INTERACTIVE DECISION ANALYSIS IN PARTICIPATORY STRATEGIC FOREST PLANNING: EXPERIENCES FROM STATE OWNED BOREAL FORESTS

JOUNI PYKÄLÄINEN, JYRKI KANGAS AND TEPPO LOIKKANEN

ABSTRACT

Decision analysis, as applied in this study, is a numeric approach to support decision making in complex and multiobjective selection problems. It was used interactively to participatory strategic planning of natural resources management in Kainuu by the Finnish Forest and Park Service. The parties defined their own goals through a multiattribute utility function. Due to interactivity, the parties could specify their goals by taking the production possibilities of the planning area and the connections between different goals into account.

The function of the interactive decision analysis (IDA) was to produce comprehensive decision support for a forest strategy selection. Such support would have been difficult to achieve otherwise. However, the IDA was not the only source of decision support. It was a part of a wider participation process where citizens and interest groups participated in the planning also through letters, open houses, phone, questionnaires, work groups, and public meetings. The results of the IDA were compared to participatory feedback received through other channels. The IDA was found applicable and worth developing further as a technique of participatory planning in the management of state owned forests.

Keywords: Decision analysis, interactive forest planning, natural resources management, participatory planning.

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INTRODUCTION

Ecology, economy, and social equity are the main dimensions of sustainable development which must be taken into account in present day forestry. Ecological and economic sustainability can be assessed by experts of forest ecology and economy, respectively. Social sustainability, instead, can not be defined by experts only. People must have an opportunity to know what is going on, and they also must have an effect on decisions which might affect their everyday lives. That is why *participatory planning* is becoming

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more common, especially in public forestry. Many participatory techniques (open houses, public meetings, phone, letters, interviews, hotlines, questionnaires etc.) have been used to involve the public and organized interest groups in forest management planning (Kangas *et al*., 1996a).

The tradition and research of participatory planning in natural resources management is based on social sciences (e.g. Creighton,1983a; 1983b; Daniels *et al*., 1996). Methods of participatory planning have primarily been developed to promote communication between the parties and gather information about the values, attitudes, and beliefs of private citizens and organised interest groups. However, applying these methods alone has not always been an adequate way to support decision making. The link between the values, attitudes, and beliefs of the participants and the management actions to be implemented is not always very effective. There is plenty of room for manipulation and even for ignoring the participatory feedback. As a consequence, the participants' goals will not be meaningfully included into planning. Therefore the final decisions might not be justifiable to all stakeholders. Accordingly, the plans will neither be accepted nor implemented. Instead, destructive conflict might arise.

Applying theory and methods of *decision analysis* into participatory forest planning could make the link between the values, attitudes, and beliefs of the participants and the management actions to be implemented more effective (e.g. Kangas, 1992). The planning might become more analytical, controlled and reliable.

Keeney (1982) divided the decision analysis into four main phases, which are necessary when modelling decision-making processes: (i) structuring the decision problem, (ii) assessing possible impacts of each alternative, (iii) determining preferences of decision-makers, and (iv) evaluating and comparing decision alternatives. These all are needed also in participatory forestry decision support. In that case, however, modelling tasks are more complicated, because there are several stakeholders instead of only one decision-maker.

According to some authors, a focus of decision analysis is on uncertainty (e.g. v. Winterfeldt & Edwards, 1986). However, decision analysis is also used deterministically

(e.g. Kangas, 1992). In these cases, no specific probability has been assessed for each event. The deterministic approach can be seen as a special case of the stochastic one where the probability of each event is one.

It is obvious that decision analysis calls for interactivity in participatory forest planning. The participants may not be able to include their goals in the analysis in a way corresponding to their values, attitudes and beliefs on the first trial. There are two basic reasons for this. The parties have fuzzy goals or production possibilities and connections between different goals are not known in advance. As its best, interactive decision analysis (IDA) is an illustrative and comprehensive way to study complex relations between different forest uses and goals set for forest management by different parties.

In tactical forest planning, the IDA is technically based on interactive optimisation. In interactive optimisation, formulation of the utility model which describes the participants' goals as a mathematical formulation and finding the optimal solution to the model, are alternated until a satisfactory solution is found (Kangas *et al.*, 1996a). Either multiattribute utility theory (MAUT), integrated with a heuristic optimisation algorithm (e.g. Pukkala & Kangas, 1993), or mathematical programming (e.g. Kangas *et al.*, 1996b) can be applied in interactive optimisation.

The goal of strategic forest planning is to define the primary course of action for a long time period for a forest area. Due to this, all possible forest- and standwise decision alternatives do not have to be included in the planning. Instead, comparing and evaluating a few well structured strategies, which include all the main dimensions of sustainability, is an appropriate approach for the IDA in strategic forest planning (e.g. Kangas, 1994). The uncertainty involved in forest inventories, planning calculations, future forecasts (timber prices, costs related to other factors of production, forest health etc.), and estimation of the decision makers' and other parties' goals is an other reason to limit the space of alternatives in strategic planning. Because of uncertainty, one can not meaningfully differentiate between slightly different strategies.

Many methods applicable for the IDA in tactical forest planning have been presented (e.g. Harrison & Rosenthal,

1988; Kangas & Pukkala, 1992; Kangas *et al.*, 1996a; 1996b;, Pukkala, 1988; Pukkala & Kangas, 1993; Mykkänen, 1994; Steuer, 1978; Steuer & Shuler, 1981). Methods for integrating public participation into strategic forest management planning have been presented as well (e.g. Kangas, 1994). However, these studies are focused on the technical planning methods. They do not tell whether the methods facilitate the process of planning or make it more analytical, controlled or reliable in real world.

Kangas *et al*. (1996b) reported about the use of an interactive approach in a real planning situation. They used the so-called HERO-method interactively in tactical planning of forest management in private non-industrial forestry. The study showed that interactive decision analysis is needed when striving for a plan fulfilling the owner's forest management goals.

In Finnish forestry, participatory planning has primarily been applied in the management planning of state forests (about 30% of all forests) administered by the Forest and Park Service (FPS). The FPS has adopted participatory planning as a planning philosophy of strategic and tactical planning (Loikkanen & Wallenius, 1997; Heinonen, 1997). In these planning tasks, the need for aggregative decision support tools has been realized and the first experiments to apply such tools have been accomplished.

In this case study, the IDA is applied to the FPS's strategic planning of natural resource management. The study area consists of state-owned land and water areas (totally 822 700 ha) in the Kainuu region in eastern Finland. The results of the study were used when defining the strategy for natural resource management to be implemented in the time period of 1997 – 2001. The strategy forms the base for more accurate tactical landscape ecological planning.

The goal of this case study is to examine the applicability and possibilities of the IDA in strategic forest planning. An important issue is to study whether the IDA can facilitate a participatory planning process by making it more analytical, controlled and reliable. The results can be utilised by different natural resource management organisations. The application of the IDA presented in this article is a product of the research conducted at the University of Joensuu and the Finnish Forest Research Institute.

METHOD OF IDA

The participatory approach of Kangas *et al*. (1996a), which has been developed for tactical forest planning, is modified for strategic planning in the present application of the IDA. The method includes the following steps:

Step 1) The decision situation is analysed, the problem is structured and the alternative strategies are defined. Many qualitative methods of participatory planning (e.g. Nominal Groups Process, Brainstorming, SWOT analysis) are applicable for this task. The methods used must be selected according to the requirements set by the planning situation and the parties involved.

Step 2) The effects of alternative strategies on the values of numeric goal variables are estimated. Planning software utilizing mathematical programming are used here (e.g. Siitonen *et al*., 1996).

Step 3) An additive *a priori* utility function is formulated. The utility of each party j is calculated as follows:

$$U_j = \sum_{i=1}^{m_j} a_{ij} u_{ij}(qij) \qquad (1)$$

where U_j is the utility of party j, m_j is the number of goals of party j, a_{ij} is the relative importance of goal i, $u_{ij}(q_{ij})$ is the sub-utility function of goal i, and q_{ij} is the quantity that the plan produces or consumes the goal variable i of party j.

Defining the goals in terms of exact goal variables is the first phase when estimating the utility function. One goal may be measured with several goal variables. For example, the goal ´business revenues‘ can be defined with variables ´net income during the planning period‘ and ´monetary value of the forest at the end of the planning period‘. In this case, the utility achieved through ´business revenues‘ is calculated as a weighted sum of the sub-utilities produced through ´net income during the planning period‘ and ´the value of the forest at the end of the planning period‘.

Technically, pairwise comparisons, graphic bars on a computer screen, or direct numerical evaluation can be used when defining the parameters of the utility function

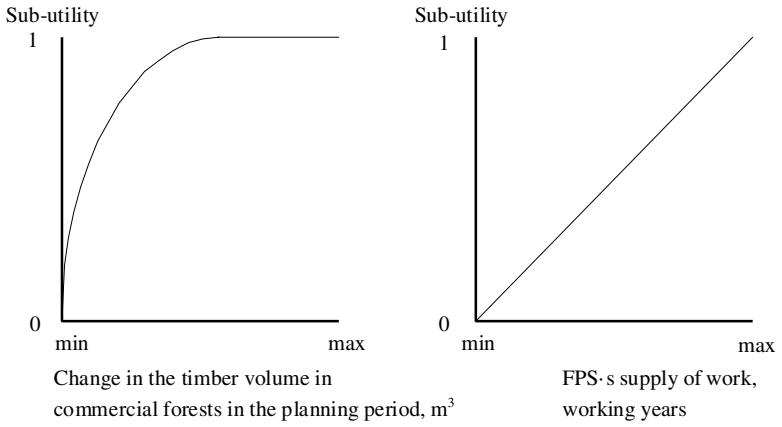

FIGURE 1. EXAMPLES OF SUB-UTILITY FUNCTIONS.

(Hämäläinen & Lauri, 1995; Pukkala & Kangas, 1993). The sub-utility functions can be drawn directly (Hämäläinen & Lauri, 1995) or they can be formulated by applying pairwise comparisons (Pukkala & Kangas, 1993).

In this application, the sub-utility functions (Figure 1) define utilities attained through forest management with respect to an upper level decision element. First, the absolute values of goal variables — usually measured in different units like m^3, monetary units, working years and hectares — are converted to relative sub-utilities which are scaled on a fixed interval between 0 and 1 (100%). The rationale of scaling is based on an assumption that the production possibilities of the planning area are fully explained and transitions from the worst to best values of different goal variables have equal effects on the total utility if the variables are weighted equally.

Second, the sub-utilities are made comparable by counting them with weights a_{ij} which describe the mutual importance of the goal variables. The differences between the minimum and the maximum values of the goal variables must be taken into account when defining the weights. The sub-utility functions and the weights of the goal variables can be defined by the participants or experts.

Step 4) The weights of the goals are defined interactively by the participants. With the interactive computer interface, the participants can see immediately how the current

utility function affects the strategy selection. If the first result is not acceptable, the weights of the goals can be changed. For example, more weight can be given to the goal not meeting the given requirements, and the consequences of this change can be seen immediately. Interactive defining of the weights is continued until the participant accepts a plan.

It is possible to use tactics by over-weighting certain goals so that the real target levels would be attained when negotiating with the other parties over the final solution. This kind of tactics can be at least partly prevented by telling the participants to justify their utility functions to the other participants involved.

Step 5) The overall utility function is formulated by integrating the parties' utility functions. In general, the overall utility function is formulated as follows:

$$U_{tot} = \sum_{j=1}^{n} w_j U_j \qquad (2)$$

where U_{tot} is the total utility, w_j is the weight of participant j, U_j is the utility of participant j, and n is the number of participants involved.

An agreement about the initial weights for the parties is a good starting point for the participatory decision analysis. That is why the weights of the parties are recommended to be defined through negotiation. However, all the participants may not be equally talented as negotiators. In these cases, the weights can be asked from the parties themselves and the weights can be calculated as an average of the weights given by the parties. The justifications of the weights given are presented to other parties. In some decision situations, the decision maker/makers may keep the right to define the weights by himself/themselves. This seems reasonable, because the DM/DMs must justify the weights given in an open process of the IDA. In any case, assessing the weights for the parties is a political process guided by the planning consultant and decision maker(s).

Step 6) The alternative forest strategies are evaluated by means of the overall utility function produced in the preceding phase. The *sensitivity analysis* is an essential part of

this step. In the sensitivity analysis, the utility function is changed according to the possible changes of the parties' goals or of the weights between the parties. A non-sensitive solution can be assessed to be the best one with a higher degree of certainty compared with a very sensitive solution due to the uncertainty involved in planning.

The decision maker does not have to implement the plan which gets the best score in the decision analysis as such. The analysis is a way to support decision making, not to offer decisions which can not be modified or rejected.

CASE OF KAINUU

Role of the IDA

The application of the IDA method was a part of a wider participation process where citizens and interest groups participated in the planning process through public meetings, phone, open houses, working groups, letters and questionnaires. The parties involved in the IDA included the FPS, one regional and four local working groups (including 10–12 interest groups each) and citizens. The whole participation process is introduced by Loikkanen & Wallenius (1997).

The formulation of the forest strategy of Kainuu was based on the national and regional goals of the FPS and the goals of interest groups and citizens living in Kainuu. The function of the IDA was to produce comprehensive decision support for the formulation and selection of a forest strategy to best meet these needs. Such support would have been difficult to achieve otherwise.

Strategies to Be Evaluated

Initially, four strategies following different scenarios were formulated. The goal of this step was to map out the feasibility of land use allocations in general and their implications on producing forest outputs. In the so called ´Basic strategy', the current principles of land allocation were kept unchanged. In the ´Business strategy' the FPS' economical goals in Kainuu were emphasised. The ´Forest recreation' and ´Nature conservation' strategies were produced to emphasize the respective goals. In spite of giving different emphasis on different goals in these strategies, each strat-

egy was considered to be a feasible one. The impacts of the strategies as measured by a set of numeric indicators (goal variables) were estimated through planning calculations.

The four initial strategies were used as control devices and as a basis for evaluating a new set of more balanced strategies. These new strategies were produced to better meet the parties' needs and other criteria as depicted in the overall utility function. The specified strategy to be adopted will be a good compromise addressing the goals of all parties. Such a strategy will also fulfil the legal, economic, social, ecological, managerial, physical, and technical feasibility requirements as well.

UtilityFunction

Expertise-based Utility Function

Formulation of the decision hierarchy (Figure 2) was the first phase in the estimation of the utility function. The decision hierarchy in Kainuu was formulated interactively by the FPS and the authors who were involved in the planning process as neutral consultants. The comments presented by the stakeholders in the regional and local working group meetings were also taken into account in this formulation process.

The decision hierarchy consisted of six levels (Figure 2). The levels (from left to right) were (1) the overall goal for forest management in the planning area, (2) the parties, (3) the criteria (i.e., four main goals) for forest management, (4) the sub-criteria (5) the indicators for the criteria and sub-criteria, and finally (6) the alternative forest strategies.

The overall utility was set as the overall goal for forest management in the Kainuu region. The overall utility in turn consisted of the parties' utilities summed together. According to the utility model, the parties' utilities consisted of the four main criteria defined for the forest management in the area. These criteria included (1) the FPS's financial goals including future opportunities for timber production in the Kainuu region, (2) socioeconomic values within the region, (3) forest recreation values and (4) nature conservation values.

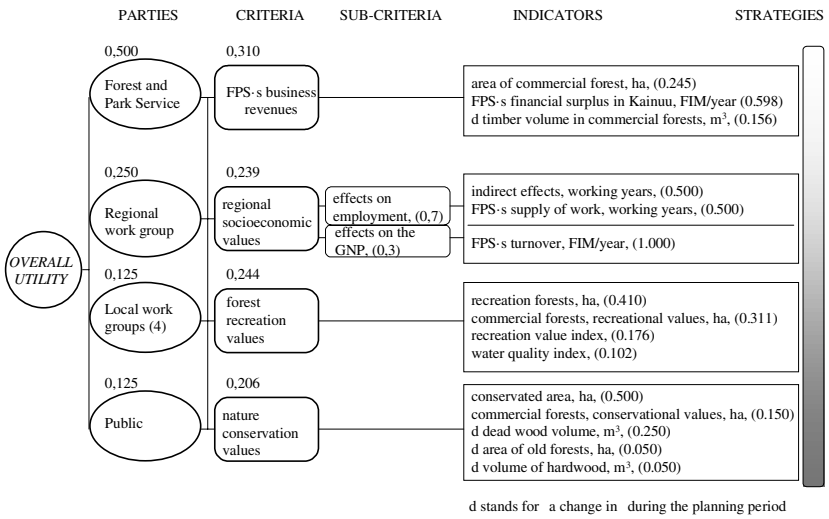

FIGURE 2. DECISION HIERARCHY APPLIED BY THE FPS.
The local weights (values in brackets) of the indicators were determined by the experts of the FPS and the local weights of the sub-criteria by the members of the regional work group. The values in the upper left corners of the ´parties' and the ´criteria' comprise the global weights of them. The local and the global weights of the parties are the same.

Socioeconomic values were further divided into sub-criteria consisting of employment opportunities and the financial impacts of utilizing state forest on the GNP of the region. The criteria and sub-criteria were further defined by quantitative indicators, and sub-utility functions were estimated for each indicator. The indicators were weighted after the formulation of the decision hierarchy and the estimation of the sub-utility functions.

Participatory Weighting Process

Regional Work Group

An opportunity to take part in the IDA was offered to the members of the regional and the local work groups. Asking (1) the weights for the criteria and sub-criteria as speci-

fied with indicators and (2) the importance of the parties provided a meaningful opportunity for participation in the IDA.

The IDA was demonstrated and its applicability was discussed thoroughly with the regional work group. Comments received were taken into account by the FPS and the consultants in formulating the overall utility model. For example, the regional socioeconomic criteria for the State forest management was included in the utility model as presented by the interest groups in the regional work group.

The members of the regional work group participated in the decision analysis via planning sessions which were scheduled separately with each interest group. The participants and the consultant (i.e., the facilitator) worked together to find the weights which best met each participants' and their representative interest group's preferences. Pairwise comparisons, a graphical method of evaluation, and direct numeric evaluation methods were applied as technical and visual means to help the participants in their weighting processes.

The interest groups in the regional work group were clustered according to their working fields so that the common weights for the criteria could be calculated as arithmetic means of the groupwise weights (Table 1). The mean weights of the sub-criteria defined by the members of the regional work group were used in the final utility function as such. The weight of the sub-criteria ´effects on employment' was 0.7 and the weight of the sub-criteria ´effects on the GNP' was 0.3. The members of the regional work group gave weights for the parties of level two as follows (weights in brackets): Forest and Park Service (0.41), regional work group (0.27), local work groups (0.21) and public (0.14).

Local Work Groups

Members of the local work groups participated through an inquiry where one hundred points was to be divided among the four criteria and among the four parties involved. Interactive planning sessions were not arranged. Nevertheless, the decision model and the implications of different weights of the criteria were demonstrated to the local work groups before the inquiry.

TABLE 1. CRITERIA, WEIGHTS AND INTEREST GROUPS.
Table 1 gives the weights for the criteria given by the representatives of the interest groups belonging to different working fields and the average values of the weights given.

Working field	FPS's business revenues in Kainuu	Socio-economic values	Forest recreation values	Nature conservation values
Agriculture and forestry	0.261	0.372	0.213	0.154
Provincial administration	0.205	0.470	0.218	0.107
Tourism	0.223	0.266	0.335	0.176
Forest industry	0.500	0.300	0.100	0.100
Small enterprises	0.268	0.357	0.217	0.158
Game husbandry	0.180	0.220	0.330	0.270
Research	0.192	0.301	0.235	0.272
Nature conservation	0.060	0.120	0.218	0.601
Average values	0.236	0.301	0.233	0.230

The weights for the criteria were calculated for each working field represented in the local work groups. The means of these values were as follows (weights in brackets): FPS's business revenues (0.285), socioeconomic values (0.261), forest recreation values (0.188) and nature conservation values (0.266). Correspondingly, the weights of the parties were: Forest and Park Service (0.380), regional work group (0.218), local work groups (0.243) and the public (0.159).

Public

First, public opinions and comments received through phone, open houses, public meetings, letters, and questionaries were written down, classified and analysed by a neutral consultant. Second, the weights for the criteria against this input were evaluated by the same consultant and approved by the FPS.

The weights used in the decision analysis model were: FPS's business revenues (0.125), socioeconomic values (0.250), forest recreation values (0.500) and nature conservation values (0.125). The weights of the parties were not directly asked from the public.

FPS as The Decision Maker

The forest strategy to be developed should be based on the national and the regional obligations and goals set for the FPS. Furthermore, the regional and the local goals of the interest groups and citizens should be included into the strategy. These aspects were taken into account by the FPS when defining its weights for the criteria, indicators, and parties.

The weights for the criteria given by the FPS were: FPS's business revenues (0.400), socioeconomic values (0.200), forest recreation values (0.200) and nature conservation values (0.200). The FPS provided the following weights for the parties: Forest and Park Service (0.500), regional work group (0.250), local work groups (0.125) and public (0.125).

These weights for the parties were also used in the decision model. I.e., the parties' importance for each other defined by the members of the work groups were not included into the decision model as such. The FPS defined the final weights based on these assessments, which was initially agreed upon.

After the participatory weighting process, the global weights for the criteria were calculated by integrating the parties' local weights for the criteria. When using the weights of the parties given by the FPS the global weights for the criteria were as follows: FPS's business revenues (0.310), socioeconomic values (0.239), forest recreation values (0.244) and nature conservation values (0.206) (Fig. 2).

EVALUATION OF THE STRATEGIES

When evaluating the alternative strategies, the overall priorities of the four original strategies were first calculated. Also some new strategies were produced so that the discussion about the strategies "between" the four initial strategies could be substantiated.

The decision situation changed during the late phases of the planning process because of a new conservation program of old growth forests implemented by the Finnish government. That is why none of the initial strategies could be selected to be implemented as such. However, the par-

ticipatory feedback got through the IDA was very useful when defining the final strategy in the new decision situation.

According to the Finnish conservation program of old forests, the area of conserved forests was to be increased from 28 000 ha to 62 000 ha. Also the landscape ecological planning in the FPS called for restrictions in wood production on certain areas (92 000 ha). Because of these new land use allocations, none of the initial strategies were feasible any more.

Because of the changes in the decision situation, two new feasible strategies were produced: ´Selection' strategy and ´Selection 2' strategy. The first of these is the ´Basic' strategy including the new nature conservation goals. The ´Selection 2' strategy is a modified version of the ´Business' strategy. The priorities of the four initial strategies and the Selection 2'- and ´Selection' -strategies were as follows:

STRATEGY	PRIORITY
´Business' strategy	0.520
´Basic' strategy	0.462
´Forest recreation' strategy	0.440
´Selection 2' strategy	0.417
´Selection' strategy	0.376
´Nature conservation' strategy	0.331

The ´Selection 2' strategy was selected to be the best one by the FPS, because it was the best strategy after the enlargement of conserved areas and new restrictions in wood production caused by the landscape ecological planning (i.e. the best feasible strategy). The total utility would have been better if either the 'Business', 'Basic' or 'Forest Recreation' strategy could have been selected. However, the conservation program of old forests was a national political decision which restricted the forestry actions in Kainuu. Concluding from the strategy evaluations, it can be argued that establishment of large conservation areas is not necessarily the most appropriate way to manage state owned forests in Kainuu.

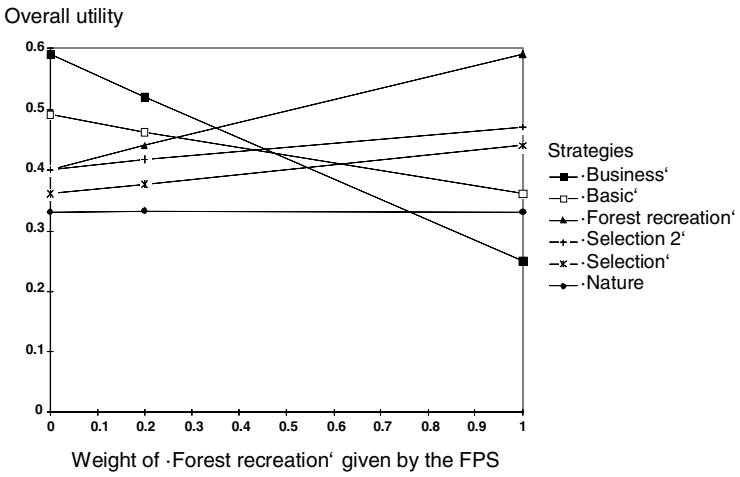

FIGURE 3A. SENSITIVITY ANALYSIS.

In the sensitivity analysis, changes in the weights of the parties did not have great effects on the priorities of the alternative strategies. The same was the case with respect to changes of the weights of the criteria given by the parties. However, if the FPS gave 35 % of total weight to the ´Forest recreation‘ criteria, the ´Forest recreation‘ strategy would have become the most preferred one (Fig 3a). The chosen strategy (´Selection 2‘) corresponds to a situation in which the FPS gives more than 40 % of total weight to the ´Nature conservation‘ criteria (Fig 3b).

EXPERIENCES OF THE USE OF THE *IDA* IN KAINUU

In the case of Kainuu, the IDA was applied as a part of a wider participation process where several means of participatory planning were used. The role of the IDA was to be a decision support method which gives comprehensive decision support to the FPS when defining the final strategy for forest management in the state owned forests in Kainuu. This proved to be a proper way to apply the IDA. The results of the IDA could be compared with the overall view got through the other participatory methods. When comparing the participatory feedback, the results of the IDA supported the overall view and the overall view supported the results of the IDA, respectively.

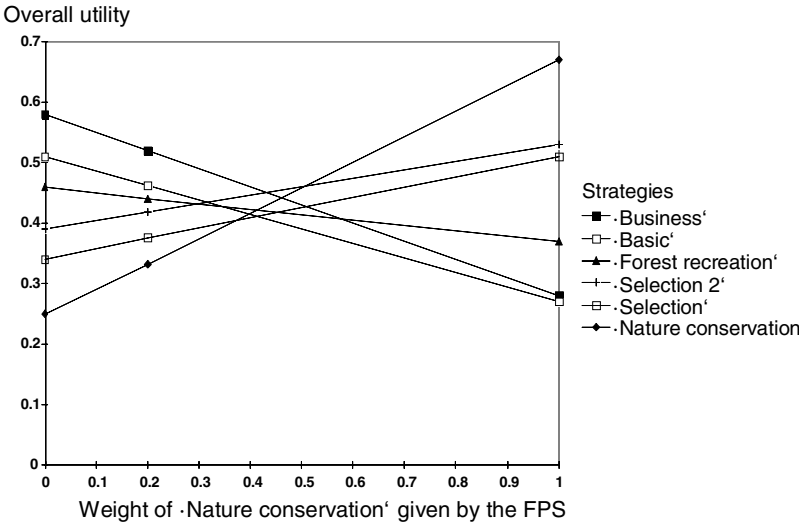

FIGURE 3B. SENSITIVITY ANALYSIS.

When comparing to the other techniques of participatory planning in forestry, the IDA has many advantages. It is both a technical decision support system and a communication promoter. It does not exclude disaggregative or aggregative planning. Instead, every strategy can be studied separately and the strategies can be evaluated holistically (directly with no aggregation methods) if wanted. Later, the IDA can be applied and the results can be compared with the earlier results obtained through the disaggregative approach. In the case of Kainuu, the IDA was performed according to an integrated approach.

However, a holistic evaluation of the strategies may be difficult and misguiding. For example, the names of the strategies and their immediate images in the participants' thoughts may have remarkable effects on the strategy selection especially among laymen. Holistic views about the priorities of the strategies may cause errors in the parties' utility functions in the IDA as well. For example, the party may give such weights to the decision criteria which actually do not correspond to party's real goals so that a certain strategy would become selected as the best one. This will cause errors also in the overall utility function.

Because of the shortcomings caused by the holistic views about the priorities of the strategies, an approach where

the strategies are not presented to the participants in advance would be worth testing. In that case, only the feasible intervals between the minimum and maximum of each indicator and the present values of them would be presented. This kind of illustration would be quite easy to understand for the participants.

The IDA works best in representative applications where the number of the participants is not very large. Creighton (1983a) suggests that the number of the participants should be in the range between five to nine in effective group processes. In larger groups, some of the participants may drop out and participate minimally. As a consequence, stronger personalities may begin to dominate in the group and the group might get polarized. In the IDA, this disadvantage can be alleviated by dividing the process of the IDA into two parts. First, each party has an own interactive planning session, which is preferably started with a thorough discussion about the stakeholder's views and goals related to the planning. This is important to set a collaborative direction to the negotiations and gaining an overview of the planning situation. After the discussion, the utility model of the party is formulated. Second, the IDA is continued with the whole work group. This approach gives all the participants equal possibilities to have their goals included into the planning process. This approach was used successfully with the regional work group in the case of Kainuu.

To start with this study's IDA, there were four alternative strategies to be compared and evaluated. More strategies were produced iteratively so that the overall utility increased. This kind of interactive approach works quite well because the space of alternatives can be enlarged if needed. However, the process of the IDA would be more simple, if all the meaningfully different and applicable strategies were produced already in the beginning of the process. This would have positive effects on the reliability of the IDA. On the other hand, it is rather common that all the aspects of the decision problem can not be mapped out at the beginning and the state of affairs changes during the planning process. That is why it is important to be capable to produce new strategies iteratively.

The scale of the strategic planning might be too large and some goals might be too difficult to define in terms of

goal variables for laymen. Due to these reasons, an expertise-based utility model was used as the basis for the participatory decision analysis in the case of Kainuu. The participants in the regional work group were mainly satisfied with this arrangement. Feedback about this course of action was not available from the other participatory groups.

Both interactive and non-interactive approaches were used in the participatory decision analysis. The members of the regional work group had an opportunity to take part in the interactive planning sessions. The local work groups, instead, participated through a form inquiry. The first of these approaches has more advantages. Understanding the decision analysis calls for both effective human-computer interaction and interpersonal communication. Furthermore, communication must be participant-oriented so that neither decision-theoretical nor forestry related jargon is used by the planning consultant more than necessary.

It is obvious that laymen are more interested in spatially bounded tactical level planning than in more general strategic planning which operates with means and sums of large scale goals. That is why the public and the local work groups may be more willing to take part in the IDA in tactical planning (e.g. landscape ecological planning) than in strategic planning. Also the difficulties to understand strategic level decision making without experience or special training make participation in strategic planning less attractive.

In the case of Kainuu, the public opinion did not get very much weight in the IDA because it was based on a consultant's subjective insight over the overall participatory feedback. And more over, there was no guarantee that this feedback was representative of the general public's opinion. In general, giving only a little weight to poorly known decision elements is an approach to take the uncertainty into account in the IDA. On the other hand, an analysis of uncertainty could also be performed.

The public opinion would be a very valuable input if it could be revealed in way which serves the IDA directly. For example, questionnaires made in large participatory planning projects could be used effectively if they were designed by taking the needs of the IDA into account. The questions could be formulated so that the answers are ap-

plicable in the decision analysis directly. An other possibility is to compare the results of questionnaires with the results of the IDA. For example, in the case of Kainuu, the overall weights of the criteria in the IDA differed only slightly from results of a questionnaire performed in the same planning project (Loikkanen, 1997). In the near future, computer networks might also be applied in the IDA applications, and hence, also the public can probably take part in the IDA. New information technology might change the practises of participatory planning dramatically.

It is important that the participants do not give such meanings to the goals which are not described via the goal variables. Breaking this principle might be a partial explanation for the large weight given to the criteria ´FPS's business revenues in Kainuu'. It is possible that the participants took the sosioeconomic values once into account in the weight of the Sosioeconomic values' criteria and again in the weight of the ´FPS's business revenues' criteria. On the other hand, the participants may have thought that the FPS's business revenues are important for the FPS's possibilities to act in Kainuu in the future, and this aspect was thought to be very important. The second explanation may hold true more often than the first one.

The FPS gave the final weights for the parties involved in the IDA. These weights did not dramatically differ from the weights given by the other parties. It seems that the citizens in Kainuu trust the FPS. All the parties approved that the FPS's goals should be taken into account with the largest weight in the strategy selection. The obligations of the FPS to take all the aspects of sustainability into account might be one reason for this. On the other hand, the FPS could have given all the decision power to the other parties without significant effects on the strategy selection.

The numeric approach of the IDA was also criticised in the case of Kainuu. Social, recreational, and conservational goals could not be adequately described quantitatively according to some participants. This criticism is justified. It is true that all aspects of non-timber values can not be measured quantitatively. But it can also be argued that, in spite of the shortcomings of the quantitative approach, it would have been much more difficult to include the non-timber goals into planning through merely a qualitative approach.

The goals which can not be measured numerically can be defined verbally and taken into account when composing quidelines for practical forestry operations.

The quantitative approach is not a very pleasant one for those who are not used to deal with mathematics. This problem can be solved partly by applying a graphical user interface instead of a direct numerical approach. However, even the graphical interface may be too technical for some participants. That is why a qualitative analysis of participants' goals in relation to the IDA should be developed also in participatory forest planning. For example, using verbal pairwise comparisons would be a means to make the IDA less technical.

In the case of Kainuu, the pairwise comparisons were not so popular as the direct graphical and numerical evaluations in estimating the weights of the decision elements. Two possible reasons for this kind of behaviour can be given. First, the participants might have thought that they can give weights for the decision elements directly because of the small number of criteria (five at maximum) and parties to be compared with each other at the same time. Second, pairwise comparisons are more difficult to perform consistently than direct graphical or numerical evaluations. On the other hand, in pairwise comparisons, the participant's must concentrate on the comparisons more deeply than in graphical or numerical evaluations and the probability to obtain the "right" weights for the decision elements becomes higher.

For some participants the IDA contained too much simplification. For example, it was argued that biodiversity as a complex phenomena could not be meaningfully included in the decision analysis. On the other hand, when simplifying, thinking about the essential attributes of a problem is necessary. Consequently, only significant aspects of the problem are included in the IDA. Less important aspects which either have minimal or no effect at all on the strategy selection are omitted to keep the model robust.

Possibilities to use competitive tactics through the decision analysis were suggested. However, applying competitive tactics is possible in all planning, and it is not more common in the IDA than in other participatory planning. In general, an important goal in participatory planning is

to get the parties to work collaboratively instead of competing with each other. An open process of the IDA is a means to attain this goal. Using competitive tactics is more difficult in the open process of the IDA than in a segmented, more traditional planning process. In the IDA, all the parties involved can not only see each other's weights for the criteria, but also have to justify their own priorities to the others as well. For example, in the case of Kainuu, all the participants were asked to justify their weights given for the criteria and the participating parties. It was realized that the participants did not compete by giving stronger weights than actually preferred for certain criteria in order to reach their goals in the strategy to be selected. There was no remarkable contradictions between the justifications given by the participants and the corresponding numerical weights given for the criteria.

Difficulties to understand the IDA were observed. That is why interactive planning sessions with the presence of a consultant giving technical support to the participants are recommended. In the case of Kainuu, every party in the regional work group had its own planning session; the consultant and the representatives of the party worked together to find out the weights for the criteria which best met the party's goals.

The problem definition and the concepts were clarified in the hierarchical formulation of the decision model. Each criteria had its numerical indicators, and the content of the indicators were clearly defined. Open and meaningful discussions were held before and during the formulation of the decision model. It was very useful to clarify which factors could be incorporated into the decision tree (i.e., what we know or can measure and predict) on one hand and, and based on this, which factors actually should be included in the model.

CONCLUSIONS

The application of the IDA in Kainuu was an encouraging experience of applying modern tools of participatory planning in practical forestry. The preferences of the interest groups were meaningfully included in planning which is one of the main criteria for effective participation. To understand and learn about the tradeoffs between the criteria

and the indicators under different schemes of weights was a prodening process of one´s view for most participants. The decision analysis was a learning process where all parties — including the analysts — learned much about strategic decision making in practical forestry. However, critical comments were also presented. This is natural because the IDA was a novel tool for all the participants including the planning consultants. This probably has caused some shortcomings in the concepts used: too much decision theoretical and forestry related jargon was used. However, the concepts used were tried to make as easy to understand as possible.

Multiobjective decision making in forestry is always a very challenging task. In Kainuu, the complexity of participatory forest planning on strategic level was realized widely through applying the IDA. This complexity was not only revealed, it was also analysed, and more over, tackled, which was made possible only by integrating modern forest planning methods with the latest knowledge of participatory planning and decision making. As a result, a well argued proposal for the best forest strategy could be presented. It would have been a much more difficult task to achieve without the IDA.

The IDA can be developed to serve practical participatory planning even better than in the case of Kainuu. First, the concepts of the IDA can be made more easy to understand for laymen. Second, the preferences of the public could be researched in a way applicable for the IDA. Third, computer networks could be used as a tool to incorporate interest groups and citizens in the IDA. And fourth, applying such qualitative methods of decision analysis as the Delphi technique, the SWOT analysis, or a semi-structured interview integrated with the quantitative decision analysis could make the planning process less technical and more human oriented without loosing its analytical nature of decision support.

In addition to the FPS's application presented in this article, the IDA is applicable also for many other planning tasks in public and private forestry. For example, it can be applied as a decision support tool when formulating provincial forest strategies. The strategic planning can be elaborated via more accurate tactical planning which can

as well be supported by the IDA. In general, a lot of research work has to be conducted to develop appropriate processes and methods for different planning situations. In modern participatory planning, the IDA is applied as a decision support tool together with the other methods of participatory planning and it is integrated wisely with the overall planning process.

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