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Applying cognitive mapping approach to explore the objective–structure of forest owners in a Northern Finnish case area

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Abstract

The present study looked into and described the objectives set by forest owners for their forest ownership and management as a hierarchical cognitive map. The foundation of cognitive mapping lies in cognitive psychology, which is a discipline examining how the human being receives, records and uses information. Cognitive mapping is a method enabling the researcher to clarify and save people's conceptions regarding their environment. These ideas are recorded in graphic form showing the concepts and their interconnections. In the case study, the individual cognitive maps were derived during the interviewing sessions applying conceptual content cognitive mapping approach. Maps were then coded qualitatively and finally the results from individual maps were aggregated using quantitative methods, including hierarchical clustering of objectives according to the proximity between them.

Twenty-three forest owners from two different planning areas in Northern Ostrobothnia (coastal western Finland) were participated into the study. The results showed that the objectives forest owners include in their cognitive maps differ somewhat from those set out in Finnish questionnaire studies. For example, the study indicates–more strongly than the former questionnaires–that many forest owners feel that the role of "good tender of the forests" and the doing of the associated work are important. An important result is that in the interviewing context forest owners often used concepts different to those used by the dominant planning approach: owners' objective lists consisted of concepts that could be seen, from utilitarian perspective, both as objectives and means. Moreover, objectives representing different hierarchy levels overlap in the cognitive maps: forest owners include in the same cognitive map both the general objectives of forest ownership and detailed objectives related to care and use of forests. Due to these experiences it can be argued that the cognitive mapping as applied in this study, when developed further, is a promising means of merging qualitative and quantitative approaches in objective survey. It could also be used as a tool of qualitative objective analysis in forest planning.

Keywords: Cognitive mapping; Forest planning; Private forestry; Forest management; Qualitative study

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1. Introduction

In the field of forest planning, defining the forest owners' and other participants' objectives for forest management has gained a lot of attention. The utilitarian-theoretical school of thought, having the dominant position in the analysing of forest management planning in Finland, has for more than 10 years emphasised objective analysis as the central stage in planning (e.g. Kangas, 1992, 1993; Schmoldt et al., 2001).

According to the multi attribute utility theory (MAUT) forest owners' are enquired as to their objectives so that they can be presented as a hierarchical structure and so that the relative importance of the objectives can be determined quantitatively (Schmoldt et al., 2001). The objectives and their mutual importance are formulated into a utility function of the decision-maker, and this function is then optimised in planning calculations. Research focusing on planning based on the utilitarian theory has especially developed methods enabling forest owners to describe the relative importance of different objectives (Kangas, 1992, 1993; Mendoza and Prabhu, 2000; Pykäläinen et al., 2001). Secondly, it has developed optimisation algorithms suitable for comparing decision alternatives (Mendoza et al., 1987; Pukkala and Kangas, 1993).

Compared to the observation that objectives are in a central position in modern multi-objective planning, quite a few studies have focused particularly on the very first phases of planning, a.k.a. problem structuring and objective inquiry. Normally, objective analysis means quantitative priorisation of objectives are given beforehand in planning studies (e.g. Pukkala and Kangas, 1993). In the method developed by Pykäläinen (2000), the forest owners' objectives are first surveyed regarding the qualitative nature. Ultimately, those operationalised into the planning system in advance are chosen as the objectives while the other objectives mentioned by forest owners can be taken into consideration as constraints, so that individual compartments (forest stands) are allocated only the treatment alternatives desired by the forest owner.

Another, increasingly important element in planning is the participation of different stakeholders in the planning process. This task calls for looking into the objectives of participants other than forest owners. Planning research has used general survey techniques (e.g. Kangas and Niemeläinen, 1996) for that purpose, or applied methods developed under the field of multi criteria decision analysis (MCDA) (Pykäläinen et al., 1999; Leskinen et al., 2004; Ananda and Herath, 2003; Mau-Crimmins et al., 2005). Recently, Mendoza and Prabhu (2005) integrated a soft qualitative methodology and MCDA, while Hjortsø (2004) applied a purely qualitative soft OR application in the participatory process connected with tactical forest planning case. In the field of forest policy, both quantitative and qualitative approaches has been used for studying forest owners' objectives (e.g. Bliss and Martin, 1989; Lönnstedt, 1997; Karppinen, 2000; Hugosson and Ingemarson, 2004).

The point of view of genuine owner-centred thinking necessitates the question of whether the objectives operationalised into numerical planning calculation systems or into quantitative surveys are of the kind that forest owners would emphasise were no objective space predefined in research or planning methods; and furthermore, what kind of inquiry methods should take into account the cognitive processes of the participants.

The methods of studying the objectives of forest ownership and management should meet the individual participants' ability to take part in the objective analysis. For example, the questions presented to the participants should not be too difficult to understand; the structure of the research (e.g. mail questionnaire, interview or quantitative objective analysis), formulation of the questions or determining of the topics should not bias the participants' feedback by limiting the answers too strongly. In other words, the participants' cognitive structure of information should be taken into account. Furthermore, when producing objective information for forest policy makers and participatory planning cases, appropriate means to aggregate and analyse the individual participants' feedback are needed. This often requires classification and statistical analysis of the data.

Eden (1988) proposed cognitive mapping as an approach to exploring values, issues, concerns, perspectives and goals. Indeed, the approach has been applied in different disciplines. In forest planning research Hjortsø (2004) used qualitative cognitive mapping as a tool for problem formulation during the very first phases of the planning process. Mendoza and Prabhu (2005) used it in presenting a planning

process where cognitive mapping was used as a "soft method" for constructing the problem image before quantitative MCDA. In this study we include the participants' cognitive structure of information in qualitative and quantitative analysis of objectives by applying a cognitive mapping technique borrowed from Kearney et al. (1999).

The specific questions addressed in the study were as follows: (1) What objectives do forest owners include in their cognitive map describing their objectives in forest ownership without predetermined alternative objectives; (2) How do forest owners connect individual objectives into objective wholenesses; and (3) Do the forest-ownership objectives in forest owners' cognitive maps differ from the alternative objectives used in comparable studies addressing this subject matter?

2. Materials and methods

2.1. Forest owners involved in the study

The forest owners interviewed for this study were selected from within two forest management planning areas located in the Oulu district. Selection of the interviewees was performed in a manner typical of qualitative research by applying purposive sampling (Eskola and Suoranta, 2000). The purpose was to select as great a diversity of forest owners as possible as interviewees. For example, one forest owner, who owned a large tract of forestland was selected and another forest owner, who owned only a small tract of forestland. Attention also was paid to the selected interviewees' place of residence, the form of forest ownership, their age, and their gender. All the interviews were recorded on tape.

Twenty-three forest owners, two of them women, were interviewed for the study. The forest owners' ages varied between 29 and 78 years. Three of them were under 40, 11 between 40 and 60, and nine over 60. Fourteen were farmers by their current or earlier occupation, and nine were pensioners. Four of the forest owners were resident outside the local district where their forest holding was located and they went into the category of urban forest owners. The interviewees owned fairly large forest holdings. Their size varied between 17 ha and 258 ha, and one out of four owned a holding of at least 100 ha in size. There was only one holding less than 20 ha in area. Nearly all owned forest either individually or together with their family or siblings. Only one of the interviewees was the person responsible for the forest holding of an estate of the deceased. Fifteen of the interviewees had a currently valid forest management plan for their forest holding, but only four of them had participated in the planning process.

2.2. Cognitive mapping with a single participant

The foundation of cognitive mapping lies in cognitive psychology, which is a discipline examining how the human being receives, records and uses information (Hjelmquist et al., 1982). The most fundamental cognitive processes, including prediction, decision making, and planning would not be possible if people did not have some way of internally presenting the external environment (Kearney and Kaplan, 1997). Mental or cognitive, models are necessary to enable people to access information related to the planning problem at hand. The method measuring such a internal cognitive structure has to meet four requirements: (1) the relevant concepts, that an individual considers important in relation to a particular issue, must be identified; (2) only those objects that a participant owns (that is those corresponding to an individual's existing internal representations) has to be reflected; (3) relationship among objectives has to be captured; and finally (4) the method would enable participants to reveal their cognitive structure to themselves during the process of externalising it (Kearney and Kaplan, 1997).

Cognitive mapping is a method enabling the researcher to clarify and save people's conceptions regarding their environment. These ideas are recorded in graphic form resulting in a "cognitive map" showing the concepts and their interconnections (Sheetz et al., 1994). The cognitive map theory first focused on mental models of the spatial environment (e.g. Lynch, 1960; Appleyard, 1970) therefore cognitive maps have found common use in connection with urban planning (Banai, 2001). However, the sphere of the approach has been extended to also include conceptual environments and cognitive maps nowadays refer to a variety of fields including social work development (Bitonti, 1993), management informa-

tion systems development (Montazemi and Conrath, 1986; Sheetz et al., 1994), organisational management planning (Hodginson et al., 2004), and policy analysis (Eden and Ackermann, 2004), to name a few.

The present study involved the use of the 3CM method, which is an implementation of cognitive mapping (open-ended conceptual content cognitive map, Kearney and Kaplan, 1997; Kearney et al., 1999) for depicting the objectives of forest owners. The objective here was to depict the objectives set by forest owners for their forest ownership in the form of a hierarchical cognitive map.

A cognitive map setting out each forest owner's objectives was drawn up in the course of the interview (Fig. 1). The purpose was to introduce the task and present it to each interviewee in the same way, but to

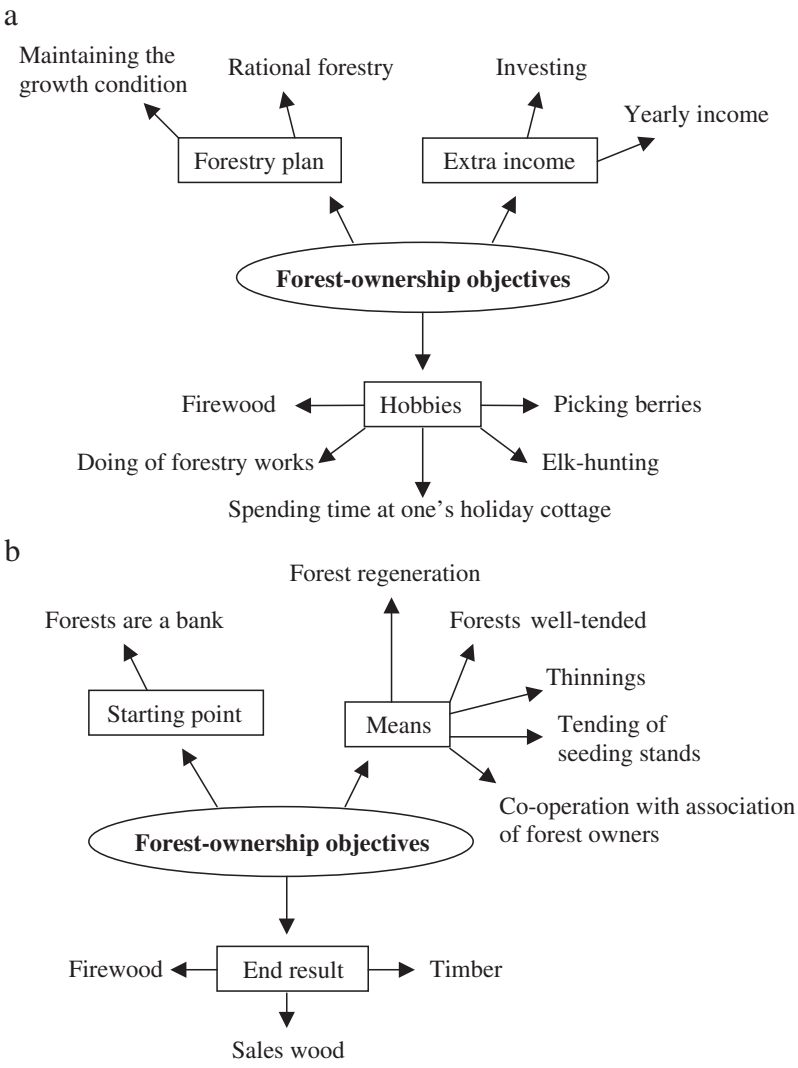

Fig. 1. Examples of cognitive maps depicting the forest owners' objectives. (a) The cognitive map of the forest owner, who emphasised "Hobbies" as his foremost objective. (b) Here the forest owner has grouped the objectives in such a way that they form a chain of functions taking place in the forest and of their consequences. Usually, the forest owners gave group titles depicting and connecting the objectives set for a group.

do it flexibly so that the additional questions varied as needed. The task was presented as follows:

1) The study sets out to clarify the objectives in forest ownership. Please list all the possible matters, which you consider to be important in forest ownership.
2) What are important to you in regard to...
   – forest use?
   – forest tending and treatment?
3) What objectives do you have in regard to your own forest holding?

The interviewer then wrote down the objectives listed by the forest owner onto slips of paper. When all the objectives had been recorded, the interviewer showed the slips to the interviewee asking them to consider and modify their list of objectives if they wanted to. Then each forest owner was asked to group his/her objectives so that the matters closely related to one another in the forest owner's opinion were placed in the same group. Finally the forest owners were asked to provide titles for the groups, explain their reasoning for the titles, and place the groups in their order of importance.

The tape recordings were transcribed immediately after the interviews. The contents of the cognitive maps were checked and objectives were added in connection with transcription if a particular objective was found to be entirely missing from the slips of paper. These additions of objectives were made for 18 interviewees, and there were 38 of them. Additions per interviewee varied between 0 and 4. The cognitive maps thus constructed were converted into table format for presentation in the Excel spreadsheet program as well as into an illustrative format for the Decision Explorer program.

2.3. Aggregated analysis of forest owners' objectives for forest management

The foundation of the research material and its analysis consisted of messages, each containing an objective considered by one interviewee/respondent to be important. All in all, there were 220 messages. The variables describing the messages are presented and explained in Table 1. Analysis of the messages was made in two stages, the first one describing the messages in a general way and the second one grouping the related objectives together into objective groups.

The first stage involved merging qualitatively messages having the same meaning into classes. The nominal variable (OBJECTIVE) formed the starting point to the following quantitative analysis (to be presented below), and eventually 28 class parameters were obtained. The objectives included in the forest owners' cognitive map were described both qualitatively and by computing the parameters depicting the distribution of the OBJECTIVE variable first for the entire study material according to each interviewee/respondent and then by cross-tabulating OBJECTIVE with respect to the order of importance (IMPORTANCE) given to it by the interviewee/respondent and some other background variables.

To begin with, 42 classes were obtained in the first stage of the classification. The classification was compared with the control classification made by another person. Forty-nine of the messages had been classified differently. All the classes differing from each other were checked. Some of the different classifications were due to it being not possible to know the background of the messages without reading the interviews. Another factor influencing the matters was differences in understanding what was meant by detailed classification. Some of the messages were re-

Table 1
Variables depicting the forest owners' objectives

Message	Group	Importance	Objective
Forest-ownership objective arising during interview (total of 220 messages).	Forest owner placed messages in groups, and typically also named groups. All groups were numbered consecutively (total 68 groups).	Forest owner arranged groups mentioned by him/her into order of importance.	Messages having same meaning were merged in classes (total of 28 categories). Classes named using expressions used by forest owners when grouping them.

peated under the same names several times and this in part added to the number of differently classified messages. Ultimately, only nine messages became problems, and three of them were the same. The person who initially did the classification and the person controlling the classification made the final classification together, and when it was done there were 28 classes. Twenty-two classes contained more than one message.

The material was accessed to compute and depict the frequencies of the background data of the messages and of the interviewees with respect to study question #1. As regards study question #2, matrix operations were computed with the data of producing a matrix depicting the proximity on the cognitive maps of the objectives proposed by forest owners. The first stage involved cross-tabulation of the OBJECTIVE variable with the variable GROUP (a nominal variable depicting messages grouped together by respondents). The 28×68 matrix thus obtained was transformed into a dichotomous one by denoting with 1 all the cells greater than 0. The dichotomous matrix was then denoted by $\mathbf{X}$ and its elements were denoted by x_{ij}, in which $i=1,\ldots, 28$ and $j=1,\ldots, 68$. Thus $x_{ij}=1$, if the objective i is in the said group j,; otherwise $x_{ij}=0$. In matrix $\mathbf{X}$ the row sums $\sum_j x_{ij}$ indicate how many groups mention the objective i.

In the next stage, the matrix $\mathbf{Y}$ was formed by multiplying the matrix $\mathbf{X}$ by its transpose, i.e. $\mathbf{Y}=\mathbf{X}\mathbf{X}^{\mathrm{T}}$. Now $\mathbf{Y}$ is a proximity matrix, whose elements y_{ij}, $i=1,\ldots, 28$, $j=1,\ldots, 28$, indicate how many times the interviewees/respondents had combined the objectives i and j in the same group (Scott, 1991). Matrix $\mathbf{Y}$ had those rows and columns deleted, which corresponded to objectives mentioned by the interviewees/respondents less than three times. This led to 14 objectives remaining in the analysis and the matrix thus obtained was denoted by $\mathbf{Y}'$.

Using matrix $\mathbf{Y}'$ a new proximity matrix $\mathbf{Z}$ was formed and its elements z_{ij}, $i=1,\ldots, 14$, $j=1,\ldots, 14$, depict the percentage of the groups containing the said row's objective i, and in which the said objective had been classified into the same group with the column objective j. In other words, $z_{ij}=y'_{ij}/\sum_j x_{ij}$. Because matrix $\mathbf{Z}$ is asymmetrical, it needs to be transformed into a symmetrical matrix $\mathbf{Z}'$ such that $z'_{ji}=(z_{ij}+z_{ji})/2$. The analysis does not allow the use of an asymmetrical matrix because belonging to a group is not a directed relation between the objectives. The symmetrized proximity matrix $\mathbf{Z}'$ obtained was used as the base data for the analyses.

The proximity of the objectives was first depicted graphically using the PROXSCAL algorithm for multidimensional scaling of SPSS. It uses the Euclidean distance between the points as its base material, and this is why the proximity matrix was first transformed into a distance matrix by deducting the initial proximity value from the sum of the biggest and smallest proximity values. In order to resolve the problem of the local minimum (Borg and Groenen, 1997), an algorithm repeating optimisation from random points of departure 1000 times was used.

The MDS procedure produces a graphical presentation with preordained number of dimensions. The axes of MDS map are, in themselves, meaningless and therefore often presented without numbers. There are two things to look for in interpreting an MDS picture: clusters and dimensions (Borgatti, 1997). Clusters are groups of items that are closer to each other than to other items. Dimensions are item attributes that appear to order the items in the map along a continuum. The final solution of the stress value is to be reported and depicts how well the MDS model fits with the original proximity data. In any case, there are not commonly shared criteria for the acceptable stress value (Everitt and Rabe-Hesketh, 1997). Therefore, graphical presentations of the MDS should be used together with other analyses. In this study, the MDS results were used for interpreting and ensuring the results of cluster analysis.

The SPSS software and its hierarchical grouping analysis were used in grouping the objectives (Johnson, 1967; Anon, 1999). This also produces information about the inter-group hierarchical structure without the group number being decided upon before analysis. A proximity matrix ($\mathbf{Z}'$) was used as the basis in grouping and thus the results are independent of the multi-dimensional scaling presented in the above and the results can be used in supporting one another and as controls (Johansson et al., 1995). Before the computations, the diagonal was given the value 100, because every objective will always be grouped in the same group with itself. The grouping algorithm used (HIECLUST) groups the objectives as the variables of the proximity matrix given stage by stage. The selected algorithm minimises the Euclidean

distance between the objectives classified into the same group. The grouping starts from a situation in which all the factors are in their own group. In the following stage, the factors nearest to each other are connected to the same pair. These constitute one group in further analysis. The average of the proximity of the factors belonging to the groups is used as the measure of the inter-group proximity. The algorithm continues to connect factors until all of them have been grouped into the same group. The results of the analysis were presented in the form of dendrogram (Fig. 5), which graphically illustrates that grouping stages when the various factors have become grouped into the same group. Furthermore, the results show as a relative value how big the average proximity between the factors classified into each of the group is.

Finally, the results were compared descriptively to the Finnish quantitative research results of Kangas and Niemeläinen (1996), Karppinen (2000) and Karppinen et al. (2002) as well as qualitative reference studies (Bliss and Martin, 1989; Lönnstedt, 1997; Hugosson and Ingemarson, 2004). The results of the comparison are presented in Section 4.

3. Results

3.1. Forest owners' objectives

3.1.1. Cognitive maps

Forest owners' ability to perceive the task given during the interview varied quite a lot. The number of the objectives varied from 2 to 16 per interviewee, with the average being 9.6. Five of the interviewed forest owners were not able to name the objective groups formed by them. The number of objectives classified into one group varied from one to seven. The interviewees named a total of 51 objective groups. The majority of the forest owners tried to group the various advantages into the same group (Fig. 1a). The commonest titles given to the objective groups, with the wordings differing, were 'Free time and hobbies', 'Income' or 'Livelihood'. Less frequently mentioned objective groups were 'Security' and 'Continuity', 'Own use of wood' and 'Energy economics' and 'Environmental values'. Five interviewees mentioned 'Forestry work in accordance with silvicultural instructions' as one objective group. Other objectives differing from traditional utilitarian thinking were 'Monitoring forest development' and 'Seeing the results of one's own', 'Link with one's place of birth' and 'Co-operation' with forestry professionals. The forest owner, whose concept map is shown in Fig. 1b, itemised his concept map differently to the others by including in his objective hierarchy the titles 'Starting point', 'Means' and 'End result'.

Table 2
Forest owners' objectives emerging in connection with the interviews and combined with objective classes

Objective class	Frequency	Percent of all messages
1. Silvicultural and basic improvement works	31	14.1
2. Free-time, hobbies	28	12.7
3. Household wood	22	10.0
4. Source of income	15	6.8
5. Picking wild berries and mushrooms	13	5.9
6. Forests well-tended	13	5.9
7. Hunting	12	5.5
8. Forests vigorous and productive	10	4.5
9. Doing of forestry works	10	4.5
10. Inheritance value	10	4.5
11. Forestry works in accordance with instructions	8	3.6
12. Economic security	7	3.2
13. Investment in forestry	7	3.2
14. Compensation and monitoring of elk damage	5	2.3
15. Avoidance of hard-line actions in forestry works	4	1.8
16. Environment and nature	4	1.8
17. Care of landscape	3	1.4
18. Forest ownership important in itself	3	1.4
19. Monitoring forest development	3	1.4
20. Not much investment into forestry	2	0.9
21. Seeing the results of one's work	2	0.9
22. Principle of continuous-cover forestry	2	0.9
23. Retaining one's forests outside nature conservation	1	0.5
24. Link with one's place of birth	1	0.5
25. Common sense in forestry works	1	0.5
26. Forests help in retaining one's professional skills	1	0.5
27. Renewable natural resource	1	0.5
28. Forests provide land for other purposes	1	0.5
Total	220	100.0

One objective class can contain several objectives of one interviewee.

3.1.2. Objective classes and their frequency

A total of 28 objective classes were obtained by connecting the forest owners' objectives (Table 2). In the following, the results are first presented by message, in which case several objectives mentioned by the same interviewee may be included in the presented frequencies, and then by interviewee, in which case we see how many of the interviewees had brought up objectives belong to the objective class.

Most often the objectives were coded into the class 'Silvicultural and basic improvement works'. The measures most frequently mentioned were thinnings and drainage. Other objectives related to silviculture were tending of seedling stands, forest regeneration, tending of young stands, and good access to stands. The second most frequently mentioned objective was forest-related 'Free time and hobbies'. The forest was felt to be a place for refreshment and both walking and skiing were frequent activities in the forest. Spending time at one's holiday cottage also came to the fore in this class.

The forests as the source of household wood and especially of firewood, was the third most important objective in forest ownership. Fourth place went to the objective of forests being a source of income. Some of the interviewees, who had mentioned income from forestry, emphasised the sustainability of the income, i.e. steady forestry yield. Some considered the household wood from their forest as being an economic benefit. The fifth most important objective was 'picking wild berries and mushrooms'.

Forest owners held it to be important that the forests were well tended and in a state of vigorous growth. For many, hunting was also connected to forest ownership. Doing forestry work was an agreeable pastime to most of the forest owners. Many

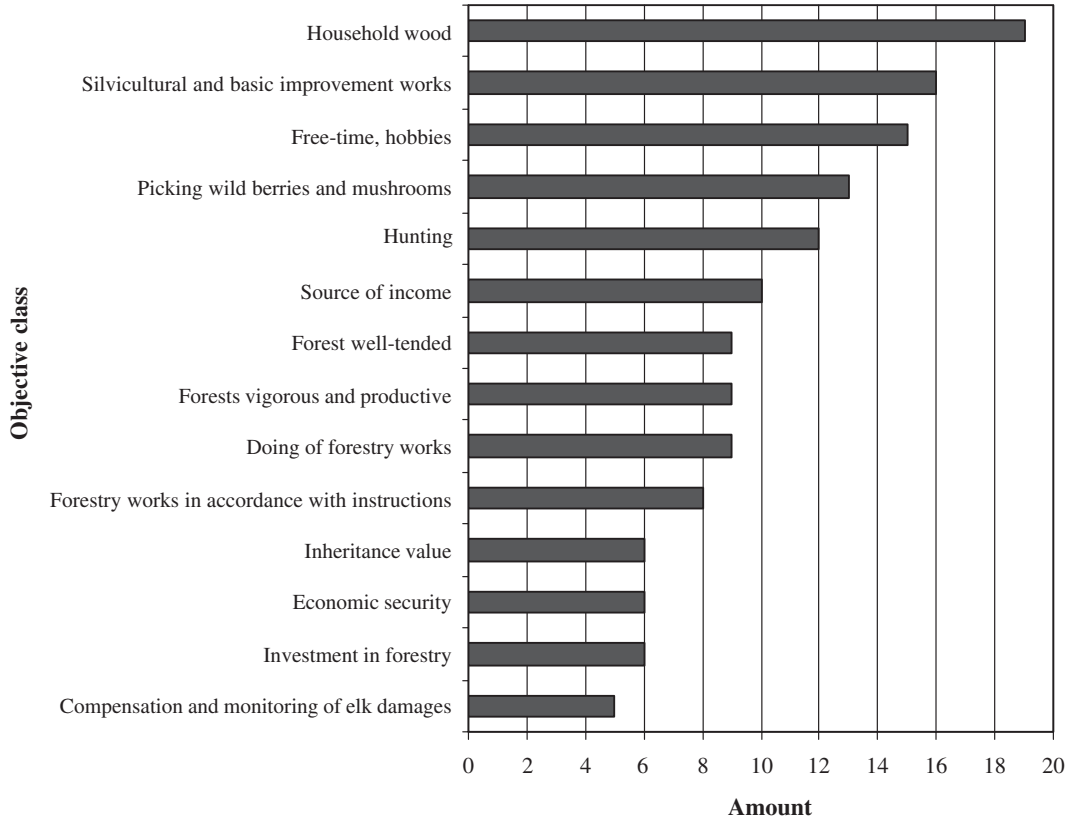

Fig. 2. Occurrence of the objective classes in the interviews. The figure shows all those objective classes, which were proposed in five or more interviews.

aimed to do these works according to the instructions provided by their local forest management association. It was hoped that the forests and their yield would in many cases pass on from one generation to the next. Economic security was also sought through forestry and forests were seen in some cases as representing a good investment target. Objectives related to the environment and to nature conservation were hardly mentioned. Nature values were mentioned by only three interviewees.

Working, on the other hand, was powerfully underscored in the results when examining the results per interviewee. Obtaining household wood from one's own forest was mentioned by almost every interviewee (Fig. 2). Second most popular objective class among the interviewees was that of 'Silvicultural and basic improvement works', while third place went to 'Free time and hobbies'. The importance of forests as a 'Source of income' came to the fore in only 10 interviews with forest owners having mentioned 'Picking wild berries and mushrooms' and 'Hunting' more often than it.

3.1.3. Order of importance of the objectives

The forest owners appreciated vigorousness and productivity in their forests (Fig. 3): Seven forest owners considered these to be the most important objective in their forest ownership. Six forest owners considered silvicultural and basic improvement works or obtaining household wood from their own forest as the most important objective. Four forest owners considered the good tending of their forests as the most important objective. Likewise, four considered income from their forests or their inheritance value to be their most important objective. Free time-related objectives were often placed only as the second or third most important as objectives.

3.2. Hierarchical clustering of objectives

Multi-dimensional scaling (PROXCAL) gave the value 0.14 to stress value − 1 when using three dimensions, with two dimensions the stress value was 0.24, and with four dimensions it was 0.09. Fig. 4 depicts the proximity of the objectives in a two-dimensional set of

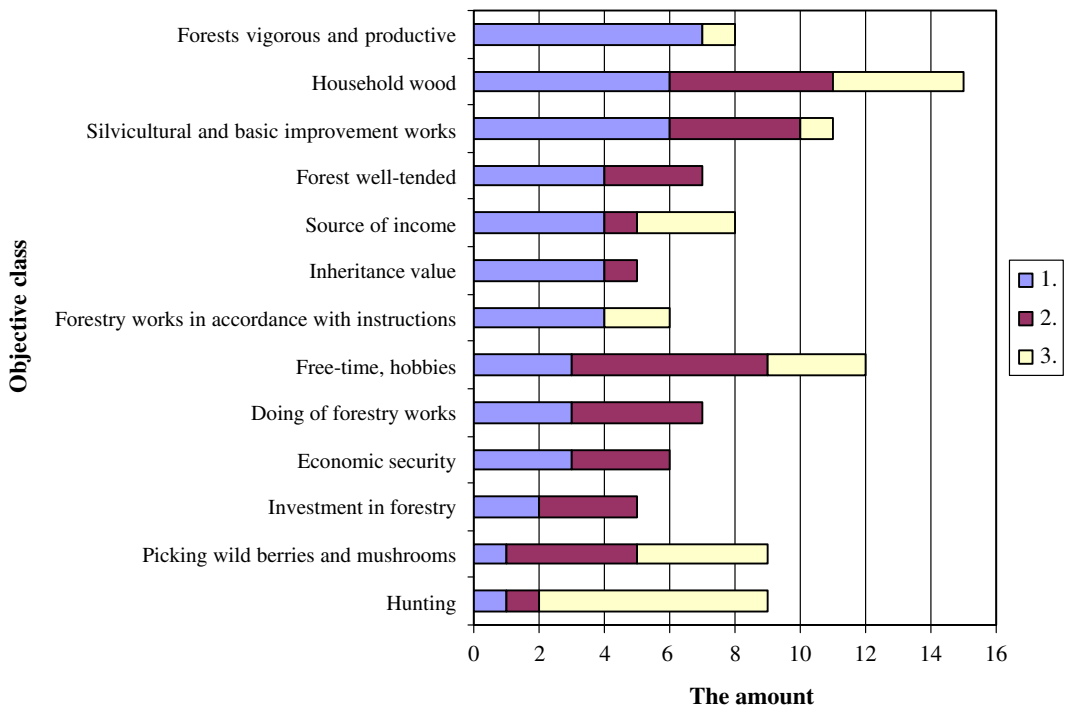

Fig. 3. Order of importance of the objectives, arranged according to the most important evaluated objective. Objectives mentioned only once or twice have been omitted from the figure. Also, objectives evaluated to be fourth or fifth in importance have been omitted.

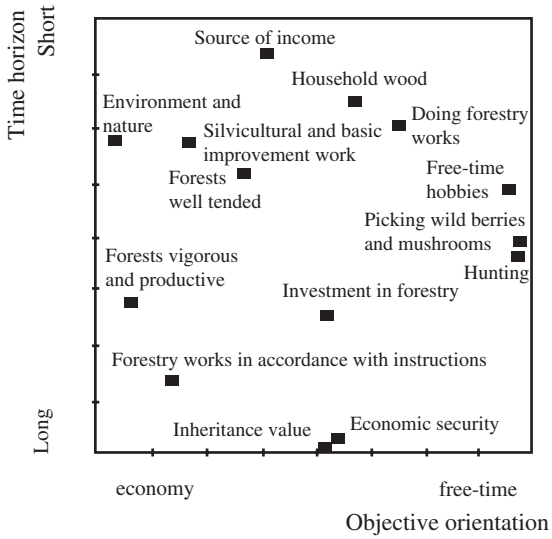

Fig. 4. The placing of the objectives in the two-dimensional set of co-ordinates produced by multi-dimensional scaling (PROXSCAL).

co-ordinates. The first dimension is relatively clear as regards its interpretation. It depicts the objective orientation, with the objectives 'Free time and hobbies', 'picking wild berries and mushrooms' being close to one another in the end of continuum. Also, the objectives 'Doing forestry works' and 'Household wood' were often mentioned in connection with objectives related to free time. The second dimension is also clear in terms of its interpretation in depicting the time horizon of the objectives. The long-term overall objectives, e.g. 'Economic security' and 'Inheritance value', are at the one extreme in regard to this dimension, whereas the objective 'Source of income' is at the other extreme. The objectives 'Investment in forestry' and 'Vigorous and productive forests' are also long-term objectives, whereas 'Household wood' and 'Doing forestry works' are short-term objectives.

The third dimension is relatively difficult to comprehend as regards its interpretation. One possible interpretation is that the dimension depicts the socialization of the forest owner as a member of the forestry discourse community (Leskinen, 2004). From the forest owner's point of view, the objective is to be 'a good tender of one's forests' as the objectives 'Forests vigorous and productive', 'Forestry works according to instructions' and 'Forests well tended' are objectives close to one another at the other end of this dimension.

On the basis of the grouping analysis (Fig. 5), the objectives formed three main groups: (1) Income from Forestry and Tending of Forests, (2) Investment Target and Security for the Future, and (3) Free time and Hobbies. Particularly powerfully related objectives are those belonging to the latter group, i.e. 'Hunting' and 'Picking wild berries and mushrooms'. They stood out as distinctly separate objective groups in all the

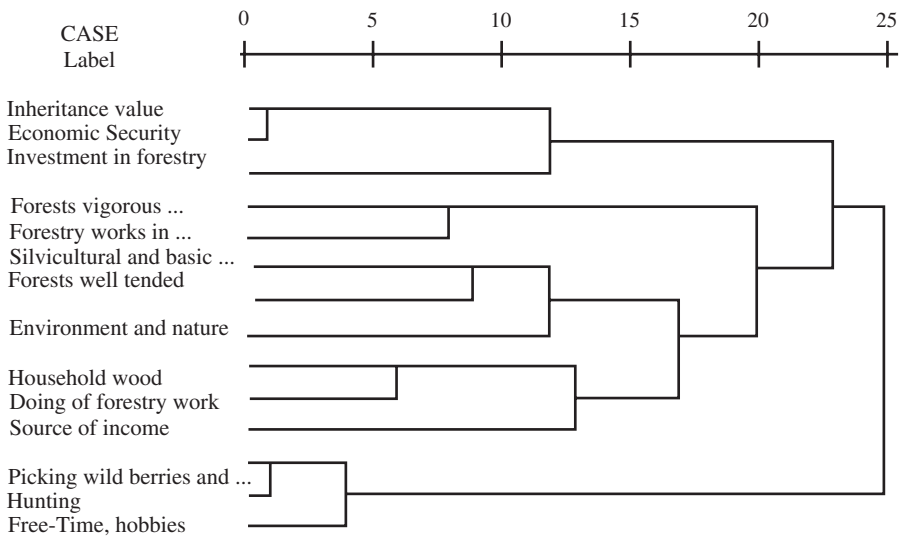

Fig. 5. Grouping of objectives to form a dendrogram.

analyses. The objectives emphasising the security provided by forests and their inheritance value also belong clearly together. Joining them, though less firmly, is the objective 'Investment in forestry'. Grouping analysis results in forming three sub-groups in the 'Income from forestry and Tending of forests' group: (1.1) 'Doing of forestry works' and 'Household wood' are related to one another and to the same main group with 'Source of income'. (1.2) 'Forests vigorous and productive' and 'Forestry works in accordance with instructions' are long-term objectives belonging to this main group. They, along with the third sub-group (1.3), which includes the objectives 'Environment and nature', 'Silvicultural and basic improvement works' and 'Forests well-tended', are characterised by the objective 'to be a good tender of one's forests'.

4. Discussion and conclusions

Mapping forest owners' objectives using the interview method without predefined objective alternatives produced study material, which could be treated quantitatively. The cognitive maps that were compiled in the course of the interviews were compared with Finnish quantitative objective studies looking into forest owners' objectives (Kangas and Niemeläinen, 1996; Karppinen, 2000; Karppinen et al., 2002). Qualitative objective studies are not available from Finland. The most relevant reference studies are Bliss and Martin (1989), Lönnstedt (1997) and Hugosson and Ingemarson (2004).

The intensive method used in this study limits the sample size. Here the sample of 23 interviewees is by no means sufficient for statistical generalisation, but still comparable to other qualitative objective studies. The main contribution of qualitative explanatory studies like the present one is that that it may yield diversified and surprising results that have been ignored in previous research. In so doing, the results can together with quantitative surveys, provide multiple data for building a theory about motivation behind the forestry-related decision making (Bliss and Martin, 1989).

When compared to the results of the Finnish questionnaire studies looking into the objectives associated with forest ownership, the present study's results differ from them and provide a surprise in that the forest owners interviewed in the present study mentioned only seldom objectives related to the environment and nature management. Usually, they combined these objectives in the same group with the objective of 'Silvicultural and basic improvement works'. The results call for further studies of the question of whether forest owners tend to prefer to see environmental matters more as 'constraints' needing to be taken into consideration when doing forestry works rather than as actual objectives. Another a noteworthy aspect of the results of the present study is that the interviewed forest owners did not make frequent direct mention of timber sales income as an objective in their forest ownership. Instead, they emphasised the importance of doing forestry works, forest vigour and silvicultural state, which indirectly and in the long term impact on timber sales incomes. Among the logical objectives for this were objectives emphasising long-term sustainability, e.g. inheritance value, investment target and economic security.

The interviews conducted for this study brought up seven objectives, which are not mentioned in any of the aforementioned Finnish quantitative surveys. Examples of interesting objectives mentioned in this study only a few times are the following: 'Forest ownership is important in itself', 'Monitoring forest development', 'Link to one's place of birth' and 'Seeing the outcome of one's own work'. All of these can be found at least in one of the qualitative objective studies implemented in other countries. It is quite possible that in mail questionnaires objectives of this type could prove to be very common.

Other qualitative objective studies of forest-owning support the current results about the importance of long-term intergenerational objectives, practical work orientation and the diversity of objectives guiding decision making by forest owners. Lönnstedt (1997) even defined the sense of security and well-being as profound objective of forest owning. Indeed, the current and other qualitative studies share the concept of 'emotional tie' as an objective emphasising the feelings a forest owner has towards his/her home district and social relations (in hunting associations or forest management associations, etc.) connected with the place of childhood, which have not been mentioned in previous quantitative Finnish studies. Another shared finding of qualitative studies is the tendency for some owners to be attracted by the challenges that

forest management has (Bliss and Martin, 1989; Hugosson and Ingemarson, 2004).

The main difference between the current study and other qualitative objective studies (Lönnstedt, 1997; Hugosson and Ingemarson, 2004) is that the objectives belonging to the conservation motive do not play a significant role among the owners interviewed for the present study, whereas other studies placed more emphasis on environmental interests. Aesthetic objectives were not mentioned in the present, which was contrary to Swedish studies. According to cluster analysis of the present study, differently from other qualitative studies, picking berries and mushrooms, game, and, to a certain extent, also firewood and other forest work have recreational functions, they are not purely economic or production objectives. In the present study, the long-term objective 'Investment target and security for the future' forms an objective group rather different from short-term economic or production functions, on contrary to the findings of Swedish reference studies.

A question of interest to those involved in the development of forest management planning systems is that of whether a particular forest owner's objectives are such that they can be operationalised in forest management planning systems. Evaluation of the possibilities of reaching the objectives related to the important objectives pinpointed in the cognitive maps produced in this study (i.e. sustainability of timber sales income, the doing of forestry works and the silvicultural state of the forest holding) is possible using existing techniques. Practical forest management planning underscores these objectives held in great value by forest owners. For example, objectives related to obtaining household wood and forest-related hobbies are objectives, which cannot be really taken into account in the present-day forest management planning systems. However, research work in the field of forest planning has introduced some methods also for these purposes (e.g. Pukkala, 1988; Pukkala and Kangas, 1993). Landscape visualization is one possibility to illustrate the effects of different forest management options for the forest owner. Also, 'economic security' and 'inheritance value' are objectives, which can be operationalised, but these objectives most probably also include sentiments, which are difficult to quantify, e.g. 'continuity between the generations'. A large proportion of such non-quantified objectives are probably indifferent, general objectives related to forest ownership, which are actualised irrespective of how the forests are treated, and consequently they do not need to be taken into account in tactical forest planning.

Another important other aspect is connected to the matter of how forest owners construct their cognitive maps. The results of the study indicate that, in the interview context, many forest owners feel that the role of 'good tender of the forests' and the doing of the associated work are important. This point of view differs somewhat from that of the research utilitarian-theoretical approach looking into forest management planning, which directly separates the objectives and the means. Moreover, objectives representing different hierarchy levels overlap in the cognitive maps: forest owners include in the same cognitive map both the general objectives of forest ownership and detailed objectives related to care and use of forests. The kinds of cognitive maps, illogical from the utilitarian-theoretical viewpoint, may be simply the result of (1) forest owners having adopted a dialogue compliant with good silviculture, which becomes emphasised in the artificial interview situation, that does not give a possibility for understanding the practical decision-making or it can be the result of (2) forest owners genuinely and consciously seeing their forest ownership from the point of view of concrete doing and complying with norms. Especially if the reason is the first one, an issue worth of studying is the cognitive processing connected with real-life forestry related decision-making. In both cases there would also be a need for examining forest management planning from learning perspective, emphasising forest owners' process of externalising and reflecting their internal cognitive representations. Anyhow, to be realistic, all planning innovations have to be analysed from the cost–benefit view: the final beneficiaries, forest owners or society, should evaluate the benefits of new kind of planning comparing with costs.

The main advantage of the qualitative method used in the present study, when compared with the method used in aforementioned qualitative studies, is that it combines qualitative data collection with quantitative analysis in a transparent way. The methodology is half-way in the direction of structured methods. One might reasonably ask whether the list of objectives is a

thorough presentation of all cognitive elements that could enter the psychological processing of the forest owner. Also Kearney and Kaplan (1997) emphasised the externalisation and reflection of internal representation during the cognitive mapping process. In the present study, externalisation and reflection was attained when respondents checked the list the interviewer produced and grouped the objectives. Anyhow, the duration of the interviews was much shorter than the in-depth interviews applied in reference studies. Another point of criticism against the method could be based on the theory of socially desirable response (SDR), postulating that respondents have either a conscious or unconscious drive to perceive themselves in a favourable light in the social context of the interview setting (Paulhus, 1984). To avoid this possibility, the interviewer, who lacked forestry as a background, asked the respondents to list as many objectives, in their own terms, as they could. In any case, the risk of SDR is relevant and has to be taken into account when making conclusions.

The mapping of objectives by means of cognitive mapping enables one to obtain versatile material supplementing quantitative questionnaire studies. Of course, the way questions are put in cognitive mapping as well as the interviewing situation also tends to orientate the answers given. Objective mapping entirely free of disturbing factors is probably not possible whatever the method being used. Anyhow, cognitive mapping appears to be a promising means of merging qualitative and quantitative approaches in objective mapping. The method used in this study can be developed in two directions in the future: (1) by making statement of the task more detailed, one can develop the method by enlarging the sample size and thus enabling further numerical analysis on objective structures, e.g. for participatory MCDA. (2) The method can be developed to be suitable for the first stages of planning pinpointing problem structuring and objective inquiry in forest planning, the objective then being that the entire planning process can be adapted to individual forest owners.

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