

**Do wood products protect the climate? Public perception of the forest-based sector's contribution to climate change mitigation**

Ranacher <sup>1\*</sup>, L., Stern, T. <sup>2</sup>, Schwarzbauer, P. <sup>3</sup>

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**Schlüsselbegriffe:** öffentliche Wahrnehmung, Kommunikation, Forst-Holz-Sektor, Klimaschutz, qualitative Inhaltsanalyse, Umfrage

**Abstract**

There is broad consent in climate research that forests and harvested wood products play a crucial role in climate change mitigation. Several studies exist on the perception or communication of the forest-based sector, but the combination of both elements is rare. We therefore 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 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 socio-demographic backgrounds. First, the websites of 16 Austrian and 25 German forest-based sector companies and associations were

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<sup>1</sup> Kompetenzzentrum Holz (Wood K plus), Market Analysis and Innovation Research, Feistmantelstraße 4, 1180 Vienna,

\*Corresponding author: Ranacher, L. (l.ranacher@kplus-wood.at)

<sup>2</sup> Institute of System Sciences, Innovation and Sustainability Research, University of Graz, Austria

<sup>3</sup> Institute of Marketing and Innovation at the Department of Economics and Social Sciences, University of Natural Resources and Life Sciences, Vienna

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 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.

## **Kurzfassung**

Die Klimaforschung ist sich einig, dass Wälder und Holzprodukte eine wichtige Rolle im Klimaschutz spielen. Es bestehen Studien über die Wahrnehmung oder die Kommunikation des Forst-Holz-Sektors, 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 Unternehmen und Verbänden des Forst-Holz-Sektors 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 wiedergeben. Insgesamt wurden 194 Antworten erhalten. Die Botschaften unterscheiden sich in der Häufigkeit, mit der sie kommuniziert werden, sowie in der öffentlichen Wahrnehmung. Hinsichtlich soziodemografischer Eigenschaften hat der Bezug der Befragten zum Forst-Holz-Sektor 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.

## **1. Introduction**

The 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 the public in Europe is 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 areas are 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 regarding climate change mitigation. Using a qualitative content analysis we investigate, I) which messages are communicated by the forest-based sector; and by using a survey II) how these messages are perceived by the general public considering their socio-demographic 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 addressed 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 this approach 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 public 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, such as opinion polls and media analyses, has a long tradition in public relations research (Watson, 2012). According to literature (Watson and Noble, 2007), 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, Lindemann (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 publicly communicated content of the forest-based sector on its role in climate change mitigation (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. to which level does the general public agree to the communicated content?). It was assumed that climate change mitigation was not at the center of communication on the organizations' websites. However, the websites are considered as 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. However, 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 qualitative content analysis and public survey to examine which messages are being publicly conveyed by the sector and which ones are adopted by the respondents. This serves as a feedback process to evaluate communication activities of the forest-based sector. More precisely, it provides information on who understands which messages.

The analysis is based on the assumptions that, if the communicated content is well perceived, which is reflected in high agreement levels, the communicated content is coherent with public perception. If agreement levels are low, then this represents a gap between communicated content and public perception. Similar method of analysis was conducted in a previous study on sustainable forest management (Ranacher and Stern, 2016). 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 messages from selected companies' and associations' webpages of the forest-based sector. Second, items are generated representing these messages and their perception is researched in a public survey.

For the content analysis, data were taken from an earlier study applying a qualitative content analysis on the websites of forest-based sector organizations in four forestry-rich European countries (Korhonen et al., 2016). The study uses eight topics as an analytic lens based on the outcomes of an international stakeholder workshop. One of the topics was the role of the forest-based sector in climate change mitigation, which is now analyzed in more detail. The sampling of the earlier study and consequently this study was based on purposive sampling (Ritchie and Lewis 2003). It was ensured that all relevant types of companies and organizations were included in the country samples. Ultimately, the sample of organizations was determined based on the content of information available on their websites, specifically targeting information rich cases.

For this study, 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 typical but purposive sample of the forest-based sector and corresponding associations in the two countries. Therefore, the sample includes a larger share of wood processing than forest management organizations. However, this must be considered as a representative picture of online communication since there are only a few forest companies with a website used for communication with

the general public. Since in Austria and Germany forestry and wood processing are strictly separated, the majority of Forest owners engage in small scale forestry. In these countries forest owners do not have a website or communicate with the general public. Their only possibility is to communicate through associations which were included in the sample.

*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
<b>Germany</b> (25)	Large companies	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)
<b>Austria</b> (16)	Large companies	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 as 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. In the first round of analysis a deductive coding was conducted identify all relevant content that addressed the role of the forest-based sector in climate change mitigation. In this process the coding unit consisted of either several sentences, a section, or a paragraph depending on the context (for more details see Korhonen et al. 2016). In the second round of analysis which forms the initial part of this study, the identified content was examined more closely. All paragraphs addressing the role of the forest-based sector contributing to climate change mitigation were coded and grouped into different categories developed in the coding process (i.e. inductive coding).

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 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 (Schreier, 2012, p. 239f).

For the survey, a module with 14 polarized items 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 socio-demographic 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 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 addressing the role of the forest-based sector contributing to climate change mitigation. These hits were coded and grouped into different categories developed in the coding process by an inductive coding procedure. Finally the categories were aggregated into two main categories covering the impact of wood products and forests on climate change mitigation. 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 two messages consists of several categories. The ma-

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 messages and number of received hits of the content analysis

Messages and categories	# of hits Germany	# of hits Austria
<b>Message: “Wood products have a positive impact on the climate”</b> 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
<b>Message: “Forests have a positive impact on the climate”</b> Contains categories: Trees use CO <sub>2</sub> , Forests serve as a carbon sink, The use of forests increases carbon sink, Tree species will differ	28	27

## 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 items on trees and forests use carbon dioxide and thereby protect the climate, whereas lowest agreement was observed for items 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 items 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 items, 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 messages according to their involvement in the forest-based sector measured with individual items in % (n=194)

Item	Uninvolved			Involved			Sign.
	-	-	+	-	-	+	
<b>Message: "Role of wood products"</b>							<5%
Considering carbon dioxide (CO <sub>2</sub> ) 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)
<b>Message: "Role of forests"</b>							<5%
Forests absorb carbon dioxide (CO <sub>2</sub> ) from the atmosphere and thereby positively influence the climate.	2	5	93	3	1	96	*(G)
Plants use carbon dioxide (CO <sub>2</sub> ) 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/ 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). The two tables are necessary to see the differences between the Austrian and German sample as well as a result of sector involvement.

*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; Ranaacher 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). Items 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<sub>2</sub> emissions remains unclear to a large percentage of respondents, especially those not involved in the sector.

The socio-demographic variables, gender, level of education, place of residence, and age were observed to have an influence on the perception of the items reflecting the communicated online content. 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 perception of forests for 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 forest sector involvement can be considered as an existing mental model of a frame of reference. Respondents with involvement have 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 of the survey 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. Hence, the absolute results are not transferable directly to the entire population whereas the reported differences between defined subsamples are most likely to be confirmed on larger scales. 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) (e.g. Lindenmann 1993) 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 hits 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 content, the creation and use of other items may have produced slightly different results. This might be in particular the case when considering the online communication of other forest related stakeholders (e.g. NGOs).

Furthermore, the examined websites are mostly from wood processing organizations. As a result it appears conclusive that the majority of relevant content represent the message "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 is 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

In contrast to other studies (Matthes et al. 2014) investigating the perception climate change by forest owners 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. An issue which is considered as highly relevant by the European forest based sector (Ruusila 2008) for several years. 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 messages. More precisely, this difference as a result of sector involvement depends on the content. The message 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, although it might be perceived differently (Živojinović and Wolfslehner 2015).

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 messages 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.

As a matter of fact, communication on “the role of wood” has not yet reached uninvolved respondents although considered as important (Butarbutar et al. 2016). However, it 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 of 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, content 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 content 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.

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