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Improving the ecologically sustainable forest management behaviour - qualitative frame analysis for argumentation

K. Vierikko, J. Kohl

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Abstract. Finnish forests are nowadays managed along principles of ecologically sustainable management. However, Finnish forests should be managed in both economic and ecologically sustainable ways. Policy tools are needed to guide the management behaviour of forest actors. Empirical studies on management behaviour have mostly concentrated on the objectives and values of private forest owners and forest workers separately. In this context, we were interested in studying forest actors' argumentation to identify which elements have a central impact on the interpretation of ecologically sustainable forest management. The study aimed at identifying the elements shared among different forest actor groups. Frame analyses were made to identify different argumentation groups. The primary data were semi-structured interviews with 20 forest actors. Four different argumentation frame types were constructed: information, work, experience and own position based. These were different in whether external experts or their own experiences were more trusted. Also, society and the individual role in maintaining the ecological sustainability of boreal forests were different among the groups. Based on the results, the most suitable policy instruments adapted to the frame types were suggested. The closer ecologically sustainable forest management is to the forest actor's daily life, the more profiled policy tools are needed to guide management behaviour to become more ecologically sound.
Keywords: argumentation, ecological sustainability, Finnish forests, forest actor, frame analyses

Authors. Kati Vierikko (kati.vierikko@helsinki.fi) Department of Biological and Environmental Sciences, P.O., Box 65, FI-00014 University of Helsinki, Finland; Johanna Kohl (johanna.kohl@gmail.com) Faculty of Social Sciences, P.O. Box 35, FI-40014 University of Jyväskylä, Finland.

Introduction

Sustainable forest management (SFM) has been a key principle of Finnish forest policy for centuries (Vehkamäki 2006). The traditional principle of SFM was based on sustainable yield management, where the yearly roundwood removals did not exceed the annual increment of the growing stock (Sverdrup & Svensson 2002). The importance of biodiversity of boreal forest ecosystems and the role of ecological sustainability in SFM emerged during the 1990s. Finnish forests are commonly used for multiple purposes such as hunting, berry and mushroom pickings, and nature trips (Salo 1995). Additionally, timber and other

non-wood forest products offer income for many households (Finnish Statistical Yearbook of Forestry 2005). Therefore, the forests have a central socio-cultural and economic role in Finnish society. However, forestry and the needs of the forest industry still have a strong role in decision making on the multiple use of boreal forests in local, regional and national scales in Finnish society. Today, securing a continuous roundwood supply for the forest industry is a key goal in Finnish forest policy (economic sustainability) (Prime Minister's Office 2008). The government has also the responsibility of preserving the biological diversity of boreal forests (ecological sustainability) (Forest Act 1093/1996, Nature Conservation Act 1096/1996). Several policy tools have recently been developed to enhance the ecological sustainability of Finnish boreal forests at national, regional and local scales.

Policy tools are used to guide the management behaviour of forest actors [1)] to achieve the abovementioned economic, social or ecological aspects of sustainable forest management (SFM). The policy tools in this article refer to techniques and instruments that the government and other agencies use to achieve certain policy goals (Schneider & Ingram 1990, Hajer 1995). We categorized current Finnish forest policy instruments which aim to maintain the biological diversity and ecological sustainability of boreal forests into five groups. Our classification is based on Schneider & Ingram's (1990) behavioural assumptions of policy tools, i.e. (1) authority, (2) incentive, (3) capacity, (4) symbolic and hortatory, and (5) learning (Table 1). These groups differ in their operational characteristics and how an agent or targeted group is assumed to behave.

Legislation and traditional conservation programmes are considered authority-based policy tools because they are hierarchical systems guided by the government. Financial incentives, such as compensation payments for timber loss due to biodiversity protection, support the forest actor to take ecological aspects into consideration when he or she manages commercial forests. Capacity tools try to guide management action by using soft law systems, such as forest management recommendations or by training and educating. Voluntary-based conservation and forest certification systems are classified into symbolic and hortatory systems, because their idea is to promote the forest actor's motivation to maintain the biological diversity of forests. Finally, learning-based policy tools are used when a problem is recognized, but there is no agreement or it is not clear what should be done (Schneinder & Ingram 1990). Therefore, what should be done depends on the situation and forest actors' values and preferences. The last instrument is most commonly used together with others. It should be flexible and try to find the most suitable practical solution. The four last policy tools can also be categorized into informative-based guidance, where the aim is to have an impact on individual decision making by offering new information, persuading or justifying (Vedung 1997). In the Finnish forest policy informative-based tools guidance has been seen as the most important policy instrument to enhance biodiversity conservation (Ministry of Agriculture and Forestry 1999, Ministry of the Environment 2008). The social acceptability of biodiversity conservation is also considered to be of great importance (Horne 2006, Juutinen et al. 2008).

The ecologically sustainable forest management of Finnish forest actors

In Finland, the continuous socio-economic change of the regional communities by urbanization and the migration of the population are important causal factors inducing value changes (Karppinen 1998). Additionally, structural changes in landowner characteristics, such as transfer from farmer to non-farmer or increased ownership, of by women and absentee owners are considered to be the most significant factors affecting the values and objectives of forest owners (Ripatti & Järveläinen 1997).

Kuuluvainen et al. (1996) and Karppinen (1998) noticed that multi-objectives non-industrial private forest (NIPF) owners were the most active and harvested significantly

1) The forest actors represent an individual, institution, stakeholder or any other group or organization which is actively connected to Finnish forests through their work, stakeholder position, ownership or recreation.

Table 1 Behavioural assumptions of policy tools (Schneider & Ingram 1990) and instruments of Finnish forest policy that influence forest actors' management behaviour to become more ecologically sound

Policy tool	Main assumptions	Characteristics	Finnish forest policy instruments
Authority	Leader-fellowship relationships; the forest actor follows the rules and is faithful to his/her duties even without incentives	Hierarchical system; commonly used together with other tools	Regulations, norms and duties based on Finnish legislation; nature conservation programmes
Financial incentives	The forest actor maximizes his/her utilization; will not change management action without incentives; capable of recognizing different opportunities	Positive and negative financial payments	Kemera*-based subsidies as compensation payments for timber loss in safeguarding local nature values
Capacity	The forest actor is a free agent and able to make his/her own decisions; open-minded to new information and assistance	Providing information; training and education; providing skill and advice; support for handling different situations	Biodiversity-based forest plans; forest management recommendations; training and education; counseling and advising
Symbolic and hortatory	The forest actor is motivated when their beliefs and values are taken into consideration; their preferences are culturally defined; intangible values	Convincing and offering images, labels and symbols	Voluntary-based biodiversity markets by Metso II**; certification system
Learning	There are no a priori assumptions	Varies among the situation's and actors' values and preferences	Exchanging experiences with other forest actors; learning through experiences; defining the most suitable solution

Note: * Kemera refers to the Act on the Financing of Sustainable Forestry (1094/1996)
** Metso II refers to a reference from the Ministry of the Environment (2008)

more than single-objective forest owners. The most active forest owners seemed to self-educate themselves and participate in courses more often than passive forest owners (Hänninen & Kurttila 2004). Karppinen (1998) also pointed out that recreationists who were more likely part-time residents and non-farmer landowners, harvested slightly less than other owners. The multi-objective group was significantly the most common group (48%), compared to recreationists (21%) or other single-objective groups among NIPF owners (Karppinen et al. 2002).

Horne et al. (2004a) carried out questionnaire survey on the views of citizens and non-industrial private forest owners on safeguarding biodiversity in Finnish forests. According to their results, more than half of the NIPF owners agreed that the current level of forest conservation is enough, and only 7% of the responses requested more protection (Horne at al. 2004b). However, 37% of NIPF owners safeguard biodiversity in their forests without any economic incentives. The majority of NIPF owners weighted anthropocentric values as the most important reason to protect forest biodiversity (Horne et al. 2004b). The most important reasons for safeguarding biodiversity were either responsibility towards nature or future generations.

A few qualitative and case studies concern socio-cultural factors that determine the management behaviour of different forest actor groups in Finland (e.g. Jokinen 1998, Jokinen & Holma 2001, Saarimaa 2003, Rinnekangas & Anttonen 2006). Jokinen (2002) conducted

case studies of resident NIPF forest owners management routines in south-western Finland. He pointed out the diversification of choices in decision-making situations. Their behaviour did not follow the rationalization behaviour of certain objectives.

Jokinen (1998) divided resident NIPF owners into four cultural models based on what forest meant to them and their relationships to forests. The five resulting models were as follows: (1) resource, (2) action, (3) good forest, (4) property and (5) living environment. He noticed that forest owning had a strong cultural position among NIPF owners. He also argued that forest owners' attitudes towards biodiversity safeguarding were positive in theory, but the willingness to make practical choices for biodiversity protection was not common. Additionally, what owners meant by biodiversity could vary strongly from the scientific definition. Rinnekangas and Anttonen (2006) studied on social sustainability in the management practices of resident NIPF owners in eastern Finland. They noticed that NIPF owners who actively manage their forest and live close to their forest adopt new information easily, but sort it through their own experiences and local knowledge.

Jokinen & Holma (2001) and Saarimaa (2003) have studied the attitudes and views of forest experts on forest management. These case studies implied that forest workers strongly believed that their expertise is needed to guide the management behaviour of laymen, i.e. private forest owners. Forest workers prioritised the economic aspects of forest management, but also they felt a responsibility to maintain the ecological function of the ecosystem (Jokinen & Holma 2001, Saarimaa 2003).

Materials and methods

Argumentation and socio-cultural elements

It seems that several socio-cultural elements simultaneously influence the management behaviour of forest actors. Therefore, it is not easy to set up appropriate policy tools to guide the ecologically sustainable management of boreal forests. The purpose of our study is to analyse the argumentation of different forest actor groups and to find similarities among their interpretation in southern Finland[2)]. Instead of limiting our interviews to a certain forest actor group, we decided to choose actors who are either by forest owning, working or participating in forest policy discourses connected to Finnish forests. We assume a person assign meaning to a concept through framing (Vierikko & Niemelä 2006). By analysing different argumentation frame types, we can discover which socio-cultural elements, in daily life, are important when forest actors interpret the concept "ecologically sustainable forest management". We base this on the idea that identifying different types of argumentation can help us to understand the differences in ecologically sound management behaviour and implement suitable policy instruments. We argue that values[3)] or long-term objectives alone do not determine ecologically sound management behaviour, but it is also a question of whether a person adjusts the concept to his/her daily routines.

Our intention is to examine how forest actor groups define the concept "ecologically sustainable forests" and to group together forest actors with similar argumentations. By analysing different argumentation groups, we will identify which personal characteristics and social structures in daily life dominate

2) The southern part of the country differs in its forest-owning structure (73% private, non-industrial owners) and has a more intense and longer land-use history than northern Finland. In addition, the proportion of strictly protected forest land is much lower in the south than in the north, 2.2% and 20.2%, respectively (Ministry of Agriculture and Forestry 2002, Finnish Statistical Yearbook of Forestry 2005, Vehkamäki et al. 2006).

3) In our study, values are understood as shared issues, elements and entities of individuals, communities and societies that are experienced as important for achieving certain goals, such as a high standard of living and control over global warming, or for maintaining certain things such as global biodiversity (Levonmäki 2004). Values can vary between different societies, and they are temporally dynamic (Puohiniemi 1993). Individuals are usually willing to promote values (Pietarinen 2000).

when a person gives a meaning to the concept "ecologically sustainable forest management". We believe that recognizing these domain characteristics and the social structures beyond the argumentation, can help us to implement policy tools to enhance forest actors' management behaviour to become more ecologically sound. The objectives of our study are to (1) interpret frames for argumentation, (2) identify the domain elements, profile characteristics and social structures beyond the argumentation that can determine the management behaviour of forest actor groups, and (3) determine appropriate policy tools for each of the argumentation frame types.

Data collection

Semi-structured, thematic interviews were chosen as a research method to examine the argumentation of forest actors and to explore the study objectives (Silverman 1993, Flick 2002). A specific number of individuals were chosen, and the interviews were schematized into three parts (theory, policy, practice) and followed up with an interview protocol, which formed a basis for the questions asked during the interviews (Appendix 1). The questions included knowledge, value and opinion-based questions, and allowed the interviewees to express their own perspectives.

The interviews were carried out between October 2003 and April 2004. The duration of the interviews varied between 40 minutes and 1h 30 minutes, with most lasting about 60 minutes. The interviews were held in the working environments: at an office or in a negotiation room, and in one case at the home of the interviewee. The interviews were auto-recorded and transcribed in a total of 287 pages of text. The original language of the linguistic data was Finnish.

The primary data included 20 face-to-face interviews with forest actors, of whom four were female. The interviewees were categorized according to their relation to forests, and the same person could represent several forest actor groups. The representatives of the forest actors could be classified as follows: (1) forest owners; (2) forest workers in the forest industry, a municipality, governmental organizations or a research institute; (3) institutional professionals at a university, governmental organization or research institute; (4) conservationists, and finally (5) forest users (recreational). The forest actors lived and worked in different regions of southern Finland.

After a short introduction, the interviews were continued with a theoretical question about sustainable forest management and ecological sustainability. The interviewees were asked to imagine an ecologically sustainable forest and define which natural elements or human actions make it ecologically sustainable using his or her own words, or with the help of a given word list. If an interviewee hesitated or was confused with the theoretical approach to the subject, he/she was allowed to use a list of words and choose the most suitable. In all three persons used the word list.

Data analysis

In this study, it was assumed that the interviewees experienced the interviewer as an expert on the discussed subject, and therefore the interview sessions were considered as a dialogue between the research expert (interviewer) and the forest actor (interviewee). Therefore, it was predicted that the interviewees' primary interest was to convince the interviewer and prove to her/him that their actions and ideas about ecological sustainability in boreal forests are "justified", i.e. the discussion between interviewer and interviewee was rhetorical (Summa 1996, Peuhkuri 2004).

The analysis used was based on frame analysis (Goffman 1974). Frame analysis has been used in sociological research concerning environmental discourses to categorize and interpret linguistic data (e.g. Vaughan & Seifert 1992, Väliverronen 1996, Saaristo 2000, Lewicki et. al. 2003, Peuhkuri 2004). Framing can be understood in two ways: (1) either it refers to the process of categorizing, sorting and giving a meaning to new information, events and experiences (definition of the situation), or (2) it can represent the process that determines our decision making and collective action (Goffman 1974, Benford & Snow 2000, Gray 2003, Peuhkuri 2004). In our frame analysis, we focused on identifying domain

characteristics and social structures that could determine the management behaviour of forest actor groups.

The data were analyzed as follows. First, the primary data were categorized according to protocol order (Appendix 1). Verbal expressions that considered the theme "theory and practice of ecologically sustainable forest management or ecologically sustainable forest" were chosen to identify different frame types of argumentations. Also, expressions concerning ecological sustainability during the whole interview were taken into consideration. Then, the elements from the "grounded approach" were used to classify the data, because different frame types were allowed, without any theoretical expectation, to emerge from the interview data (Glaser & Strauss 1967). Below is an example: Interviewee H07M4MTd*: "We have been taught and which I have quite well absorbed is that ecological sustainability is strongly connected to organisms and saving their habitats…" The marked part (in spacing letters) indicated parts of the sentence that determined the frame type. In the given case it was 'information - expert based'.

Results

Frame types of argumentation of ecological sustainability

The following four argumentation frame types emerged from the interview data: 1a) information - scientific, 1b) information-expert, 2) working, 3a) experience-practice based, 3b) experience-expertise based and 4) own position based (Table 2). The argumentation frame types are named according to the perspective the forest actors used when framing the subject during the interview. Like Peuhkuri (2004, p. 107), we considered the forest actor's argumentation framing as a dynamic process, not a constant element. The forest actor can change argumentation type according to the situation or circumstance, and argumentation types are reformed and reframed constantly.

The information-based frame type was divided into two subtypes: scientific and expert based, because of their different attitudes towards the information. Those forest actors using scientific-based argumentation were sceptical towards all kinds of information produced by different institutions, while expert-based argumentators were more trusting of external experts. In the scientific-based argumentation the ecologically sustainable forest (ESF) was interpreted as the biodiversity of the forest ecosystem as defined by ecological research. The idea that natural science produces analytical and objective information about the ecological sustainability of boreal forests and, therefore, represents the best available information was highlighted.

In the information-expert-based argumentation frame type, ecologically sustainable forest and ecologically sustainable forest management (ESFM) had several meanings: species protection, biodiversity, forest (tree) vitality and ecosystem function. The argumentation was based on institutional definitions of ecological sustainability, such as forest policy programmes, Finnish law and scientific authorities. Institutional refers in this study to departments, authorities and public sector entities and their formal instruments (laws, political programmes, research results and strategic papers) (North 1990). The forest actors trusted external experts without any strong investigation about whether they represented the best available information.

The work-based argumentation emerged from the forest actor's working position. In this group, ESF or ESFM were related to either conservation of species or forest (tree) vitality. In this argumentation group, the actor's own responsibilities for practising ecologically sustainable forest management were underlined.

The argumentation that emerged from the forest actor's own experiences was classified as the experience-based frame type. In this group, ESF or ESFM had two meanings: conservation of species or forest ecosystem function. The group was divided into two subtypes: practice and expertise-based. In practice-based argumentation, actors underlined their own responsibilities for maintaining ecological sustainability. It was also expressed that implementing ecologically sustainable forest management is dependent on societal values. In the expertise-based argumentation, the forest

Table 2 Argumentation frame types, description of expressions and examples

Frame type	Meaning for ES/ ESFM	Description	Example
Information-scientific based (1 person)	Biodiversity of the boreal forest ecosystem	Stating the role of natural science and its authorities. The meaning for ES is provided by authorities in natural sciences, and the term ES is something that has been scientifically proven.	*"Hanski et al. says based on their studies that... and that is the best knowledge that I have."*
Information-expert based (6 persons)	Conservation of species and their habitats (2) Biodiversity (1) Forest ecosystem function (2) Forest (tree) vitality (1)	Taking ES as a given definition by an external expert. Defining ES is avoided. Experts do not necessarily represent natural scientific experts, but can be any institution that has given meaning to ES.	*"...as old foresters say so forests need to managed that that they are healthy and grows well..."* *"During the Natura process there were clear definitions for ES such as species abundance..."*
Work based (5 persons)	Conservation of species and their habitats (3) Forest (tree) vitality (2)	Taking his/her own working position into consideration and expressing that as a worker he/she has serious responsibilities and duties to enhance ESFM.	*"As an organization we have to take responsibility and train, educate and lead action to..."*
Experience - practice based (3 persons)	Conservation of species and their habitats (2) Forest ecosystem function (1)	Expressing ES from his/her own practical perspective, and being personally responsible for enhancing ES, while at same time expressing that other forest actors are responsible for unsustainable forest management.	*"We do not have natural forest left in this region... we have to take reality into consideration when making goals for ES."*
Experience-expertise based (2 persons)	Conservation of species and their habitats (1) Forest ecosystem function (1)	Highlighting his/her own experiences, while at the same time expressing that he/she is not responsible for enhancing ES. The expertise is subject related and information from external experts is used from his/her own viewpoint.	*"Why should we use the term ES if we are not utilizing natural resources? ES is just a term for a forest planning system, we cannot define ES before we are managing the forests"*
Own position based (3 persons)	Conservation of species and their habitats (1) Forest ecosystem function (3)	Avoiding a clear definition of ES, or a definition for ES has emerged from a stakeholder or working position.	*"..this is one kind of problem and I think we cannot set an absolute level for ES, because it is somehow connected to values or perspectives."*

Note: ES = ecological sustainability, ESFM = ecologically sustainable forest management.

actors trusted their own perspectives on the ecological sustainability of boreal forests. In contradiction to practice-based framing, those acting on expertise did not feel that they had a personal duty to enhance ecologically sustainable forest management.

In the own position-based frame types the forest actors avoided defining ecological sustainability and they felt that the subject was strongly value-laden. Avoidance of setting definitions for the terms could be identified from their expressions, while at the same time the forest actors emphasized governmental actions in improving ecological sustainability in boreal forests. ESF or ESFM had two meanings for such actors: conservation of species or forest ecosystem function.

Profiling characteristics and social structures

After creating the argumentation frame types, we identified characteristics and social structures beyond the different argumentation frame types (Table 3). These entities are shared cha-

racteristics and not directly connected to a certain frame type or forest actor group (e.g. Vierikko & Niemelä 2006).

The information-based argumentation frame types had a strong theoretical approach to the concept "ecological sustainability" (Table 3). Instead of assigning a definition from their own experiences, they preferred professional or institutional experts. Scientific-based argumentation was typical for researchers. Even though they felt that natural science represents the "best available information", at the same time they were critical of the quality of forest-related research. They felt that society's preferences and political interests take over scientific facts. In contradiction to the scientific-based argumentation frame type in the expert-based argumentation the forest actors were not so critical towards the source of information. They also felt that science should determine decision making and guide forest management planning. This frame type was the most heterogeneous group in which all they forest actor groups (forest owners, forest workers, professions, conservationists and forest users) and meanings for ecological sustainability (species protection, ecosystem function, forest vitality and biodiversity) were represented.

Most of the interviewees whose argumentation were work based, were forest workers, who have traditionally, had a strong work ethic and have good practical knowledge of forest management (see Hannigan 1995, p. 43, Saaristo 2000, Jokinen & Holma 2001, Saarimaa 2003). The forest actors in the work-based argumentation frame type claimed that they are not experts in ecologically sustainable management, but are more likely to follow orders from their superiors. The forest managers or engineers felt a responsibility to follow the

Table 3 Domain characteristics, the role of society and the role of scientific knowledge identified beyond the argumentation frame types

Frame type	Domain characteristics	Role of the society	Role of scientific knowledge
Information-scientific based	Academically educated Trusts scientific experts	Society preferences control the practice of ESFM	Best available information, guided by political interests
Information-expert based	Heterogeneous working group Trusts external experts	Legislation and institutions control the practice of ESFM	Usable knowledge, controls decision making
Work based	Working in forest Organizational position Local knowledge Strong work ethic	Norms and rules control the practice of ESFM, responsibilities compete with each other	Base for management planning
Experience-practice based	Owning forest Local knowledge Takes personal responsibility	Construct their own practice Society values determine the practice of ESFM	Base for management planning
Experience-expertise based	Academically educated Working in office Strong own opinions No personal response for doing the "right thing"	Construct their own practice, Society's values determine the practice of ESFM	Controlled by policy interests
Own position based	Stakeholder position Organizational position	Public opinion and society values controls the practice of ESFM	Not expressed precisely

orders set up by government (legislation) or other institutions (recommendations), while at the same time they have a competing responsibility to sustain forests in an ecologically, economically and socially sustainable way. The forest workers also felt that they have a responsibility towards both forest owners and their property (Jokinen & Holma 2001) and also for the improvement of forest health, vitality and maintain species diversity.

The practice-based frame type argumentation emerged from the actors' life histories. In particular, the forest owners who had strong local knowledge because they lived near by their forest properties and managed the forests by themselves, believed that their management actions were ecologically sustainable. In this frame type, it was strongly argued that societal values determine whether forests are managed in an ecologically or economically sustainable way. The forest owners felt that their only choice was to accept social values.

The expertise-based frame type argumentation represented a problem-related expertise, which typically emerges during environmental conflicts (counter-expert in Saaristo 2000). In our study, the forest actor's expertise was more likely related to a subject concerning them i.e. ecological sustainability, than to their own working or stakeholder position. In this frame type the forest actors were academically educated, and they were used to representing and defending their opinions in political discourses. In the expertise-based argumentation the forest actors stated that ecological sustainability is related to social values and preferences, i.e. others (not us) are in charge of maintaining ecological sustainability in Finnish forests. Therefore, they cannot do themselves anything concrete to manage the forest in an ecologically sustainable way, except for instructing other forest actors in improving forest management to be more ecologically sound. These actors felt that there is enough research data available to develop an "ecologically sound forest management" system. However, they emphasized that the forest research is controlled by political interests.

In the work- and own position-based frames, the argumentation strongly emerged from the forest actor's working position viewpoint. Gray (2003, p. 22-23) speaks about "institutional framing", where an actor holds to his or her working agenda, when giving meaning to a subject or phenomenon. In our study, the forest actors were cautious not to give too personal opinion and not to reveal their working or agenda position.

In work-based and practice-based frame types, the forest actors who worked daily in the forests or were closely connected to practical forest management strongly felt that they can manage the forest in an ecologically sustainable way. They expressed their trust in ecological research information, but at the same time underlined that not enough research data have been produced about whether an "ecological crisis" truly exists in the Finnish boreal forests, as many researchers have claimed (Hildén et al. 2005).

Discussion

In this section we will place our study results in the current perspective of Finnish forest policy. Earlier, we listed policy tools classified into the categories of authority, incentive, capacity, symbolic and learning (Table 1). We compared five policy tools with different argumentation frame types and made some suggestions about which tools would be most appropriate for each frame type. We considered the strengths and weaknesses of each argumentation frame type in regards to their management behaviour towards maintain an ecologically sustainable forest.

The most suitable instruments for the information-based frame type, which included a variety of forest actor groups, would be authority-based tools. Based on our results, this group trusted mostly in external experts and believed that legislation and institutions control ESFM (Table 3). Making new ecological information easy to reach and offering different information sources depending on the person's domain characteristics (forest owner, forest worker, researcher) would be the most efficient way to affect their management behaviour. The weakness of the information - expert-based frame type, however, is that it is vulnerable to all kinds of information sources. Therefore, different information sources with variable political interests and competing

preferences could have contradictory effect on forest actors in the information frame type.

Most NIPF owners trust forest management service providers as a dependable information source (Hänninen & Kurttila 2004). Other local advisors such as ornithologists can also be trustful information source to some owners (Leskinen 2004). The proportion of forest owners belonging to the information expert-based frame type probably will increase in the near future, because of an increasing number of absentee forest owners (Ripatti & Järveläinen 1997). Forest management service providers have a significant role, and, therefore, they must have a strong capability of adopting new ecological information and delivering their knowledge to private forest owners.

Forest workers in work-based frame types have a central role in improving ESFM, because they can have a strong impact on the decision making of other forest actors, especially forest owners (Jokinen & Holma 2001). Forest workers are a widely accepted forest actor group among forest owners (Kurttila & Hänninen 2006, Paloniemi et al. 2006, Primmer & Keinonen 2006). However, the ability to assimilate new ecological information can vary among forest workers. For example, Wolf and Primmer (2006) studied biodiversity conservation competencies among Finnish forest management service providers. They noted that the number of years on the job among forest workers was negatively correlated with biodiversity training and value derived from interaction with external biodiversity experts. Based on these results, we argue that forest workers would adopt new information and management behaviour most efficiently through their management routines (capacity tools). Training courses with other forest workers would be an appropriate instrument to teach new ecologically sound management routines. Additionally, training should be continuous and workers need to update their ecological knowledge.

The forest workers in the work-based frame type felt that they have contradictory responsibilities towards forest management. Leskinen (2004) noted in her interview studies that "Forestry professionals felt that forest owners should not be pressed too much in the direction of nature conservation and biodiversity management". If the economic components of sustainable forest management are exclusively directed towards the ecology, capacity tools will not change management behaviour to become more ecologically sound. Putting an effort into educating their ethical role enhancing ESFM could be a valuable way to change their management behaviour to be more ecologically sound (symbolic tools). In addition, preferences in the working agenda have a significant impact on the management behaviour of this group (Wolf & Primmer 2006). Therefore, working agendas should be open-minded about ecological thinking, even if there is strong pressure to increase timber production and logging (Wolf & Primmer 2006).

Based on our results we assume that private forest owners belonging to the practice-based frame type are the most demanding group, because they have a strong faith in doing the right thing and they blame society for why economic imperatives have taken over ecological thinking. Personal advice and local counselling by forest workers or other resources that this forest actor group relies on could be the most suitable way to teach them management practices of ESFM (capacity tools). Especially, when a forest actor from this group has a strong negative attitude towards ecologically sustainable forest management actions, and he/she is not interested in enhancing their management behaviour to become ecologically sustainable, we believe that neither financial incentives nor capacity-based policy instruments would have much effect on their management behaviour.

The forest owners belonging to the practice-based frame type felt that they have strong responsibilities towards their forest, as did the forest workers in the work-based frame type (Table 3). Therefore, we believe that symbolic-based policy tools could have a strong influence on their management behaviour. Their ethics, responsibilities towards biodiversity protection and ecologically sound management behaviour should be strengthened. Also, forest owners usually need information about the ecological function of forest management recommendations, such as how leaving reten-

tion trees in clear-cuttings increase species diversity (Kurttila & Hänninen 2006). Additionally, we think that exchanging experiences with forest owners with similar experiences would be an appropriate way to educate their ethical role towards ecologically sustainable forest management (Learning tool).

Authority-based policy tools, such as legislation and regulations, would be the most definite way to sustain the ecological sustainability of a forest stand with high biodiversity values. For example, in the United States policy tools have increasingly shifted towards regulation-based conservation tools among private forest owners (Janota & Broussard 2008). Authority-based tools have their weaknesses. First, they could diminish the willingness of practice-based forest owners to manage their forests in an ecologically sustainable way because they would feel that their actions are controlled by institutional authorities (Horne et al. 2004a, Paloniemi et al. 2006). Secondly, it does not take the forest owners' motivations and values into consideration and offers little space for decision making based on practical and local knowledge, which can lead to an increased negative attitude against experts and institutions (Horne et al. 2004a).

Conclusions

Our analysis were descriptive, and general conclusions could not be made. The limited number of representatives (20) in our analyses was valid from qualitative research point of view (Eskola & Suoranta 2000), but not for analyzing causal relationships between actions and arguments of forest actors. Nevertheless, our results indicated that it is valuable to know whether a forest actor has defined ecological sustainability based on their own experiences, or by trusting external experts. In particular, non-industrial private forest owners and forest workers working in organizations that offer management services are the most challenging groups for further studies. To reach forest actors belonging to practice-based and work-based argumentation types, it is crucial to choose suitable policy instruments. More studies and quantitative analysis are needed to study whether there is empirical evidence that the management behaviour differs significantly between different argumentation frame types.

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APPENDIX 1. The interview protocol and themes

01	Forest owning
02	Experiences through work
03	Experiences and hobbies in nature
A1	Theory of sustainability and sustainable forestry and the interactions of three elements
A2	Ecological sustainability and defining an ecologically sustainable forest area
A2.1	Minimum value for ecological sustainabilty
A2.2	Spatiality
A2.3	Temporality
A3	Human effect on ecological sustainability
B1	Aims of Finnish forest policy NFP 2010
B2	Criteria and indicators for sustainable forest management
B3	Forest certification system
C1	Tools to maintain boreal forest biodiversity
C1.1	Voluntary-based protection
C1.2	Forest protection program (traditional)
C1.3	Others (ecological forest planning D1, restoration)
C2	Principles for maintenance biodiversity in managed forests
C2.1	Prescribed burning as a forest management practice and biodiversity conservation tool
C2.2	Green tree retention in clear-cuts and coarse woody debris in managed forests
C2.3	Restoration as a conservation tool in boreal forests
C2.4	Key biotopes in managed forests
D1	Theory and model of ecological forest planning/ adjusted forest management
D1.1.	Model for uneven-aged, continuous forest structure by adjusted silviculture system
E1.1	The future of the Finnish forests: how our forests will look in the year 2030
E1.2	The future of Finnish forestry and the forest industry: where the forest sector will be heading in the year 2030
F1	The role of knowledge in ecological sustainable management
F1.2	Science role
F2.3	The role of local knowledge
G1	The role of the media and information