2007; Rametsteiner et al., 2009; Rollins et al., 2015), and public news media discourse on forest and forestry related issues (Bengston and Fan, 1999; Fabra-Crespo and Rojas-Briales, 2015a; Logmani et al., 2016; Park and Kleinschmit, 2016; Webb et al., 2008). As a result, research on the communication and public perception of the forest-based sector has been conducted in several different contexts. However, fails to compare how the sector presents itself publicly and how this image is perceived by the general public.

Furthermore, in the context of public perception of forests and forestry, scholars (Fabra-Crespo et al., 2014) point out the need for further investigate the influence of socio-demographic variables and personal values on the perception and how perceptions can be modified. Thus, the aim of this dissertation is to increase the knowledge about how the forest-based sector can tailor its communication to the general public regarding its contribution to sustainability. More precisely, the research questions are:

- How does the forest-based sector communicate selected sustainability topics to the general public?
- How do personal characteristics influence the perception of sustainability related messages conveyed by forest-based sector?
- How does the general public conceptualize forest ES in relation to the environmental impact of the forest-based sector?

- How does tailored communication influence the perception of the environmental impact of the forest-based sector?

The results will provide selective insights into the communication of the forest-based sector, the general public's perception regarding selected sustainability topics, and how communication can be used to achieve congruence (see figure 1).

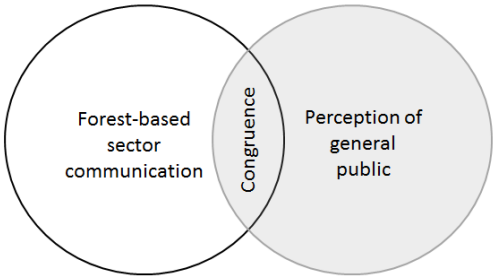

Figure 1: Schematic figure depicting the communication of the forest-based sector and the perception of the general public, as well as an area of congruence (own illustration).

2. Theoretical Background

2.1 Sustainability in the forest-based sector

One central issue regarding forest-based sector sustainability is the impact on forest ecosystems. For example, sustainable forest management was found to be the most important topic in large forest-based companies' sustainability reporting (Vidal and Kozak, 2008). However, the concept of sustainable forest management is a complex and multidimensional issue. It no longer only refers to a sustained wood yield and steady forest cover, but to the provision of a diversity of ES demanded by society (Päivinen et al., 2010; Rametsteiner, 2001). This is also reflected in the fact, that forest-based sector businesses increasingly pay attention to ES in their sustainability reporting (D'Amato et al., 2015).

Forests deliver a wide range of different ES, which can be categorized into social, environmental, and economic benefits. As a result, different land-use expectations represent a challenge for land owners and policy managers to manage forest lands (Sandström et al., 2011). With the forest-based sector's role in bioeconomy and climate politics, pursuing more bio-based materials will have a significant environmental impact and can result in potential conflicts about how to use forest resources. Therefore, forest management regarding the provision of forest ES will remain in focus (Kleinschmit et al., 2014) and investigating forest values for different societal groups can

contribute to conflict management and resolutions by engaging in appropriate ecosystem management (Bengston, 1994).

Identifying which forest ES are recognized by the general public can help forest-based sector companies to adequately address these in their environmental management and communication. However, research shows that different societal groups differ in their expectations towards the management of ecosystems in producing ES (Eriksson, 2012; Grilli et al., 2016; Martín-López et al., 2012). Reason may be that ES are generated and supplied at different spatial scales i.e. from plant to global and from individual to international (Hein et al., 2006). Furthermore, the recognition of ES has a time perspective as stakeholder perceptions can change over time and some may not have been recognized yet as for example, the role of forests in carbon sequestration is new (de Groot et al., 2012).

For nature-based industries, such as the forest-based sector, the social license to operate (SLO) is central for its acceptance and legitimacy in a society. The concept of SLO originated from the mining industry and describes the societal acceptance of an organization and its core activities, e.g. extracting natural resources (Hall et al., 2015). A legitimacy gap refers to a discrepancy between public perception of what an organization is doing and what is expected of the organization (Roper, 2005). An organization loses or gains legitimacy depending on how appropriate or inappropriate a society considers the behavior of an organization regarding e.g. social or environmental issues (Panwar et al., 2012). The loss of social legitimacy is thought to lead to restrictive legislation, environmental and social activism, penalties, prohibitions, and consumer boycotts, which are costly and restrain companies from pursuing their economic and other goals (Li and Toppinen, 2011).

By getting to know the general public's expectations and perceptions of the forest-based sector's responsibility, the sector can close potential legitimacy gaps through minimizing the difference between societal expectations about "what ought to be" and stakeholders current perceptions of business activities about "what is" (Panwar et al. 2012). Therefore, next to the public perception of forest ES, investigating public perceptions of forest-based sector responsibility regarding the sector's environmental impact are considered as essential elements for societal legitimacy.

2.2 Communication of sustainability

To increase the legitimacy of a business within society, the business engages in Corporate Social Responsibility (CSR) programs. CSR is a process to integrate social, environmental, ethical, human rights and consumer concerns into business operations and core strategy in close collaboration with their stakeholders (European Commission, 2011). Stakeholders, from a wider perspective, are groups of people who have an impact on an organization or are influenced by it (Freeman, 1984). How CSR reports can build corporate reputation has been investigated for large extractive companies of the mining industry (Sethi et al., 2016).

The concepts of CSR and Corporate Responsibility (CR) have gained increasing attention in the forest-based sector (Johansson, 2014; Lähtinen et al., 2016; Li and Toppinen, 2011; Panwar et al., 2010), and are considered to have the potential to improve the company's competitive advantage and increase social legitimacy (Li and Toppinen, 2011; Porter and Kramer, 2006). A central element of CSR is to facilitate a communication process between the business and its stakeholders to be informed about their concerns. Grunig (2001) introduced communication models with one-way and two-way communication and coined the terms asymmetrical and symmetrical communication. One-way communication is always asymmetrical since it represents a mere distribution of information from the communicator to the receiver, whereas two-way communication can be either symmetrical or asymmetrical. Symmetrical two-way communication means that each participant is equally able to influence the other (van Ruler, 2004), whereas organizations with two-way asymmetrical communication listen to their stakeholders but use the information to tailor their communication to allay the concerns of stakeholders but do not change their behavior (Roper, 2005). Thus corporate communication can be either facilitated as a dialogue by integrating the general public's concerns or persuasion by merely providing information in response to stakeholder concerns.

Effective communication of CSR programs to improve the company image and achieve social legitimacy is of increasing concern among scholars and practitioners alike. Research on the so-called "CSR Image" refers to the perceptions of corporate responses to general social concerns of stakeholder groups (Pérez and Rodríguez del Bosque, 2013, 2015). Researching the perceptions of the general public, it needs to be acknowledged that this is not a homogenous group. Therefore, audience segmentation can be conducted to identify coherent groups within a population. For example, this has been done for global warming communication, since communication campaigns that target specific audiences are considered to be more successful (Maibach et al., 2011). In the context of consumer oriented CSR communication, attitudes and values are considered to

influence the perception of companies' engagement and CSR communication (Schmeltz, 2012). As a result, when researching the public perception of the forest-based sector, respondents' characteristics such as sociodemographic characteristics or values need to be considered. It needs to be acknowledged that CSR is a concept that is usually applied to an individual company. Therefore, the concept of CSR-communication is used in analogy since existing research on CSR-communication is considered valuable to examine the communication of the forest-based sector.

2.3 Influence of communication

Scholars (Alon and Vidovic, 2015; Lai et al., 2010) empirically demonstrated the positive impact of sustainability activities on reputation. However, increasing public skepticism and cynicism towards - sometimes pretended - environmental claims coined the term greenwashing (Laufer, 2003). As a result, communication on a company's contribution to sustainability can lead to opposite i.e. negative perception of the company. Companies' motives to engage in environmental policy or CSR were found to have an influence on the corporate reputation. Communicating a self-serving along with society-serving motive reduces skepticism (de Vries et al., 2015; Forehand and Grier, 2003; Kim, 2014) and research suggests that companies' CSR practices need to be coherent with the core business to be credible (Yoon et al., 2006). This indicates that there are many factors that influence the effectivity of a communicated content. So called "domino models", which argue that merely communicating a message will result in a specific outcome are only of limited validity (Watson and Noble, 2007, p. 14).

The effectivity of communication can be described as the extent to which its content is learned and retained by the audience (Greenwald 1968). However, there is a difference between learning and accepting a communicated content in comparison to retaining the content but not accepting it (Greenwald 1968, Hovland et al. 1968). Changes of knowledge as a result of receiving communication will not automatically lead to changes in attitudes or even behaviors (McNamara, 2011). Thus, in persuasive situations, unfavorably cognitive reactions can occur. Therefore, when researching the impact of communication, the individual's cognitive processes need to be considered to evaluate communication.

There are several ways how to react to persuasive content. Cognitive consistency theories argue that cognitive responses to persuasion will be consistent with pre-existing cognitions which are relevant for the attitude in question (Greenwald 1968). In contrast, the theory of cognitive dissonance argues that attitudes can be changed if they are contrasted with a dissonant attitude that is inconsistent with the existing viewpoint (Festinger, 1957). However, it is also argued that

people select information because it is relevant to them, rather than because it reinforces existing attitudes (McCoy and Hargie, 2003). Reactance theory (Brehm 1966) argues that, when the individual's freedom to engage in a specific behavior is taken away, the threatened behavior becomes more attractive. Similarly, individuals can reject persuasive communication, since it may restrict their freedom to decide an issue. Therefore, regarding the perception of the forest-based sector, existing knowledge about or attitudes towards a specific issue are considered central, since these influence the uptake of information either because it is supporting or contrasting existing attitudes.

The public perception of the forest-based sector is considered to be mostly built indirectly through media consumption and some, if at all, individual personal experiences. Surveys show that respondents have little knowledge of the forest-based sector and its activities (European Commission, 2002; Pauli et al., 1998). Therefore, personal experiences with the forest-based sector gained through being involved in the forest-based sector through formal education, profession or forest ownership are considered have an influence on the level of knowledge and thus the perception of the forest-based sector.

2.4 Measuring communication

Communication models usually include at least the elements sender, message, and recipient. One of the earliest and most basic communication models is the Osgon-Schramm model, in which a message is being encoded by the communicator and after successful transmission decoded by the recipient and a reaction is transmitted back to the communicator (Schramm 1954). It is a circular model because the recipient can respond to the communicator, for example, whether he or she understood or disagrees and thus contains a feedback mechanism. The forest-based sector communicates with a large number of different stakeholders with different backgrounds and attitudes. For this kind of communication, Lasswell's model (1948), which was developed from mass media communication, is considered suitable. It contains a communicator, a message, a medium, an audience, and an effect and can therefore be described in five questions: Who, says what, in which channel, to whom, with what effect? Lasswell's model states that there is a recipient but lacks a feedback process from the recipient to the communicator, making it a linear model.

Organizations communicate with the intention to have an impact on the attitude or behavior of its recipients. They intend to manage the recipients' opinion and consequentially his or her activities e.g. vote or buy (Watson and Noble, 2007, p. 4). The question arises how

communication activities can be measured and evaluated regarding their effectivity. Since communication activities are increasingly planned and based on research it is important to distinguish between formative and evaluative research. Formative research is done before a communication campaign or activity to provide information about, e.g. the target audience, whereas evaluative research is done to measure its effectiveness. Both elements should be a continuous process to measure communication activities (McNamara, 2011). There are two basic measurements which are largely used since the development of public relations more than a century ago. Firstly, the use of social science methods such as opinion polls and secondly, the use of media analytics such as media analysis (Watson, 2012).

There are several models to measure communication activities at different stages: the Preparation, Implementation, Impact (PII) Model; Lindenmann's Public Relations Yardstick; or the Pyramid Model. They all have in common that they have different stages such as an output variable which causes an impact and translates into an outcome (Watson and Noble, 2007, p. 81f). The Public Relations Yardstick suggests to measure public relations at three different stages. First, the amount of exposure an organization received in the media; second, whether or not target groups received the messages; and third, whether the communication activities resulted in an opinion or behavioral change (Lindenmann, 1993). However, these models have been criticized for being too static, step-by-step processes at the end of a campaign (Watson and Noble, 2007, p. 88). Other models such as the Unified Model and The Planning, Research and Evaluation (PRE) process are circular models with continuous measurement not specifically aimed at a specific campaign but aim to provide a framework how to continuously evaluate the communication environment. Complementary, the Unified Model contains the input stage which is central to conduct formative research (see Figure 2). Furthermore, it also distinguishes between cognitive and behavioral changes, and acknowledges a feedback mechanism between the different stages (Noble and Watson 1999).

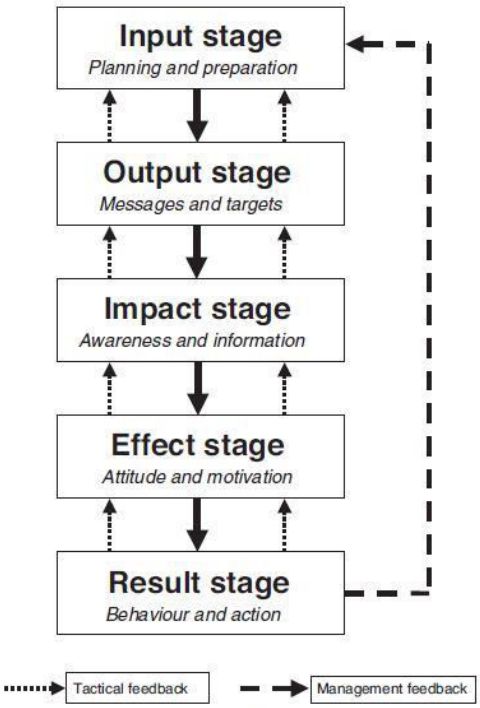

Figure 2: The Unified Model of public relations evaluation (Watson and Noble, 2007, p. 93)

To increase the knowledge about how the forest-based sector can tailor its communication to the general public, the Unified Model is considered suitable. The input stage provides formative research on the public perception of forest ES. The other stages provide evaluative research on selected aspects of forest-based sector communication. The input stage reveals on what the general public is interested in (Article IV), the output stage reveals what the forest-based sector communicates (Articles I, V) third the impact stage of the communication examines how the communication is perceived (Articles II, III), and fourth the effect stage examines how the attitude changes (Article VI). The result stage is not researched.

3. Research design

3.1 Framework of the study

The framework of the thesis is described to provide a foundation for the summary on the key findings of the six research articles. Figure 3 presents the framework and position of the articles for this thesis. The Unified Model (see figure 2 in previous chapter) organizes the articles according to their different stages. For selected stages, the influence of respondents' characteristics (socio-demographics, sector involvement, level of environmental awareness) is researched.

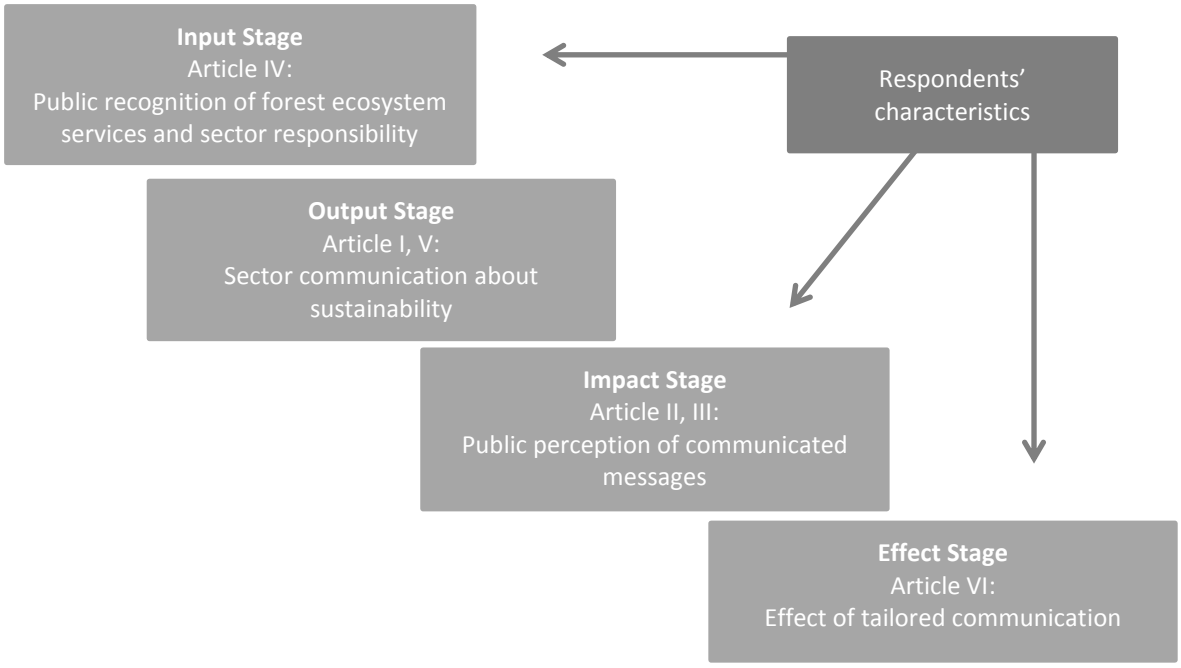

Figure 3: Framework of the thesis and position of the Articles I-VI (own illustration)

When aiming to conduct evaluative research on the communication of the forest-based sector, the following difficulties occur. First, several different organizations communicate on various different channels, since the forest-based sector encompasses a variety of organizations along the value chain. These companies may have different communication policies regarding the general public. Second, there is no proof whether the general public actually has been exposed to the messages conveyed by the sector and whether these messages were processed or even caused a change in attitude. Therefore, the thesis does not attempt to evaluate a specific communication campaign. Instead, it aims to increase the understanding of how the forest-based sector can

improve its communication towards the general public by researching the general public's perception of selected topics which have been communicated by the sector.

It needs to be acknowledged that the different stages research a variety of sustainability related topics. More precisely, Article I examines how selected sustainability topics are conveyed via the websites of selected forest-based sector organizations. The communication of the forest-based sector is considered to be reflected in the organizations' websites. Furthermore, websites are an important tool for communication because they are easily available to the general public. Therefore, they are used as a proxy in order to research the publicly communicated messages. Articles II and III research the public perception of sustainability messages communicated by the sector regarding sustainable forest management and climate change mitigation. These two topics are considered to be central in the context of bioeconomy. Article IV investigates the public perception of forest ES in relation to the environmental impact of forest-based sector companies. Article V examines the published scientific literature on the communication of the European forest-based sector with its stakeholders regarding sustainability. Article VI researches how tailored communication influences the attitudes of forest visitors towards harvesting operations.

3.2 Material and methods

The mixed methods approach was chosen to answer the research questions. The dissertation builds upon four different data sources which consist of primary quantitative and qualitative data. Figure 4 gives an overview of the methods and materials used for each article.

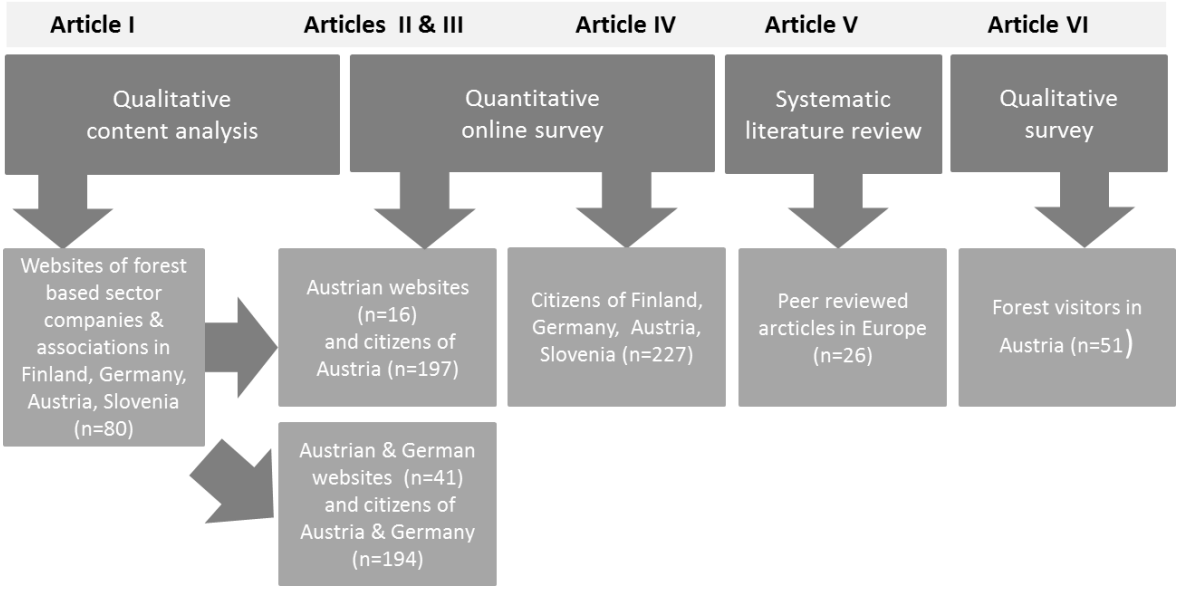

Figure 4: Overview of methods and materials used for Articles I-VI (own illustration)

The first main data source are the websites of 61 companies and 19 industry associations encompassing the forest-based sector value chain covering forestry, sawmilling, pulp and paper, wood-processing industries and bio-energy production. The sampling process was purposive, particularly targeting information-rich cases whilst covering all relevant types of organizations in Finland, Austria, Germany, and Slovenia. A deductive coding scheme was developed, which focused on eight core sustainability topics of interest, identified at an international forest-based sector stakeholder workshop in Helsinki in fall 2014. The topics are "wood-based innovations", "multifunctional forestry and forest ecosystem services", "forest conservation by production", "forests and global warming", "forests and the economy", "added value of wood", "building with wood", and "efficient use of wood". They address different dimensions (social, economic, environmental) and levels (societal, sectoral, corporate, product) of sustainability. A qualitative content analysis of the 80 websites was conducted in three languages (German, Finnish, and Slovenian) by three researchers working in close collaboration and utilizing the software Atlas.ti or MAXQDA for coding. The coding unit depended on the context and consisted of several sentences, a section, or a paragraph. The analysis focused on the frequency of the eight topics per country

In a second round of content analysis, the websites of the Austrian and German sample were analyzed in more detail to identify key messages regarding two selected topics of interest. For the topic of "forest conservation by production", all paragraphs on sustainable forest management including the origin of the raw material wood and the impact of forestry on forests were coded and grouped into different categories. This was only done for the Austrian sample. For the topic of "forests and global warming", all paragraphs about the role of the forest-based sector in climate change mitigation were coded and grouped into different categories. This was done for both, the Austrian and German sample. Next to the identification of key messages, the analysis focused on the frequency of key messages received in the respective samples.

The second main data source is made up by three online surveys[3] which took place from May to September 2015. Respondents were collected through convenience sampling by sharing the survey link in social networks targeting respondents uninvolved in the forest-based sector through profession, education or forest ownership. The survey on sustainable forest management and climate change mitigation used statements generated from the key messages identified in the

[3] The "What We Wood Believe" project conducted an online survey covering eight different topics in eight different questionnaires which were selected randomly by clicking on the link. Thus, the respondents of the questionnaires were different people and therefore each survey is treated as an individual survey.

second round of the content analysis. Respondents' perceptions of the key messages were researched asking for their level of agreement. For these questions, a five-point Likert-scale was used with an additional "I don't know" answer. In all three surveys, the influence of respondents' sociodemographic characteristics and their involvement in the forest-based sector on their answer behavior was investigated. Additionally, the survey on sustainable forest management, researched the level of environmental awareness which was considered to have an important influence on the perception of forestry activities. Thus, the New Ecological Paradigm was used in the form of a nine item version already used in previous research (Bartczak, 2015).

The third survey used a list of 24 ES based on the Millennium Ecosystem Assessment (MA, 2005) and (Bennett et al., 2015) comprised a theoretical framework for categorizing "Provisioning", "Regulating", "Socio-cultural", and "Supporting" ES. Respondents were asked whether they think that forests are important in providing these services. Next to descriptive statistics, the answers were analyzed with an exploratory factor analysis to identify bundles of recognized ES. Furthermore, respondents were asked which topics they require information about in order to assess the impact of the forest-based sector on ecosystems and whether they think that forest-based sector companies act responsibly in relation to these topics.

The third data source are research articles already published or "in press" in international peer-reviewed scientific journals between January 2005 and October 2015. Searches were carried out using the ScienceDirect database by using pre-determined search words for titles, abstracts, and keywords. The keywords concentrated on the themes directly relevant to the European forest-based sector in relation to perceived sustainability and acceptability expectations of different stakeholder groups. General studies without clear links to stakeholder sustainability information about communications were excluded. In three steps, which included a database search, scanning of abstracts, and thorough reading of abstracts, the number of relevant articles was reduced from 2350 hits received in ScienceDirect to 26 journal articles strictly relevant to this study. To analyze the state of communication research, the remaining articles were examined according to two dimensions. First, they were assigned to one of the four hierarchical levels of sustainability. Second, for each article, the communicator, the medium, and audience were identified as well as a summary of the research finding and geographic area provided.

The fourth data source is a qualitative survey using the laddering technique. First, a pre-study was conducted to create a survey tool, i.e. a hierarchical value map. For this, twelve participants were selected by convenience sampling using the selection criterion that they occasionally visit a

nearby forest for recreational purposes. Their attitudes on harvesting operations were collected using the laddering method. This step aimed at developing a preliminary hierarchical value map for the data collection in the field. Second, the developed hierarchical value map was used to survey visitors passing by a harvesting site in the Vienna Woods. To measure the effect of the tailored communication, the study applied an experimental research design. The information boards were placed directly at a recent clear cut in the Vienna Woods, Austria, a popular area for recreation. To measure the effect of the information boards on the forest visitors' attitudes, there have been survey periods without (group A) and survey periods with information boards (group B). There was an additional group that was exposed to the boards but did not read them (group C). After forest visitors passed the clear cut site, they were asked what they thought using the laddering technique. In total, 51 surveys were conducted in spring 2016 covering groups A, B, and C. The answers were analyzed quantitatively by counting the frequency of each mentioned property and comparing the three groups.

4. Summary of Articles

4.1 Article I: Communicating forest sector responsibility: results from four European countries

The objective of Article I is to gain a better understanding of how selected sustainability topics are being communicated by the forest-based sector. Using a qualitative content analysis, the article examines how forest-based sector companies and industry associations communicate eight selected sustainability topics on their websites.

In total, the data set accounts for 7090 observations of the eight topics of interest. The results show a strong focus on a few topics, whilst neglecting others. The most frequently communicated topic was the economic contribution of forests, particularly in Finland and Austria, debate over forest conservation in Germany, and added value of wood products in Slovenia. Future oriented topics, such as "wood-based innovations" and "multifunctional forestry and forest ecosystem services", received the least weight in the data of all countries. Overall, regarding the quality of distributed information, the communication efforts seem to be strongly focused on the distribution of information (e.g. supplying facts or by mentioning use of environmental certificates or standards). This raises the question whether the strong focus on the provision of information about economic contributions and factual information is suitable for the general public.

It is concluded that there is a lack of a consistent sustainability communication strategy that would encompass all participants of the forest-based sector and stretch across national borders in Europe and there is a clear need for developing a more targeted communication regarding forest-based sector sustainability towards the general public.

4.2 Article II: Are your messages being heard? Evaluation of the forest-based sector's communication on sustainable forest management in Austria

Article II examines the communication and the public perception of the forest-based sector regarding sustainable forest management, in Austria. First it is investigated, which messages are communicated by the forest-based sector, and second, how they are being perceived by the general public. Furthermore, it is researched how respondents' characteristics influence the perception of the messages.

Two key messages on sustainable forest management were identified. The first message received 93 hits and emphasizes the responsible use of forests for economic purposes ("responsible use"). The second message received 27 hits and emphasizes the role of forestry in taking care of the forest in providing welfare services to society ("taking care"). The survey reveals, that measured in levels of agreement, the key messages are perceived differently. "Taking care" messages received higher agreement rates than "responsible use" messages.

When considering respondents' characteristics, half of the statements revealed significant differences as a result of respondents sector involvement, whereas only a few significant results were observed as a result of gender, age and environmental awareness. In general, respondents involved in the sector had higher rates of agreement and lower rates of neutral answers, compared to uninvolved respondents. Differences concerning sector involvement were smaller for statements of the key message "taking care" than for "responsible use". This suggests that the agreement to the key message "taking care" is less affected by respondents' sector involvement. In conclusion, the two key messages differ in the amount of being communicated and how they are perceived by the general public. Especially the respondents' sector involvement has a significant influence on the perception the statements, but it depends on the message. Statements on "taking care" are mostly perceived independent from sector involvement, whereas statements on "responsible use" are mostly perceived by respondents with sector involvement. These results suggest that, when forestry activities are communicated as activities that take care

of the forest, they generally are perceived in more positively than when communicated as economic activities.

4.3 Article III: Perceiving the wood but not the trees? Public perception of the forest-based sector's contribution to climate change mitigation

Article III examines which messages the forest-based sector communicates about its role in climate change mitigation and how they are being perceived by society in Austria and Germany. It investigates, I) which messages on the role of wood and forest in climate change mitigation are communicated by the forest-based sector in Austria and Germany; and II) how these messages are perceived by respondents with different characteristics.

In both countries the role of wood products was communicated more often than the role of forests with 200 and 55 hits, respectively. Next to the amount that they are being communicated, the two messages differ as to how they are being perceived (measured in levels of agreement). The survey reveals that statements regarding "role of forests" were perceived more positively than regarding "role of wood".

When considering respondents' characteristics, respondents' involvement in the forest-based sector accounted for the majority of significant differences, whereas socio-demographics accounted only for minor differences. In general, respondents involved in the sector had higher rates of agreement and lower rates of neutral answers, compared to uninvolved respondents. However, significant differences as a result of sector involvement were mostly found for statements on "role of wood", whereas this effect was not observed for statements on "role of forests". Fewer significant results were observed for other variables such as gender, level of education, age, country, and residency. The results suggest that the message about the role of forests in climate change mitigation is broadly understood by the general public, whereas the message about the role of wood is significantly influenced by sector involvement.

4.4 Article IV: Perceptions of the general public on forest sector responsibility: A survey related to ecosystem services and forest sector business impacts in four European countries

Article IV aims to I) build a more in-depth understanding of the public perception of forest ES, II) information demand on forest-based sector business impacts, and III) actual perceived forest-based sector responsibility concerning these impacts.

The results show that, the general public strongly recognized the contribution of forests to ES. Especially the group of “Regulating” and “Supporting” ES received high agreement rates, whereas the recognition of “Socio-cultural” ES was only moderate. The least agreed on issues concerning the importance of forests were mostly connected to “Provisioning” ES comprising, for example, non-wood forest products such as pharmaceuticals or food. The answers of the respondents indicates either their actual knowledge of forest ES or their perceptions of their state of knowledge about those issues. The majority of respondents voiced that it is necessary to have information about the suggested topics to assess forest-based sector business impacts, especially regarding “threats to wildlife and fauna”. However, it seems to be difficult for them to prioritize between the different impacts, since the all of the items received similar agreement rates. In contrast, perception of forest-based sector responsibility was much more dispersed among respondents and showed high rates of neutral answers. This indicates a potential legitimacy gap and risk for losing SLO among forest-based sector businesses.

In the exploratory factor analysis, a three dimensional factor solution including the three groups of “Primary ES”, “Consumable ES” and “Social cohesion related ES”, was identified as the best solution in depicting the differences in perceiving the characteristics of ES among the respondents. To a large extent, the variable loadings for three factors followed the theoretical MA framework categorization for “Supporting”, “Provisioning”, “Regulating” and Socio-cultural” ES. However, the basis of rationale for perceiving the characteristics of ES among the respondents seems to differ notably from the MA framework that is driven from natural sciences. The three identified dimensions of ES are perceived differently, depending on respondents’ characteristics (socio-demographics and sector involvement). “consumable ES” were more important for female respondents or respondents without sector involvement, whereas “social cohesion related ES” were more important for people involved in the sector.

The study provides insights into how the general public categorizes forest ES. This reveals the need to better capture how the general public sees forest ES in their daily lives. It seems that clearer communication strategies are needed to increase public understanding of environmental impacts of the forest-based sector. Acknowledging the influence of respondents characteristics, such as sociodemographic background or sector involvement, is considered promising for the development of future communication strategies.

4.5 Article V: Forest sector sustainability communication in Europe: A systematic review on the contents and gaps

Article V investigates the current state of forest-based sector communication research with its stakeholders at different hierarchical levels of sustainability (i.e., societal, sectorial, corporate, and product sustainability) in Europe. Using a systematic literature review, potential gaps in published scientific research on acceptability and public perceptions of the European forest-based sector are identified.

The results show, that there is plenty of peer-reviewed research on sustainability related issues regarding the forest-based sector with general findings on communicators, audiences and sustainability themes. However, there seems to be a lack of research on specific sustainability information needs of different stakeholders in Europe and information channels regarding different levels of sustainability. Existing research on stakeholder communication was found to be inconsistent, since the different levels of sustainability were not approached evenly with all stakeholders. According to published research, the forest-based sector as a whole seems to lack genuine information exchange with its various stakeholders.

It is concluded that there is a need to research the specific communication needs of different stakeholders such as the general public via two-way and proactive information exchange. More attention should be paid to theoretical and empirical research on forest-based sector communication to send more specified messages to selected audiences.

4.6 Article VI: Forest management or greed of gain? – An information experiment on peri-urban forest visitors' attitudes regarding harvesting operations

Article VI explored how tailored communication influences the attitudes of peri-urban forest visitors regarding the environmental impact of forestry. Three information boards explaining forest operations were created and placed next to a clear cut in an urban forest in Vienna and it was researched whether the provision of information increases acceptance towards forest management practices that strongly affect the visual appearance and potentially disturbs recreational value of forests.

Forest visitors who passed the site without being provided with information (group A) emphasized negative aspects regarding visual appearance and environmental concerns. In comparison, forest visitors who read the information (group B) emphasized the usage of the raw material wood and put less emphasis on environmental concerns. The results indicate that the

information boards caused a shift in the weight of certain topics mentioned in the laddering process. The provision of information boards may take off some strength from visual appearance and environmental concerns and redirect attention towards other topics mentioned on the boards. Furthermore, considering forest visitors' involvement in the forest-based sector, the information boards were able to adjust the uninvolved ones on the level of the involved ones, whereas the involved ones did not show any attitude change. Based on the theory of cognitive response, linking new information with other information already present can lead to convergence, dissonance, and reactance. No indication for a reactant reaction was observed. Dissonance may mostly be included for forest visitors who were exposed to the information but did not read it (group C), since they did not want to read the provided boards. A convergent uptake of information was assumed to cause the differences between group A and B.

5. Discussion

5.1 Contribution and discussion of results

Article I contributes to the literature on forest-based sector communication regarding sustainability topics. The results show that the communication of the forest-based sector in the four case countries focuses on supplying factual information. It is suggested that communication with the general public would require clearer messages that address emotional aspects in order to be successful (Morsing and Schultz, 2006). The communicated content focuses on its economic contribution, added value of its products, and sustainable forest management. It is hypothesized that the strong focus on economic issues is used to legitimize its activities among society through the provision of economic benefits. However, the question arises whether the general public is interested in this information. The study further reveals that there is a lack of a consistent sustainability communication strategy that encompasses all participants of the forest-based sector. The concept of sector sustainability requires collaboration with other companies in the same sector to enhance the legitimacy within society or to improve the competitiveness in comparison to other sectors. The communication of uniform messages is considered crucial since the public has difficulties in telling apart different actors of the value chain (European Commission, 2002).

Similarly, the results of Article V show that, according to published peer-reviewed research, the forest-based sector fails to address different stakeholders at different levels of sustainability. The lack of knowledge on stakeholder information needs and appropriate communication channels

may be a consequence of deficiencies in stakeholder management resulting in one-way communication without well targeted messages. To reach the general public with their communication, knowledge about their information demand is necessary, as the value of provided information on those issues is limited as long as communication is not specifically targeted to the desired audience, such as the general public (Schmeltz, 2012).

Articles II and III contribute to research on the public perception of the forest-based sector regarding sustainable forest management and climate change mitigation. The forest-based sector's emphasis on the responsible use of forest resources and the role of wood in climate change mitigation is considered to be used as a central argument to increase societal legitimacy, as pointed out in earlier research (Räty et al., 2014). However, the communicated content about sustainable forest management and climate change mitigation was only partly perceived by the general public. In both studies, the critical part is the economic aspect of providing raw material in the form of tree harvests. As long as forest management is communicated as an activity that takes care of the forest, it is positively perceived by the general public. Similarly, forests and trees are widely recognized to contribute to climate change mitigation. The positive perception of fewer communicated topics might be the result of earlier communication and might be an observation of the effects of past communication. On the contrary, harvesting trees and turning them into wood products is less acknowledged of having a positive impact on the climate. This critical perception towards the economic use of forests is considered to relate to earlier studies indicating skepticism towards the environmental impact of tree harvests (Lovell and O'Brian, 2009; Rametsteiner et al., 2007). The lack of agreement towards the environmental claims made, is considered to be connected to the skepticism towards available forest-based sector communication, since green washing is a serious issue in corporate communication (Laufer, 2003) as well as the complex and multidimensional impact of the forest-based sector on ecosystems.

The acceptance of messages regarding responsible forest use and the role of wood in climate change mitigation was predominately influenced by respondents' involvement in the forest-based sector through formal education, profession or forest ownership. More precisely, respondents' involvement had a significant influence on the perception of "responsible use" and "role of wood products", whereas this effect was not observed for "taking care" and "role of forests". This suggests that the general public strongly acknowledges the social and environmental function of forests, but is skeptical towards the use of the economic function of forests in providing raw material (i.e. tree harvests). The results are in line with the differences found in the valuation of forests, where forest owners emphasized economic values and the general public recreational

and ecological values (Eriksson, 2012). Other characteristics such as socio-demographics or environmental awareness only had limited influence. Therefore, results suggest that people without sector involvement may face difficulties in connecting the provided information to their existing knowledge. The three-stage memory model (Bettman 1979) of information processing implies that respondents encode new information by linking it with other information already present in their long term memory. Thus, it is argued that respondents with sector involvement have higher agreement rates, since they are able to connect the provided information to their existing knowledge. On the contrary, respondents without sector involvement do not have sufficient background information regarding "responsible use" and "role of wood products" and therefore cannot connect the new information as well as the group with sector involvement, visible in the high share of neutral responses. To target the group of the uninvolved people in the future, messages they are interested in and have knowledge of should be chosen. To avoid cognitive dissonance or reactance (Festinger 1957, Brehm 1966), items with a high share of neutral answers should be preferred over those with clear disagreement.

Article IV contributes to research on the public perception of forest ES in the context of societal legitimacy of forest-based sector activities. The strong but varying recognition of different ES can be explained with the concept of "visible" ES which are recognized as a result of personal experience and "invisible" ES which are recognized through theoretical learning (Lewan and Söderqvist, 2002). The explanatory factor analysis revealed three dimensions (primary, consumable, social cohesion), which differ from the MA framework derived from natural science based-view. This supports the need to incorporate the general public's view into the conceptual development of ES (Danley and Widmark, 2016), especially when using it for decision making in the management of forest ecosystems. Furthermore, the three identified dimensions of ES are perceived differently, depending on respondents' socio-demographic characteristics or sector involvement. Respondents no involved put higher emphasis on consumables. This supports previous studies on the perception of ES by different societal groups (Grilli et al., 2016; Hein et al., 2006; Lamarque et al., 2011; Martín-López et al., 2012). Since the perception of ES dimensions was found to differ among respondents, addressing these differences can help forest-based sector organizations to tailor their sustainability communication to the general public.

Furthermore, the majority of respondents found it necessary to have information on the forest-based sector impact on ES to assess its responsibility, but had difficulties in distinguishing between different forms of impact. This may be connected to the lack of knowledge about forest-based sector activities as reported in an earlier study (European Commission, 2002) which is

considered to affect the knowledge about the environmental impact related to these activities. In contrast, regarding the perceived level of forest-based sector responsibility, perceptions were much more divided, indicating a potential legitimacy gap and a risk of losing the SLO for forest-based sector businesses. Varying levels of perceived forest-based sector responsibility regarding environmental impact were reported in previous studies (Panwar et al., 2012; Valkeapää and Karppinen, 2013). The observed inability to make a judgement may be the result from a lack of available information of from a lack of trust in the available information.

Article VI contributes to research on the effect of tailored communication. It researched the influence of tailored communication on the attitudes of forest visitors towards forest management in a real social setting. The experiment is the only study in this thesis that allows evaluating the impact of communication on public attitudes. The results suggest that through tailored communication negative attitudes towards forest harvesting, in form of a clear cut, can be reduced. The visual impact of forest management is important to consider since the visual appearance of forests influences the recreational and scenic value of forests (Edwards et al., 2012; Tahvanainen et al., 2001). Contrary to possible claims of greenwashing, the results show that the provided information in the experiment can increase the acceptance of a forest clear-cut. Again, respondents' involvement in the forest-based sector plays a crucial role. The change of attitude was only observed for respondents uninvolved in the forest-based sector. The uptake of information is considered to be related to the emotional activation through providing information the harvesting site. The role of emotions by facilitating an uptake of information has been discussed in the context of forest conflicts (Buijs and Lawrence, 2013). This new aspect shows that tailored communication provided at the place of emotional concern is processed and can alleviate negative attitudes.

Overall, the results contribute to an increased understanding on how the forest-based sector can tailor its communication to the general public from different but complementary perspectives. The thesis conceptualizes a framework how to investigate the communication of the forest-based sector by researching the messages conveyed through the websites of the forest-based sector, peer-reviewed research articles, the general public's perception regarding selected topics, the public perception of forest ecosystems, and the effect of tailored communication.

The use of different concepts was necessary to answer the research questions. As a result, the thesis combines different methodologies and research disciplines to deepen the understanding of forest-based sector communication and public perception. Using concepts from different research

disciplines is sound with the current development in sustainability research that mono-disciplinary research is limited in their application and new interdisciplinary approaches are necessary (Chang et al., 2017; Lam et al., 2014). It is considered as strength of this thesis, to investigate the public perception and communication of the forest-based sector from many different perspectives and using different methodologies. As a result this study not only provides practical input for the communication of forest-based sector organizations, but also advances existing communication research in the field of the forest-based sector by providing a framework how to research different aspects of communication. However, since the results are based on different data sources, collected at different places and points in time, this is considered a weakness to be discussed in the next section.

5.2 Limitations

Regarding the content analysis, the sample is limited regarding country comparisons because of structural differences between the forest-based sector in each country and the available communication. Furthermore, the sample has a focus on wood processing companies, which is considered to have an influence on the frequency counts of the topics. Further limitations are that three different coders were employed in the data coding because of the different languages in the case countries. Therefore, making comparisons between countries should be done carefully. In addition, some of the identified sustainability topics used for deductive coding are clearly wider in scope than others. The focus on the economic contribution of the forest-based sector is a result of the inclusion of a broad range of economic, environmental, and social aspects in this category. This partially explains why this topic is the most commonly covered in the sustainability related online communication. These features inevitably influence the numeric frequency counts, which therefore should be treated only as indicative. Furthermore, the approach only considers the number of statements made but not the individual intensity or coverage of the information. Regarding the analysis, it is worth noting that the website data was analyzed with a qualitative content analysis, but the results are presented in a quantitative way. Qualitative content analysis emerged from shortcomings of quantitative content analysis regarding the meaning of a text. However, there is no sharp line dividing quantitative and qualitative content analysis (Schreier, 2012, p. 13f). Qualitative content analysis can also present results in a frequency format when the focus is on the categories and not the individual cases. This allows identifying which categories are most frequent. Some scholars argue however, that quantifying the qualitative results is a mixed-method design, combining qualitative and quantitative features (Schreier, 2012, p. 239f). As a

result the content analysis employed in Articles II, IV, and V can be referred to as qualitative with frequency counts.

Overall, one of the biggest limitations of the three quantitative surveys is the lack of generalizability on the populations of the investigated case countries. The respondents of the surveys were not representative samples of the case countries, since the samples were clearly biased in terms of education, age, and forest-based sector involvement. Especially, the large share of people with higher education and university students are considered to be a bias. However, considering the surveys as exploratory, they are a legitimate way to research a phenomenon and could provide a springboard for further research or allow links with existing findings in an area (Bryman, 2012, p. 201). Since survey-based research in the field of forest sciences is growing and their methodological rigor has been recently systematically investigated (Stevanov et al., 2016), allows to use the findings of the surveys as a basis for future research on the communication and the perception of forest-based sector sustainability. Another issue to be considered is the generation of items used in the surveys. The use of items with a different wording may cause slightly different results. Furthermore, the use of polarizing statements can have an influence on the level of agreement. However, to simply measure a difference in the perception of items and investigate differences as a result of socio-demographic characteristics, the quality of the items is considered sufficiently regarding their validity as a measurement instrument. In addition, there are further restrictions related to the research design. The presented approach allows for investigating the state of communication (i.e. provided information and perception on a specific topic) at a general sector level, but it is not possible to provide information on the direct impact of certain communication activities. It is not possible to say who was exposed to which kind of information or media and whether this kind of exposure caused this perception.

The main limitation of Article III is the time delay common for scientific publications and that only one database was used. Furthermore, there might be more knowledge on the communication with different stakeholders but this might not be subject to scientific literature.

Limitations regarding the information processing experiment (Article VI) are that no statement about the long term nature of the attitude change can be made. Furthermore, the results are only based on a small sample as a result of the qualitative character of the study. However, due to the lack of research regarding this problem the chosen qualitative method provides a useful basis to make sure that no important aspects are overlooked. It can be assumed that the information boards are a tool to increase acceptance towards forest management. Even though this study is

only indicative, its strength is its ecological validity. Ecological validity is concerned with the question of whether social scientific findings are applicable to people's everyday, natural social settings (Bryman, 2012, p. 48). Since the forest visitors were confronted with the information boards in a real life setting and asked about their attitudes after passing the harvesting site, their perception of information was observed in a natural social setting. However, a quantitative study is recommended to verify the results.

Apart from the limitations encountered in the individual Articles I-VI, the following limitations occur regarding the dissertation in answering the research questions. The conducted research on the forest-based sector communication and public perception only provides several limited snapshots. The study researched the messages conveyed via organizations' websites and the analysis of the website data was conducted on the assumption that the website content reflects the content that is also communicated in other channels and is easily available to the general public. However, their communication with the general public may differ from the observed website content. Furthermore, the question arises, how the general public obtains information about forest-based sector sustainability, which was not researched in this thesis. Except for the experimental study in the Vienna Woods, it simply provides an understanding how the communicated messages are perceived by the general public.

Regarding the selection of case countries, it is worth noting that some studies research all four countries, some only one or two. As a result this study does not allow any cross country comparison. Forest-based sector communication and public perception of forest ES were researched on a general level for Europe, whereas the more detailed studies mainly investigated Austrian and to some extent German citizens. As a result some of the conclusions drawn between the individual articles have to be treated with caution. Furthermore, this study researched different organizations of the forest-based sector, however no comparison between different actors of the value chain (e.g. forestry and pulp & paper) was done.

5.3 Future research

Based on this thesis, the following prospective areas of study regarding the sustainability communication of the forest-based sector were identified. Regarding the perception of forest-based sector sustainability, future research on why the public is ambivalent regarding the environmental claims made and what specific information people request would be interesting to address (e.g. qualitative, focus groups). These studies would further the knowledge about the information demand of the general public, as required for targeted communication (Pratt et al.,

2013). In this context, it would be interesting to not only research whether a message is being agreed to or not, as done in this thesis, but to conduct research on message interpretations and which emotions they address. Since emotions can positively influence information processing, it is important to understand how people deal with ecological information that is provided to them and the role of emotions in this process (Buijs and Lawrence, 2013). To some extent this has been done in the experimental study (Article IV) and could be further explored.

Future research could further investigate how socio-demographics, personal values, and sector involvement influence perceptions and attitudinal changes. In this context, future research could identify target groups based on recognized forest ES and experiment on whether addressing these differences can help forest-based sector organizations to tailor their communication to the general public.

Since the sustainability-related online communication has increased (Montague et al., 2016) future research on the available information online is forward looking. For example, apply and refine existing tools for website analysis (Siano et al., 2016) to assess and improve the online presence of the forest-based sector based on defined elements that are necessary for adequate sustainability communication for different audience groups. Since this study did not investigate the connection between media consumption and public perception, future research could investigate this relationship, as already pointed out in literature (Fabra-Crespo et al., 2014). However, since consumers usually do not pro-actively seek information about company behavior (Dawkins, 2005), it would be interesting to know how the general public informs themselves about the sustainability of the forest-based sector and which influence media consumption has on their perception.

Next to media consumption, interpersonal networks are considered as an important influencer. Since people create, modify and retain attitudes in discussion with other people in all their social networks (Watson and Noble, 2007, p. 13), it would be interesting how the attitude change is facilitated in interactions with others. Since involvement in the forest-based sector was found to have a significant impact on the perception of communication, it would be interesting to know when, how, and about which topics interaction between involved and uninvolved people takes place. In this context, future research could investigate the effectiveness of new media to facilitate exchange between the forest-based sector and the general public.

6. Conclusion

The aim of this dissertation was to increase knowledge about how to tailor the communication of the forest-based sector towards the general public. It investigated selected aspects of forest-based sector communication and public perception from several different perspectives.

On a general level, the results suggest that current forest-based sector communication lacks stakeholder-oriented communication and revealed the need to integrate stakeholder information needs in their communication activities, especially regarding the general public. This represents a significant challenge to increase the public acceptance of the forest-based sector. Furthermore, it was empirically demonstrated that current messages communicated by forest-based sector organizations fail to resonate with the general public regarding the economic aspect of tree harvests. Researching the level of public agreement towards key messages communicated by the forest-based sector, indicates that the general public is skeptical about the environmental claims of the sector regarding the responsible use of forest resources and the role of wood products in climate change mitigation. This may be related to the general public's low emphasis on the economic values of forests. In both cases, forest-based sector involvement was found to play a crucial role in the perception of the communicated environmental claims. The results further suggest that clearer communication regarding the environmental impact of the forest-based sector is needed. In this context audience segmentation based on recognized forest ES is promising. An experiment using tailored communication revealed its effectiveness in increasing the acceptance of visible environmental impact on the forest and decreasing negative attitudes towards tree harvests.

The strength of the thesis is combining the insights of forest-based sector communication and public perception at different levels of communication research (Input, Output, Impact, Effect). Thereby it provides a multi-faceted view about forest-based sector communication and public perception grounded on empirical results. However, the results were generated in different countries and thematic contexts. Furthermore, the employed sampling procedure does not allow any generalizations towards the populations of the researched case countries, which is considered as a major weakness.

For practitioners, the forest-based sector should communicate coherent messages to the general public and overcome individual communication goals. Furthermore, messages the general public can easily relate to and messages that address emotions, such as tree harvesting, can be used to make the general public susceptible to process new information and facilitate an attitude change.

Future research can address the effect of above mentioned issues as well as expand and improve the proposed framework to advance research on the communication of forest-based sector.

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Article I

Communicating Forest Sector Sustainability: Results from Four European Countries

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Abstract

Communication is an important tool in maintaining legitimacy and acceptability of forest sector operations and activities, and expectations by the general public on the forest sector conduct in Europe are in general very high. Despite this, there is scarce research in cross-national contexts on how forest sector sustainability is communicated to the general public and what development areas can be identified in terms of communication content. This study applies a qualitative content analysis in four forestry-rich European countries (Austria, Finland, Germany, and Slovenia). The state of online communication of 61 companies and 19 industry associations was qualitatively analyzed in 2014 with a focus on eight core sustainability topics of interest that were identified via an international forest sector stakeholder feedback process. Our results show some great similarities, but also some interesting differences in terms of communication frequency and weight of hot topics across countries. The most frequently communicated area was economic contribution of forests (in Finland and Austria), followed by debate over forest conservation versus production (Germany) and the concept-added value of wood (in Slovenia). With the exception of Slovenia, the role of forests in combating global warming was emphasized more frequently within industry associations than among individual forest industry companies. Characteristically, current content of sustainability communication focuses on supplying factual information. Thus, there is a need for developing more targeted and bidirectional forms of stakeholder communication in the future, emphasizing also more active use of social media channels and empowering organizations to promote interactive communication and collaborative learning.

Forests are a source of many ecological, economic, and social benefits, especially in European countries in which the forest resource base is relatively most abundant (e.g., Rämö et al. 2002). Wood is used for various purposes, such as construction material, energy carrier, boards, paper, cellulose, fibers, and chemicals. Co-products such as chips from sawmilling can be used directly on site, can be used for energy production or pellets, or can be sold to a company using the fibers for subordinated processing. However, the forest-based industry has to seek a more efficient exploitation of raw materials, new products, or even alternative product concepts (Stern et al. 2014).

The European Strategy for Sustainable Development (European Commission 2009) calls for the creation of sustainable communities able to manage and use resources efficiently and able to tap the ecological and social innovation potential of the economy. In a recent development, as reported by, for example, European Commission (2012) and Finnish Forest Industries Federation (2013), the forest industry has an increasing role in the discussion of how to adapt and mitigate impacts of climate change. With the emergence of a bio-based economy (Kleinschmit et al. 2014), the forest sector is a key player because it is producing wood-based renewable and sustainable raw materials, biofuels, heat, and electricity as a substitute for fossil-based materials and energy. Owing to decreasing demand for paper products, there is a strong need for the European forest sector to renew its product and service portfolio and put efforts into developing new forest and wood-based innovations (Hetemäki 2014). The ultimate market demand is, however, determined by consumer

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Forest Prod. J. 66(5/6):362–370.
doi:10.13073/FPJ-D-15-00046

acceptance and based on competitiveness between wood-based and alternative products and services.

Communication is an important tool in maintaining legitimacy and acceptability of forest sector operations among the general public. According to Scott (1998), organizational legitimacy is a negotiated point between the perceptions of society and an organization's decision makers regarding any issue of concern. Sustainability—consisting of three interconnected domains (ecologic, economic, social)—is a core element in the forest sector because of its dependence on natural resources. In the forest sector, achieving social license to operate can be related to concepts such as corporate responsibility, maintaining legitimacy, acceptability of operations, meeting diverse stakeholder expectations, and building trust, not only with local communities, but also along the entire supply chain (Gold et al. 2010). With continued increases of societal awareness regarding social and environmental issues, it may be expected that the forest products industry falls short of changing societal expectations about its social and environmental performance (Panwar et al. 2014). Maintaining legitimacy of the forest sector is therefore highly contingent on how sustainability is perceived, not just throughout the production chain, but also among the general public.

Public expectations of forest sector conduct are high (European Commission 2002, Ranängen and Zobel 2014). The environmental discussion within the forest sector in Europe began with concerns about emissions to water and air in the 1970s and continued to recycling, chlorine bleaching, and certification of sustainable forest management (e.g., the Programme for the Endorsement of Forest Certification and the Forest Stewardship Council) to materialize forest sector sustainability (Ranängen and Zobel 2014). The concept of corporate (social) responsibility (CR/CSR) became a more familiar approach to the European forest products industry by the mid-1990s, once publication of environmental reports became more common (Panwar et al. 2006). According to Han et al. (2013), as in the broader context of under-sustainable development, the ''triple-bottom-line'' model (economic, social, and environmental aspects) is currently used in the sector to conceptualize implementation of CR.

Overall, the business sector is facing increasing external pressure because issues of interest to consumers and other stakeholders are not necessarily the same as those that the organizations themselves tend to communicate about. In general, companies typically highlight their positive development and progress in terms of sustainability issues in their communications (Halme et al. 2011). Regarding sustainability communication in the forest sector, it is very clear that previous studies focused on the state of industry reporting (see Mikkilä and Toppinen 2008, Vidal and Kozak 2008, Han et al. 2013). In addition to corporate reports (including environmental reports, annual reports, CR and sustainability reports, and project reports; Li and Toppinen 2011), official Web sites of different organizations form a significant part of sustainability strategy and communication of the sector. Apart from analysis on the reporting practices, very few studies have approached the sustainability image of the sector from the external stakeholders' point of view (see, e.g., Thompson et al. 2010 for the case in North America or Hitchner et al. 2014 for a review on wood-based bioenergy). A myriad of sustainability indicators and measurement systems for assessing, for example, regional and national sustainability of forest sector have been developed, but in general they have had more limited applicability at managerial decision making (see, e.g., Lähtinen et al. 2014).

This study contributes to the issue of sustainability communication by applying a qualitative content analysis in the case of four forestry-rich European countries (Austria, Finland, Germany, Slovenia). After widespread digitalization, the importance of sustainability-related online communication has increased in the forest sector (see Montague et al. 2016), especially among forest companies and associations, and this information will therefore form the core material of this study. According to Singh et al. (2008), a cross-cultural analysis could help identify the similarities and the differences between the peoples' perceptions of sustainability issues. In our case, while these countries are culturally similar in that they are part of the European Union, there is some geographical variation (Finland in northern Europe, Austria and Germany in central Europe, and Slovenia in southeastern Europe). At the same time, the four countries have differences in their economic development and growth—as well as cultural, historical, and political traditions—that make their comparison interesting.

In this study, online communication of 61 companies and 19 industry associations in the four case countries is qualitatively analyzed based on a two-stage research process. In the first stage, eight ''core sustainability topics of interest'' (TOIs) are identified from an international stakeholder feedback process (including companies and associations of the forest-based sector). In the second phase, the list of identified sustainability topics is used as a lens to analyze the content of communication. In the ''Discussion and Concluding Remarks,'' gaps in communication and some future research areas are identified.

Conceptual Background

Our point of departure in this article is that the triple-bottom-line concept of sustainability (environmental, social, and economic) can be implemented at four hierarchical levels, i.e., the societal, sectoral, corporate, and product (or service) levels. First, the societal level of sustainability, which is a more extensive level of the sustainability concept, includes strategic decisions, regulations, and operations related to sustainable development on a global scale. The societal level has a high impact on the other three levels as carried through the implementation of national and international regulations and commitments, which creates limitations and incentives for societies, governments, companies, organizations, and individuals. Second, the main focus or sectoral level of sustainability, which is according to Draper (2006) a lesser used concept, is to maintain or enhance the current legitimacy or solid reputation of a sector in sustainability-related matters with the aim of improving competitiveness in relation to other sectors. Thus, the success of improving sustainability performance requires collaboration with other companies, organizations, and value-chain members in the same sector. Third, sustainability at the corporate level encompasses communicating the current state and goals of corporate social responsibility, as mentioned above. Fourth, the product level of sustainability is primarily concerned with consumers' perceptions on environmental and social sustainability of products, which has been affected by the corporate strategic decision-making process. Based on

Toppinen et al. (2013), for Finnish consumers of wood products, the safety aspects and health impacts of a product are emphasized. In wooden furniture markets, young people in Germany and Finland have been found to favor secondhand, inherited, and recycled furniture for budgetary as well as environmental and ethical reasons (Hakala et al. 2014).

According to Dawkins (2004), to produce efficient communication on sustainability issues, an organization must fulfill four of the most essential requirements. First, a clear communication strategy needs to be developed, considering which aspects of the CR program are the most suitable with the concerns of its stakeholders and company reputation. Second, communication channel, style, and content of communications that meet various expectations of the different stakeholder groups need to be designed. This includes maintaining comprehensive consistency of the company's message along with involving stakeholders when developing communication on sustainability. Third, conformity and coherence of the company's communication when coordinating sustainability messages need to be ensured. The most efficient communication may comprise embedding CR messages as part of the general stream of communication. Fourth, the company must take into account internal communication channels (e.g., product/label itself, marketing campaigns, voluntary CR reports, corporate Web site, and informal word of mouth) together with traditional communication channels.

Furthermore, Dawkins (2004) points out that the main concern companies are facing in their sustainability communication is diverse expectations of stakeholders and the companies' ability to respond to these different expectations. This calls for improving communication by developing a clear and strong communication strategy tailoring content in accordance with the image and desired reputation of the company. Based on characterization of different perspectives of sustainability communication by Morsing and Schultz (2006), three communication strategies related to CR can be pointed out: the one-way stakeholder information strategy, the stakeholder response strategy, and the stakeholder involvement strategy. The more advanced stakeholder response and involvement strategies concentrate on changing public behavior and attitudes rather than changing the company as a result of public relations. However, real two-way discussion and mutual dialogue between the company and its stakeholders only takes place in the stakeholder involvement strategy.

Halme et al. (2011, pp. 260–265) note that active communication with stakeholders, i.e., sharing common goals and views and giving stakeholders a chance to have an influence on a decision-making process, positively influences transparency in a company's overall performance. In their review, Li and Toppinen (2011) emphasize the importance of interaction between a company and its stakeholders to develop CR even further and to conserve the company's social legitimacy from possible loss by adopting CR practices. Legitimacy loss can lead, for instance, to consumer boycotts and environmental and social activism, which can negatively affect the economic performance of a company. In order to retain a company's societal legitimacy and to maximize its long-run financial viability, CR can be used as a tool for forest sector companies to reflect the concerns and needs of their stakeholders (Mikkilä and Toppinen 2008).

The Internet has become an important public relations tool and communication channel for transmitting companies' sustainability actions to different stakeholders because it allows companies to disclose information more economically and faster than other communication channels (e.g., newspapers, magazines, brochures, campaigns, television, radio; Wanderley et al. 2008, Gomez and Chalmeta 2011). In addition, the detailed up-to-date information on the Web remains available for the larger audience, and hence, Internet users are able to select which information is relevant for them (Wanderley et al. 2008). Therefore, this study focuses on online communication as available on organizational Web sites in the context of the forest sector.

Data and Research Design

In the first stage, eight TOIs were chosen as an analytic lens based on scoping company interviews and written stakeholder feedback in individual countries; these topics were summarized in a final discussion at a joint stakeholder workshop held in Helsinki on September 22, 2014. The 1-day workshop consisted of two parts: explaining the scope of the study to foster elaboration among the 23 participants and the discussion finalizing the eight TOIs. Based on the earlier literature on forest industry corporate responsibility conduct and stakeholder perceptions (see previous sections), the initial set of eight hot topics was chosen both for stakeholder interest from the forest-based sector and also to cover a clear societal relevance toward a bio-based and sustainable economy. In addition, based on workshop discussions, sustainability of forest-based ecosystem services, including provisioning of wood-based products (Räty et al. 2016), was included. The topics are identified as follows in Figure 1: wood-based innovations (WBI), multifunctional forestry and forest ecosystem services (FES), forest conservation by [forest management and] production (CBP), forests and global warming (FGW), forests and economy (FEC), added value of wood (AVA), building with wood (BWW), and efficient use of wood (EUW). As can be seen in Figure 1, there are several topics falling under the domain of environmental sustainability (CBP, FGW, FES) only, whereas some topics had both environmental and economic dimensions (EUW), and then there were some with emphasis on both social and economic dimensions (AVA, FEC, BWW, and WBI). The primary scope of the topics could also be identified to range between four levels, from societal (global) to product level, and therefore fitted with our initial thinking on the hierarchical nature of hot topics under sustainability-related communication.

In the second stage, the sampling of data in qualitative content analysis followed aims of the purposive sampling method (Ritchie and Lewis 2003), particularly targeting information-rich cases reflecting particular features for in-depth study. First, we ensured that all relevant types of organizations from the forest sector were covered and overviewed in the potential candidates of the four countries via online screening. Second, we categorized the identified organizations with seemingly sufficient online content under four different segments; (1) large-scale international companies, (2) small- and medium-sized enterprises (SMEs, which are mostly family businesses), (3) industry associations, and (4) bioenergy producers. It is important that there is sufficient diversity within each segment to disengage impacts of the segment's feature and other factors involved. Therefore, each of the four segments contains a comprehensive range of

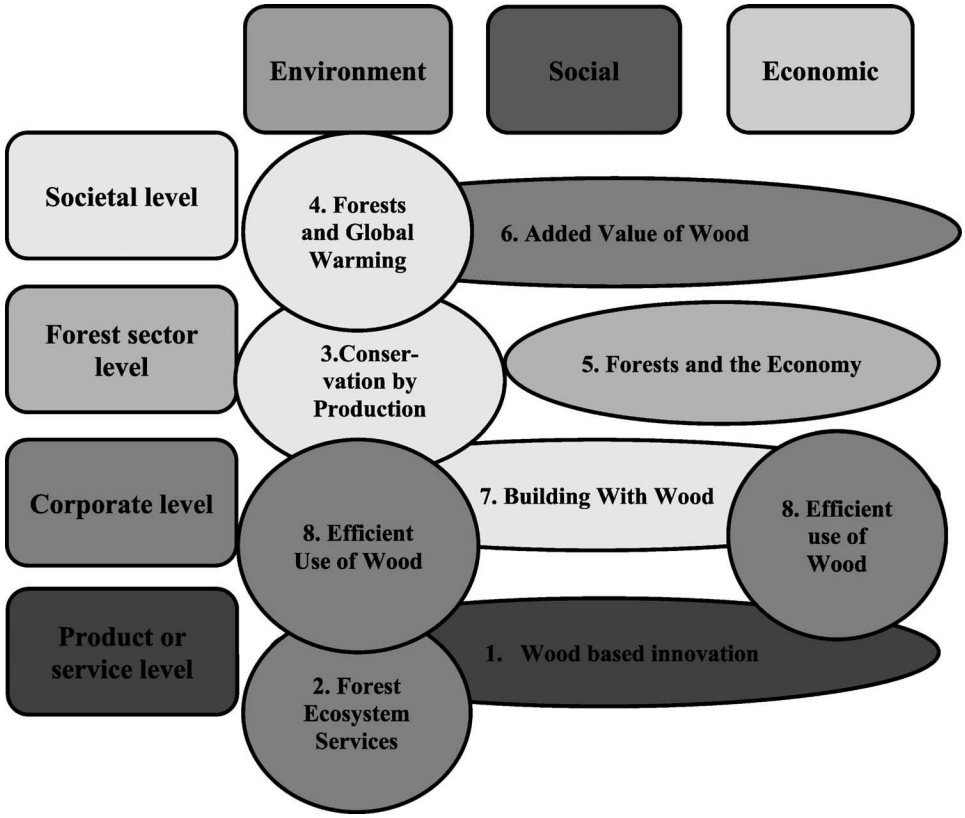

Figure 1.—Eight topics of interest and their alignment with level of analysis and dimensions of sustainability (environmental, social, and economic sustainability).

representative organizations. Ultimately, the sample of individual companies and organizations was determined for this study based on the content of information available on their Web sites in terms of sustainability communication and targeting a balanced geographic setting covering wood, pulp, and paper and bioenergy production. Instead of pictures, reports in PDF form, job advertisements, and news older than 6 months, all text and tables from the Web pages were encompassed into raw data text files.

The content analysis coding process in four countries was undertaken in three languages (German, Finnish, and Slovenian) by three researchers working in close collaboration and using software (Atlas/MaxDQA) for coding. Their coding process followed suggested patterns and stages of qualitative content analysis to improve validity of the content classification (Schreier 2012, see also Berg 2009). In this deductive form of content analysis, the coding unit consisted of either several sentences, a section, or a paragraph depending on the context. Specific quotations, tagged with a code, were composed of sections, which were separated from each other with a section break. Eventually, the length of the coded quote had no great significance to the results, because frequency counts were based on number of quotations (with some of them also used later as illustrative examples). The codes and subcategories were grouped into code families under eight TOIs. Only one code from the same code family could be chosen to avoid the risk of double coding and in order to make the coding and results more comparable between the four countries.

Our final sample was limited from the perspective of different segments and countries because of structural differences between forest sectors in each country and availability of communication. However, we believe that communication by the included 61 companies and 19 industry associations given in Table 1 provides a rich representation of different types of forest sector activities and therefore can be helpful in order to build a coherent overall picture of the current state of communication in these countries.

Results

General

Table 1 gives a breakdown of data of the included organizations. The share that each of the four countries contributes to the total count is interesting and it is shown that 40 percent of the data are from Finland, followed by Germany and Slovenia (21% each) and Austria (18%). The number of analyzed units in each country is given. For example, the content of Web sites for 23 organizations was analyzed in the case of Finland, and the data for Finland are available from large-scale companies (1,255 observations, i.e., 44% of observations for Finland), followed by bioenergy producers (791, i.e., 28%), SMEs (530, i.e., 18%), and industry associations (292, i.e., 10%).

In total, our data set consists of a count of 7,090 observations regarding eight stakeholder predefined topics in the data (see Table 1), which is a sizable amount of information. Based on volume of count data, the Finnish organizations were found to score the highest number of observations, also reflecting the sophisticated stage of Finland's well-established forest-based industry. The Slovenian sample in particular was not at all representative

Table 1.—Breakdown of counted observations of topics of interest by each country and segment.[a]

Country	No. of observations				Total	
	Large companies	SMEs	Industry associations	Bioenergy producers	No.	%
Finland ($n = 23$)	1,255	530	292	791	2,868	40
Germany ($n = 25$)	759	116	497	102	1,479	21
Austria ($n = 16$)	548	133	440	128	1,249	18
Slovenia ($n = 16$)	275	1,198	21	0	1,494	21
Data by segments	2,837	1,977	1,250	1,021	7,090	100

[a] Please note double counting by country as segment 4 ''Bioenergy producers'' is a subsample of large-scale or small- and medium-sized enterprises (SMEs) in the case of Finland and Austria.

from the empirical data point of view because most of the observations were obtained from SMEs (80.2%), while large companies produced 18.2 percent, and only 1.2 percent was from associations. When looking at the Austrian and German samples, the low number of observations in the content of communication was somewhat surprising. Because Austria and Germany both have an advanced forest-based industry, it is surprising that the intensity of communication is less than in Slovenia, in which the forest-based sector is much smaller both in absolute and relative terms (e.g., forest area of slightly over 1 million ha in Slovenia in comparison to 20 million ha in Finland or 4 million ha in Austria; see Rämö et al. 2002). However, the observed variation in the level of communication activity might be partly related to the smaller number of included organizations in Austria (only 16 different Web sites, while 25 organizations in Germany and 23 organizations in Finland were included), a wider coding unit used (the Austrian coder marked paragraphs rather than sentences to maintain the context), and avoidance of double coding, or a stricter coding logic (i.e., researcher decisions concerning what to code and what to leave out). Therefore, some caution should be exercised in looking into the absolute numbers of topic frequency counts in Table 1. Furthermore, because bioenergy producers in the samples were partly the same companies as in the large companies category, and these data were not available for Slovenia, we decided to exclude this group from the reported results by countries.

On first glance, the state of communication efforts of the analyzed organizations in four countries strongly focused on distributing information (e.g., supplying facts or mentioning use of environmental certificates or standards). Formally, the communication in the sector seemed to lack feedback mechanisms, especially among SMEs. Thus, stakeholder expectations about tailored communication were rarely expressed in explicit terms, which makes the evaluation of the effectiveness of communication practices quite difficult. From the perspective of revealing the quality of communication, our results focusing on the frequency of communicated topics in the data can only be considered a preliminary assessment.

Country level results

We will discuss the results based on mean frequencies by segments from different countries. Frequency of communication on selected topics is available by each segment in Table 2. Nevertheless, we would like to emphasize that direct comparison between categories in different countries should be done with caution because of the purposive sampling and content analysis process explained in the previous section.

For Finland, the highest number of counts was received on FEC (28%) and FGW (19%), as illustrated in Figure 2. More detailed results by organizational types are given in Table 2. For example, for TOI FEC, the entry number 364

Table 2.—Total and mean values of frequency counts of communicated topics by country and organizational type.

TOIs[a]	Frequency of large companies	Mean	Frequency of SMEs	Mean	Frequency of associations	Mean
Finland						
1. WBI	111	37	21	1	31	6
2. FES	71	24	21	1	38	8
3. CBP	108	36	59	4	33	7
4. FGW	260	87	71	5	63	13
5. FEC	364	121	126	8	75	15
6. AVA	129	43	113	8	7	1
7. BWW	89	30	77	5	5	1
8. EUW	123	41	42	3	40	8
Germany						
1. WBI	24	2	1	0	10	1
2. FES	105	11	0	0	60	7
3. CBP	212	21	19	5	114	13
4. FGW	47	5	8	2	101	11
5. FEC	174	17	14	4	94	10
6. AVA	124	12	23	6	68	8
7. BWW	55	6	5	1	52	6
8. EUW	18	2	5	1	44	5
Austria						
1. WBI	46	6	11	3	40	10
2. FES	38	5	1	0	30	8
3. CBP	73	9	20	5	27	7
4. FGW	18	2	6	2	111	28
5. FEC	224	28	29	7	90	23
6. AVA	78	10	52	13	25	6
7. BWW	44	6	9	2	69	17
8. EUW	27	3	5	1	48	12
Slovenia						
1. WBI	25	6	76	8	8	3
2. FES	0	0	1	0	0	0
3. CBP	67	17	158	18	5	2
4. FGW	17	4	31	3	0	0
5. FEC	24	6	97	11	4	1
6. AVA	69	17	490	54	1	0
7. BWW	11	3	329	37	2	1
8. EUW	62	16	16	2	1	0

[a] TOI = topics of interest; WBI = wood-based innovation; FES = forest ecosystem services; CBP = conservation by production; FGW = forests and global warming; FEC = forests and the economy; AVA = added value of wood; BWW = building with wood; EUW = efficient use of wood.

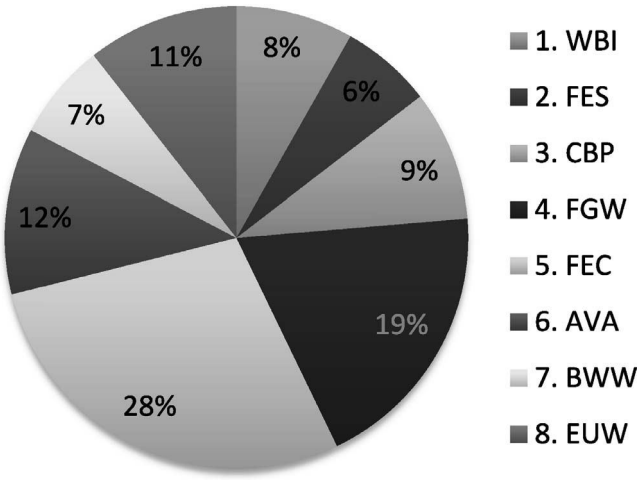

Figure 2.—Percent distributions of eight topics of interest in total, Finland (number of organizations = 23). WBI = wood-based innovation; FES = forest ecosystem services; CBP = conservation by production; FGW = forests and global warming; FEC = forests and the economy; AVA = added value of wood; BWW = building with wood; EUW = efficient use of wood. To read the pie chart, start at the top right with WBI (8%) and move clockwise.

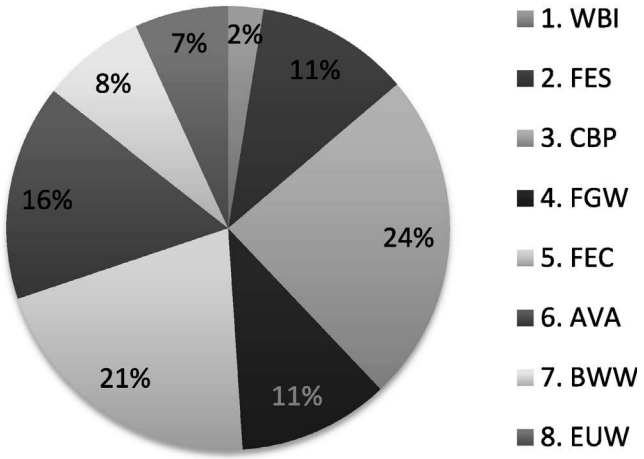

Figure 3.—Percent distributions of topics of interest in total, Germany (number of organizations = 25). For definitions of abbreviations, see the text and the legend for Figure 2. To read the pie chart, start at the top right with WBI (2%) and move clockwise.

under the group of large companies in Finland means that in total 364 observations were recorded among three large-scale companies, resulting in a mean value of 121 and the highest ranking terms of communication frequency in this segment. Inclusion of a broad range of economic, environmental, and social aspects in this category partially explains why this topic is the most commonly covered theme in sustainability-related online communication. The role of stakeholder groups such as communities, competitors, contractors, and forest owners seems important in the case of Finland, and recognizing support from the sector to the well-being of communities and society is included in communication activities, as quoted in the following example: ''We generate well-being at work, in local communities, and in society at large and commit to global sustainability principles. By behaving responsibly towards our employees and society, we can improve the quality of life of our stakeholders'' (Metsä Group, June 10, 2014).

Although the topic of FGW as a code is much narrower than FEC, FGW has a strong emphasis on forest sector communication. On the other hand, multifunctional FES (6%) and BWW (7%) received the lowest number of observations in sustainability communication because both themes are quite narrow. In addition, it appears that the value of ecosystem services is not yet recognized as a core communication topic, although there has been a growing interest in the subject in recent years.

In Germany, according to Figure 3, CBP is the most commonly communicated topic. It seems that an ongoing media discussion between representatives of nature conservation organizations and forestry associations unveiled a conflict regarding whether forests are actually endangered or preserved by production interventions. In this sample, forest companies and associations formulated arguments on how careful forest management can enhance vitality and diversity within forest resources and still be used for productive purposes. There is considerable ongoing conflict between forestry and representatives over nature conservation policies in Germany, and thus companies and associations frequently cover this topic and argue that the forest resources are carefully handled, as the following quote from one association demonstrates: ''Only those who keep an eye on (possible developments in) the future will be able to preserve and secure all vital functions of the forests as a living environment and economic base. This is why for generations there have been strict sustainability requirements for forest management in Germany'' (Arbeitsgemeinschaft Deutscher Waldbesitzerverbände e.V., September 18, 2014).

At the other extreme, the topic WBI was not frequently communicated in Germany. Scattered observations were mainly about research and development activities or launching of new innovative products. Part of the reason for the low frequency regarding WBI may lie within the sample focusing on primary producers and not on research-oriented or value-added organizations.

In comparing different segments in Germany, EUW had the lowest frequency count within the large companies. In the few cases detected, large companies communicated about efficient usage of their main resource or the use of wood residues for bioenergy or selling wood residues to other industries. The following quote illustrates this: ''Accumulating residues (sawdust, wood chips, bark) are also sold to the processing industry'' (Klausner Group, September 18, 2014). Interestingly, topics such as cascading use of wood as a resource have not been communicated by any company. Reasons for that communication strategy might be found in the companies' strong focus on their own main product and its production process, rather than on side products and their recycling. Other topics on cascading use or efficiency in the value chain are partially quite political and therefore sensitive topics in the communication, and therefore those might not be covered in online communication.

For Austria, as shown in Figure 4, the highest level of communication concerned FEC (31%). The high frequency of FEC can be partially explained by the category itself, which covers a wide range of different aspects. The forest-

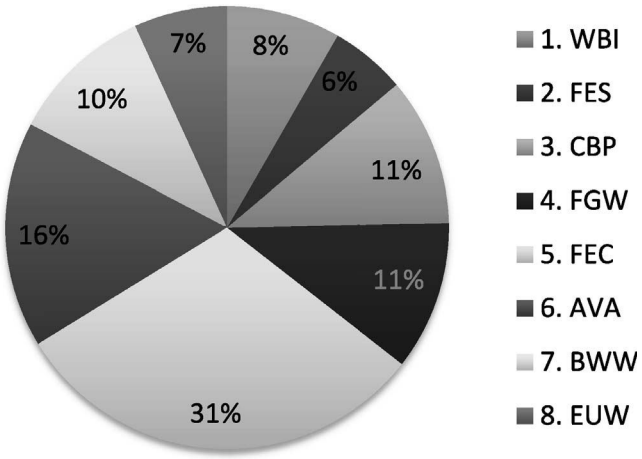

Figure 4.—Percent distributions of topics of interest in total, Austria (number of organizations = 16). For definitions of abbreviations, see the text and the legend for Figure 2. To read the pie chart, start at the top right with WBI (8%) and move clockwise.

based sector is a very important source of national income for Austria, and therefore it is natural that the sector's communication focuses on its economic contribution. The observations range from sales and investment figures to employment numbers and the amount of eco-energy feed-in: ''At our production site Hallein in Tennengau, approximately 15 kilometers south of Salzburg City, we employ about 230 employees. With about 40 hectares the production area is one of the biggest industry sites in the federal state of Salzburg'' (Schweighofer, October 14, 2014).

Furthermore, online communication touches on important themes, such as employment and career opportunities of the forest-based sector, importance of generating income in Austria, and social responsibilities such as fair, safe, and healthy working conditions and the social engagement of the company like ''We take responsibility for the well-being and development of our employees'' (Lenzing, November 14, 2014). The topic AVA (16%) scored second highest. Communication efforts were mainly clustered around various technical product characteristics, which can be explained by companies' focus on advertising their products. Next to eco-labels, wooden furniture and floors were promoted with characteristics like ''natural,'' ''strong,'' or ''individual.'' Health benefits such as antibacterial characteristics resulting from essential oils stored in wood are communicated as well. The emotional and health benefits of wood products, especially concerning furniture and flooring, were emphasized, as in the following quote: ''Parquet floor is a unique natural product. It creates a comfortable atmosphere and makes rooms cosier and warmer'' (Weitzer, November 14, 2014).

The lowest number of observations in Austria concerned FES (6%). Thus, the Austrian forest-based sector does not yet recognize the concept of forest ecosystem services in their online communication because availability of these (especially nonmarketed) services might be taken for granted. Within different organizations, associations were found to give the highest weight in terms of communicating FGW. One explanation may be that lobbying for the positive role of forests in climate change mitigation serves the needs of different types of companies equally and therefore can be communicated broadly to the general public. In this case, the associations appear to cover both aspects, the role of wood as a material and forests as a stand for combating global warming. Compared with the large companies and the SMEs, associations also argue that the carbon sink of forests is significantly higher when used for active forestry instead of leaving them unused for nature conservation purposes.

In Slovenia, as shown in Figure 5, most observations on TOIs of the content analysis were categorized as AVA, where communication of wood products in relation to emotion, health, and labels were included. Most of the observations were related to a subcategory of labels (47%), for example, ''In addition to the CE mark, which is characterized by European standards, in Jelovica the quality of the houses is demonstrated by the RAL quality mark, which is particularly important for the sale of prefabricated houses in the German and Swiss markets'' (Jelovica, November 8, 2014). The results showed that organizations communicate information about sustainability and related certifications and labels. However, it should be noted that volume of communication is based on what few specific organizations disclose: 81 percent of all AVA observations came from four wooden house manufacturers and one window producer. The health benefits of wooden houses are communicated as in the following quote: ''Buildings must be designed and built in accordance with the regulations on sound protection of a building. This ensures that the noise to which the users and people around the building are exposed too, is at a level ensuring appropriate conditions for work and rest and does not threaten their health'' (Marles Hiše Maribor, November 8, 2014). The many AVA observations were followed by the topic BWW, where communication of performance, image, and substitutions (comparison of wood to other materials) were emphasized. Most of the observations were related to performance (89%) of wood in construction, for example, ''Raw particleboards EKONIP E1 P3 are non–load bearing panels suitable for use in moist conditions'' (LESNA TIP Tovarna ivernih plošč, August 11, 2014).

The topic of interest that produced the lowest number of observations in the sample of 16 Slovenian organizations

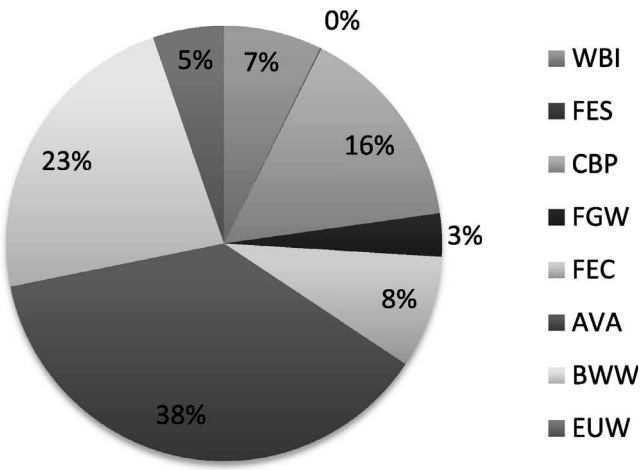

Figure 5.—Percent distributions of topics of interest in total, Slovenia (number of organizations = 16). For definitions of abbreviations, see the text and the legend for Figure 2. To read the pie chart, start at the top right with WBI (7%) and move clockwise.

was multifunctional FES. The only example was found from a forestry SME, ''Our concern for forest and forest land is best reflected in the forests of the vast region of Snežnik and Javorniki, where we managed with intensive management in the last five decades to maintain plant diversity and habitat for many endangered species including large carnivores'' (Gozdno gospodarstvo Postojna, August 11, 2014). The second least frequently communicated topic was FGW, including forest and carbon aspects. Here communication was related to carbon absorption and storage in forests and in the form of wood and wood-based products. However, for TOI FGW the result is not representative of the forest sector in Slovenia, because all FGW-related observations were found on the Web sites of the four actively communicating wooden house manufacturers and one window producer. Other analyzed organizations in Slovenia did not communicate these topics at all.

Study limitations

Our analysis was limited because three different coders were employed in the data coding, and because different languages were used (i.e., Finnish, German, and Slovenian) inter-coder reliability could not be checked. While the three coders were working closely together to ensure similar coding logic and they also employed statistical software in the process, some differences between countries are still likely present in the data. In addition, some of the defined sustainability topics are clearly wider in scope than others (e.g., contribution of forests to the economy) while some other topics are much narrower by nature (such as efficient use of wood). These features inevitably influence the numeric frequency counts, which should be therefore treated as only indicative. However, because our approach was dictated in the first stage by defining the topicality of issues as identified by the forest sector stakeholder community, we saw no other way around this. Our results are of international comparative interest at this specific light and with these limitations in mind.

Discussion and Concluding Remarks

Our results indicate some differences in communication frequency and selection of topics across countries: the most frequently communicated issue was economic contribution of forests (FEC), particularly in Finland and Austria; debate over forest conservation versus production in Germany; and added value of wood in Slovenia. In addition, the important role of forests in global warming was emphasized more frequently within industry associations than among individual forest industry companies (with the exception of Slovenia, where it was communicated by a few SMEs and not by industry associations). In our opinion, the two most future-oriented topics among the eight TOIs, WBI and FES, deserve the least weight in the data throughout different sectors and countries.

It is also interesting to compare our results on the TOIs with results of the previous corporate level analysis that focused on sustainability reports. For example, Vidal and Kozak (2008) found for the 100 largest forest companies that sustainable forest management was on average the most commonly reported topic, and the largest global companies also reported on a wider range of activities than did the smaller sized forest firms. Owing to purposive sampling and wider background differences between analyzed organizations, it was not possible to draw this conclusion from our sample. However, we can hypothesize that sustainability reporting may be more suitable for communicating with regulators and auditors, whereas general communication toward a wide range of stakeholder groups, such as consumers, would require clearer messages that also hold more emotional appeal (see, e.g., Morsing and Schultz 2006, Joutsenvirta 2009). Such issues would seem to include, for example, forest sector contribution to solving global sustainability challenges, demand for renewable energy, or emphasizing safety and health benefits of wood material at the individual or societal level (see also Hitchner et al. 2014).

Characteristically, current content of sustainability communication appeared to have a focus on supplying factual information or referring to various certificates. Stakeholder expectations about tailored communication were rarely expressed in explicit terms, making the evaluation of the communication effectiveness difficult. In addition, the communication efforts of sample organizations focused heavily on distributing information (e.g., supplying facts or mentioning use of environmental certificates or standards) and lacked feedback mechanisms with targeted stakeholders, especially among the smaller sized wood companies. We can conclude that there is a lack of a consistent sustainability communication strategy that would encompass all participants of the forest-based sector and would stretch across national borders in Europe. This may be owing to the differences in how different types of actors position themselves in terms of sustainability issues and in terms of competitors in the markets. Therefore, there is a clear need for developing more targeted stakeholder communication activities regarding forest sector sustainability. Certain topics of interest, such as wood-based innovations or forest ecosystem services, have had less coverage, and therefore generated less awareness; these topics may require future development areas in communication. The lack of very specialized information requirements of some stakeholder groups and the increased requirements for the use of social media–based communication can also be considered as areas for further development in the future.

In conclusion, the transformation of the forest sector from a resource-intensive to a knowledge-intensive, sustainable, and resource-efficient sector within a European bioeconomy (see Kleinschmit et al. 2014) calls for development of suitable communication strategies. From this perspective, professional communicators in the forest sector should critically examine their expertise and efficacy of communicating in a wide range of topical issues. For example, is all the economic performance and value-added related communication that we see presently in Europe becoming tautological, and is it truly worth the invested money? Or should more communication efforts, especially toward the general public, be targeted on issues with a higher human interest factor?

The effectiveness of both traditional and Web-based communication between the companies and their stakeholders should be further investigated by canvassing the existing richness provided by different potential communication channels, such as the use of novel Web-based tools and online forums, traditional visitor surveys, or tailored stakeholder consultation forums. To improve effectiveness of communication, forest sector companies and associations are starting to emphasize more in-depth engagement with their key stakeholder groups in sustainability-related decision-making processes (e.g., Morsing and Schultz 2006). An example is the increased use of social media

communication in the forest sector (Haarasilta 2013, Toppinen et al. 2015, Montague et al. 2016), empowering organizations to promote more interactive communication and collaborative learning. Better understanding of these forms of communication provides great opportunities for conducting empirical forest products–related research in Europe and beyond.

Acknowledgments

Financial support from ERANET WoodWisdom Net W3B partners and financers is gratefully acknowledged. A.K. was supported by the Slovenian Ministry of Education, Science, and Sport. Valuable feedback from two anonymous reviewers is gratefully acknowledged.

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Article II

Are your messages being heard? Evaluation of the forest-based sector's communication on sustainable forest management in Austria

Werden Ihre Botschaften gehört? Evaluierung der Kommunikation des Forst-Holz-Sektors über nachhaltige Forstwirtschaft in Österreich

Lea RANACHER and Tobias STERN

Summary
Communication is important for the forest-based sector to maintain legitimacy of forestry actives among the general public. The study examines communication activities of the Austrian forest-based sector concerning sustainable forest management. First it is investigated, which key messages are communicated online, and second, how they are perceived. The results suggest that the key messages differ in their effectiveness, and that the perception of the messages is mainly influenced by respondents' involvement in the forest-based sector.
Keywords: communication, forest-based sector, perception, sustainable forest management

Zusammenfassung

Kommunikation ist für den Forst-Holz-Sektor von Bedeutung, um seine forstwirtschaftlichen Tätigkeiten in der Öffentlichkeit zu legitimieren. Die Studie untersucht die Kommunikationsaktivitäten des Österreichischen Forst-Holz-Sektors zum Thema nachhaltige Forstwirtschaft. Es wird zunächst untersucht, welche Botschaften kommuniziert werden und anschließend, wie diese wahrgenommen werden. Die Ergebnisse lassen darauf schließen, dass sich die Botschaften in ihrer Wirksamkeit unterscheiden und, dass deren Wahrnehmung hauptsächlich durch den Bezug der Befragten zum Forst-Holz-Sektor beeinflusst wird.

Erschienen im *Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie*, Band 25: 159-168, Jahr 2016. On-line verfügbar: http://oega.boku.ac.at.

Schlagworte: Kommunikation, Forst-Holz-Sektor, Wahrnehmung, nachhaltige Forstwirtschaft

1. Introduction

Due to its dependence on natural resources and increased environmental awareness among the public, the forest-based sector is under constant public surveillance (BOWYER, 2008, 5). According to a survey, EU citizens consider conservation and protection of forests as the most important topic when being asked about forests in their country (RAMETSTEINER et al., 2009, 55). A study on the top 100 forest companies as determined by PricewaterhouseCoopers reveals that sustainable forest management is by far the most prominent topic in their sustainability reports (VIDAL and KOZAK, 2008, 67).

The Austrian forestry law states in §1 (2) production and environmental protection as parallel goals and emphasises sustainable forest management for the provision of forest ecosystem services to society (BGBl I 59/2002). Approximately 69% of the Austrian forest cover is sustainable forest management certified (PEFC, 2013). Forest owners need to balance the provision of raw material for the industry and other societal demands.

About 80% of the forestland in Austria is privately owned (BFW, 2015). Over 120,000 of private owners hold lots smaller than 200 hectares (STATISTIK AUSTRIA, 2008), of which about 78% are considered to have some sort of agricultural background (HOGL et al., 2005).

As communication is an important tool to maintain legitimacy of forestry actives among the general public, corporate social responsibility reports or sustainability reports, are used to manage public opinion. A study on the forest-based sector's online communication in four forestry-rich countries in Europe found that in Austria, economic activities and product characteristics are emphasised, whereas forest ecosystem services are communicated less (KORHONEN et al., 2016).

Against this background the purpose of this study is to investigate which key messages are communicated by the Austrian forest-based sector concerning sustainable forest management, and how these key

messages are perceived by respondents with different sociodemographic background.

2. Theoretical background

Communication can be viewed as the transmission of information, ideas, attitudes, or emotion from one person or group to another and in some cases as an attempt by a sender to produce a predefined attitudinal change in the receiver (VAN RULER, 2004, 128). It is necessary to set communication goals and determine the levels of measurement to assess the effect of communication activities. In their most basic form, communication goals aim to "get certain messages, themes, or ideas out" and levels of measurement give you an answer "if anyone 'out there' heard you" (LINDENMANN, 1993, 7f).

The evaluation of communication activities needs to encompass the full communication process from sharing information to the target groups' behavioural change (WATSON and NOBLE 2007, 14f). A simple method to evaluate communication activities is to examine how these messages are perceived by the desired audience.

In this study, perception is referred to as an evaluative belief (i.e. agreement or disagreement) regarding a specific message (see table 1). Beliefs about a phenomenon are considered as important antecedents to attitude or behaviour (AJZEN and FISHBEIN, 1980), such as a negative attitude towards the forest-based sector.

It has been argued that the perception of agriculture is mostly built indirectly through media consumption, since many people lack personal, first-hand experiences (HELMLE, 2010, 52). This proposition can be applied to the forest-based sector: studies show that many respondents have little knowledge of the forest-based sector and its activities (EUROPEAN COMMISSION, 2002, 21f; PAULI et al., 1998, 12). Thus, personal experiences with the forest-based sector, as a result of profession, formal education or forest ownership, are considered to have a strong influence on the respondents' knowledge and their perception of the forest-based sector.

To catalogue existing knowledge, the three-stage memory model is applied (BETTMAN, 1979), arguing that consumers encode new information by linking it with other information already present in their long term memory.

3. Method and material

To evaluate the communication activities of the forest-based sector, this case study consists of two parts: first, a content analysis is conducted to identify key messages from webpages of the forest-based sector. Second, statements are generated from these key messages and their perception is analysed in a survey.

For the content analysis, data was taken from a larger study (KORHONEN et al., in press), in which a selection of 16 Austrian companies and organisations covering wood, pulp and paper, and bio-energy production were analysed. Selection criteria were different size of annual turnover, the position in the value chain, and the amount of information available on their websites. Except for pictures, reports in PDF form, job advertisements and news older than six months, all text and tables from the webpages were saved as raw data text files and analysed with MAXQDA software in fall 2014. All paragraphs on sustainable forest management including the origin of the raw material wood and impacts of forestry on forests were coded and grouped into different categories.

A questionnaire with 20 polarised statements was developed, covering the categories identified in the content analysis. Since the level of environmental awareness is considered to have an important influence on the perception of forestry activities, the New Ecological Paradigm (DUNLAP et al., 2000) was used in the form of a nine item version already used in previous research (BARTCZAK, 2015, 362).

The questionnaire was available online and advertised via e-mail and social media. In order to increase the diversity of the sample, personal interviews were made based on quotas (i.e. at least half of the respondents without involvement in the forest-based sector, wide range of different age groups, gender, and urbanity). Thus, respondents were selected through convenience sampling and no conclusions can be drawn on the opinion of the Austrian population.

In total, 204 responses were received in summer 2015. The sample displays an above average level of education with 45% holding a university degree and 30% being university students. Slightly more women 52% than men took part in the survey, half of the respondents were aged 30 or over, and half of the respondents were involved in the

forest-based sector through profession, formal education or forest ownership.

The level of environmental awareness was measured in a range from 9, indicating the lowest level, to 45 points, indicating the highest level of environmental awareness. With a median of 36, respondents displayed an above average level of environmental awareness.

Depending on their sociodemographic characteristics, respondents were split in two groups. To compare their answers, behaviour crosstabs and Chi-Square tests of independence were used at a significance level of $\alpha = 0.05$. For that, the six-point Likert-scale was recoded into a 3-point Likert scale distinguishing between agreement, neutrality, and disagreement. The answer 'I don't know' was added to 'undecided', since both answers indicate a neutral position.

4. Results

Two key messages on the topic of sustainable forest management were identified based on 120 hits in the content analysis. The first message emphasises the responsible use of forests for economic purposes, the second message emphasises the role of forestry in providing welfare services to society. They are summarised as:

1. "The forest-based sector in Austria uses forests responsibly" (short: "responsible use"). This message covers: legal compliance, use of certification schemes, ecological origin of wood, annual increment exceeds harvest.
2. "Forestry in Austria takes care of the forest" (short: "taking care"). This message covers: supporting forest health, supporting species diversity, supporting protection services, forestry with ecological expertise.

"Responsible use" accounted for 93 hits, whereas "taking care" only accounted for 27 hits. The survey reveals that the key messages were perceived differently (measured in levels of agreement): "taking care" messages were perceived more positively than "responsible use" messages.

High agreement was observed for statements that forestry contributes to protection services, and/or forest health, or that foresters contribute to nature protection. At the same time, high disagreement was observed

for statements that forestry or wood production has a negative effect on forests, suggesting a positive perception of forestry activities and its impact on forests. This is in contrast to statements that wood in Austria comes from ecologically sound sources, the increase of forest cover or that legal compliance is kept, for which lower levels of agreement were observed.

When considering the respondents' involvement in the forest-based sector, half of the statements revealed significant differences. In general, respondents involved in the sector had higher rates of agreement (or disagreement, depending on the polarisation of the statement), and lower rates of neutral answers, compared to respondents not involved.

Table 1 shows the distribution of answers for selected statements grouped by respondents' involvement in the forest-based sector. Significant relationships with the respondents' involvement are marked with an asterisk (*). Interestingly, differences between sector involvement are smaller for statements of the key message "taking care", in comparison to statements of the key message "responsible use".

Only few significant results were observed for other socio-demographic variables, such as age, gender and level of environmental awareness: respondents younger than 30, women, or with higher environmental awareness were more sceptical towards some statements. This may relate to respondents' involvement in the forest-based sector, since this group has a higher share of men and respondents aged 30 or older.

The survey has limitations due to the sample. It is assumed that some of those who participated in the survey did so for a reason, such as familiarity either with the topic, the research institution or the interviewer. It likely attracted respondents interested in forestry and forest issues even when not formally involved in the sector. Thus the existence of a response bias must be considered.

Tab. 1: Distribution of answers (%) grouped by the respondents' involvement in the forest-based sector

Statements	Involved			Not involved		
	-	~	+	-	~	+
Key-message "taking care"						
Areas used for forestry provide protection from erosion, avalanches, and water pollution	7	14	79	13	19	68
Forestry keeps the forest healthy and strong*	9	12	79	8	28	64
Foresters contribute to nature protection	6	22	73	12	16	72
Forests are endangered due to wood production*	79	14	7	63	17	20
Forestry negatively influences the forest ecosystems*	61	31	8	56	24	20
Areas used for forestry are home to many animal and plant species	24	17	58	22	25	54
Key-message "responsible use"						
Forest cover is increasing*	19	12	70	40	30	39
Forestry follows the law*	3	34	63	8	55	38
Wood produced in my country comes from ecologically sound sources*	10	31	59	19	43	39
Forestry regulations need adjustment to protect the forest*	31	23	46	10	41	50
Wood processing companies in my country mainly use certified (FSC, PEFC) wood	4	44	52	6	56	39
Wood processing companies in my country do not use illegally harvested wood	18	38	44	8	58	35

Strongly disagree/disagree (-), undecided/I don't know (~), agree/strongly agree (+)
*Significant relationships with the respondents' involvement in the forest-based sector"
Source: OWN DATA AND CALCULATIONS

4. Discussion and conclusion

The results reveal that in the online communication of the forest-based sector, messages on "responsible use" are being communicated more often than messages on "taking care". However, messages on "taking care" are perceived more positive than "responsible use". This suggests that, when forestry activities are communicated as activities that take

care of the forest, they are perceived in general more positive than when communicated as economic activities.

A study (ERIKSSON, 2012, 1102) explained differences in the perception of forest ecosystem services between forest owners and the general public: forest owners were found to emphasize the economic function, whereas the general public was found to emphasize recreational and ecological functions. Thus, the lower agreement rates for "responsible use" may also be explained through respondents' lack of recognition of the economic function of the forests.

When looking at the perception of the messages based on respondents' sociodemographic background, the results suggest that people without forest-based sector involvement are more sceptical and indecisive towards messages communicated by the sector. Differences concerning sector involvement were found to be smaller for statements of the key message "taking care", than for "responsible use". This suggests that the adoption of the key message "taking care" is less affected by respondents' sector involvement.

Applying the three-stage memory model (BETTMAN, 1979), it is argued that the respondents involved in the sector have higher agreement levels since they are able to connect the provided information to their existing knowledge. It is suggested that people without sector involvement do not have sufficient background information and therefore cannot connect the information as well as the group with sector involvement. This is exemplified by the large number of neutral responses for some items. Results for the statement that Austrian wood "comes from ecological sound sources" suggest that some messages are too complex to be comprehensively communicated.

In conclusion, the two key messages differ in the amount being communicated and in their perception (measured in agreement). Especially sector involvement makes a difference in the perception of communicated key messages, but it depends on the content. Messages on "taking care" are more comprehensively understood than messages on "responsible use".

People without sector involvement, consequently lacking background information seem to have difficulties in connecting the provided information to their existing knowledge. To target this group in order to

avoid negative attitudes towards forestry activites, messages to which they are interested in and can easily relate should be chosen. To identify which messages to use, more research, e.g. with focus groups, is necessary.

Acknowledgements

The study was funded under the Wood Wisdom era-net and is a result of the research project "What We Wood Believe – Societal perceptions of the forest-based sector". Co-financed by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management under grant agreement 101002/1.

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Article III

Perceiving the wood but not the trees? Public perception of the forest-based sector's contribution to climate change mitigation

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Abstract

There is broad consent in climate research that forests and harvested wood products play a crucial role in climate change mitigation. There are several studies on the perception or communication of the forest-based sector, but studies combining both elements are rare. We therefore introduce an approach to examine the communication and the public perception of the forest-based sector regarding its contribution to climate change mitigation. We investigate, I) what messages on the role of wood and forest in climate change mitigation are communicated by the forest-based sector in Austria and Germany; and II) how these messages are perceived by respondents with different sociodemographic backgrounds. First, the websites of 16 Austrian and 25 German forest-based sector companies and associations were analyzed using a content analysis. Second, an online survey targeting German and Austrian residents was conducted to research public opinion, using items that reflect the messages identified in the content analysis. In total, 194 responses were received. The communicated messages differ in the amount being communicated and in how they are perceived. Regarding socio-demographic differences, respondents' involvement in the forest-based sector, account for the majority of significant differences in the perception of communicated key messages, but not in all cases. The message "role of forests" is more comprehensively understood than the message "role of wood", which is more likely to be understood from people with sector involvement.

Keywords: Perception, communication, forest-based sector, climate change mitigation

Kurzfassung

Die Klimaforschung ist sich einig, dass Wälder und Holzprodukte eine wichtige Rolle im Klimaschutz spielen. Studien über die Wahrnehmung oder die Kommunikation des Forst-Holz-Sektors sind vorhanden, allerdings ist die Kombination von beiden Elementen selten. Wir stellen deshalb einen Zugang vor, wie man die Kommunikation und Wahrnehmung des Forst-Holz-Sektors bezüglich dessen Beitrag zum Klimaschutz untersuchen kann. Wir untersuchen I) welche Botschaften der Forst-Holz-Sektor über den Beitrag von Wald und Holzprodukten zum Klimaschutz kommuniziert; und II) wie diese Botschaften von Personen mit unterschiedlichen soziodemografischen Merkmalen wahrgenommen werden. Dafür wurden zunächst die Webseiten von 16 österreichischen und 25 deutschen Forst-Holz-Sektor

Unternehmen und Verbänden mit einer Inhaltsanalyse untersucht. Anschließend wurde eine Onlineumfrage durchgeführt, um die öffentliche Wahrnehmung zu diesem Thema zu erfassen. Dafür wurden in der Umfrage Items verwendet, die die Botschaften aus der Inhaltsanalyse widergeben. Insgesamt wurden 194 Antworten erhalten. Die Botschaften unterscheiden sich in der Häufigkeit in der sie kommuniziert werden, sowie in der öffentlichen Wahrnehmung. Hinsichtlich soziodemografischer Eigenschaften, hat der Bezug zum Forst-Holz-Sektor der Befragten den größten Einfluss auf die Wahrnehmung der Botschaften, allerdings nicht in allen Fällen. Die Botschaft „Rolle von Wald“ wird umfassender verstanden als die Botschaft „Rolle von Holzprodukten“, welche eher von Personen mit Sektorbezug verstanden wird.

Keywords: Wahrnehmung, Kommunikation, Forst-Holz-Sektor, Klimaschutz

1. Introduction

The European European Commission (2012) endows the forest-based sector with an increasing role in the discussion of how to mitigate climate change and contribute to a low-carbon economy. On a global level, it is widely agreed that forests as well as the sustainable use of harvested wood products positively contribute to reducing greenhouse gas emissions by forming a storage pool of wood-based carbon or substituting fossil based material and fuels (Braun et al., 2016a; Feldpausch-Parker, 2015; UNECE/FAO, 2016). Accordingly, studies on carbon sequestration of forest ecosystems (Hasenauer, 2011; Merganicová et al., 2012; Rubatscher et al., 2006) and harvested wood products (Braun et al., 2016b; Chen et al., 2008) are an emerging research field. Butarbutar et al. (2016) concluded that the observation and perception of carbon sequestration should not be restricted to sustainable forest management but should be extended to the utilization of extracted timber. Substitution effects from use for materials and energy production have been shown (Braun et al., 2016a; Butarbutar et al., 2016) to potentially compensate for the loss of forest carbon and contribute to the overall climate change mitigation benefits from forestry sector. A study (Rametsteiner et al., 2009) found that Europeans are increasingly concerned and interested to learn more about the interconnectedness between forests and climate change.

Nevertheless, the climate change mitigation effect of the forest-based sector is determined by market demand and consumer preference of wood products over conventional products, as well as the acceptance of managing of forest resources. Therefore, public perception of the forest-based sector and its products, especially in terms of its potential to reduce greenhouse gas emissions and contribute to a sustainable bio-economy, is considered crucial. Furthermore, with an increasing public environmental awareness and interest in companies’ contribution to sustainability, climate change benefits of wood products represent a potential competitive advantage for the forest-based sector. As Bowyer (2008, p. 7) put it: “*Ironically, it may be environmental issues that cause society to “rediscover” wood. Current attention to carbon, for instance, could bring active forest management and use of wood squarely to the forefront in a society seeking solutions to the threat of climate change. Alternatively, the same issue could lead to new restrictions on harvesting and reductions in wood consumption*.”

In Europe, several surveys investigated the role of wood products, the forest-based sector, and forests concerning their role in climate change mitigation. These surveys reveal that the

public perception of these topics is often contradicting, indicating respondents' lack of knowledge or skepticism. For example, Rametsteiner et al. (2007) report in their review that a majority of Europeans think forest area is decreasing in Europe and that harvesting wood makes climate change worse, even when trees are replanted. On the contrary, using wood to replace non-renewable materials is perceived to be good for mitigating climate change but in some cases using wood as fuel is perceived to make climate change worse. Similarly, Lovell and O'Brian (2009) found that children and young people had negative perceptions of using wood as fuel as it would contribute to emissions and preferred to preserve existing forests over reforestation to remove carbon dioxide. Investigating the public perception of intensification of forest management in Sweden to enable an increased use of such biomass to mitigate climate change, Hemström et al. (2014) found that a majority supports measures to increase forest growth but oppose the use of intensive forestry practices such as the cultivation of exotic tree species, clones, and forest fertilization. In the US, Feldpausch-Parker (2015) and colleagues investigated the role of biomass in context of carbon capture and storage based on a regional media analysis but without surveying public perception.

As a result of this timely yet controversially perceived topic, this study aims to investigate forest-based sector communication and public perception of the role of forests and wood products to mitigate climate change. We investigate, I) which messages are communicated by the forest-based sector; and II) how these messages are perceived by respondents with different sociodemographic background. Investigating the sector's communication and public perception of this topic in Germany and Austria will provide new, explorative insights into communication research in the forest-based sector.

2. Communication and public perception of the forest-based sector

In recent years, the general public has been increasingly acknowledged as an important stakeholder in forest-based sector activities. This resulted in an increase of studies on the perception of the forest-based sector or investigation of its communication activities. There are several studies on how the sector is being perceived (e.g. European Commission, 2002; Fabra-Crespo et al., 2012; Mynttinen, 2009; Rametsteiner and Kraxner, 2003; Rametsteiner et al., 2007) or on how the sector communicates (e.g. Aasetre, 2006; Fabra-Crespo and Rojas-Briales, 2015; Korhonen et al., 2016; Vidal and Kozak, 2008). However, there is only little research (e.g. Ranacher and Stern, 2016) that connects forest-based sector communication with public perception regarding a specific topic. This kind of research is considered to be crucial to evaluate communication efforts and to better target communication activities in the future. We therefore introduce a new approach how to research both, forest-based sector communication on, as well as public perception of a selected topic. The basic assumptions and guiding models for this methodology are described below.

To gain a better understanding of the communication and societal perception of the forest sector regarding its potential to mitigate climate change, this study uses the concept of public relations evaluation. Public relations can be described as a process in which an organization intends to influence public perception to achieve a desired outcome e.g. vote or buy (Watson and Noble, 2007). The use of social science methods an media analytics, such as opinion polls and media analysis respectively, have a long tradition in public relations research (Watson, 2012). There are several models to evaluate the effectiveness of

communication activities. Usually, input and output variables are compared to find out if someone paid attention or thinks or acts differently as a result of the communication efforts. To measure whether the communication activities caused an impact on the recipient, Lindenmann (1993) suggests to measure awareness or reception towards a topic. In this study, perception is referred to as an evaluative belief (i.e. agreement or disagreement) regarding a specific message (see table 1). Beliefs about a phenomenon are considered as important antecedents to attitude or behavior (Ajzen, 1980), such as a negative attitude towards use of wood products or their potential for climate change mitigation

In this study, the input variable is the public communication of the forest-based sector (i.e. what kind of information does the sector communicate on their websites) and the output variable is the public perception of the forest-based sector (i.e. what kind of perception does the public have of the communicated information). It needs to be acknowledged, that this comparison does not allow an evaluation of specific communication activities, such as a campaign. It rather is a comparison of what is currently communicated and what is currently being perceived regarding the forest-based sectors role in climate change mitigation.

This article therefore introduces a conceptual frame for the analysis of a publicly communicated content and the public perception of this content. We conduct a content analysis and survey to examine which key messages are being communicated by the sector and which ones are adopted by the respondents. It enables a feedback process for the evaluation of communication activities. More precisely, it provides information on who understands which messages. If the communicated content is well perceived (=high agreement levels) the communicated content is coherent with public perception. If not (=low agreement levels), there is a gap between communicated content and public perception. However, no direct evaluation of the communication activities is possible since we do not know to which messages the respondents were exposed to. An observed lack in perception could therefore not clearly be traced back to certain aspects in the communication strategy. Nevertheless, this analysis allows identifying those areas that need further attention.

Personal experiences with the forest-based sector, as a result of profession, formal education or forest ownership, are considered to have a strong influence on the respondents' knowledge and thus their perception of forest-based sector related topics (Ranacher and Stern, 2016). The three-stage memory model of information processing (Bettman, 1979) implies that respondents encode new information by linking it with other information already present in their long term memory. If respondents are confronted with new information, they try to connect this new information to their already existing knowledge. The existing information may create beliefs that could be different from the new information and original knowledge (Petty, 1981). The interaction of new information and existing knowledge is therefore of superior significance for attitudinal change (Stern et al., 2009). Additionally, the theories of cognitive dissonance by (Festinger, 1957) and of psychological reactance by (Brehm, 1966) can be considered in this context. Especially the dissonance theory has been expanded concerning confirmation bias in sequential information search (Jonas, 2001), stating that respondents prefer confirming over conflicting information.

3. Material and Method

To examine the communication activities of the forest-based sector, this case study consists of two parts. First, a content analysis is conducted to identify key messages from selected companies' and associations' webpages of the forest-based sector. Second, statements are generated representing these key messages and their perception is researched in a public survey.

For the content analysis, data were taken from an earlier study (Korhonen et al., 2016). A selection of 16 Austrian and 25 German companies and associations covering forestry, sawmilling, pulp and paper, wood-processing industries and bio-energy production, were analyzed. In the Austrian sample there are three bio-energy producers which are not individual companies, but part of the wood processing or pulp and paper companies. Table 1 provides an overview of the characteristics of the sample. Selection criteria were different size of annual turnover, the position in the value chain, and the amount of information available on their websites. The overall approach was to obtain a balanced sample of the forest-base sector and corresponding associations in the two countries. The sample rather represents the sphere of wood processing than forest management. This is partly due to the fact, that there is only a little share of forest companies with a website used for communication with the general public.

Table 1: Selected sample of forest-based sector organizations for the content analysis, categorized by country, kind, and position in the value chain.

Country	Size/Assoc.	Position in the value chain
Germany (25)	Large companies (10)	Forest company (2), sawmilling (2), pulp and paper & bio-energy (1), wood processing industry & bio-energy* (5), Bioenergy (2)
	SMEs (6)	Forest company (2), Sawmilling (4)
	Associations (7)	Forestry (2), sawmilling (1), pulp and paper (1), wood processing industry* (2), bioenergy (1)
Austria (16)	Large companies (8)	Forest company (1), sawmilling (1), pulp and paper (3), wood processing industry* (3)
	SMEs (4)	Sawmilling (1), Pulp and Paper (1), wood processing industry* (2)
	Associations (4)	forestry and wood products (1), wood processing industry* (1), pulp and paper (1), bioenergy (1)

*includes intermediate products, such engineered wood products, and final products such as flooring and furniture.

Except for pictures, reports in PDF form, job advertisements and news older than six months, all text and tables from the webpages were saved as raw data text files and analyzed with MAXQDA software in fall 2014. A detailed description of the overall research design of the content analysis can be found in Korhonen et al. (2016). For this study, all paragraphs addressing the role of the forest-based sector contributing to climate change mitigation were coded and grouped into different categories.

For the survey, a module with 14 polarized statements was developed, covering either the role of forests or the role of wood products in climate change mitigation. Finally, questions on socio-demographic characteristics of respondents were included such as age, gender, education, residential area, employment and involvement in the forest-based sector through formal education, profession or forest-ownership. The survey data used in this study was part of a larger European survey on public perception of the forest-based sector (http://wood-w3b.eu/en/project). The survey was available online and advertised via e-mail and social media through the researchers' personal networks in Austria and Germany. Additionally, paper questionnaires were used in both countries to increase the diversity of the sample with a purpose of reaching both, people involved and not involved with the forest sector. Thus, respondents were selected through convenience sampling and no conclusions can be drawn on the opinion of the Austrian or German population. To test whether there was a bias resulting from the paper questionnaires, we excluded them and reran analysis but results did not change significantly.

In total, 194 responses were received in summer 2015. Of these respondents, 60% were from Austria, 50% were involved in the forest-based sector through formal education, profession or forest ownership. Slightly fewer women 46% took part in the survey and the mean age was 36 years, and 53% were in working life. The sample displays an above average level of education with 51% holding a university degree and 40% students.

Depending on their sector involvement and sociodemographic characteristics, respondents were split in two groups. To compare their answers, crosstabs and Chi-Square tests of independence were used at a significance level of $\alpha = 0.05$. For that, the six-point Likert-scale was recoded into a 3-point Likert scale distinguishing between agreement, neutrality, and disagreement. This was done to reduce the number of cells to achieve a sufficient level of expected cell count. The answer "I don't know" was was not excluded but added to "undecided", since both answers indicate a neutral position indicating a lack of knowledge.

4. Results

4.1 Results of the content analysis

In total, there were 255 relevant hits recorded during the content analysis. The coded paragraphs were aggregated into two main categories covering the impact of wood products and forests. Based on these two categories and the according literature, two principal messages were identified, which are described in table 2 together with the number of hits observed. The majority of hits account for the message "*Wood products have a positive impact on the climate*" (short: "*role of wood products*") with 200 hits. Whereas the message "*Forests have a positive impact on the climate*" (short: "*role of forests*") received only 55 hits. The relative amounts are similar for both countries, despite the smaller sample size for Austria

Table 2: Identified key messages and number of received hits of the content analysis

Messages and categories	# of hits Germany	# of hits Austria	# of hits total
Message: "*Wood products have a positive impact on the climate*" Contains categories: Wood serves as a carbon sink, Wood is climate friendly, The use of wood products protects the climate, The use of wood as fuel protects the climate	105	95	200
Message*: "Forests have a positive impact on the climate"* Contains categories: Trees use CO_2, Forests serve as a carbon sink, The use of forests increases carbon sink, Tree species will differ	28	27	55

4.2 Results of the survey

As shown in table 3, the majority of respondents agreed to the items accounting for the message "*role of forests*" with agreement rates between 75 and 96% depending on items and the involvement of respondent. Items measuring the message "*role of wood products*" received lower agreement rates of 22 and 90% respectively. Highest agreement was observed for statements that trees and forests use carbon dioxide and thereby protect the climate, whereas lowest agreement was observed for statements on the positive effect of wood for energy purposes and carbon storage effect of wood. This suggests that the message on forests contribution to climate change mitigation, receives more public support than the message on the contribution of wood products.

When considering the respondents' involvement in the forest-based sector, the majority of statements revealed significant differences. In general, respondents involved in the sector had higher rates of agreement and lower rates of neutral answers, compared to uninvolved respondents. Table 3 shows the distribution of answers for selected statements, grouped by respondents' involvement in the forest-based sector. Significant relationships with the respondents' involvement are marked with an asterisk and "I" (*I).This indicates that regarding the message on the "*role of wood products*", respondents involved in the sector are significantly more likely to agree than uninvolved respondents, whereas this effect was not observed for the message "*role of forests*".

Table 3: Respondents' perception of key messages according to their involvement in the forest-based sector in % (n=194).

Item	Uninvolved			Involved			Sign.
Message: "Role of wood products"	**-**	**~**	**+**	**-**	**~**	**+**	**<5%**
Considering carbon dioxide (CO2) emissions, wood is more environmental friendly than other common building material (e.g., concrete, steel, plastics)	5	23	72	4	6	90	*(I,C)
If a tree is used for wood products (e.g. furniture) carbon is stored during the products life cycle.	7	42	51	5	13	81	*(I, E, G)
The use of wood for construction such as for furniture or houses positively influences the global carbon balance.	6	46	47	6	17	77	*(I,E, G,C)
The relationship between the use of wood as construction (e.g., houses built with wood) and carbon sequestration is strong.	7	45	47	3	20	77	* (I)
Wood can be re-used plenty of times as material before it is burnt for energy.	4	29	67	13	10	76	*(I,A, G,C)
Wood is carbon neutral	21	30	50	10	19	71	* (I)
Wood consists of 50% carbon.	7	71	22	5	38	57	*(I,R, C)
The use of wood for energy purposes (e.g., burning pellets, wood chips or solid wood) positively influences the global carbon balance.	21	41	38	20	23	58	* (I)
The relationship between the use of wood for energy purposes and carbon sequestration is strong.	12	42	45	22	24	55	* (I)
Message: "Role of forests"	**-**	**~**	**+**	**-**	**~**	**+**	**<5%**
Forests absorb carbon dioxide (CO2) from the atmosphere and thereby positively influence the climate.	2	5	93	3	1	96	*(G)
Plants use carbon dioxide (CO2) for photosynthesis and thereby positively influence the climate.	2	8	90	2	3	95	
Increasing forest cover positively influences the global carbon balance.	1	16	84	1	9	90	
The relationship between forests and carbon sequestration is strong.	1	24	75	2	12	86	*(G)
Tree species composition will differ in the future because of a change of climate.	2	19	79	5	4	91	*(I,G)

Strongly disagree/disagree (-), undecided/I don't know (~), agree/strongly agree (+), significant differences based on involvement in the forest-based sector (I), gender (G), education (E), age (A), residency (R), or country (C).

In comparison to respondents' involvement in the sector, fewer significant results were observed for other socio-demographic variables such as gender (G), education (E), age (A), country (C) and residency (R). For some items regarding the "*role of wood*", men, people with university degree, over 30 years old, from Austria, or with rural residency showed higher agreement rates. However, regarding items measuring "*role of forest*", only gender was observed to be significant. For example, whether forests absorb carbon dioxide, received higher agreement rates among men.

These differences are considered to relate to respondents' different answer behavior as a result of their involvement in the forest-based sector as well as differences in the Austrian

and German sample. Comparing involved and uninvolved respondents reveals significant differences concerning gender, education, and residency (see table 4). Furthermore, the Austrian sample did significantly differ from the German regarding age, gender, and percentage of involved respondents (see table 5).

Table 4: Differences of socio-demographic characteristics between the involved and uninvolved respondents (n=194)

Socio-demographic variable	Involved	Uninvolved	Sign.
Mean age in years	36	36	ns.
Gender (women)	32%	60%	<0.05
Residency (urban)	57%	73%	<0.05
Education (university degree)	58%	43%	<0.05

Table 5: Differences of socio-demographic characteristics between respondents from Austria and Germany (n=194)

Socio-demographic variable	Austria	Germany	Sign.
Mean age in years	34	40	<0.05
Gender (women)	40	56	<0.05
Residency (urban)	60	72	ns.
Education (university degree)	49	53	ns.
Involved	56	41	<0.05

5. Discussion

According to the information available on the websites, the forest-based sector in Austria and Germany communicates two principal messages concerning its role in climate change mitigation, of which the first message received by far most attention:

1. Wood products have a positive impact on the climate,
2. Forests have a positive impact on the climate.

It appears conclusive that the companies and associations examined in this study communicate less on the role of forests, since most of them are selling wood-based products and only a small amount is in forest management. The direct advantage of wood over other materials is more likely an argument in marketing, than indirect effects to be considered via sustainable forest management. The impacts of sustainable forest management may be considered as more complex and hence difficult to communicate but also including the risk of potential negative associations linked to forest management, in particular harvesting

(Bowyer, 2008; Ranacher and Stern, 2016). It could have negative effects on sales when products are associated with the deforestation and associated loss of valuable carbon sinks. The Eurobarometer survey shows that problems such as species loss and deforestation continue to be a big issue for many citizens of the European Union (European Commission, 2014).

The survey reveals, that these messages were perceived differently (measured in levels of agreement). Statements covering the message "*role of forests*" are perceived more positive than covering "*role of wood products*". This suggests that respondents are well aware about the climate change mitigation benefits that can be derived from forests, but are divided concerning the benefits that can be derived from wood products. The capacity of wood products in substituting fossil-based energy or storing carbon from CO_2 emissions remains unclear to a large percentage of respondents, especially those not involved in the sector.

The sociodemographic variables, gender, level of education, place of residence, and age were observed to have an influence on the perception of the statements. This effect is considered to be parallel to the influenced by sector involvement, since more men than women are working in the forest-based sector (Hansen et al., 2016). Furthermore, it was found that forestry profession influences nature perception more strongly than gender (Storch, 2011).

The results suggest, that the role of forests in climate change mitigation is broadly understood and independent from respondents' involvement in the forest-based sector, whereas the perception of wood products is significantly influenced by respondents' involvement in the forest-based sector. This influence of sector involvement can be considered as an existing mental model of a frame of reference. Respondents with involvement have a frame of reference for this topic and are therefore more likely to understand and agree to this message.

However, before drawing some conclusions based on the results and discussion some basic limitations of the study need to be considered. First of all, the convenience sampling limits the generalization of results to larger populations. As it can be seen from the socio-demographic description of the sample it is clearly biased compared to the population of Austria and Germany in terms of education, age, amount of students, and forest-based sector involvement. These differences must be taken into account when interpreting the results. In addition to these limitations based on the sampling procedure, further restrictions are related to the research design. As stated in the methods section, the presented approach allows investigating the state of communication (i.e. provided information and perception on a specific topic) on a general sector level but lacks precise information based on single communication campaigns. Therefore, it is not possible to provide information on the direct effects of certain communication activities. In particular, the approach considers the number of statements made but not the individual intensity or coverage of the information. Finally, the items used to investigate the perception are only representing a selection of the most common messages, the creation and use of other items may have produced slightly different results.

Furthermore, the examined websites are mostly from wood processing organizations. As a result it appears conclusive that the majority of key messages represents the "*role of wood*

products". Investigating more forest management websites could influence the results regarding the amount of coverage regarding "*role of forests*". However, this study aimed to examine the communication of the forest-based sector and there are more websites used for communication by wood processing companies than by forest companies. Furthermore, research shows that the general public in unable to distinguish between different actors in the value chain (European Commission, 2002). Therefore this sample is considered to represent the available information provided to the general public.

6. Conclusion

The aim of this study was to research the messages communicated by the forest-based sector regarding its contribution to climate change mitigation and how these messages are perceived by the general public. In conclusion, the messages differ in the amount being communicated and in their perception (measured in agreement). Respondents' sector involvement accounts for significant differences in the perception of communicated key messages. More precisely, this difference as a result of sector involvement depends on the content. Messages on the contribution of wood products to climate change mitigation is more likely to be understood from people with sector involvement, whereas the contribution of forests is equally understood.

This is interesting since the message "*role of wood*" is by far more communicated by the 41 forest-based sector organizations considered in the content analysis. Still, this could be explained due to differences in the intensity of particular communication campaigns or even by a time lack between information and perception, assuming that the "*role of forests*" was the main message in an earlier stage. Since the sample was focused on wood processing rather than forest management, this difference in the amount of coverage of the two statements is only of limited value. However, when considering the websites of forest-based sector as a communicator to the public, it shows on which messages the focus is put on.

As a matter of fact, communication on "*the role of wood*" has not yet reached uninvolved respondents, but is well perceived by involved respondents. Still, due to the applied research approach it is not possible to conclude whether this is the case because of a lack of communication coverage (e.g. exposure to communication by respondents, selection of communication channels, communication intensity) or failure in affecting the perception of respondents by the information provided (e.g. dissonance, reactance, lack of interest or connection with pre-knowledge).

Still, we can state that people without sector involvement may face difficulties in connecting the provided information to their existing knowledge (e.g. on the role of forests) since information on the "role of forests" is relatively scarce; only a quarter than the information provided on the "role of wood". To target this group to manage public opinion on the use of wood products to protect the climate, messages in which they are interested and can easily relate to should be chosen. Considering the three-stage memory model (Bettman, 1979) of information processing theory, the existing knowledge on the role of forests could be used as a starting point to connect with new messages on the role of wood. Furthermore, items of the message "*role of wood products*" that show a high share of undecided answers among uninvolved respondents, should be preferred over such with clear disagreement in order to avoid cognitive dissonance or reactance (Brehm, 1966; Festinger, 1957). Hence, the issue of

carbon storage in long term wood products through explaining the carbon content of wood referring to principles of photosynthesis is seemingly a potential story line. For a detailed development of according narratives, further predominantly qualitative research, e.g. by means of focus groups, is necessary.

This study presented an approach to investigate the status of general (one way) communication efforts within a specific sector on a general topic. Despite its weaknesses e.g. by not providing a direct link between a single information campaign and the associated perception effect it offers detailed insights on the status of a general communication issue (information provision and perception) and therefore allows several practical conclusions and pathways for further research and development.

Acknowledgements

The study was funded under the Wood Wisdom era-net and is a result of the research project “What We Wood Believe - Societal perceptions of the forest-based sector”. Co-financed by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management under grant agreement 101002/1.

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Article IV

Forest Policy and Economics 78 (2017) 180–189

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Perceptions of the general public on forest sector responsibility: A survey related to ecosystem services and forest sector business impacts in four European countries

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ARTICLE INFO

Article history:
Received 13 May 2016
Received in revised form 17 January 2017
Accepted 17 January 2017
Available online xxxx

ABSTRACT

This paper investigates public perceptions related to forest ecosystem services (ES), which have been identified as one of the key topics in forest sector communication. ES represents a prime example of an issue that merits more in-depth analysis. In this study, we (I) evaluate the views of the general public on the importance of forests contributing to different ES; (II) determine the public's need for information on the impact of forest sector businesses on ecosystems; and (III) assess how responsibly the public believes that forest sector companies act in relation to their impacts on ecosystems. A structured questionnaire using a 5-point Likert-scale was made available as an online survey targeting respondents from four European countries (Austria, Germany, Finland and Slovenia) in each national language and English. Between May and September 2015, 219 responses were received and analyzed using descriptive statistics, exploratory factor analysis, *t*-test, and ANOVA. Respondents showed high levels of agreement for items accounting for regulating and supporting ES. Information needs on forest sector business impacts were found to be high, whereas there was much greater division about the level of perceived forest sector responsibility. Regarding the public perception of forest ES, three dimensions were identified: "primary ES", "consumable ES", and "social cohesion related ES". Some relationships between the respondents' socio-demographic characteristics and the three dimensions of ES were uncovered: for example, "Consumable ES" are more important for female respondents and those who do not derive income from the forest sector.

1. Introduction

A growing public interest in environmental and social issues has led to intensified pressure on business actors in nature-dependent sectors, such as the forest industry, to gain legitimacy by meeting different and sometimes even conflicting stakeholder expectations (Winn and Pogutz, 2013). Thus, a focal issue is how these business organizations manage to secure ecosystem services (ES), which comprise the physical components of the ecosystems, the functions and interactions of those components, and the contribution of the ecosystems to human welfare (Danley and Widmark, 2016). Alongside societal pressures, business organizations have also started to realize that the loss of ecosystems and biodiversity poses a risk to their long-term profitability. This has motivated them to employ information and tools provided by different ecosystem conservation programs, such as The Economics of Ecosystems and Biodiversity (TEEB) initiative, in their sustainability management (e.g., Robinson, 2012) and disclosure (D'Amato et al., 2015).

Ecosystem-based considerations should be the starting point for making decisions about the various resource usage options when seeking to harvest the ecological, socio-cultural, and economic benefits provided by European forests (Andersson et al., 2000). Currently in Europe, the forest sector plays a pivotal role in the development of a sustainable, bio-based society (e.g., Ollikainen, 2014; Bugge et al., 2016), in which the economic (e.g., profitability of businesses), environmental (e.g., securing ecosystem services), social (e.g., rural employment), and cultural (e.g., forest-related traditions) aspects of using natural resources are taken into account (e.g., Lähtinen et al., 2014). In creating appropriate conditions for developing a bio-based European society, the following are required: an understanding of forest ecosystem functions

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http://dx.doi.org/10.1016/j.forpol.2017.01.016
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and how to integrate different sustainability dimensions (i.e., economic, environmental, social and cultural) into decision-making processes, more attention to be paid to public views on forest ecosystems (Marchetti et al., 2014), an understanding of the potential conflicts that might arise among people who value different ES (Von Döhren and Haase, 2015), and, finally, information about the development of consumer preferences in the evolving bioeconomy markets (Kleinschmit et al., 2014).

For a bio-based society, the concept of social license (SL), which was introduced in the early 2000s by Gunningham et al. (2004), is considered as particularly important and refers to the need for business organizations to build and secure the legitimacy of operations through better fulfilment of social obligations and management of stakeholder relations. As an empirical case, Gunningham et al. (2004) used pulp and paper production, which until the late 1990s involved severe emissions of dioxin from chlorine-based bleaching processes causing severe legitimacy gaps in companies' operations. The SL approach has also been employed to the mining industry to evaluate how companies have responded to the needs and pressures of society (Hall et al., 2015).

As pointed out by Hall and Jeanneret (2015), SL, or social license to operate (SLO) provides a stakeholder-centric extension of insights into corporate sustainability practices. In other words, while corporate responsibility reporting may enhance the acceptability of business operations, it is the SLO that acts as a proxy for the perceived acceptability of a company's operations in their business and in the natural environment (Mikkilä, 2003; Lähtinen et al., 2016a). For reputation-sensitive industries, it is especially crucial that they provide information that goes beyond the obligations of law (Gunningham et al., 2004). Thus, to gain an SLO, businesses need to close their legitimacy gap by minimizing the difference between stakeholder expectations about "what ought to be" and stakeholders' current perception of business activities, i.e. "what is" (Panwar et al., 2012).

At the moment, no up-to-date understanding exists of the public perceptions or expectations affecting the legitimacy and SLO of the forest sector in Europe, especially in a cross-national context. In a review of consumer and business surveys from the early 2000s, Rametsteiner et al. (2007) found that consumers thought wood was a renewable material in general, but many seemed unsure whether increasing timber harvesting was acceptable for substituting non-renewable materials. Regarding wood energy, Hitchner et al. (2014) found that the public discourse in Europe is positioned around its potential for green economic growth, energy security, rural development, and climate change mitigation. In a recent study (Korhonen et al., 2016), eight topical themes (namely, innovations, forest ecosystem services, forest conservation, global warming, economy, added value, wood construction, and efficient use of wood) were identified as important in online stakeholder communication in reference to the aim of developing a bio-based, sustainable society in Europe. Finally, in the context of western Canada (Hajjar and Kozak, 2015), it was found that there are a multitude of experiential, attitudinal, demographic, and perceptional actors affecting people"s views about accepting or rejecting forest adaptation strategies to climate change.

With global awareness of ES building momentum and business organizations increasingly required to gain SLO, more in-depth analysis is required into how the responsibility of forest sector operations is actually perceived by European stakeholders. For example, according to Valkeapää and Karppinen (2013), there is a divide between the legitimacy of forestry and nature conservation policies, which reflects the conflicting interests between the intensive use of forests and biodiversity conservation. Thus a wider perspective on the benefits of the forest, such as its health and recreational uses, is needed for forest industries to obtain legitimacy among the general public.

Regarding the practical consideration of the expectations of the general public, understanding their perceptions of the contents and characteristics of forest ES is fundamental in enhancing the forest sector SLO. While concepts and issues related to forest ES are being broadly tackled by business organizations and societal decision-makers, there is still a lack of comprehensive information at the European level about the perceptions of the general public (i.e., private people) of the different types of forest ES, as well as their views on the responsibility of the forest sector operations in relation to forest ES.

Therefore, the overall purpose of this study is to shed light on the views of the general public on forest ES and the linkages between forest ES and their potential to enhance the SLO of the forest sector. In total, there are three related aims that combine to meet the overall objective of this study: (I) to evaluate the views of the general public on the importance of the contribution of forests to different ES; (II) to determine the public's need for information on the impact of forest sector businesses on ecosystems; and (III) assess how responsibly the public believes that forest sector companies act in relation to their impacts on ecosystems.

2. Conceptual background

According to the Millennium Ecosystem Assessment (MA, 2005), human beings acquire benefits from biodiversity via ES, which contributes to well-being by providing material for a good life, freedom of choice, health, social relations, and security. Conceptually, biodiversity sits at the core of ES by providing support to the key processes in ecosystems, affecting the delivery of some ES, and also being a service itself (Mace Georgina et al., 2012).

In this study, the ES approach is grounded in the MA framework (2005), which is applicable, for example, when making evaluations both from strategic and societal viewpoints (Bull et al., 2016). From a scientific point of view, the MA framework is based on the largest study ever made on the ES approach, whose aim was to identify the connections between ES and human well-being (Pereira et al., 2005). A drawback of the ES approach is that it does not sufficiently acknowledge the trade-offs between different ES and the negative impacts of ES on human well-being (see, e.g., Von Döhren and Haase, 2015); another is that it represents "a reflection of a utilitarian and anthropocentric view of nature" (Bull et al., 2016). Yet, Reid (2006) has emphasized that adding utilitarian and economic arguments as motivations for securing ES does not take away their non-monetary value.

Despite its deficiencies, such as the simplified description (Danley and Widmark, 2016), the results of Bull et al. (2016) show that many strengths and opportunities lay in the use of the ES approach. These strengths comprise its applicability in strategic and political decision-making, its potential to increase environmental awareness in society, and use in interdisciplinary research. In addition, in the future the applicability of the ES approach can be enhanced by conceptual development targeted at different decision-making contexts (i.e., organization management, policy making, and science) (Danley and Widmark, 2016). From the perspective of interdisciplinary development, there is potential in increasing the consideration of trade-offs between different ES by incorporating anthropocentric views (e.g., in connection to social sciences and economics) related to the expectations of different groups of people about ES in ecological management (Von Döhren and Haase, 2015).

In the ES approach, humans and their cultural diversity are considered as an integral part of ecosystems, while business sectors and governments are seen as a focal group in transforming the ES approach in practice (Vihervaara and Kamppinen, 2009; Winn and Pogutz, 2013). In the MA framework, ES are categorized into provisioning, regulating, socio-cultural, and supporting ES, as illustrated in Fig. 1. In addition to this categorization, the MA framework also attempts to provide information on the relationships between ecosystems and constituents of well-being, both from the perspective of the mediative potential of a particular ES to well-being as well as the intensity of those linkages (Pascual et al., 2016).

The changes in ES are caused by direct (climate change and deforestation) and indirect (global trade and demographics) drivers (Carpenter et al., 2006). In Europe, the sustainable supply of provisioning, regulating,

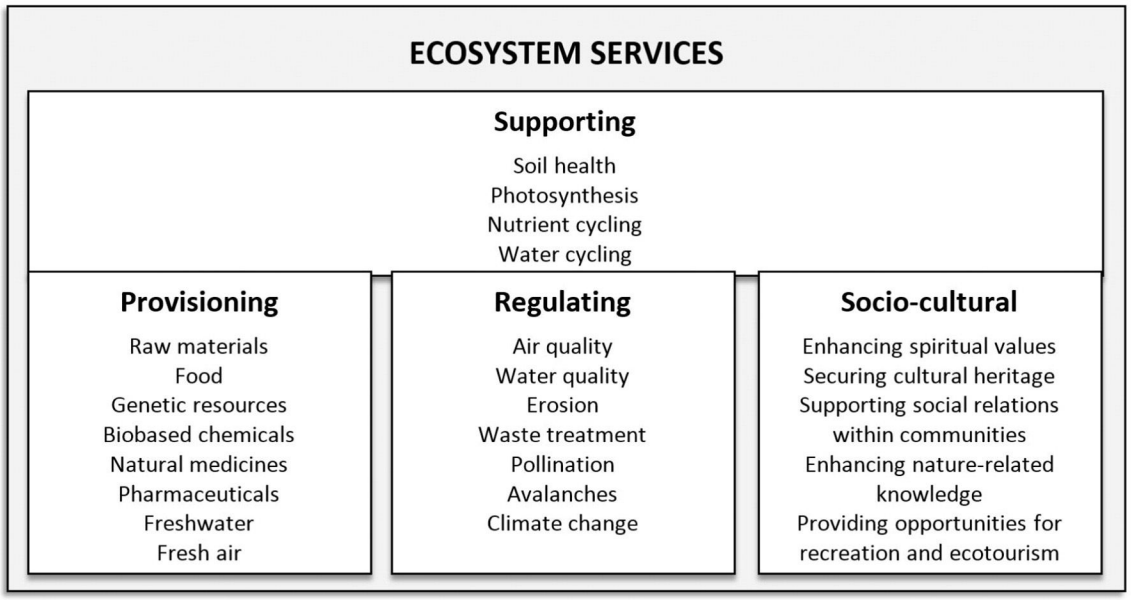

Fig. 1. Categorization of supporting, provisioning, regulating, and socio-cultural ES modified from the Millennium Ecosystem Assessment (MA, 2005).

socio-cultural, and supporting ES in the future is considered to be a challenge (Maes et al., 2013). According to Schröter et al. (2005), for Europe, long-term scenarios forecast major changes in ES, which may be positive, especially for the forest sector (e.g., increase in forest area and productivity) and offer new business opportunities (e.g., new potential for bioenergy production). But, along with these positive impacts, the supply of ES may decrease resulting in declining soil fertility, declining water availability, and increasing risk of forest fires. Yet, depending on the scenario assumptions, the vulnerability of ES to global change differs between regions (e.g., boreal and southern regions) (Metzger et al., 2008).

The provision of ES is influenced by changing and competing land use. In Europe, for example, increasing urbanization makes substantial investments for securing green infrastructures necessary in order to secure a sustained supply of ES (Maes et al., 2015). In addition, an increased competition between forest functions within the existing forest areas will occur due to changing demands on forest land, resulting in a need to manage trade-offs between non-market driven functions and traditional market driven functions (Sandström et al., 2011). Although trade-offs between different services within ES categories (e.g., wood fiber and berry production within provisioning services) and between different ES categories (e.g., wood fiber production and soil management) may exist, forest sector organizations' actions may also support preserving ES by, for example, reducing deforestation and counteracting climate change (Cohen and Winn, 2007; McMullen and Shepherd, 2006). From the business point of view, knowledge about natural and business environments, understanding of changing market circumstances, and a consideration of stakeholder needs enable companies to recognize sustainable development opportunities (Patzelt and Shepherd, 2011).

From forest sector businesses' point of view, ES have started to gain more attention in companies' sustainability disclosure documents (D'Amato et al., 2015). Although the lack of market prices for many ES was identified as the main obstacle to their breakthrough in the forest sector, and more broadly in all land-use planning, among representatives of large Finnish forest sector companies, the importance of ES for businesses is expected to increase in the future (Vihervaara and Kamppinen, 2009). In addition, there is also remarkable variation within the European region when it comes to the preferences of people regarding the forest management practices that affect the recreational value of forests, which is related to the provision of cultural ES (Edwards et al., 2012).

Although, issues of environmental management are taken seriously in the forest sector, further focus may be needed on the broader application of the ES approach to corporate responsibility assessments (Vihervaara, 2010; D'Amato et al., 2015, 2016). The concept of forest sector sustainability has already become more complex than its previous concentration on sustained wood yield and steady forest cover; however, a common instrument for quantitative sustainability assessment for the whole sector is still missing (Päivinen et al., 2010). This is a challenge for forest sector sustainability information provision and it is necessary to enhance the acceptability of business operations in order to decrease the legitimacy gap within society. For the forest sector, cultivating a general awareness of the impacts of its operations on ES can contribute to improved stakeholder engagement, yielding a competitive advantage in the markets. Yet, without forward-looking business thinking and efficient and comprehensive consideration of public perceptions, forest sector actions that have positive benefits for society—for example, in helping to develop a more bio-based economy—will not translate into a better SLO (Toppinen et al., 2016).

3. Material and methods

A survey instrument was developed for collecting empirical data from the general public. While designing the instrument, questions and measurement scales were developed to assess (I) the level of agreement regarding the importance of forests in relation to provisioning, regulating, socio-cultural, and supporting ES; (II) the level of agreement about the topics on which further information was required to assess the impacts of forest sector businesses on ecosystems; and (III) the level of agreement about whether forest sector companies act responsibly concerning these topics. In the data, variables related to these three aspects were classified into three modules as illustrated in Table 1.

In Module 1, respondents' perception of ES (I) was identified using a list of 24 items based on the Millennium Ecosystem Assessment (2005) and Bennett et al. (2015), comprising a theoretical framework for categorizing "provisioning", "regulating", "socio-cultural", and "supporting" ES (see Table 1). From 24 items, eight were related to "provisioning", seven to "regulating", five to "socio-cultural", and four to "supporting" ES. In Module 1, respondents were asked for their views on the importance of forest ecosystems in providing these ES using a five-point Likert-scale (1 = strongly disagree, 3 = undecided, 5 = strongly agree), including an additional "I don't know" option. Thus, respondents

Table 1
Overview of modules used in the survey.

Module 1	
Forest ecosystems are important in providing the following for society	
Raw materials	Natural medicines
Food	Pharmaceuticals
Genetic resources	Freshwater
Biobased materials	Fresh air
Forest ecosystems are important in regulating	
Air quality	Pollination
Water quality	Avalanches
Erosion	Climate change
Waste treatment	
Forest ecosystems provide cultural value by	
Enhancing spiritual values	Enhancing nature-related knowledge
Securing cultural heritage	Providing opportunities for recreation and ecotourism
Supporting social relations within communities	
Forest ecosystems are important in supporting	
Soil health	Nutrient cycling
Photosynthesis	Water cycling
Module 2	
It is important to have information related to the following topics in order to assess forest sector business impacts on ecosystems	
Habitat loss related to forest sector business activities	
Threats to wildlife and fauna due to forest sector business activities	
Water pollution contributions	
Water nutrient contributions	
Emissions to air	
Landscape changes affecting the appearance of forest areas	
Changes to nature that accumulate over time caused by forestry operations	
Module 3	
I think forest sector companies act responsibly with relation to	
Habitat loss related to forest sector business activities	
Threats to wildlife and fauna due to forest sector business activities	
Water pollution contributions	
Water nutrient contributions	
Emissions to air	
Landscape changes affecting the appearance of forest areas	
Changes to nature that accumulate over time caused by forestry operations	

were not forced into statements and the reliability of the scale developed was checked in conjunction with factor analysis.

In Modules 2 and 3, the information needs of respondents in relation to their perceptions of the responsibility of forest sector operations were assessed with reference to different ecological and social sustainability impacts (see, Lähtinen et al., 2014; Lähtinen et al., 2016b). Using the same 5-point scale as in Module 1, respondents were asked in Module 2 to give the topics they required further information about in order to assess the impact of forest sector businesses on ecosystems (II), and in Module 3 whether they thought that forest sector companies acted responsibly in relation to these topics (III). Module 2 and 3 were compared in order to identify which topics should be addressed by the forest sector when making decisions related to the issue of ES and when evaluating the acceptability of forest sector operations. Furthermore, Module 3 was used to build a summative variable describing how responsible respondents perceived the forest sector to be. Depending on the possible scores given by individual respondents, ranging between 7 and 35, the full set of scores was separated into two groups using the median value of 25 to split the sample, resulting in a group of respondents who believed forest sector responsibility to be low and a group of respondents who believed forest sector responsibility to be high.

As a first step in the data analysis, the answers were analyzed using descriptive statistics to compare agreement rates for the individual items in each module. Assuming equal distances between the answer categories, the ordinal Likert-scale was considered as a continuous scale to calculate means for each item, excluding "I don't know" responses. Since a score 3 was the neutral answer, a mean score above 3 was considered to be a positive perception (i.e., suggesting higher importance, information demand, or responsibility), and a mean score below 3 a negative perception (i.e., suggesting lower importance, information demand or responsibility).

In addition, questions about the socio-demographic characteristics of the respondents were also included in the survey (e.g., age, gender, education, residential area, employment status, and involvement in the forest sector through formal education, profession or forest-ownership). In the last phase of the survey prior to implementation of actual data gathering—the instrument preparation phase—in all four countries a pre-test was conducted in April 2015 ($n = 20$) to make sure the questions could be understood. As a result, some changes were made to the questionnaire, such as the wording ("biochemicals" was altered to "bio-based chemicals", and "fibers" to "raw materials", for example), to improve understanding. No differences of understanding were experienced across countries. The results of the pre-test questionnaires were not included in the final sample.

The data gathering was implemented during May–September 2015, targeting respondents in four forestry rich European countries (Austria, Finland, Germany, and Slovenia). The link to the survey was promoted via e-mail (e.g., professional e-mail lists, including different forest stakeholder representatives and students), social media, and online forums with the purpose of reaching both people involved and not involved in the forest sector. A total of 227 responses were received. A small proportion of respondents lived in other countries than the target countries. These were excluded from the analysis resulting in a sample size of 219.

In the next phase of data analysis, exploratory factor analysis (principal axis factoring) with Varimax rotation based on the answers in Module 1 was employed to identify the dimensionality of the perceived

Table 2
Description of the sample by different socio-demographic variables.

Demographic variable		%
Age group (mean age 38 years)	Under 30	44
	30–59	43
	60 or more	14
Gender	Male	54
	Female	46
Highest level of education	Less than high school degree	2
	High school graduate	33
	Trade, technical of vocational training	6
	University degree	59
Residential area	City or urban area	57
	Suburban	13
	Rural	30
Involvement in the forest sector	Profession	23
	Formal education	28
	Forest ownership	12
	None	43
Income from forest sector	Yes	24
	No	76
Employment status	Wage earner or self-employed	51
	In education	36
	Pensioner	10
	Other	3
Country of residence	Austria	23
	Finland	8
	Germany	37
	Slovenia	32

ES, a latent structure behind the measured variables. As depicted in Eq. (1), it was assumed that every observed value of an observed output variable Xj can be described with a linear combination of several factors Fp (Janssen and Laatz, 2007) and the factor loading Aj1 indicates to what extent the factor is connected with the output variable (Backhaus et al., 2016):

$$Xj = Aj1\,F1 + Aj2\,F2 + \ldots + AjkFk \quad (1)$$

Reliability analysis was conducted with Cronbach Alpha to assess the consistency of the Likert scales used in Modules 1 to 3, as well as for the factors extracted from the factor analysis of Module 1. The minimum value for scale reliability is a Cronbach Alpha of 0.7 and the estimation of reliability was based on the correlation of all items (Janssen and Laatz, 2007).

After determining the factor model dimensionality, mean factor scores were calculated. Differences between the mean factor scores (dependent variable) and respondents' socio-demographic characteristics (independent variable) were tested using the *t*-test for two groups and one-way analysis of variance (ANOVA) for more than two groups. The analysis was conducted with the SPSS 21 program and graphs were produced with MS Excel.

4. Results

4.1. Sample characteristics

As illustrated in Table 2, the mean age of respondents was 38 years, 54% were male, and more than half had university level education, lived in urban areas, and were working. In addition, 57% of respondents were involved in the forest sector—either through profession, education, or forest ownership—and 24% had gained some income from the forest sector. Most of the respondents lived in Germany, Slovenia, or Austria; Finland was less represented. As the purpose of this study was to assess the overall views of the general public related to the acceptability of forest sector operations in the context of ES (rather than, say, trying to grasp country-level differences or aiming to achieve representative results for the whole of Europe), differences in the number of respondents from the various countries did not violate the analysis of the study. In addition, socio-demographic characteristics did not differ significantly across countries, which further justified pooling the data.

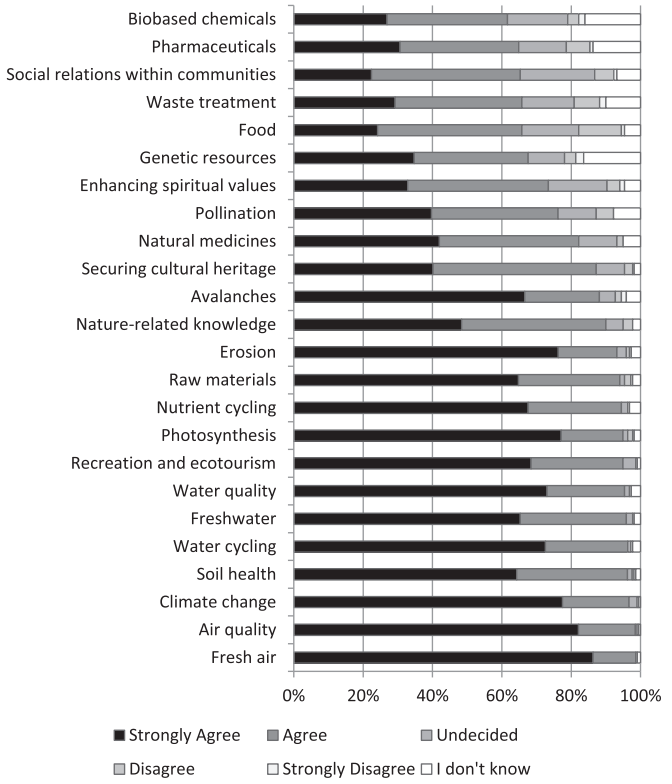

Fig. 2. Level of agreement on the importance of forests in producing "provisioning", "regulating", "socio-cultural", and "supporting" ES as categorized in the MA framework (2005) ($n = 219$).

4.2. Perceptions of respondents on forests contributing to ES

In general, the respondents considered forests to be important contributors to ES, which was reflected in the high percentage of "strongly agree" and "agree" answers for all 24 variables in the MA framework in Module 1. The Cronbach Alpha for these items was 0.881, indicating scale consistency.

As illustrated in Fig. 2, the highest level of agreement (93–98%) mainly concerned respondent opinions on variables related to "regulating" ES (e.g., "air quality", "water quality", "climate change") and "supporting" ES (e.g., "water cycling", "soil health"), with the exception of "fresh air", which saw its highest agreement categorized as "provisioning" ES. Mean values for these recognized variables range from 4.60 to 4.86. A medium level of agreement (74–90%) was mainly found with the MA variables encompassing "socio-cultural" ES (e.g., "enhancing nature-related knowledge", "supporting social relations"), with mean values ranging from 4.05 to 4.57. The lowest level of agreement (62–68%) on the importance of forests in contributing to ES occurred in the domain of "provisioning" ES (e.g., "food", "pharmaceuticals"), with mean values ranging between 3.79 and 4.13. In addition, regarding bio-based chemicals, genetic resources and pharmaceuticals, there were a considerable number of "I don't know" answers (14–16%).

Overall, the statements made by respondents on the level of their agreement about the importance of forests in producing different types of ES indicated either the actual level of their knowledge on forest ES, or their perceptions of their state of knowledge on those issues. As an example of this, although the importance of some ES varies in different geographical areas (e.g., "prevention of avalanches"), others—climate change mitigation and pollination, for example—are fundamental the world over (Foley et al., 2005). Based on this, those respondents, who

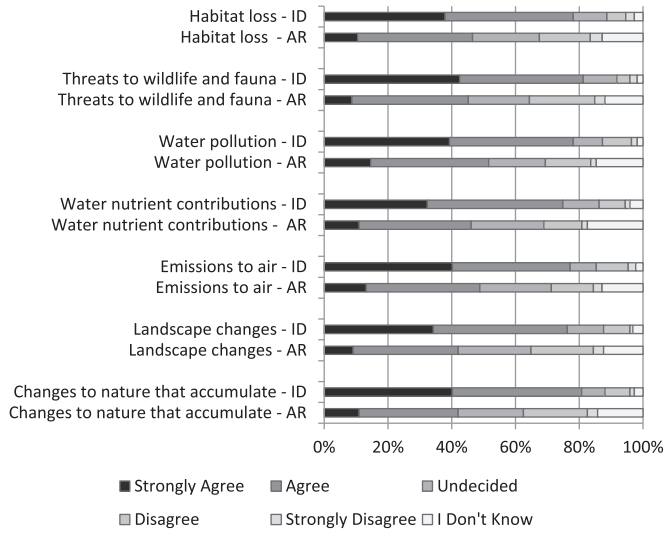

Fig. 3. Comparison of information needs concerning impacts of forest sector businesses on ecosystems and views on the level of responsibility of business operations ($n = 219$); AR = act responsibly, ID = information demand.

have given "disagree" or "strongly disagree" answers on these globally relevant issues may actually lack some fundamental knowledge without recognizing it. In contrast to this, "I don't know" answers indicate that in the case of some forest ES (e.g., "bio-based chemicals", "genetic resources" and "pharmaceuticals"), there was a comprehensive lack of knowledge among the respondents.

4.3. Information needs and perceived level of responsibility concerning impacts of forest sector businesses on ecosystems

The information needs and the opinions of the respondents on the level of responsibility of forest sector business operations were assessed in Modules 2 and 3 with five environmental and two socio-cultural items. The environmental themes were: "habitat loss related to forest sector business activities", "threats to wildlife and fauna due to forest sector business activities", "water pollution contributions", "water nutrient contributions", "emissions to air"; and the socio-cultural themes were "landscape changes affecting the appearance of forest areas", and "changes to nature that accumulate over time caused by forestry operations".

As shown in Fig. 3, the respondents rated all items as having roughly equal importance when assessing the impact of forest sector business operations. The lowest value for the importance of receiving information was for "water nutrient contributions" (75%) and the highest for "threats to wildlife and fauna due to forest sector business activities" (81%). The respective mean values of the responses varied between 4.00 and 4.17. Reliability analysis of the scale revealed a Cronbach alpha of 0.912, indicating scale consistency. In comparison, the overall level of agreement about whether forest sector companies acted responsibly ranged from 42% for "changes to nature that accumulate over time caused by forestry operations" to 52% for "water pollution contributions" with mean values between 3.29 and 3.5. However, the high amount of "undecided" (18–23%) and "I don't know" (12–17%) answers reflected respondents' limited ability to make a judgement. The reliability of the scale was validated through a Cronbach alpha value of 0.919.

4.4. Classification of the ES variables

In order to acquire a deeper understanding of how the respondents conceptualized the ES, exploratory factor analysis was implemented. Beforehand, however, all "I don't know" answers were omitted list wise from further analysis, resulting in $n = 148$. By MA categorization, the smallest proportion of "I don't know" responses was for air quality and climate change (<1%) and the highest proportion for genetic resources (16%) (see, Fig. 2). The sample's suitability for factor analysis was tested with the Kaiser-Meyer-Olkin (KMO) measure for sampling adequacy and Bartlett's test of sphericity. Both the sampling adequacy (KMO = 0.870) and the correlation matrix of the MA variable values (Bartlett's test of sphericity $p = 0.000$) confirmed the sample's suitability for factor analysis (Beavers et al., 2013).

In factor analysis it is important to choose a sufficient number of factors to adequately represent the data, while excluding factors that are not relevant (Beavers et al., 2013). According to the literature (Janssen and Laatz, 2007; Beavers et al., 2013; Williams et al., 2012), several criteria are used to determine the number of factors necessary, and it is recommended that multiple approaches should be used. As in the exploratory factor analysis, there are numerous potential solutions (Treiblmaier and Filzmoser, 2010), and in the analysis it is critical to check for the stability of the solution. In our analysis, this was achieved by changing the number of factors to be extracted and the number of MA variables entered into the analysis, while also exploring the sensitivity of alternative four- and five-factor solutions.

Based on criteria Eigenvalues exceeding one, scree plot, number of variance explained, and theoretical assumptions, four- and five-factor solutions were investigated first. However, the interpretability of the factors was unclear, the extracted factors overlapped, or the factors did not meet the requirement of having a minimum of three variables with sufficient loadings (see, e.g., Beavers et al., 2013). Therefore, a three-factor solution was also investigated. Additional parallel analysis (Patil et al., 2007), which compared randomly generated Eigenvalues with Eigenvalues from the data, suggested a three-factor solution. The literature (Treiblmaier and Filzmoser, 2010) suggests that, in many cases, picking a high number of factors leads to fewer errors, but, conversely, that picking too many factors might lead to the creation of constructs with little explanatory value—as was found to be the case here.

Table 3
The final three-factor solution of the perceived importance of forest ecosystems in providing different ES for human well-being ($n = 148$).

Variables	Factor 1 primary ES	Factor 2 consumable ES	Factor 3 social cohesion related ES	Communalities initial
Air quality	**0.855**	0.021	−0.060	0.749
Water quality	**0.827**	−0.061	−0.023	0.769
Water cycling	**0.806**	0.075	0.212	0.765
Fresh air	**0.792**	0.092	−0.001	0.707
Nutrient cycling	**0.777**	0.102	0.224	0.790
Soil health	**0.729**	0.163	0.152	0.634
Erosion	**0.719**	0.075	−0.022	0.668
Freshwater	**0.703**	0.126	0.037	0.704
Climate change	**0.689**	0.145	0.194	0.593
Photosynthesis	**0.600**	0.207	0.152	0.601
Raw materials	**0.599**	0.135	0.000	0.455
Providing opportunities for recreation and ecotourism	**0.592**	0.018	0.176	0.487
Avalanches	**0.523**	0.071	0.116	0.587
Pharmaceuticals	0.100	**0.790**	0.141	0.591
Natural medicines	0.244	**0.730**	0.069	0.582
Food	0.047	**0.582**	0.095	0.472
Pollination	0.270	**0.497**	0.193	0.383
Biobased chemicals	−0.058	**0.446**	0.062	0.354
Securing cultural heritage	−0.018	0.062	**0.742**	0.409
Supporting social relations within communities	0.158	0.250	**0.683**	0.471
Enhancing spiritual values	0.180	0.189	**0.519**	0.371
Eigenvalue	7.888	2.692	1.528	
Explained variance (%)	32.660	10.731	7.503	
Cronbach's alpha	0.920	0.749	0.664	

Factor loadings that are over 0.4 are marked with bold.

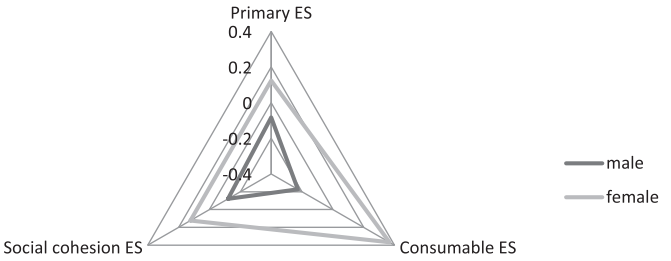

Fig. 4. Mean factor scores for "primary ES, "extracted ES" and "social cohesion ES" for male and female respondents.

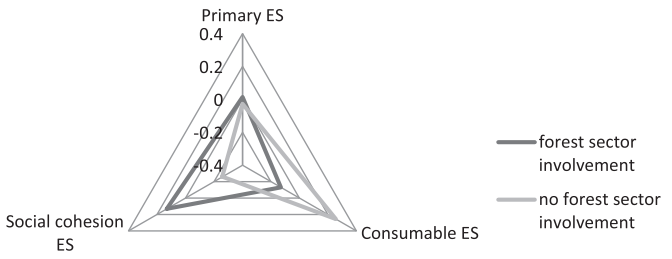

Fig. 6. Mean factor scores for "primary ES, "extracted ES" and "social cohesion ES" for respondents with and without forest sector involvement.

Since exploratory factor analysis and the selection of factors is subjective (Backhaus et al., 2016), and the most interpretable and simplest solution should be picked from among the possible options (Beavers et al., 2013), the most interpretable and robust three-factor solution was chosen. Altogether, the three-factor solution accounts for 51% of the total variance explained by the model. During the analysis, three items derived from the MA categorization ("enhancing nature-related knowledge", "genetic resources", "waste treatment") were deleted from the original set of variables either because of low factor loadings (<0.400) or because they displayed ambiguous cross-loading (see, Beavers et al., 2013). According to the reliability analysis, Cronbach's alpha for each factor varied from 0.664 to 0.920 suggesting an acceptable level of scale consistency.

As shown in Table 3, in the final three-factor solution, Factor 1 explains 33% of the total variable variation and it mainly comprises MA variables connected to "supporting" and "regulating" ES. In more detail, Factor 1 includes 13 of the original variables from the MA categorization. In addition, as exceptions to the original contents of the MA categories, "raw materials" (e.g., wood) and "providing opportunities for recreation and ecotourism" also have the highest loadings in Factor 1. Since all MA variables in Factor 1 are related either to unprocessed primary production processes of forest ecosystems (see, e.g., Running and Coughlan, 1988) or direct experiences in the forests perceived without, for example, extraction processes (e.g., Rantala, 2010), Factor 1 is named "primary ES".

In comparison with Factor 1, Factor 2 is to a large extent composed of MA variables linked to "provisioning" ES, which explains 11% of the total variable variation. More specifically, Factor 2 is composed of five original variables from the MA framework category, mostly from "provisioning" ES. Together with "provisioning" ES in the original MA categorization, as an exception the MA variable "pollination" from the original MA framework category of "regulating" ES also has its highest loading in Factor 2. Other than "pollination", all MA variables in Factor 2 are directly consumable ES, either without extraction or after extraction. In addition, pollination has been found to be directly linked, for example, to food quality and quantity (see, e.g., Klatt et al., 2013), which makes it directly connected to other MA variables in this factor Thus, Factor 2 is called "consumable ES".

Compared to the original MA framework categories, Factor 3 is the most coherent one, consisting only of MA variables (i.e., "securing cultural heritage", "supporting social relations within communities", "enhancing spiritual values") from "socio-cultural" ES in the original MA categorization. In all, Factor 3 explains 8% of the total variable variation and was named "social cohesion related ES".

In the follow-up stage, the link between the perceptions of forest ES was calculated with the mean factor scores from the factor analysis, and respondents' socio-demographic characteristics was analyzed using *t*-test and ANOVA. The assumptions for the *t*-test and ANOVA, such as homoscedasticity, were tested with Levene's test indicating equal variances and sample adequacy for all groups ($p > 0.05$ for all groups). Respondents' socio-demographics were used to create groups based on gender, age, level of education, residential area, income derived from the sector, involvement in the sector, and employment status. Additionally, individual's perceptions on the level of responsibility of forest sector business operations in relation to the variables illustrated in Fig. 3 was used.

According to the results on the linkages between respondent views on the importance of "primary ES", "consumable ES", and "social cohesion related ES" and their socio-demographic characteristics, some differences between the groups were identified in the analysis. As a high factor score mean indicates that the particular dimension of ES is important to this group, the following conclusions can be drawn: first, "consumable ES" are more important for female than for male respondents ($t(138) = 3.990$, $p = 0.000$) (Fig. 4). Second, "consumable ES" are more important for respondents who do not receive any income from the forest sector than for respondents with such an income ($t(146) = -2.512$, $p = 0.013$) (Fig. 5). Third, "consumable ES" are more important for respondents without any forest sector involvement ($t(146) = -2.513$, $p = 0.013$), whereas "social cohesion related ES" ($t(146) = -2.677$, $p = 0.008$) are more important for respondents with forest sector involvement (Fig. 6).

Similar to the linkages between the views on the importance of ES and socio-demographics, differences between respondents' views on the level of responsibility of forest sector companies by "primary ES", "consumable ES", and "social cohesion related ES" were identified (Fig. 7). Respondents who perceived forest sector businesses as having higher responsibility towards ecosystems placed relatively lower emphasis on "primary ES" but significantly higher importance on "consumable ES" ($t(134) = -2.409$, $p = 0.017$).

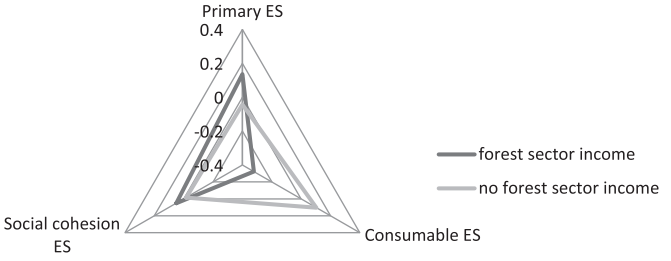

Fig. 5. Mean factor scores for "primary ES, "extracted ES" and "social cohesion ES" for respondents with and without forest sector income.

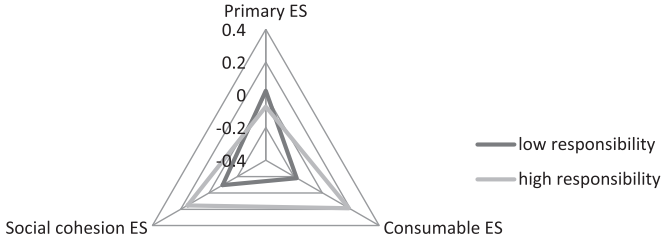

Fig. 7. Mean factor scores for "primary ES, "extracted ES" and "social cohesion ES" for respondents with low and high perception of forest sector responsibility.

5. Discussion

The purpose of our study was to shed light on the public perceptions on the role of forests in providing ES, on what kind of information is required to assess forest sector impacts on ecosystems, and on how responsibly the public believes that forest sector companies act in relation to their impacts on ecosystems.

According to our results, the respondents in Austria, Finland, Germany, and Slovenia agreed most often on the importance of the contribution of forests to "regulating" and "supporting" ES (e.g., their effects on regulating air quality, water quality and climate change, or supporting water cycling and soil health), with the exception of "fresh air" being the highest recognized item accounting for "provisioning" ES. On the other hand, unanimity in responses related to "socio-cultural" ES (e.g., enhancing nature-related knowledge or supporting social relations) was only moderate. The issues with the least agreement concerning the importance of forests were mostly connected to "provisioning" ES, comprising, for example, non-wood forest products such as pharmaceuticals or food.

In recent studies, communication about ES-related sustainability issues has been found to be a weakness in existing industry practices (Korhonen et al., 2016; Lähtinen et al., 2016a). Our results regarding the views of respondents on the role of forests in ES are in line with a recent survey by Häyrinen et al. (2016), in which socio-cultural, provisioning and regulating aspects of ES were found to have a positive value to Finnish private forest owners. Lewan and Söderqvist (2002) also argue that some ES are more difficult to comprehend than others because there are not only "visible" ES, which are recognized as a result of personal experience, but also "invisible" ES, which are recognized as a result of theoretical learning. Similarly, previous research (Lamarque et al., 2011) on the perception of ES suggests that respondents usually recall "visible'" services, such as recreation, aesthetics, or natural hazard regulation, prior to "invisible" services, such as pollination or waste treatment, as a result of the abstract entity of the latter. This could serve as an explanation for the varying levels of agreement. Those respondents in our study who gave "disagree" or "strongly disagree" answers on globally relevant issues, such as pollination, may actually lack some fundamental knowledge on the scope of ES without realizing it. In contrast, the high proportion of "I don't know" answers indicates that in the case of some forest ES (e.g., "bio-based chemicals", "genetic resources" and "pharmaceuticals"), there was likely a lack of conceptual knowledge among the respondents.

Furthermore, the majority of respondents in our study felt that it was necessary to have information on the suggested topics (i.e., the five environmental and two socio-cultural items in Module 2) in order to assess the impact of forest sector business. This suggests that respondents are keen to receive information about the effects of forest sector businesses on the natural environment, but it seems to be difficult for them to locate precisely the various forms of ecosystem impacts or to prioritize them in their detailed information needs. In contrast, regarding the perceived level of forest sector responsibility, perceptions were much more dispersed among respondents, indicating a potential legitimacy gap and a risk of losing SLO for forest sector businesses. In addition, the difference between the demand for information among respondents and their views on the forest sector operations' level of responsibility indicates that there exists a parallel interest in understanding the impact of forest sector businesses and a potential lack of legitimacy of forest sector operations. Varying levels of public acceptance of forest sector responsibility has been documented in previous studies in Finland and the western USA (Valkeapää and Karppinen, 2013; Panwar et al., 2010), and issues have commonly centered around the intensification of forest management practices and nature conservation policies, in which there is history of conflict (Hellström and Vehmasto, 2001).

In the exploratory factor analysis, the three dimensional factor solution—including the three groups of "primary ES", "consumable ES" and "social cohesion related ES"—was recognized as the best solution for depicting the differences in perception of the characteristics of ES among the respondents. Although, to a large extent, the variable loadings for the three factors followed the theoretical MA framework categorization of "supporting", "provisioning", "regulating" and socio-cultural" ES, it is worth noting that the basis of the rationale for perceiving the characteristics of ES among the respondents seems to differ from the MA framework, which is derived from the natural sciences. In this study, we found that three dimensions of ES describe perception and preferences better than the proposed four dimensions. Classification into three dimensions, as in the TEEB or the Common International Classification of Ecosystem Services (CICES), thus appears likely to be useful for future studies on the perception of ES.

The distinct differences in the logics of "natural science-based" and "general public-view" for understanding the scope of ES supports the necessity of incorporating both social and economic points of view (Von Döhren and Haase, 2015) in the conceptual development of ES (Danley and Widmark, 2016). This will make it possible to enhance the applicability of the concept of ES for various societal groups and different decision-making contexts.

Connected to the differences in the theoretical MA categories and the empirical factor analysis solution in this study, there are some points worth noting. Although from a "natural science" point of view, the MA variable "raw materials" is composed of products obtained from ecosystems, from the viewpoint of the general public, "raw materials" are probably not seen as products as such, but unprocessed tangible items only existing in forest ecosystems. Similarly, "providing opportunities for recreation and ecotourism" is, in the eyes of a general audience, quite likely to be seen as something to be experienced directly in the forest ecosystem, rather than something with socio-cultural characteristics. Due to this, it is logical that "raw materials" and "providing opportunities for recreation and ecotourism" have the highest loadings in factor "primary ES", which consists of a body of MA variables that are somehow experienced or consumed directly in the forest.

Following the logic related to "primary ES", the factor "consumable ES" comprises MA variables that are in most cases somehow processed prior to utilization—unlike those in "primary ES". As an example of processing, "food" in the theoretical MA framework category of "provisioning ES" can, from societal and economic points of view, be understood as something sold in packages, in contrast to berries and mushrooms, for example, which are consumable directly in the forest. Finally, the factor "social cohesion ES" is a coherent class of variables linked to intangible issues related to culture and values, which cannot be processed or marketed and which are quite often strongly connected to individual feelings.

In valuing the importance of "primary ES", "consumable ES", and "social cohesion related ES", the respondents differed from each other according to their socio-demographic characteristics. For example, "consumable ES" were found to be more important for females and respondents who did not derive income from the forest sector. Thus, "Consumable ES", consisting of food and pharmaceuticals, may be the most well-known dimension of ES among the respondents without linkages to the forest sector. In addition, "social cohesion related ES" were more important for respondents involved in the forest sector. As an explanation for this, for example, Paaskoski (2008) and Rekola et al. (2010) have discovered strong common social traditions among forest professionals. In all, the differences in the views of the respondents on the importance of different types of ES according to their socio-demographics is in accordance with the results of Martín-López et al. (2012), who found that the perception of ES is influenced by gender, place of living, and local ecological knowledge. For comparison, according to Grilli et al. (2016), personal attitudes towards forest ecosystem services in Poland were much more related to the degree of preferences for a specific forest type than other socio-economic variables, such as gender or education.

Overall, the results of our study provide new insights into how the general public may categorize ES and this emphasizes the need to better capture the idea of how the general public sees forest-based ES in their daily lives. Related to that, it seems that the development of clearer communication strategies is needed to increase public understanding of impacts of industrial practices on ecosystems and to improve SLO for forest sector operations. In summary, information derived from natural sciences may not be comprehensible or valid from the viewpoint of people who lack in-depth understanding of ecosystem functions or forest sector business operations. In our results, the high proportion of "undecided" and "I don't know" answers on perceived forest sector responsibility reflected respondents' inability to make a judgement, which can be considered to result from a lack of available information or from a lack of trust in the available information. In addition, the contents of "primary ES", "consumable ES", and "social cohesion related ES" gave indications of the necessity of acquiring a better understanding of how a general audience perceives the linkages between the various ES in their daily lives. The findings of this study are comparable to the results of Panwar et al. (2012), who found empirical evidence for social and environmental legitimacy gaps in the context of the U.S. forest products industry.

The first and the main limitation of this study is the sampling procedure. Using online data collection, was likely to include a younger population (mean age of 38 years) and people with a high level of education. As the study was an explorative exercise designed to investigate public perception and based on convenience sampling, the results cannot be generalized to the broader population. We hypothesized that respondents belonging to the European Union would be sufficiently homogeneous to be treated as one sample, which was also indicated by the fact that there no significant country differences were found in respondent background data. Despite this, the number of responses varied between the target countries, and therefore the results are likely to reflect a Slovenian-Austrian-German-nationality than a Finnish domain. However, considering our data as a homogenous sample from the European Union has its drawbacks. Even though ES classification schemes, such as the MA, work on an aggregate global level, individual level perception of the forest ES may differ. The reason for this might be that, for example, the tree species composition, the current use of different types of ES, traditions and national cultures in using ES, the structure of forest ownership or public access to forests may differ across countries. To add an understanding of the country specific impacts of ecological, economic, and socio-cultural factors to the individual perceptions of ES, future research regarding the employment of MA should also aim to shed light on these national aspects of forests.

Since only few other studies (e.g., Lamarque et al., 2011; Pereira et al., 2005; Grilli et al., 2016) have tackled this research topic, we argue that even our preliminary findings are useful in pointing to its importance and are of practical value in terms of pointing out areas in which communication is weak, and should thus help the sector to project a better image and thereby increase its legitimization in the eyes of the general public.

6. Conclusions

The impact of the forest sector on ES is a complex and multidimensional topic and it therefore remains a challenge to communicate lucidly about it. Overall, this study provides new insights into public perception of forest ES, especially in terms of information demand on the impact of the forest sector on the natural environment, and the state of public perception of forest sector responsibility. Our results indicate that the role of forests in providing ES is widely recognized, however some of the MA framework categories of ES (regulating, supporting) are likely to be more eminent than others (socio-cultural, provisioning). At the same time, the general public perceives and recognizes ES differently than the way it is typically studied in the natural sciences, which places more emphasis on ES that cannot be directly experienced in the forest. Additionally, the differences in the recognition of different dimensions of ESs, depending on the socio-demographic background of the individual, need to be acknowledged in developing future communication strategies for ES.

From the scientific viewpoint, stakeholder segmentation based on recognized ES creates promising directions for future studies. It would be interesting to experiment on how better to address these differences in order to better help forest sector organizations to tailor their sustainability communication efforts towards specific stakeholder groups. Since the general public seems to be keen on following forest sector impacts but is ambivalent in terms of actual forest sector conduct, this is an issue that future research needs to address in order to narrow the potential legitimacy gap. Future studies may also improve the methodology, addressing the drawbacks of the sampling method used and acknowledging possible cross-country effects resulting from differences in the physical environment or respondents' socio-economic backgrounds in respective countries.

Acknowledgements

Financial support from ERANET WoodWisdom Net W3B partners and financers is gratefully acknowledged. Cofinanced by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management under grant agreement 101002/1 and Tekes under grant agreement 40393/13. Valuable feedback from the anonymous reviewers is gratefully acknowledged.

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Article V

Forest sector sustainability communication in Europe: A systematic review on the contents and gaps

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Highlights

- Stakeholder communication affects the societal sustainability of the forest sector;
- Coherent knowledge on stakeholder communication needs is lacking;
- Currently, communication is mostly one-dimensional information delivery;
- Identification of specific information needs of different stakeholders is needed;
- Integration of stakeholders in communication strategies is a promising avenue.

Abstract

Stakeholder communication plays an important role in enhancing the societal sustainability and business acceptability of the forest sector. The purpose of this study is to present the current state of forest-sector communication research with its stakeholders at different hierarchical levels of sustainability (i.e., societal, sectorial, corporate and product sustainability) in Europe. A systematic literature review has been completed to acquire information on the research outcomes related to sustainability communication between the forest sector and different stakeholders presented in international peer-reviewed journals between 2005 and 2015. The most important gaps in scientific information have been identified. The examined literature emphasizes the role of stakeholder communication for forest sector sustainability and acceptability, but no specific information seems to exist on how to communicate and build the forest sector image in eyes of different stakeholders. This gap indicates there is a need for more theoretical and empirical work on communication and image building processes by, e.g., recognizing the specific communication needs of different stakeholders via two-way and proactive information exchange and by tailoring forest sector communication and image building by sending well-specified messages for well-targeted audiences.

Keywords: stakeholders; information, channels, acceptability; sustainable development, societal well-being

1. Introduction

During the 2000s, increasing pressures to find balance in using forest resources to enhance economic, environmental, social, and cultural benefits have emerged at the local, national, and regional levels (e.g., Dargush et al. 2010; Lähtinen & Myllyviita 2015). For example, intensified requirements for decreasing the impacts of forest resource usage to the ecosystems and increased interest in the society towards recreational benefits acquired from the forests have driven the request for forest sector to be responsive to a broad scope of environmental and societal issues (Cohen et al. 2014). Simultaneously, the global emphasis on enhancing sustainable development *via* increased renewable resource utilization has simulated large-scale demand for forest resources for many end uses, such as energy production (e.g., Jonsson 2013; Lähtinen et al. 2014).

Related to the discourse of sustainable development, sustainability communication refers to deepening an understanding and awareness of the relationship between humans and their environment together with consideration of economic, environmental, social and cultural values and norms for creating general acceptance in the eyes of different actors in the society (Godemann & Michelsen 2011). The fundamental purpose of sustainability communication is to enhance developing methods of interactions in the society to support people moving towards sustainable behaviour and lifestyles (Kruse, 2011). In Europe, the forest sector has a pivotal role in the development of a sustainable society, where economic (e.g., profitability of businesses), environmental (e.g., securing ecosystem services), social (e.g., rural employment) and cultural (e.g., forest-related traditions) aspects of using natural resources are taken into account. The forest sector's actual and perceived contribution to these issues, however, is dependent on management of stakeholder communication to acquire information on different societal needs to develop methods to meet their value expectations and enhancing social license to operate (SLO) (e.g., Korhonen et al. 2016; Lähtinen et al. 2015).

At the moment, there is no comprehensive understanding of public perceptions or expectations related to forest sector sustainability. Instead, information on forest sector sustainability information or communication issues is grounded on a diverse set of information related to, e.g., specific forest industry products, sustainability issues or stakeholder groups (e.g., Amberla et al. 2010; Toivonen et al. 2012; Toppinen et al. 2013; Lähtinen et al. 2014). As a comparison, findings from North America (e.g., Panwar et al. 2012) indicate no similar holistic information on societal perceptions on the forest sector sustainability exists, either. The absence of this comprehensive understanding and the forest sector's close relationship to both society and the environment (e.g., Li and Toppinen 2011), sets the sector apart as an excellent platform for making a contribution to general sustainability research.

The purpose of this study is to identify potential gaps in the scientific research on public acceptability and perceptions of the European forest sector by studying at different hierarchical levels of sustainability (i.e., societal, sectorial, corporate, and product sustainability) (Draper 2006). Hence, this study provides a general view on the communication of sustainability issues between the forest sector and its diverse stakeholders. Our evaluations emphasises both the

ways, content and communication channels are employed by forest sector actors to enhance the acceptability and image of the sector.

2. Stakeholders in the forest sector

According to stakeholder theory (Freeman 1984) stakeholders are groups of people who have an impact on an organization and/or are influenced by it. Primary stakeholders are those without whose continuing participation the company would not survive (i.e., shareholders, employees, customers, suppliers, and the government), while secondary stakeholders are groups of people without direct transactions with the company, but otherwise affected by it (e.g., communities, civil society organizations, competitors, and the media). For the forest sector, growing public awareness related to environmental and social issues has created a great need to build and secure the legitimacy of operations through transparent production and management processes and trustful stakeholder relationships (e.g., Toppinen et al. 2016).

According to Smudde and Coutrigt (2011), stakeholder management involves three main tasks: 1) Identifying important audiences, topics important to them, and appropriate methods to communicate with them; 2) Maintaining relationships with them; and 3) Improving those relationships. Furthermore, stakeholder management can be either reactive or proactive. Reactive stakeholder management relies on lessons learned in previous engagements, identification of how strengths have been utilized, how weaknesses can be avoided or minimized, and then determining how to manage future engagements. In contrast, the proactive approach focuses on the future activities to produce new opportunities for affecting and implementing collaboration with any stakeholders, comprised of ethical communication strategies and tactics for managing opportunities and threats with a forward looking attitude. Integrated communication with stakeholders comprises both the aspects of general management of public relations and marketing enhanced by informal connections, social interaction and open communication systems. The mechanics of integrated communication include, for example, special focus on content (i.e., messages, the image to be created), channels, strategic audience targeting and information sharing (Smith 2012).

The European forest sector's stakeholder system is composed of various stakeholder groups each of which may interact with different hierarchical levels of sustainability with high societal relevance (Fig. 1). The forest sector operates at the forefront of a rapidly changing global business environment, in which the importance of issues related to social change, sustainability, and justice is constantly increasing (Lindahl and Westholm 2012). Correspondingly, understanding and managing the needs of various stakeholder groups and improving communication with them through targeted messages is increasingly difficult as attitudes and needs evolve (Toppinen et al. 2016).

According to Donaldson and Preston (1995), the role of *governments* is to ensure the interests of all stakeholder groups are considered and to bring the most critical normative issues into the legislative process. In addition, governments may also cooperate with *non-governmental organizations* (NGOs) in voluntary systems intended to enhance sustainability such as creation of certification labels (e.g., Rametsteiner 2002; Räty et al. 2014), which provide information on the sustainability impacts of companies and products (Toppinen et al., 2016). In the changing business

environment and increasing demand for environmentally and socially acceptable business practices, *financiers* have emerged as a stakeholder group requesting certification systems and stakeholder communication for managing their own business risks (Nikolakis et al. 2012). The role of *employees* as a stakeholder group for forest sector is multi-dimensional, since workers are not only members of local communities, but also potential source of business success due to their tacit knowledge and individual relationships with other stakeholder group members (Toppinen et al. 2016). Relationships with the *forest owners* are critical for the forest sector, which is dependent on the availability of raw material for all of its processes (Lähtinen et al. 2016). As a result of this dependency, the natural environment can be considered a factor that is both affected by and affects forest sector operations (e.g., Matthies et al. 2016). Finally, decisions related to the use nature affect society as a whole, for example, by creating or eliminating recreation possibilities and by changes to the landscape (e.g., Lähtinen & Myllyviita 2015), making the *general public* an important stakeholder group that affects general opinion on the acceptability of forest sector activities.

The different stakeholder groups may differ in their perception of and demand for sustainability communication. As sustainability can be assessed at different reference levels (societal, sectorial, corporate, product) it is likely that not all stakeholders are, or should be, addressed at all levels in the same way. Societal sustainability (e.g., Dempsey et al. 2011), for example, focuses on the social dimension and impacts whereas the sectorial level refers to particular industries or branches of them (e.g., Labuschagne et al. 2005; Azapagic and Perdan 2000). The societal level is highly relevant for the forest based sector as society is often affected by the forest sector, for example, by ecosystem services. The sectorial level is relevant when it comes to referring on value chain sustainability and comparisons with other sectors. Krajnc and Glavič (2005) compare companies at the corporate level on relevant dimensions of sustainability, which as a result of, for example, corporate responsibility reporting procedures is the most common level of sustainability communication for companies. (e.g., Dyllick and Hockerts 2002; Linnenluecke and Griffiths 2010). Finally, sustainability is also considered at the product level, which, in case of wood products, is often associated with certification (Cai and Aguilar 2013).

3. Forest sector communication

According to Lasswell's model of communication (Lasswell 1948) also adaptable to sustainability communication (see Kruse, 2011), communication is a linear process including five elements: a communicator, a message, a medium, an audience, and an effect. Based on this, the process of communication can be described by identifying the sender (communicator), the content of the message, the channel of communication (medium), the receiver of the message (audience), and the impact of communication (effect). If the flow of information goes only from the sender to the receiver, it can be considered as one-way communication based on information delivery (e.g., image-building campaigns and advertising). One-way communication has the inherent weakness of lacking the interaction between the sender and the receiver (Morsing and Schultz 2006). Consequently, the actual information needs of the receiver may not be met and this shortcoming may remain unknown, particularly in cases when the needs of different forest sector stakeholders are contradictory (see, e.g., Rientjes 2000).

In contrast to one-way communication, two-way communication is composed of interaction between different elements of the communication process enabling a more proactive and engaging approach to seeking solutions to manage complex needs of different stakeholders (see, e.g., Crane and Livesey 2003). Furthermore, two-way communication can be divided into two categories, i.e., stakeholder response strategies with asymmetric characteristics and stakeholder involvement strategies with symmetry in communication between the communicator and stakeholder representing the audience (Morsing and Schultz 2006). Two-way symmetrical communication is characterized by a willingness to listen and respond to stakeholders, whereas in two-way asymmetrical communication organizations listen to their stakeholders but do not make a corresponding alteration to their organizational processes (Roper 2005). Accordingly, successful communication between the communicator and the audience is not restricted to the dissemination of information, but also involves characteristics of making sense to messages, for example, providing information with a special value for the receivers (Schoeneborn and Tittin 2013).

With the rising emphasis on sustainability issues in the forest sector in the early 2000s (e.g., Toppinen et al. 2016), communication started to gain more attention within the industry and among researchers as a measure to face the challenges of the sector. For example, in Finland, studies were made on forest sector communication practices and issues (e.g., Janse 2005, 2007a, 2007b). During this time, problems with communication activities and the image of the sector were recognized and acted as a driving force to bringing the needs for proactive and strategic communication to the forefront (e.g., Hellström 2004). According to Janse (2005), the forest sector has focused mainly on one-way communication, by only sending communications outwards instead of engaging in bidirectional exchanges of information with their target audiences (Morsing and Schultz 2006).

Due to its focus on one-way information delivery, forest sector communication has been criticized for lacking communication strategies based on meaningful interaction with the diverse stakeholders (e.g., Janse 2005; Morsing and Schultz 2006). For example, according to the results of a large scale survey implemented in Europe (Rametsteiner 2009), the forest sector has lacked simple, coordinated, and effective messages that meet the needs of the various stakeholders. Rametsteiner (2009) suggested utilizing a strong media presence and coordinated campaigns with clear messages explaining forest related topics in understandable ways as a solution.

The theoretical framework of this study is based on Lasswell's (1948) model of communication as illustrated in Fig. 2. In this study, classifications of the differences between in one-way and two-way communication are context-specific. For example, mediums providing no possibilities for interactions between the sender and receiver (e.g., newspaper articles, static websites, and advertisements) are as one-way communication processes, while mediums providing possibilities for exchange of information (e.g., many web-based services, education) are as two-way communication processes. In addition, following Janse (2005), communication can be categorized into internal communication within the forest sector core (e.g., forest industries, employees, forest owners, authorities dealing with forestry issues, and science), external communication with clusters in connection with the forest sectors (e.g., NGOs, organizations operating in construction,

information and communications technology and transportation) and external communication with society at large (e.g., consumers and general public).

4. Material and methods

This study examined peer-reviewed research articles published or in the state of "in press" between January 2005 and October 2015 in international peer-reviewed scientific journals. Searches were carried out using the ScienceDirect database by using pre-determined search words for titles, abstracts, and keywords to concentrate on the themes directly relevant to the European forest sector in relation to perceived sustainability and acceptability expectations of different stakeholder groups. In addition, the expectations were scrutinized in regard to levels of societal, sectorial, corporate, and product sustainability. To focus directly on the state of stakeholder communication in the European forest sector, general sustainability studies without clear links to stakeholder sustainability information or communications were excluded from inclusion in this systematic literature review.

Materials were gathered following established systematic literature review methodology (e.g., Lähtinen et al. 2014, Zhang et al. 2014). Prior to the systematic literature review, search terms were identified by using previous literature and the expert knowledge of the researchers involved in this study. The actual systematic literature review of this study comprised three steps. In STEP 1, the database searches were implemented in ScienceDirect to seek articles relevant to this study. In STEP 2, the abstracts of the articles identified in STEP 1 were thoroughly examined to select studies for further scanning in STEP 3. In order to avoid selection bias resulting from an overly strict selection procedure, all abstracts, even those with seemingly weak relevance to this study, were selected for further review in STEP 3. In STEP 3, the whole contents of the articles selected in STEP 2 were studied to identify the initial set of articles for the material of this study. As can be seen in Fig. 3, STEP 1 comprised seven rounds of database inquiries implemented by eight search terms to identify sectorial relevance combined with 18 thematic search terms leading to a total of 126 searches. A detailed description of the search words used in STEP 1 and the number of hits received in search rounds are illustrated in Fig. 3. During the selection process, the articles to review were reduced from 2305 hits received in ScienceDirect to 26 journal articles strictly relevant to this study.

As can be seen in Fig. 3, only 76 abstracts proceeded from STEP 1 to STEP 2 despite including abstracts with seemingly weak relevance to study for further consideration in STEP 3. This was caused by the fact that relatively little of research exists specifically related to forest sector information delivery and communication, although sustainability and acceptability issues have gained increasing attention in general societal discussions especially during the 2000s. Furthermore, scanning the titles of the 26 selected articles (Table 1) shows that, at a conceptual level, the terms "information" or "communication" have not been commonly employed in the context of forest sector stakeholder or sustainability studies.

5. Results

The results of this study are organized according to the four hierarchical levels of sustainability: societal (Table 2), sectorial (Table 3), corporate (Table 4), and product sustainability (Table 5).

Overall, the systematic literature review revealed substantial differences in the quality and contents of stakeholder communication at different hierarchical levels of sustainability by different stakeholder groups. This review focused on the stakeholders identified in Fig. 1, however, no results related to financiers were found while designers, engineers, and scientists were identified as separate and important stakeholder groups.

In general, stakeholder communication in the forest sector is inconsistent: issues related to the different hierarchical levels of sustainability were not approached evenly with all stakeholders. Another important result is the fact that in most cases there was no clear definition of the mediums (channels) employed to communicate sustainability related information between stakeholders using either one-way or two-way communication. However, in the 26 articles reviewed in this study, it was possible to identify the communicator, the audience, and the sustainability content in most cases.

Table 2 provides a summary of results related to societal sustainability communication from seven articles examining multiple European countries. The communication relationships at the level of the societal sustainability has been between governments (communicator) and the general public (audience), forest owners (communicator) and governments (audience), the general public and stakeholders in general (audience), and the whole forest sector (communicator) and the general public (audience). According to the results, the content of communication has been related to governance topics (e.g., national and EU level forest policies) and the search for solutions to balance the various needs and expectations of different stakeholders related to forest management practices in rural and urban areas. Regarding the types of information exchange, both one-way (e.g., newsletters), two-way asymmetric (e.g., websites, contact and information offices, social surveys), and two-way symmetric (e.g., public workshops and interactive web-based tools) methods of communication have been discussed. Overall, table 2 shows a considerable amount of examples given in a couple of studies on the potential of using two-way symmetric mediums in communicating on societal sustainability, although in general their implementation in the forest sector information exchange seem to be scarce.

The results on sectorial sustainability are presented in Table 3 based on the content of five articles related to Finland, Germany, Romania, and UK. In comparison with communication on societal sustainability, the results in the literature show less variety in both communicators and audiences. Actually, the only identified communicators of sectorial sustainability are governmental bodies implementing information exchange towards forest sector actors (e.g., forest owners, employees and NGOs). However, let it be mentioned that in the reviewed articles no differentiation was made between different types of forest sector stakeholders acting as target audiences. Therefore, in Table 3, forest sector stakeholders are combined to one group representing the stakeholders of the sector in general.

Regarding sectorial sustainability, information exchange between governments (communicator), the forest sector (audience), and forest owners (audience) has been related to the implementation of different forest policy actions, programs, governmental objectives (e.g., producing wood for energy), and an effort to enhance the acceptability of these governmental actions with forest sector representatives. However, no clear definition of the appropriate

mediums for implementing these communications effectively existed in the literature. As an exception for this, in the case of the construction sector (audience), governmental tools for enhancing acceptability were identified comprising various asymmetric and symmetric communication mediums from TV programs to education.

Corporate sustainability communication was covered in five articles, which detailed the circumstances in several countries (Table 4). According to the literature, communication of corporate sustainability has been from governments (communicator) towards the general public (audience) and forest owners (audience), and from the forest sector (communicator) towards the natural environment (audience), the general public (audience), and NGOs (audience). The communicated content has been related to enhancing nature protection in general (government) or in a more focused way (forest sector) through corporate responsibility reporting and forest certification labels. In the area of corporate sustainability communication, most of the mediums have been composed of one-way information delivery tools (e.g., newspapers, magazines, certification labels), although two-way asymmetric ways of communication have been mentioned as well (e.g., information from forestry professionals).

In comparison with articles approaching societal, sectorial and corporate sustainability, articles related to product sustainability (Table 5) identified mediums of communication more frequently. Altogether, six out of nine studies comprising findings related to UK (and US), Denmark, Finland, Greece, Germany, Switzerland, Spain, and Sweden contained information on the mediums employed to deliver messages between the governments and NGOS (communicators) and consumers (audience), as well as between the forest sector (communicator) and consumers (audience), the general public (audience), environmental technicians and engineers (audience), and architects (audience). However, related to the characteristics of the mediums employed, approaches for communicating with the audiences are related to one-way information dissemination like employing forest certification labels or advertisement, while two-way communication such as participatory processes to enhance knowledge were mentioned only once in the literature.

Table 6 is a summary of the roles stakeholders in the forest sector take as communicators and audiences as well as the mediums of communication they use (one-way, asymmetric two-way and symmetric two-way communication). In general, it can be noted that in the literature stakeholders were mentioned to have been involved in many types of communication activities both as communicators and audiences. Yet, as in some cases the findings in table 6 are grounded on findings of one study (e.g., symmetric two-way forest sector communication on product sustainability), they provide merely indications whether some type of communication seem to have even existed in the forest sector, instead of illustrating the magnitude of implementation of different models of communication processes among forest sector stakeholders at different levels of sustainability.

In general, the government is the only stakeholder group, which has been active as a communicator at all hierarchical levels of sustainability. In addition, excluding product sustainability, governmental have also bodies employed all types of mediums in their communication efforts. Along with the government, only the forest sector as a whole (societal

and corporate sustainability), forest owners (societal sustainability), and NGOs (product sustainability) were considered as communicators attempting to affect the views of acceptability in the eyes of other forest sector stakeholders. In other words, no literature reviewed indicated that consumers, financiers, employees, the natural environment, the general public, scientists, the construction sector, environmental technicians, designers, or architects were ~~i~~nvolved at all in forest sector information dissemination as communicators.

The stakeholders groups most frequently targeted by communicators were the general public (regarding societal, corporate, and product sustainability), NGOs (sectorial and product sustainability), and forest owners (sectorial and corporate sustainability). The stakeholder groups acting as audiences at only one hierarchical level of sustainability were governments (societal sustainability), consumers (product sustainability), employees (sectorial sustainability), the forest sector as a whole (sectorial sustainability), scientists (sectorial sustainability), the construction sector (sectorial sustainability), and environmental technicians, designers or architects (product sustainability).

6. Discussion

The forest sector's actual and perceived contribution to enhancing sustainable development and societal well-being is dependent on success in communication to acquire information on needs of different stakeholders and enhancing social license to operate, for example (e.g., Korhonen et al. 2016; Lähtinen et al. 2015). For gaining "sustainable superiority" (see, e.g., Simula et al. 2009; Parsons et al. 2014), the forest sector must be both perceived as highly sustainable and be highly sustainable in their operations. Otherwise there is a risk of being positioned in the society as "green washers" (high perceived, low actual sustainability) or "opportunity losers" (high actual, low perceived sustainability), which both are risks for gaining SLO.

The purpose of this study has been to present an overview on the ways, content and communication channels that have been employed by forest sector actors to enhance the acceptability and image of the sector in the eyes of different stakeholders in Europe during the 2000s. The material of the study was composed of studies related to the scope of the study published in January 2005– October 2015 in international peer-reviewed journals. As a research methodology for gathering the relevant literature, a systematic literature review approach has been employed.

According to the results of the analysis, a relatively large body research information on sustainability and acceptability related issues exist with a focus on general findings on communicators, audiences and sustainability themes considered as important for different stakeholders. Instead, there seems to be a lack of coherent and profound knowledge on specific sustainability information needs of different stakeholders in Europe as well as appropriate and efficient communication channels regarding different levels of sustainability (i.e., societal, sectorial, corporate, product). In all, while governments seem to employ as communicators both one-way and two-way communication channels quite broadly especially in the context of societal, sectorial and product sustainability, all other actors (e.g., forest sector as a whole) seem to lack genuine information exchange with their various stakeholders regarding, for example, sectorial sustainability. As a general finding it can be said, that forest sector communication has remained

to be dominated by reactive methods, while proactive approaches have been continued to be underutilized, as they were in the early 2000s (e.g., Hellström 2004).

If forest sector organizations are to enhance their SLO among different stakeholders in the society broad-scope and profound communication strategies in relation to different stakeholder needs at different hierarchical levels of sustainability need to be developed. For example, for forest sector as a whole, employing two-way communication merely on product sustainability is not sufficient enhancing acceptability of operations and competitiveness in the markets. In addition, although governmental bodies are relatively active communicators on sustainability issues towards general public, for example, most of their communication content is related to general policy issues, although forest policy issues are not a focal point in the everyday life of the general public. Thus, societal issues (e.g., positive impact in the form of climate change mitigation, new innovative product possibilities, etc.) could be more attempting in the eyes of the general public.

The lack of knowledge on stakeholder information needs and appropriate communication channels may be a consequence of deficiencies in stakeholder management. If stakeholder relationships were considered as a strategic asset for the organizations, also well-targeted two-way symmetric interaction with the ones affecting and being affected from organizations' operations would probably be integrated into communication plans. Instead, as a result of gaps on stakeholder management, different actors in the forest sector seem to be very much focused on one-way communication without well-targeted messages or heterogeneous and purposeful employment of different communication channels.

To make a change in the forest sector communication, organizations should acknowledge the varying information needs of different audiences in order to effectively reach them. Regarding corporate sustainability communication, for example, Schmeltz (2011) has stated that the value of providing information on those issues is limited as long as communication is not specifically targeted to relevant stakeholders. In addition, proactive communication of future activities will be one way to produce new opportunities for meaningful collaboration with stakeholders that employ ethical communication strategies and tactics for managing opportunities and threats with a forward looking attitude.

Regarding the reliability and validity of the results, some limitations associated with systematic literature reviews should be considered when weighing the outcome of this study. Most importantly, the lack of existing scientific publications on certain aspects of sustainability communication does not necessarily imply that these types of communication do not exist. For a variety of reasons, certain aspects of communication may not have been subject to research or the results may not have been published as journal papers. Furthermore, because of the significant time delay commonly associated with the scientific publication process these study results should not be considered to fully cover all research performed during the target period. Additionally, only one database (ScienceDirect) was searched and therefore certain journals may be missing from the analysis. However, given that the analysis consisted of 26 papers in a narrow scope published during the last ten years this review can reasonably be considered to comprehensively cover the topic. Correspondingly, the latest developments in related areas, such as sustainability communications related to the bioeconomy are not necessarily covered in detail.

7. Conclusions

The results of the study indicate a need to pay more theoretical and empirical attention to communication and image building processes, for example, by recognizing the specific communication needs of different stakeholders via two-way and proactive information exchange. In addition to send truthful messages, it is important to send messages that support stakeholders to perceive the societal benefits of the forest sector operations from different societal, sectorial, corporate and product sustainability perspectives.

Tailoring forest sector communication and image building by sending well-specified messages for well-defined audiences is another critical aspect for improving forest sector communication. This issue should be addressed by future research projects as well as by practical communication activities in the sector. The analytic frame applied in this study could be used to study other sectors (agriculture, construction, chemical industries) as well in order to assess the sectorial differences in communication at different hierarchical sustainability levels and addressing different stakeholders.

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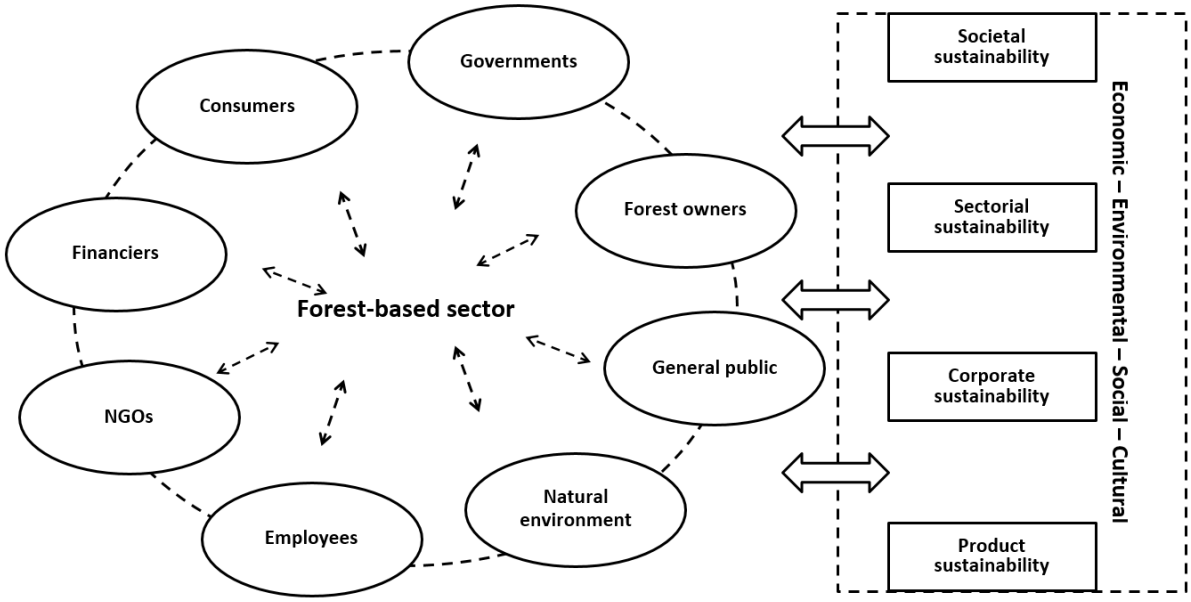

Figure 1. The stakeholder system of the European forest sector (adapted from Draper 2006).

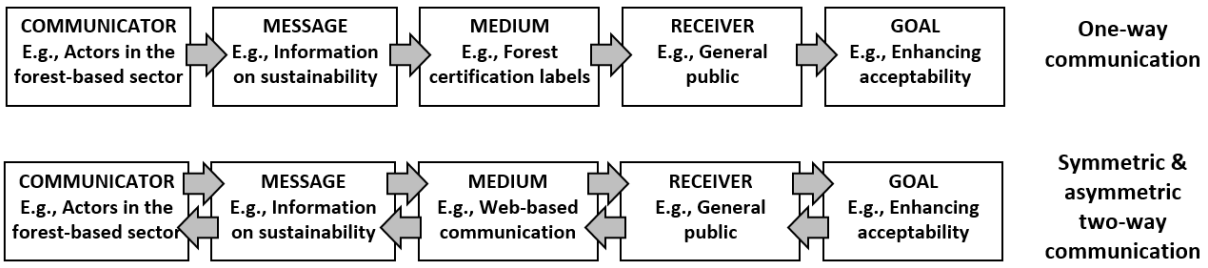

Figure 2. Models of communication processes in the forest sector (adapted from Lasswell 1948; Janse 2005; Morsing and Schultz 2006)

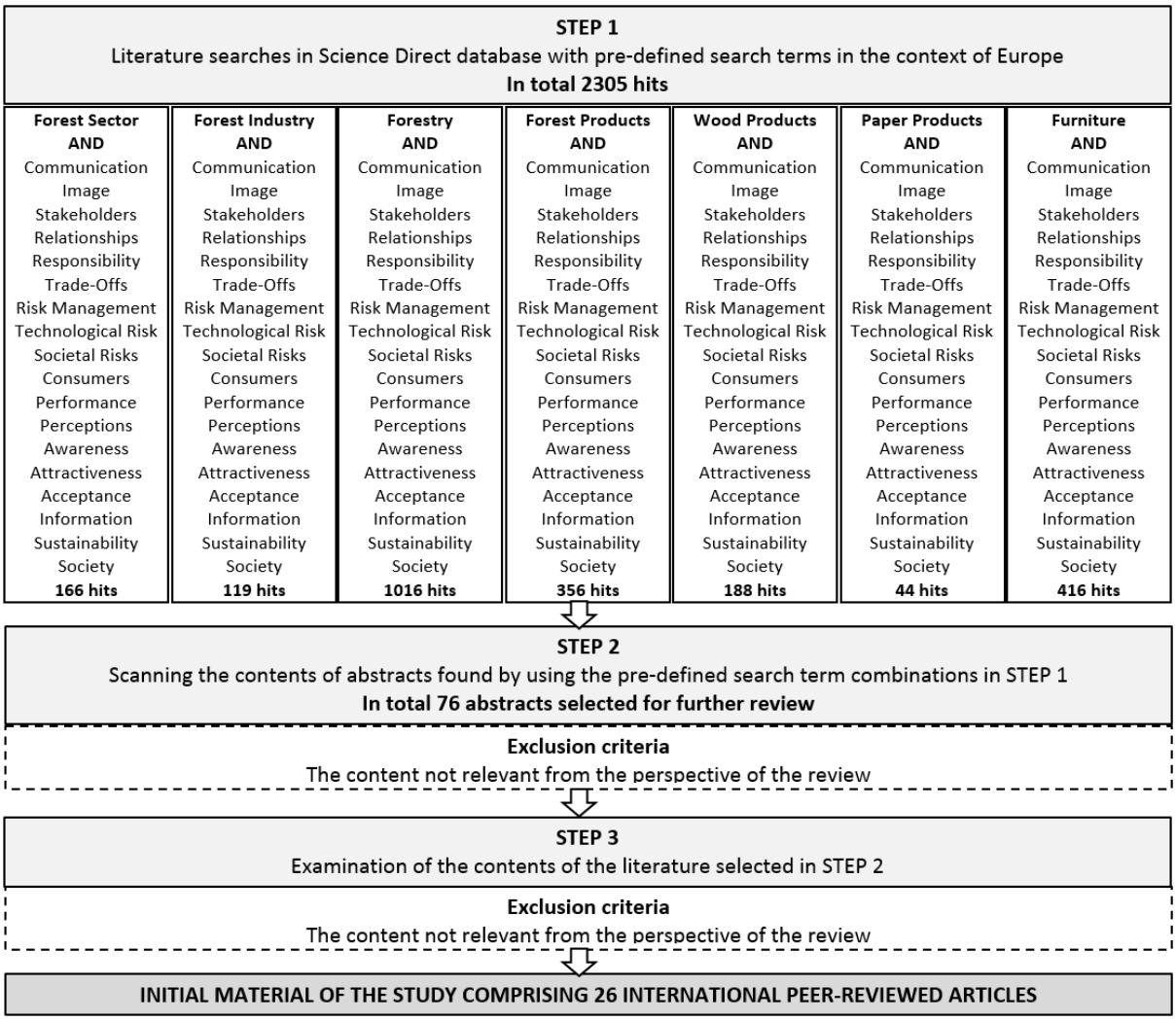

Figure 3. Implementation of material gathering with a systematic literature review methodology.

Table 1. Material of the study gathered with a systematic literature review approach.

	Author(s)	Year	Title	Journal
1	Aasetre	2006	Perceptions on communication in Norwegian forest management	Forest Policy and Economics
2	Aguilar and Cai	2010	Conjoint effect of environmental labeling, disclosure of forest origin and price on consumer preferences for wood products in the US and UK	Ecological Economics
3	Appelhanz et al.	2016	Traceability system for capturing, processing and providing consumer-relevant information about wood products: system solution and its economic feasibility	Journal of Cleaner Production
4	Bjärstig	2013	The Swedish forest sector's approach to a formalized policy within the EU	Forest Policy and Economics
5	Brouhle and Khanna	2012	Determinants of participation versus consumption in the Nordic Swan eco-labeled markets	Ecological Economics
6	Dragoi et al.	2011	Improving communication among stakeholders through ex-post transactional analysis – case study on Romanian forestry	Forest Policy and Economics
7	Fabra-Crespo and Rojas-Briales	2015	Comparative analysis on the communication strategies of the forest owners' associations in Europe	Forest Policy and Economics
8	González-García et al.	2012	Eco-innovation of a wooden childhood furniture set: An example of environmental solutions in the wood sector	Science of the Total Environment
9	Haltofová and Adámek	2014	Corporate social responsibility in companies of the primary sector in Czech Republic, a preliminary study	Procedia Economics and Finance
10	Hansmann et al.	2006	Influence on consumers' socioecological and economic orientations on preferences for wood products with sustainability labels	Forest Policy and Economics
11	Hemström et al.	2011	Perceptions, attitudes and interest of Swedish architects towards the use of wood frames in multi-storey buildings	Resources, Conservation and Recycling
12	Husgafvel et al.	2013	Review of sustainability management initiatives within Finnish forest products industry companies – Translating EU level steering into proactive initiatives	Resources, Conservation and Recycling
13	Huttunen	2014	Stakeholder frames in the making of forest bioenergy legislation in Finland	Geoforum
14	Janse and Konijnendijk	2007	Communication between science, policy and citizens in public participation in urban forestry – Experiments from the Neighbourwoods project	Urban Forestry & Urban Greening
15	Kangas et al.	2010	Stakeholder perspectives about proper participation for Regional Forest Programmes in Finland	Forest Policy and Economics
16	Korhonen et al.	2013	Diffusion of voluntary protection among family forest owners: Decision process and success factors	Forest Policy and Economics
17	Kourula	2010	Corporate engagement with NGOs in different institutional contexts – A case study of a forest products company	Journal of World Business
18	Li and Toppinen	2011	Corporate responsibility and sustainable competitive advantage in forest industry: Complementary or conflicting goals	Forest Policy and Economics
19	Maier et al.	2014	Stakeholders' perceptions of participation in forest policy: A case study from Baden-Württemberg	Land Use Policy
20	Osburg et al.	2016	An empirical investigation of wood product information valued by young consumers	Journal of Cleaner Production
21	Rämö et al.	2009	Interest in energy wood end energy crop production among Finnish non-industrial private forest owners	Biomass and Bioenergy
22	Toivonen	2012	Product quality and value from consumer perspective – An application to wooden products	Journal of Forest Economics
23	Tsourgiannis et al.	2013	Exploring consumers' attitudes towards wood products that could be derived from transgenic plantations in Greece	Procedia Technology
24	Ugolini et al.	2015	Knowledge transfer between stakeholders in the field of urban forestry and green infrastructure: Results of a European survey	Land Use Policy
25	Valkeapää and Karppinen	2013	Citizens' views of legitimacy in the context of Finnish forest policy	Forest Policy and Economics
26	Wang et al.	2014	Use of wood in green building: a study of expert perspectives from the UK	Journal of Cleaner Production

Table 2. Research results on sustainability communication in the forest sector at the hierarchical level of societal sustainability.

COMMUNICATOR	MEDIUM	AUDIENCE	RESEARCH FINDINGS	GEOGRAPHIC AREA
Governments	Not identified	General public	Designing more legitimate forest policy requires wider perspective on the benefits of the forests (e.g., recreation), more flexible forest management practices, more attention to the justice of decision-making procedures, e.g., by equal treatment of all stakeholders. (Valkeapää & Karppinen 2013)	Finland
	Newsletters, websites, contact and information offices, public events, social surveys and interviews, public workshops, thinking days, youth work-play events and education activities	General public	Implementing successful communication processes among different stakeholders in urban forestry is challenging, since all participants should be able to connect each other's messages to their own frames of references. With potential conflicting interests between different stakeholders, their experiences, knowledge, and social settings affect communication. (Janse & Konijnendijk 2007)	Italy, Belgium, Finland, UK, Sweden and Denmark
	Interactive web-based tools, online databases for e-learning	General public	Establishment and management of green infrastructure by urban forestry requires involvement of complex and heterogeneous stakeholder groups. Stakeholders need better understanding of the importance of forming collaborative teams, optimizing financial resources, and having a common language to overcome the challenges posed by their diverse needs and backgrounds. An important approach for this is combining scientific knowledge dissemination with practical training to support easy access to the latest knowledge, e.g., via the internet, which remains an underutilized tool in the forest sector. (Ugolini et al. 2015)	Europe and some areas outside Europe (not identified)
Forest owners	Not identified	Governments, general public and other stakeholders in the society	Communication strategies among forest owner associations should and could be improved by considering, e.g., objectives, messages, targets and channels. Success would require benchmarking more experienced organizations, defining clear messages, utilising a variety of communication, collaboration with other organizations (e.g., agriculture and wood construction), as well as using mass media and communication professionals. (Fabra-Crespo & Rojas-Briales 2015)	Czech Republic, Estonia, Finland, France, Germany, Sweden, Norway, Switzerland, Lithuania, Luxembourg, Slovenia, Spain, UK, Latvia, Hungary
Forest sector	Not identified	Governments (i.e., public authorities working with legislation)	More open and purposeful analysis of stakeholder interests is needed when preparing legislation related to bioenergy production and pushing innovations linked to increased value of products. (Huttunen 2014)	Finland
	Not identified	Governments (i.e., public authorities with an impact on EU policies)	As forest-related questions have come to the EU to stay, the important question is not whether there will be some kind of formal European forest policy, but what form EU forest policy will take. In this, both the preferences and strategies of stakeholders have a fundamental role. (Bjärstig 2013)	Sweden
	Public participation	General public	Coordination and compromises between heterogeneous groups of stakeholders are needed in forest management. In this, communication between different groups stakeholders together with their participation in decision-making is crucial. Communication between forestry representatives and forest industries is good. In addition, communication also exists among forestry representatives, forest industries, and the nature management sector, which is not perceived positively among forest owners and their organizations. In managing diverse interests, decision makers should try to distribute power between different stakeholders fairly instead of trying to eliminate it (Aasetre 2006).	Norway

Table 3. Research results on sustainability communication in the forest sector at the hierarchical level of sectorial sustainability.

COMMUNICATOR	MEDIUM	AUDIENCE	RESEARCH FINDINGS	GEOGRAPHIC AREA
Governments	Not identified	Forest sector (e.g., forest owners, administrative organizations, employees, NGOs)	In developing Regional Forest Programmes (RFP), emphasis should be on motivating all different stakeholder groups to involve in the process, to increase the commitment of all important stakeholder groups to RFPs and developing methods to reach viewpoints of general audience more efficiently. (Kangas et al. 2010)	Finland
	Not identified	Forest sector (e.g., state forestry representatives, forest owners, NGOs, scientists)	Perceptions and attitudes toward participation in forest policy differed notably among different stakeholder groups. Private forest owners were the most sceptical, while nature conservation groups favoured most increase in participation. In addition, no substantial mutual policy learning among stakeholders, or improvements in the relationships between actors representing production and conservation were observed (Maier et al. 2014)	Germany
	Not identified	Forest sector (e.g., forest owners, local and county public administration representatives)	Lack of confidence exists between forest owners and forest management structures (e.g., professional foresters). To overcome this problem, landowners could be trained in forestry to build communication bridges between professional foresters and forest owners. (Dragoi et al. 2011)	Romania
	Not identified	Forest owners	Attitudes of non-industrial private forest owners toward energy wood production are positive, but increasing the supply requires more information on, e.g., production technologies and energy wood markets. In addition, information needs seemed to be linked with urban living far from the forest estate. (Rämö et al. 2009)	Finland
	TV programs, green building awards, education and training programs	Construction sector (i.e., experts representing NGOs)	UK government has played crucial role in promoting wood construction. Experts with sound knowledge on the wood as a construction material agree on its superior environmental credentials, while end users who may lack information and knowledge often show strong prejudices against its use. (Wang et al. 2014)	UK

Table 4. Research results on sustainability communication in the forest sector at the hierarchical level of corporate sustainability.

COMMUNICATOR	MEDIUM	AUDIENCE	OUTCOME OF RESEARCH	GEOGRAPHIC AREA
Governments	Not identified	Natural environment	Forest industry companies could potentially benefit from proactive, strategic, and a self-organized approach to sustainability management by exceeding the norm-level regarding, e.g. energy and material efficiency, recycling and waste prevention/utilization. At the moment, they are not receiving sufficient focus from corporate management. In addition, forest industry companies should have more guidance on sustainability management issues via EU level or national regulatory frameworks. (Husgafvel et al. 2013).	Finland
	Information from forestry professionals, neighboring forest owners, local newspapers, forestry magazines	Forest owners	Delivering the message of voluntary protection has been effective, especially via newspaper articles and in the context of preparing forest management plan together with Forestry Centre officials. The message of voluntary protection has gone through well, because in the eyes of forest owners, they represent "forestry people". In contrast, for some forest owners, officials in the Centre of Economic Development, Transport and Environment (ELY), represent "nature protection people", against whom they are prejudiced. However, the ones who have been in contact with ELY officials, were highly satisfied with the collaboration afterwards. (Korhonen et al., 2013).	Finland
Forest sector	Corporate responsibility reporting	General public	Forest sector businesses are obligated to responsibly and beneficially towards society while achieving a sustainable level of profitability. Along with the growth of ethical markets, companies could renew their businesses via corporate responsibility by making radical changes in fundamental values, policy principles and operational procedures by organizational learning. (Li & Toppinen 2011).	Global
	Forest certification labels	General public	Based on their webpages, companies operating in forestry and logging are very seldom involved in certification (about one out of ten companies) or other forms of non-governmental actions (e.g., supporting youth hobbies). Regarding certification, most companies implementing corporate responsibility have PEFC certification. (Haltofová & Adámek 2014).	Czech Republic
	Not identified	NGOs	Non-governmental engagement forms can be categorized into three general strategies: sponsorship, dialogue, and partnerships. Among forest industries, understanding global pressures and opportunities in relation to forming partnerships, voluntary governance (e.g., forest certification), stakeholder dialogue and philanthropy is necessary. (Kourula 2010)	Finland, Brazil, Poland, Russia

Table 5. Research results on sustainability communication in the forest sector at the hierarchical level of product sustainability.

COMMUNICATOR	MEDIUM	AUDIENCE	OUTCOME OF RESEARCH	GEOGRAPHIC AREA
Governments and NGOs	Forest certification labels	Consumers	Disclosing the origin of wood products has a significant effect on consumer preferences. In the case of products originating from temperate forests, there is a positive impact related to information on raw material source. In contrast, the impact is negative when disclosing information on raw material acquirement from tropical forests. In general, attitudes among UK wood product consumers are stronger towards the need of environmental certification in comparison with US respondents (Aguilar & Cai 2010).	UK and US
	Nordic Swan eco-label	Consumers	To substantively expand the market for eco-labelled toilet paper products and paper towels among and beyond environmentally conscious consumers, products must be more readily available (e.g., widely available for purchasing) and present attractive bargains (e.g., sales) for consumers. In addition, governments can support eco-labelling programs to provide clear, consistent and trusted information on the environmental characteristics of products (Brouhle & Khanna 2012).	Denmark
Forest sector	Not identified	Consumers	Perceived quality of a product is composed of tangible (i.e., technical quality, aesthetics, and design) and intangible (i.e., quality of suppliers and sales persons, and service and information as well as environmental friendliness, and domestic origin) (Toivonen 2012).	Finland
	Effective advertisement, attractive packaging and labeling	General public	Positive attitudes seem to exist towards the future market potential for raw material originating from transgenic plantations. Consumers can be categorized into three types according to their preferences. Those who would buy transgenic wood products, but would want them to be labelled as transgenic; those who are influenced mainly by the quality of wood products, its characteristics, and brand; and those, who are not influenced in any way by the transgenic raw material origin of the wood products. (Tsourgiannis et al., 2013)	Greece
	Not identified	Consumers	Information on origin (i.e., country), environmental impacts (i.e., sustainability of the raw material, carbon footprint, recycling), and material (e.g., type of wood, material composition, additives and comments of the producers) should be widely available to young consumers. In addition, marketers should be able to disseminate the information to consumers (Osburg et al. 2015).	Germany
	Marketing efforts, participatory processes to enhance knowledge	Consumers	Along with ecological issues, social views on forest management (e.g., aesthetics and leisure activities) in relation to the general public and forest visitors should be taken into account in creating certification labels. Among consumers, knowledge on forest certification labels is superficial although for having effect in the markets, consumers should recognize the labels during the time of purchase. Communication about forest certification labels should not focus only on ecologically or socially aware consumers, but also on the ones with economic orientation. (Hansmann et al. 2006)	Switzerland
	Product information	Consumers	Providing consumers with product information with traceability information system could allow satisfying their needs for wood product information related to seeking for eco-friendly products at reasonable costs. To support this, consumers should be informed and instructed about the new service possibilities. (Appelhanz et al. 2015).	Germany
	Not identified	Environmental technicians and designers	Analytical methodologies to assess environmental impacts of wooden furniture (i.e., Life-Cycle Analysis and Design for Environment) can be employed as communication tools among environmental technicians and designers. In addition, they can be employed in further environmental analysis to improve environmental performance and sustainability of the furniture sector (González-Carcia et al. 2012).	Spain
	Promotion of wooden multi-storey construction with examples	Architects	Wood is considered the least suitable construction frame material from engineering aspects (i.e., fire safety, sound insulation, acoustics, stability and durability), but the overall attitude towards using wood is positive related to its perceived environmental benefits. (Hemström et al. 2011).	Sweden

Table 6. Forest sector stakeholders acting as communicators and audiences at different hierarchical levels of sustainability.

	SOCIETAL SUSTAINABILITY		SECTORIAL SUSTAINABILITY		CORPORATE SUSTAINABILITY		PRODUCT SUSTAINABILITY	
	Communicator	Audience	Communicator	Audience	Communicator	Audience	Communicator	Audience
Government	X [a, b, c]	X [?]	X [a, b, c]		X [a, b, c]		X [a]	
NGOs				X [d, e, f]		X [?]	X [a]	
Consumers								X [d, e, f]
Financiers								
Employees				X [?]				
Forest owners	X [?]			X [?]		X [d, e, f]		
Natural environment						X [?]		
General public		X [d, e, f]				X [d]		X [d]
Forest sector	X [c]			X [?]	X [a]		X [a, b, c]	
Scientists				X [?]				
Construction sector				X [d, e, f]				
Environmental technicians and designers								X [?]
Architects								X [d]

[a] one-way communicators; [b] asymmetric two-way communicators; [c] symmetric two-way communicators; [d] audiences of one-way communication; [e] participants in asymmetric two-way communication; [f] participants in symmetric two-way communication; [?] not identified

Article VI

Forest management or greed of gain? – An information experiment on peri-urban forest visitors' attitudes regarding harvesting operations

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Abstract
Forestry operations in urban forests are often negatively perceived by forest visitors when seeking recreational purposes. This study investigates the range of attitudes present among recreational forest visitors regarding forestry operations and how targeted information can influence their perceptions. First, in a pre-study with 12 participants a hierarchical value map (HVM) was created to identify attributes and values associated with forestry operations. Second, 51 forest visitors were surveyed in the Vienna Woods, Austria, using the laddering method to identify focal points and shifts of attributes and values in the HVM. Results show that the information boards used in the experiment take off some strength from visual appearance and ecology related factors and redirect attention towards wood-industrial properties. We conclude that providing information at the place of emotional concern is easily picked up and leads to attitude changes. These attitude changes are directly linked to the information provided (e.g. less worries about environment, ecosocial market economy, support of regional economy).

Highlights:

- We investigated the perception of recreational forest visitors on forestry operations
- In an experimental study information boards on forestry activities were installed in the Vienna Woods next to a recent clear cut
- Forest visitors passing the clear cut (N=51) were asked for their attitudes used the laddering technique
- Our results show that visual appearance is a strong starting point for the respondents' perceptions and the information board cause an attitude shift in the weight of certain topics.
- By using targeted information we show, how to take off some strength from visual appearance and ecology-related factors and redirect attention towards wood-industrial properties which is considered to be useful for the visitor management of urban forests.

1. Introduction

Research on the perception of urban and peri-urban forests has a vital tradition (cf. Schroeder, 1990). Understanding relationships between urban populations and forest ecosystems is considered necessary for balanced natural resources management. Previous research focused on city resident's attitudes on the management of urban forests and other green spaces (cf. Baur, et al., 2016), which preferences they have for site characteristics when seeking for stress relief (cf. Arnberger & Eder, 2015), and how they perceive and use these spaces (cf. Ode Sang, et al., 2016).

Wild-Eck and Schmithüsen (2001) showed that the urban public perceives forests predominantly by their recreational and environmental functions. In Central Europe, with predominantly semi-natural forests used for both forestry and recreation, management is necessary to balance between these two functions. Tahvanainen et al. (2001) showed that the visual aspect is more relevant for perception building than verbal information.

Also, consumer attitudes towards wood-based products were a subject of research. Especially in context of building materials (cf. Roos & Hugosson, 2008; Jonsson, 2005) and furniture (cf. Brinberg, et al., 2007; Ridoutt, et al., 2002), wood receives relatively positive perceptions. However, these rather positive perceptions of wood stand in contrast to the perception of harvesting operations, especially clear cuts (cf. Bliss, 2000). This phenomenon, the positive perception of wood products but the negative attitude towards the foregoing harvesting process, can be attributed to the so-called "Schlachthausparadox" (cf. Pauli, et al., 1998) which describes an attitude that contains a positive perception of the product and a negative perception of the production process.

As in case of agricultural production, a lack of personal knowledge and experience regarding the underlying processes is expected to increase the difference between the negative and the positive perceptions within the chain (cf. Helmle, 2010). Ranacher and Stern (2016) showed the influence of a personal forest-based sector connection to the person's perception of forest management. Similarly, there is a strong relationship between preferences for forest scenes and attitudes towards forest management (cf. Kearney, 2011).

Therefore, the aim of the study was to explore how peri-urban forest visitors' attitudes are affected by the provision of information boards at the highly emotional setting of a clear cut harvesting site, and whether this is a tool to increase acceptance towards forest management practices that strongly affect the visual appearance.

2. Material & Method

According to Fishbein and Ajzen (1975) "an attitude represents a person's general feeling of favourableness or unfavourableness toward some stimulus object". In this study, attributes and values are used to express people's attitudes by using a hierarchical value map (cf. Gengler, et al., 1995). Previous studies (cf. López-Mosquera & Sánchez, 2011; López-Mosquera & Sánchez, 2013) used means-end chain techniques to examine how visitors of peri-urban green areas reflect their own personal values through the benefits and attributes they perceive in the natural areas.

Thus, we wanted to explore the range of attitudes of recreational forest visitors regarding forest management in a peri-urban forest. Additionally, we wanted to examine how targeted information can influence attributes and values that are mentioned by the forest visitors regarding forest management. A preparation study is first required to create the survey tool. Thereafter, this tool is applied to survey visitors passing by a harvesting site in the Vienna Woods.

2.1 Preparation study

As the aim of the study is to measure attitudes towards harvesting operations and not towards a product , the means-end-concept (cf. Liebel, 2007) was adapted to suit this purpose. The Means-End-Theory assumes that characteristics of a product (1st level), consequences of using a product (2nd level) and value concepts of a person (3rd level) influence his or her consumer behaviour (cf. Liebel, 2007). A subdivision of some properties into attributes (1st level) and consequences (2nd level) seemed arbitrary and not expedient. The term “construction timber” demonstrates this situation exemplary: Is the use of construction timer an attribute or already a consequence of the harvested logs?” Therefore, instead of dividing properties into attributes and consequences, they were summarised as attributes.

Twelve participants were selected by convenience sampling based on the selection criterion that they occasionally visit a nearby forest for recreational purposes. They were asked in a comfortable environment what they think of and how they feel when encountering a harvesting site when seeking recreational purposes in the forest. Their attitudes on harvesting operations were collected using the laddering method. After providing the answers, the interviewer asked iterative counter questions like “Why is this important to you?”, to identify attributes and deeper values to more precisely characterize their attitudes. This step aimed at developing a preliminary hierarchical value map for the data collection in the field.

2.2 Experimental Design of the Survey

To measure the effect of provided information at the emotional setting of a harvesting site, we applied an experimental research design: three info boards were placed directly at a recently harvested area in the Vienna Woods, Austria, nearby a popular destination in the district of Mödling, close to the Anningerhaus, a popular restaurant among forest visitors in this area. The content used on the info boards was influenced by previous studies (Ranacher and Stern 2016; Luggauer 2016). The boards contained information on forest management, its impacts and wood use (see Appendix).

Due to the novelty of the research design and the content used on the information boards, the application of a qualitative-explorative primary research design (cf. Barton & Lazarsfeld, 1984) seems reasonable. The study applied a semi-standardized questionnaire in a guided interview, using the method of soft laddering (cf. Costa, et al., 2004) to measure the effect of the info boards on people’s perceptions. Because of the time-consuming and for the recipient strenuous character of the technique, a shortened form of the laddering questioning, with minimum loss of information is desirable (cf. Kaciak, et al., 2010). For this reason, the hierarchical value map (HVM) in the preparation study intended to train the interviewer and to carry out the survey as comfortable as possible for the recipients.

To measure the effect of the info boards on the perception, there have been survey periods, where the information boards were disposed (group B), and survey periods, where they were put away in order to get a reference group (group A). However, an additional group must be considered which had the possibility to read the boards but did not read them (group C). To control external influences, the information boards were disposed alternating in the morning or in the afternoon. Additionally, the information boards were set by the wayside. To make sure, that the forest visitors read the information boards just because of their self-interest and in a self-chosen intensity, the interviewers were out of their eyeshot. Every visitor passing by being older than 15 years was asked to participate, which was affirmed by more than 90%.

After informing the recipients about the framework conditions (issue of the survey, investigating institution, assurance to treat the information anonymously) the survey was proceeded with aid of the semi-standardized questionnaire. The first question asked focused on the perception of the harvesting area and about the information boards (in case of groups B and C). The attitudes of the forest visitors were identified by measuring attributes and values using the laddering method. The participants were asked: "How do you think of this harvesting measure? Why has it been done? Why do you attach importance to [named properties]?" Therefore, the HVM of the preparation study formed a basis to carry out the laddering part as quick as possible. The last part of the survey comprises the frequency of forest walks in the Vienna Woods, and sociodemographic data. Furthermore, the survey participants were asked if they have a connection to the forest-based sector through formal education, forest ownership of profession, since this was found to have an influence on the perception of the economic use of forests (Ranacher and Stern 2016).

The laddering part was analysed quantitatively by counting the frequency of each mentioned property. As a result, a second final HVM was created, which shows the results in a clear arrangement. Afterwards linkages between named properties were set out in an implication matrix (cf. Reynolds & Gutman, 1988; Liebel, 2007). Furthermore, chains by relations, which outline frequent linkages, were developed out of the implication matrix (cf. Reynolds & Gutman, 1988). Because it would not have been expedient to divide into direct and indirect linkages, the chains by relations (so called attitude chains) are presented in a reader-friendly figure.

3. Results

3.1 Hierarchical Value Map

In the explorative, qualitative preparation study, a preliminary HVM was created through structuring the answers of the participants by condensing similar responses. It serves the foundation for the survey in the Vienna Woods, Austria.

Fig. 1: Preliminary HVM based on the preparatory study (n=12)

Fig. 1 shows the extensive HVM as the first outcome of the preparatory study. It uses a wide range of attributes and values – like *furniture*, *paper*, *sustainability, responsibility*,

but also *destruction of the environment, ecology: wish for jungle* or *greed of gain* – to describe possible attitudes people may have concerning to harvesting operations like harvesting wood.

In the second part of the study, the forest visitors' attitudes were examined by measuring important attributes and values using the laddering method. For the evaluation of a HVM it is usual to count the number of mentions (cf. Reynolds & Gutman, 1988).

In contrast to the HVM of the preparation study, the following differences yielded: The property *earnings* was split in the properties *earnings/economic factor* and *greed of gain*. While both describe the fact of earning money by using raw material of the forest, *greed of gain* seems to be a negative property and *economic factor* appears neutral or even positive. The following properties, which were developed in the preparation study, were not mentioned at the survey in the Vienna Woods at all: *change of use (building area, grazing area, ski slope), hunting, legitimacy, interior (furniture, floor)* and - *chemical industry (wood sugar, plastics)*. The reasons for them not being named can be attributed to lacking relevance (e.g. hunting), to detailed specification (e.g. chemical industry) or to the interview place and season, which may complicate the mental association with certain properties as furniture or ski slope.

For each of the groups A, B and C a specific HVM was derived from the cumulated answers of the forest visitors. The following table shows the major differences. The percent value describes the number of people within each group, which named the specific property.

Table 1: Frequency of mentioned properties by the particular groups in % (n_A=23, n_B=20, n_C=8) including multiple counting.

In group A, in total 176 properties were mentioned by 23 individuals, which gives an average of 7.7 mentions per person, in group B there have been 135 properties mentioned by 20 individuals which results in 6.8 mentions per person and in group C, 8 persons gave 49 mentions, which are 6.1 mentions per person on average.
Group A is characterized by strong assets in the fields of *visual appearance* (78%) and ecology (*worries about environmental compatibility*, 57%, and *wish for jungle*, 17%). Egocentric values like the own *well-being*, *health*, *activity*, *spirituality*, *tradition and culture* were named by many forest visitors. Small assets could be found at most of the wood-industrial properties, only the very general properties *raw material wood* and *livelihood for forestry sector* were named more often. 30% of group A has a connection to the forest-based sector.

In contrast, respondents of group B named more detailed mentions regarding usage of the raw material wood. In comparison to group A, *worries about environmental compatibility* (20%) and *wish for jungle* (0%) lost importance. In addition, less egocentric values were named, presumable because they seem less important against the background of knowing the reasons for the harvesting operations. 40% of group B has a connection to the forest-based sector.

Group C resembles group A concerning wood-industrial and egocentric properties but the groups were not completely identical, great differences could be measured in the following aspects: *worries about environmental compatibility* (13%) was named clearly less, properties of wood-industrial usage gained further importance. In contrast to group B the *worries about environmental compatibility* became also less important and more egocentric properties were named. 3 out of 8 respondents in group C have a connection to the forest-based sector.

Considering respondents' connection to the forest-based sector, it was observed that the connected members of groups A and C were more similar to group B regarding mentioned properties like *destruction of the environment/overexploitation* and *sustainability*. In addition, the info boards were able to adjust the unconnected forest visitors on the level of the connected in properties of e.g. *raw material wood*, *visual appearance* or *sustainability*, while the connected stay in most properties on the same level.

3.2 Implication Matrix and Attitude Chains

An implication matrix exposes the number of linkages between properties. Accordingly, attitude chains were derived from the implication matrix. Attitude chains show the condensed combination of mentioned properties within a group. Fig. 2 shows the attitude chains of group A and B. The numbers on the lines give the amount of mentions of the particular combination.

Fig. 2: Attitude Chains of groups A (no boards, left, n_A=23) and B (with boards, right, n_B=20)

The most frequent combination of properties in group A were *visual appearance*, *forest management*, *worries about environmental compatibility* and *sustainability, long-term raw materials supply* Their attitude can be condensed to: "The forest shall be cultivated, but I am not sure whether this approach is environmentally compatible."

The linkages observed in case of group B are more diverse and as a result, their attitude chain is not as clear as in group A. However, it centres around the properties *visual appearance*, *damage repair*, *forest management* and *environment, species and soil protection.* Although the frequency of the attribute *visual appearance* is clearly reduced, it is still part of the prominent combination. In total, group B seems more optimistic than group A, it can be implied that they have more confidence towards forest management. Their attitude can be condensed to: "It does not look nice, but I think there are legitimate reasons for this harvesting measure."

4. Discussion and Conclusion

The study measured attitudes of forest visitors to identify changes potentially caused by information boards. It tries to find a way to balance the recreational interests of forest visitors with forestry operations that strongly affect the visual appearance. The results showed that the boards or more specifically the reading of the boards' content by the respondents did not influence the frequency of mentions during the laddering process. However, the results imply that the boards account for a shift in the weight of certain

topics mentioned in the laddering process. In line with Tahvanainen et al. (2001) the visual appearance is a strong starting point for the respondents' perceptions. Furthermore, the provision and use of information boards may take off some strength from visual appearance (as well as ecology related factors) and redirect attention towards other topics mentioned on the boards (e.g. renewable materials, energy production, incomes and regional economies). Nevertheless, personal characteristics of the respondents seem to remain a major factor regarding different attributes or values.

The theory of the cognitive response (Petty, et al., 1981) may be helpful to interpret the results of the study. According to this concept, people encode new information by linking it with other information already present in their long-term memory. In general, an attitude change can only occur due to central influences, however strongly dependent on the situation, the used media and the personal involvement (cf. Raab, et al., 2010, p. 97ff). One strong influencer of personal involvement in forest-sector related topics, is respondents' connection through formal education, profession or forest ownership. Additionally, an intensive confrontation with the message transmitted is necessary to get people to a change of their opinion and further attitude (cf. Raab, et al., 2010, p. 99).

While the intake and conversion of new information that is inconsistent with existing knowledge may cause a cognitive dissonance (Festinger, 1957) respondents will attempt to eliminate this dissonance. They might try to ignore or avoid dissonant information beforehand and/or try to devalue the meaning of dissonant information (Stern, et al., 2009). Jonas et al. (2001) showed that after having made a decision, people prefer supporting information over conflicting information, especially when information is presented sequentially instead of simultaneously. By contrast, the theory of psychological reactance (Brehm, 1966) follows the idea that respondents could interpret the new information as an attempt to influence their opinion. With highly involved topics, such as harvesting operations in a recreational forest setting, this attempt could be understood as a threat to the respondent's freedom to decide. The respondent would then be expected to defend his freedom by adopting a very negative attitude to the intake and conversion of the new information.

In case of the present study, we can assume a cognitive response with central intensity. The highly emotional setting of a clear cut harvesting site in a recreational area is a situation with high involvement. Consequently, the basis for an attitude change was given insofar as the forest visitors are interested in the information and read the information boards which was confirmed by the fact that 71% of the respondents passing by with boards being in place did read them. Based on the cognitive response theory, linking of new information with other information already present could lead to three basic reactions: convergence, dissonance and reactance. No indication for reactant reactions can be observed when comparing the results of group B with those of groups A and C as presented in table 1.

In case of reactance, the most frequent attributes and values not positively connected with the information on the boards in groups A and C would be expected to perceive even more attention in group B. This is obviously not the case. Cognitive dissonance may be mostly included in group C since this group had the opportunity to read the boards but did decide not to do so. Three properties may indicate a particular potential for

dissonance: *ecology – wish for jungle*, *activity/movement* and *greed of gain*. In those cases, the percentage of mentions exceeded those of group A. Especially in case of the first two it is imaginable that reading the info boards is somewhat contradicting the respondents' wish for activity/movement and jungle. Finally, a convergent take up of information can be assumed to cause some of the differences between group A and B, at least those which are directly linked to the information provided (e.g. less worries about environment, ecosocial market economy, support of regional economy).

Beside the regular biases associated with such surveys (e.g. social compliance, forming of categories), some aspects that could partly explain the differences between respondents may be considered. One concern of the study was to get the very first reaction of the forest visitors to make sure they do not get used to the harvesting site. Even though the survey started right after completion of the harvesting operations, the operations took place over a period of six weeks. Hence, some respondents may have passed by the harvesting side before the survey took place and may therefore show different reactions (less extreme) than other respondents.

As the survey took place as a snapshot, no statement about a long-term nature of the attitude change can be made. The results are based only on a small sample size because of the qualitative character of the study. Due to the research approach's novelty and for lack of existing data concerning the present problem, the chosen qualitative method provides a sensible basis to make sure that no important aspects are overlooked. It can be assumed, that the information boards are a tool to increase acceptance towards forest management. However, a quantitative study based on this research would be recommendable to verify the results.

Acknowledgements

The study was funded under the Wood Wisdom era-net and is a result of the research project "What We Wood Believe – Societal perceptions of the forest-based sector". It was co-financed by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management [grant number 101002/1].

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Appendix

For the information boards (here translated in English) we used the following content and design, see Figs. 3-5.

Fig. 3: Information board number 1

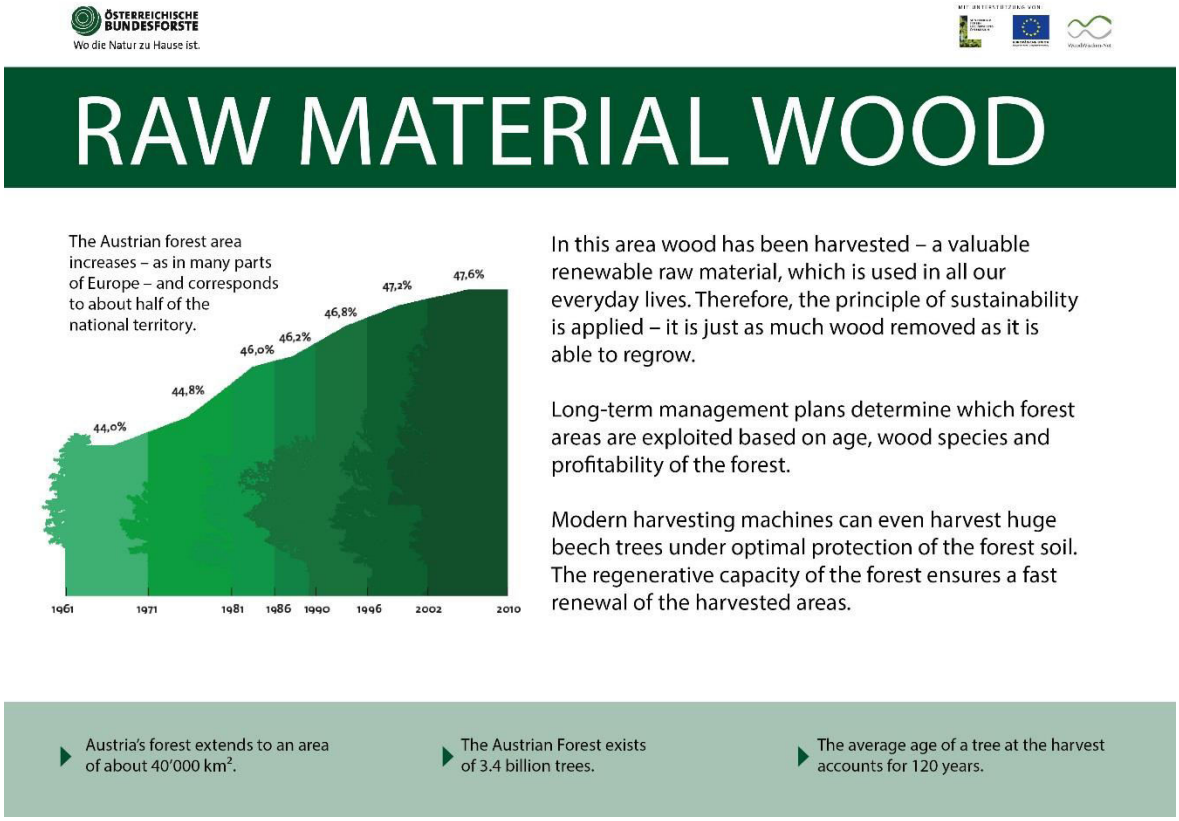
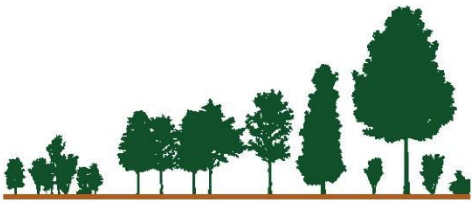


Fig. 4: Information board number 2

ÖSTERREICHISCHE BUNDESFORSTE
Wo die Natur zu Hause ist.

HABITAT FOREST



Different levels of forest development (plant heights) represent a diverse habitat.

The wood harvest selectively intervenes in the ecosystem forest. But a sustainable forest management creates habitats for animals and plants that need sparse areas as well.

By implementing targeted measures like the planting of resistant wood species, the forest is adapted to the changed environmental conditions and is made "fit for climate".

Ecologically valuable areas in the biosphere park Vienna Woods are under protection and not exploited.

Fig. 5: Information board number 4

- One handful of forest soil contains more living beings than humans on earth.
- Deadwood provides habitat and food for many organisms.
- Over 70 wood species live in Austria's forests.

ÖSTERREICHISCHE BUNDESFORSTE
Wo die Natur zu Hause ist.

WOOD IN EVERYDAY LIFE

Wood can not only be processed as building material but also as paper and textiles or used as an ecologic combustible. It can as well be found in the form of vanillin in vanilla ice-cream or as xylitol in tooth paste.

While a tree is growing it absorbs carbon dioxide (CO_2) from the air, retains the carbon in the wood and gives oxygen to the atmosphere.

If a tree is felled and the wood is being processed, the carbon remains in the wood and is not released in the form of CO_2 until the wood burns or rots.

- To get one cubic meter wood, one ton CO_2 is absorbed.
- Wood consists of 50% carbon.
- Even viscose consists of wood.

Figures & Tables used in the manuscript

Fig. 1: Preliminary HVM based on the preparatory study (n=12)

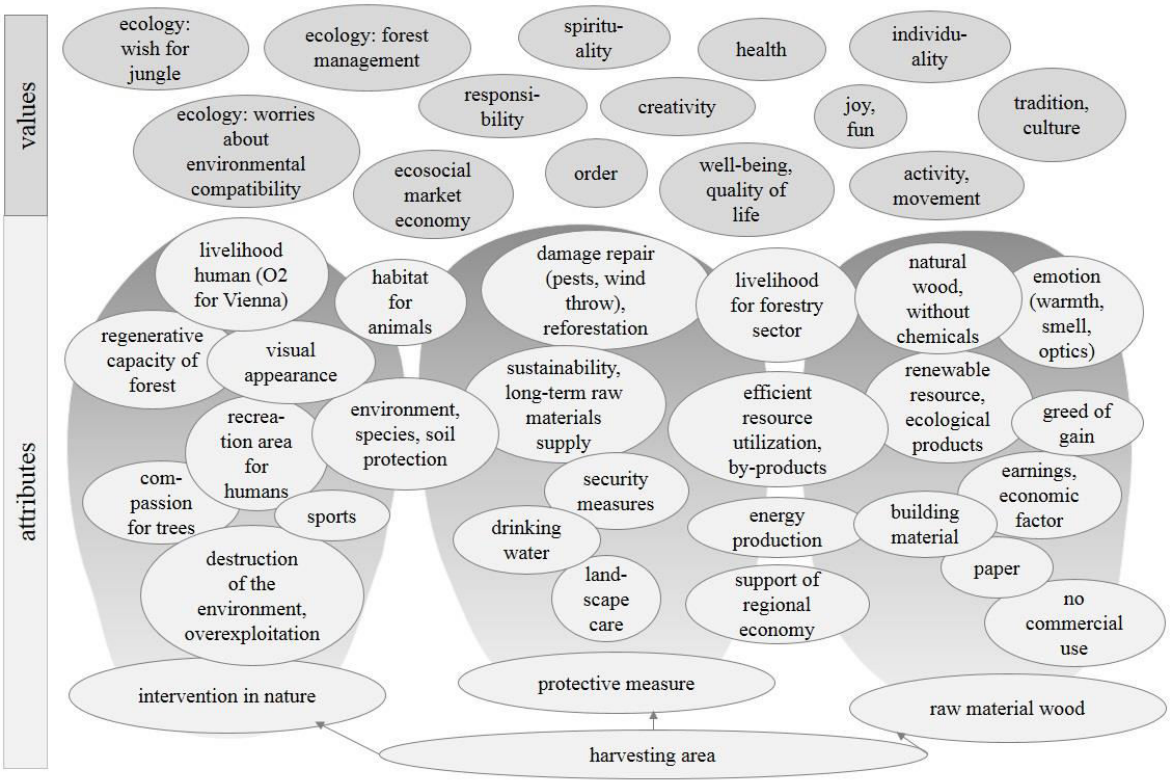


Fig. 2: Attitude Chains of groups A (no boards, left, nA=23) and B (with boards, right, nB=20)

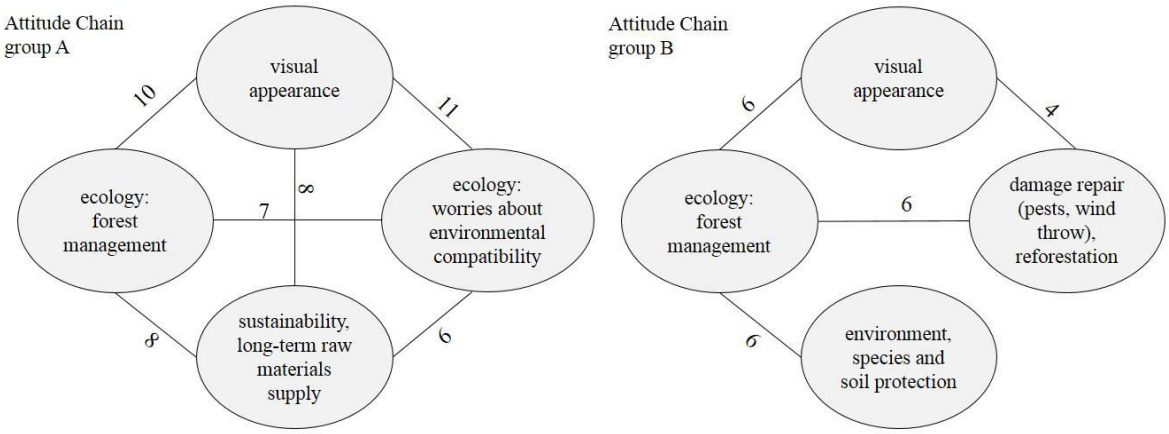


Table 1: Frequency of mentioned properties by the particular groups in % (nA=23, nB=20, nC=8) including multiple counting

property (attribute or value)		A (no boards)	B (with boards)	C (without reading boards)
ecological	ecology – wish for jungle	17%	0%	25%
	ecology – worries about environmental compatibility	57%	20%	13%
egocentric	visual appearance	78%	40%	50%
	well-being, quality of life	39%	25%	0%
	activity, movement	17%	5%	25%
	spirituality	13%	5%	13%
wood-industrial	ecosocial market economy	9%	30%	25%
	raw material wood	30%	40%	38%
	livelihood for forestry sector	30%	20%	13%
	support of regional economy	0%	25%	0%
	natural wood, without chemicals	0%	10%	0%
	renewable resource, ecological products	0%	5%	0%
	energy production	4%	15%	13%
	earnings, economic factor	0%	5%	0%
	greed of gain	9%	0%	13%