BUILDING INSIGHTS OF MANAGERIAL ECONOMICS AND ACCOUNTING TOWARDS SUSTAINABLE FOREST MANAGEMENT

Proceedings of the International Symposium organised by the IUFRO Unit 4.05.00 and the Department of Ecological Economics, Ukrainian National Forestry University

Lviv, Ukraine, May 17-19, 2007

Edited by
L. Zahvoyska, H. Jöbstl, S. Kant, L. Maksymiv

Proceedings of the IUFRO-symposium 2007
Units: 4.05.00 Managerial Economics and Accounting
4.05.01 Managerial, Social and Environmental Accounting
4.05.02 Managerial Economics

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Lviv – 2009

УДК 630*903+630*6
ББК 65.050:43

Економіка управління та управлінський облік у контексті менеджменту сталого лісового господарства // Матеріали конф. групи 4.05.00 IUFRO, м. Львів, НЛТУ України, 17-19 травня 2007 р. / За ред. Л. Загвойської, Г. Джобстля, Ш. Канта і Л. Максимів. – Львів: РВВ НЛТУ України, Камула, 2009. – 184 с.

Building insights of managerial economics and accounting towards sustainable forest management. Proceedings of the IUFRO unit 4.05.00 international symposium. May 17-19, 2007, Lviv, Ukraine / Edited by L. Zahvoyska, H. Jöbstl, S. Kant, L. Maksymiv. UNFU Press, Kamula, Lviv, Ukraine. 184 p.

Organisers:

IUFRO unit 4.05.00 Managerial Economics and Accounting

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Збірник містить матеріали конференції «Економіка управління та управлінський облік у контексті менеджменту сталого лісового господарства», проведеної Міжнародною спілкою лісівничих дослідницьких організацій (IUFRO, група 4.05.00 Економіка управління та управлінський облік) і кафедрою екологічної економіки Національного лісотехнічного університету України. Статті відображають напрацювання науковців провідних університетів світу в галузі економіки та менеджменту сталого лісового господарства, інкорпорування вартостей ресурсів і послуг лісових екосистем у практику прийняття управлінських рішень, а також сучасні підходи до відображення цих вартостей в управлінському екологічному обліку.

Для широкого кола наукових працівників і фахівців із проблем ведення сталого лісового господарства, а також для студентів та аспірантів.

Рекомендовано до друку Вченою радою Інституту екологічної економіки Національного лісотехнічного університету України

First published in Ukraine in 2009 by Ukrainian National Forestry University (UNFU), Department of Ecological Economics, Generala Chuprynky, 103, Lviv, Ukraine 79057

Available from: http://unfu.edu.ua; http://enareco.narod.ru/iufro.htm

ISBN 978-966-433-039-5

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Foreword

The emerging paradigm of sustainable forest management (SFM), which aroused as a response of policy makers and the scientific community to the alarming state of the global environment, demands an innovative, well-grounded and comprehensive conceptual framework of managerial economics and accounting. Such critically important issues as complex ecosystem management which meet the diverse and dynamic demands of different stakeholders – both present and future generations – should be crucial point of this framework. Multi-attribute and transparent forest accounting should provide a sound background for forest management.

Similarly, delivering relevant managerial economics and accounting research findings to decision makers and entrepreneurs, and transferring research knowledge to society for the sake of shaping environmentally responsible production and consumption of forest goods and services are critical for designing sustainable forest management practices at local, regional, and national levels. These issues become even more critical under conditions of transition economy and weak institutional environment.

Accordingly, the central focus of the symposium was on the discussion of recent research findings in the field of managerial economics and accounting for SFM, bringing together all stakeholders to highlight new questions/issues related to the managerial economics and accounting, and to deliver new knowledge to society to accelerate the implementation of SFM for the common benefits.

Initially, the idea to hold IUFRO symposium in Ukraine belonged to Prof. Dr. Maurizio Merlo, former leader of IUFRO group 4.04.02 Managerial Economics in Forestry. Ukrainian National Forestry University (UNFU) was chosen for this aim as the only university of Ukraine fully dedicated to forestry education with long traditions of scientific research towards incorporating ecological imperative in decision making, as a leader in the field of greening research and curriculum in Ukraine.

We would not have succeeded in involving so many prominent scientists from two continents and eleven countries without the professional support and advice of experienced members of IUFRO 4.05.00 group. Many thanks to them. Considerable contribution to the symposium field trip planning and logistics has been made by Dr. Anatoliy Deyneka, director of the Lviv Regional Forestry Administration, and we acknowledge his support. The symposium was held with the assistance of Environment and Natural Resources Economics Master Programme students, graduated from the UNFU in 2008, especially Mariana Dushna, Mazhena Dzyama, Andriy Melnyk, Natalya Stryamets, and Tetyana Tyhonyuk. We also appreciate all participants' efforts in preparing and presenting the papers that made the symposium successful. The editors wish to thank Christina Roder, BOKU-Vienna, for her valuable support in the editing process. The joint efforts of all authors enabled the present Proceedings publication.

Lyudmyla Zahvoyska
on behalf of the Symposium
Organising Committee

ANALYSING FOREST MANAGEMENT ALTERNATIVES WITHIN INTERDEPENDENT GOALS

Lidija Zadnik Stirn[a]

Abstract

The objective of this paper is to demonstrate how a combined SWOT, AHP, ANP and group expert interview model can be used as aid in forest management scenario selection problem that has multiple criteria and interdependence property. The forest management indicators are first determined according to proposed sustainable scenarios by SWOT analysis. SWOT identifies the factors in strength, weakness, opportunity and threat clusters, but does not find the most significant cluster. To yield analytically determined priorities for the SWOT factors and to make them commensurable the Saaty's decision analysis method, the analytic hierarchy process (AHP), is integrated with SWOT analysis. However, the use of AHP means that the model is still lacking in that it does not consider interactions among and between decision-making levels. Analytic network process (ANP) is handling interdependencies among elements by obtaining the composite weights through the development of so-called supermatrix. We collect the data for supermatrix development by group expert interview. Application of the presented model deals with three forest management scenarios in the Primorska region, Slovenia.

Keywords*: forest management, scenario selection, decision support model, SWOT, AHP, ANP analysis, expert interview, case study of a forest in Slovenia*

1. Introduction

In order to select "the best" scenario for sustainable management of a particular forest area from a suggested competing set of forest management alternatives, the alternatives have to be evaluated according to different criteria. Thus, problem of assessing, ranking, rating and pairwise comparisons of forest management scenarios is a multi-criteria decision-making problem. Prior research of these problems mostly neglects an important aspect of information technology, namely the interdependencies that exist among the criteria and indicators designed to evaluate the scenarios and among the decision-makers who express their opinion about the most preferred forest management scenario. The objective of this paper is to demonstrate how a combined SWOT, AHP, ANP and group expert interview model can be used as aid in forest

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management scenario selection problem that has multiple criteria and interdependence property.

The forest management indicators are first determined according to proposed sustainable scenarios by SWOT (strengths, weaknesses, opportunities and threats) analysis. SWOT can provide a good basis for successful strategy/alternative formulation, but it lacks the possibility of comprehensively appraising the strategic decision making situation. It identifies the factors in strength, weakness, opportunity and threat clusters, but does not find the most significant cluster. In addition, SWOT is mainly based on the qualitative analysis and expertise of the persons participating in the evaluation and decision process (Bhattacharya, 1998). Thus, to yield analytically determined priorities for the SWOT factors and to make them commensurable the Saaty's decision analysis method (Saaty, 2005), the analytic hierarchy process (AHP), and its eigenvalue calculation method were integrated with SWOT analysis. Pairwise comparisons between SWOT factors within each SWOT group and between the four SWOT groups are carried out. The similar approach was, for example, also used by Pesonen *et al.* (2001) for determining the priorities of investment factors in Finnish forest industry.

AHP is a comprehensive framework designed to cope with the intuitive, the rational, and the irrational when we make multiobjective and multiactor decisions with and without certainty for any number of alternatives. AHP models a decision-making problem that assumes a unidirectional hierarchical relationship among decision levels. The top element of the hierarchy is the overall goal for the decision model. The hierarchy decomposes to a more specific attribute until a level of management decision criteria is met. The hierarchy is a type of system where one set of entities influences another set. However, even though the use of AHP means that the models are still lacking in that they do not consider important interactions among and between decision-making levels, it has been much used with real forest management problems because it is very simple and easy to understand, so decision-makers feel comfortable with it.

ANP (analytic network process) (Meade and Sarkis, 1999) is a general form of AHP. It allows relationships among the decision levels and among the attributes. It does not require strictly hierarchical structure. Two-way arrows represent interdependencies among attributes or attribute levels. The directions of the arrows signify dependence. Arrows emanate from an attribute to other attributes that may influence it. The relative importance of the impacts on a given element is measured on a ratio scale similar to Saaty's AHP 9-point scale. ANP is handling interdependencies among elements by obtaining the composite weights through the development of the so-called supermatrix. We collect the data for supermatrix development by group expert interview. In the paper we show the procedure using the supermatrix manipulation based on Saaty and Takizawa's concept (1986) instead of Saaty's supermatrix concept (Saaty, 1996) which is explained as a parallel to the Markov chain process.

As a result, using the presented SWOT/AHP/ANP model, the quantitative information of the forest management scenario factors is achieved; the feasible management scenarios are evaluated and ranked. Thus, the forest managers, decision-makers and experts can attain the most preferred scenario.

In the application part, the paper deals with three forest management scenarios in the Primorska region, Slovenia.

2. Forest management scenario evaluation model and methods

Decision-making is an important area of managing any system. It deals with strategies (decisions, alternative paths, alternatives, different projects and scenarios) and objectives (goals) in the perspective of a changing environment. Further, it requires careful consideration and evaluation of the external and internal factors. Equally important is the assessment of opportunities, threats, strengths and weaknesses of the strategic paths under consideration. Thus, decision-making process involves the following steps:

- Being aware of the opportunity itself. The decision-makers must be fully equipped with all relevant facts and figures, and the data should be within their knowledge. They must be aware of present and of future opportunities of strategies under consideration, and of their strengths and weaknesses in relation to competitive alternatives;
- Establishing objectives. After being aware of the environment in which the strategy should be undertaken, objectives of the strategy are to be established;
- Evaluating alternative strategies. The opportunities and threats, and strengths and weaknesses of each strategy are to be properly evaluated and their relative advantage is to be analyzed;
- Selecting the optimal alternative and course of action. After careful evaluation of various possible alternatives in relation to opportunities, threats, strengths and weaknesses, the alternative that will suit the objectives best and will be practically possible to implement is to be selected.

Taking into consideration the steps of a decision making process, it is proclaimed that this process, as such, presents a multiple criteria problem which could be solved by the use of SWOT analysis advocated by AHP method, ANP method and group experts' interviews.

2.1 SWOT analysis for systematic examination of forest management scenarios

SWOT analysis means analysis and assessment of comparative strengths and weaknesses of a strategy in relation to competitive strategies, and environmental opportunities and threats which the strategy under consideration may face. SWOT analysis is, as such, a systematic study and identification of those aspects of the strategy that best suit, in our case, sustainability, maximal expected profit, refers to ecological objectives, and respects the public's acceptance of the examined alternatives. SWOT should be based on logic and relational thinking such that the selected strategy improves the strategy's strength and opportunities and at the same time reduces the weaknesses and threats.

Strength is a distinct superiority (competitive advantage) of technical knowledge, financial resources, skills of people involved, image of products and services, access to best network, of discipline and morale. Weakness is the incapability, limitations and deficiency in resources such as technical, financial, manpower, skills, image and distribution patterns of the alternative under examination. It refers to constraints and obstacles of the alternative. Corporate weaknesses and strengths are a matter of how the alternative can achieve the best results compared to other, similar competitive alternatives. Weaknesses and strengths of the alternative present internal forces and factors required to be studied and assessed with the goal to evaluate and rank the alternatives under consideration.

Opportunities and threats are the external factors of the examined strategies. These factors are changing with the change of governmental, industrial, monetary and market policies, including the changes of legal and social environment. Environmental opportunity is an area in which the particular strategy would enjoy a competitive advantage. A proper analysis of the environment, identification of new market, new and improved customer groups and new relationship could present opportunity for the strategy. Threat is an unfavorable environment for the strategy. Increased bargaining power of users and suppliers, quick changes of government policy, rules and regulations may pose a serious threat to the strategy undertaken.

SWOT analysis is nowadays very important for decision making. Such analysis can be undertaken effectively through brainstorming sessions with the participation of experts, owners and users of the environment, land, firm, etc. involved in the strategy. SWOT analysis has many advantages. Within SWOT internal and external factors are analyzed and summarized in order to attain a systematic decision situation. There are also several shortcomings of using SWOT. SWOT results in listing and quantitative examination of internal and external factors, and groups the factors in strength, weakness, opportunity and threat groups, but it is not able to identify or analytically determine the most significant factor or group in relation to the examined strategy. In order to get a qualitative information, to yield analytically determined priorities for the factors and groups included in SWOT analysis and, to make them commensurable, the integration of the analytic hierarchy process (AHP) with SWOT analysis is suggested.

2.2 AHP analysis for assessing independent effects of scenario's attributes

Dealing with problems of multiple and conflictive objectives (goals, factors) of the alternatives, and above all with objectives of different importance, Saaty's analytic hierarchy process, assigned as AHP method, is employed to determine the best alternative. AHP can incorporate mixed data that may include both qualitative and quantitative judgments, and is capable of analyzing multiple factors (Bhattacharya, 1998). AHP is based on a gradual mutual comparison of two objectives (pairwise comparison) at the same level. A scale from 1 to 9 is used for making the comparison, where, for example, 1 means that two objectives are of equal importance, 3 means that the judgments slightly favour one objective over another, ….., 9 means that favouring one objective over another is of the highest possible order of affirmation, 2, 4, 6 and 8 are intermediate values, while the reciprocals of these values tell that if objective k has one of the reasonable assumptions of the above nonzero numbers assigned to it when compared with objective j, then j has the reciprocal value when compared with k.

Comparisons between individual objectives are gathered in a pairwise comparison matrix A. Each objective k is associated with a weight w_k. The weights ratio of the objectives k and j is written as intensity of importance:

$$a_{kj} = \frac{w_k}{w_j}. \qquad (1)$$

The matrix A = $[a_{kj}]$, (k = 1, 2, ... K, j = 1, 2, ... K) if there are K objectives. By entering the estimated values a_{kj} into the matrix we get the pairwise comparison matrix A. The pairwise comparison matrix A is a square, positive and reciprocal matrix, its diagonal values equal 1 and symmetrical values are inverse. Since, in practice, we never encounter perfectly consistent estimations (Saaty, 2005), we proved the consistency as described in Winston (1994), using the consistency index. Further, the vector of weights $w = (w_1, w_2, \ldots, w_K)$ is calculated with multiple squaring of matrix A to the satisfactory exponent, i.e., A, A^2, $(A^2)^2$, etc. and then sum up the lines and normalize the values (Winston, 1994). The vector of weights $w = (w_1, w_2, \ldots, w_K)$ is therefore scaled between 0 and 1, $\sum w_k = 1$, and calculated by the following equation:

$$w_k = \sum_{j=1}^{K} a_{kj} / \left(\sum_{k=1}^{K} \left(\sum_{j=1}^{K} a_{kj} \right) \right). \qquad (2)$$

2.3 ANP analysis for assessing interdependent effects of scenario's attributes

The procedure to be followed for the evaluation of the alternative is presented in a hierarchical structure (Zadnik Stirn, 2005). The hierarchy is organized around the concept of objectives (in our case SWOT groups: strengths, weaknesses, opportunities, threats), and attributes (in our case SWOT factors), within a two level hierarchy (Fig. 1). The first level is viewed as the objective/group level. These groups are not directly measurable by themselves, but are presented by factors which are found at the second level. The factors define the cumulative effect of the SWOT group. Further, because the evaluation of a forest management alternative, as presented in Fig. 1, involves the interaction and dependence among the objectives' and attributes' levels, the analytic network process (ANP) is introduced into the model to solve the problem. ANP is the framework that allows one to include all the factors and criteria, tangible and intangible which have bearing on making the best decision. The key concept of the ANP is that influence does not necessarily have to flow only downwards, as is the case with the hierarchy in the AHP. Influence can flow between any factors in the network, causing non-linear networks of priorities and alternative choices. The ANP allows both interaction and feedback within clusters of elements (inner dependence) and between clusters (outer dependence). Such feedback best captures the complex effects of interplay, especially when risk and uncertainty are involved. The ANP, developed by Saaty (2001), provides a way to input judgments and measurements to derive ratio scale priorities for the distribution of influence among the factors and groups of factors in the decision. Thus, the AHP is a special case of the ANP. ANP models have two parts: the first is a control hierarchy or network of objectives and criteria that control the interactions in the system under study; the second is determining the degree of impact or influence between the criteria and attributes, i.e. the pairwise comparisons (Bhattacharya, 1998). However, since in forest management practice the exact relationship in the network structure (Fig. 1) or the degree of interdependence among considering criteria and attributes is not known, it is inappropriate to determine these data by one or two decision-maker(s). Thus, we need to establish the interdependencies and to collect the pairwise comparison data by group expert discussion in general.

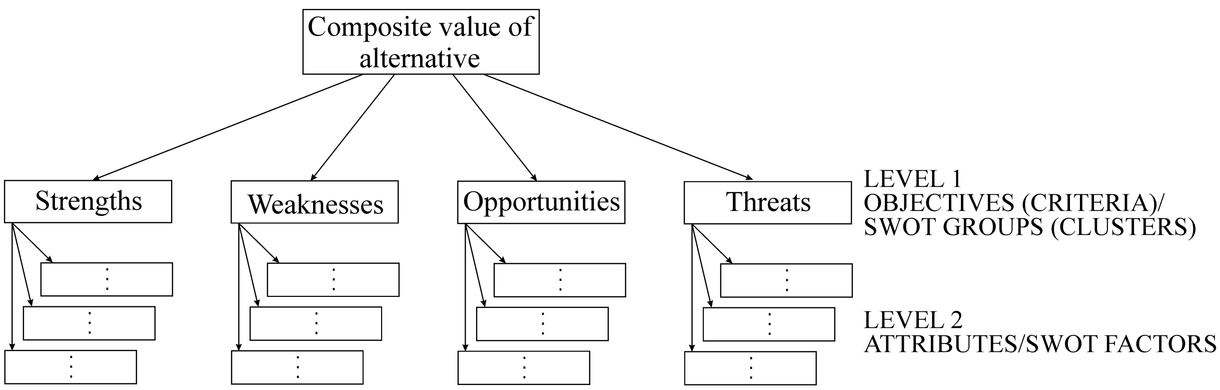

Fig. **1**. Objectives' and attributes' hierarchy for composite value of the scenario (alternative).

2.4 Cumulative effects of scenario's (alternative's) factors (attributes)

Hence, the impacts of factors to the group to which they belong must be aggregated. That is, composite value of objective/group is measured based on a number of attributes/factors. The factors define suitable reference conditions for a group and therefore constitute the primary source of data or information for assessing the composite value of the alternative because the latter reflects the cumulative effects of all SWOT groups. In this paper, a simple method of aggregation involving the linear combination of all factors and groups is used. This method was chosen because of its simplicity and transparency where the cumulative effect is aggregated by simply adding the individual effects of all factors at the first level and groups at the second level. In the aggregation process, we also consider the fact that some factors, respectively some groups, must be viewed as relatively more significant as others. Therefore, aggregating the effects of all factors, respectively groups, must also take into account their relative importance.

Some of the impacts of the factors on groups are only subjective judgments. Thus, they need to be defined by the interview with experts (Zadnik Stirn, 2006). The impact values are normalized between 0 and 1 and reflect varying degrees of favorability to the group. In other words, the extent or impact of the factor on the SWOT group may be difficult or impossible to evaluate. It can only be judged in terms of the degree to which they lead to favorable value of the group. Factors close to one imply being close to "favorable composite value of the group". In the paper, we use a linear function of a trapezoidal form (Fig. 2), but some complex functions may also be used:

$$f(x) = \begin{Bmatrix} \frac{x}{a} & \text{for } 0 \le x \le a \\ 1 & \text{for } x \ge a \end{Bmatrix} \text{ if factors represent strengths or opportunities} \tag{3}$$

and

$$f(x) = \begin{Bmatrix} 1 & \text{for } 0 \le x \le b \\ \frac{1}{c-b}(-x+c) & \text{for } b \le x \le c \\ 0 & \text{for } x \ge c \end{Bmatrix} \text{ if factors represent weaknesses or threats} \tag{4}$$

where a, b, c are parameters representing limits or threshold values of the factors with regard to their favourability to the SWOT group, and x is the current value of the factor, i.e., the mean value obtained from surveys.

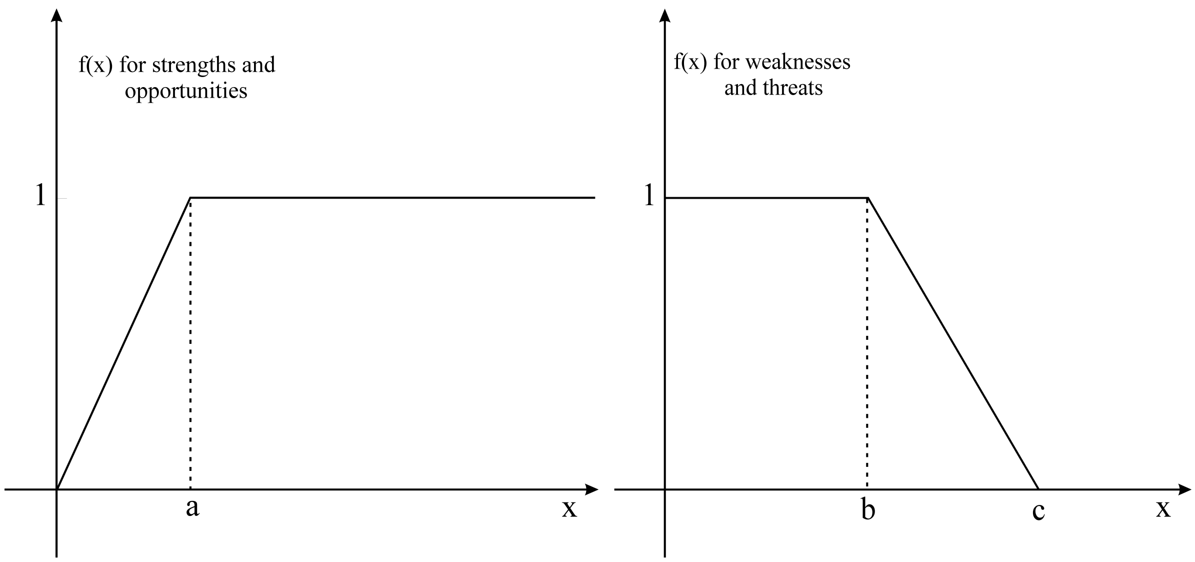

Fig. **2**. Impact functions f(x) of SWOT factors.

In the next step, the analysis involves estimating the cumulative impacts of attributes that are calculated as a sum over all products of attribute's impact function f(x) (equation 3 and equation 4) and its relative importance (weight) w_x (obtained from AHP):

$$I_j = \sum w_x f(x). \tag{5}$$

I_j provides the cumulative impacts of all factors on the favorability of objective j, i.e. SWOT group j, to the composite value of the alternative. The values of I_j are also between 0 and 1. Its value close to 1 implies that the objective j is favorable to the composite value of the alternative, while its low value implies that the objective contributes poorly to composite value of the alternative.

At the second level, the cumulative impacts of objectives, i.e. SWOT groups (strengths, weaknesses, opportunities, threats) are calculated by combining the values from both levels:

$$CUV = \sum s_j I_j, \tag{6}$$

where s_j are the weights of SWOT groups obtained by AHP and ANP.

3. Application of the model

The presented decision support model is illustrated with the management problem of the Panovec area which lies in the immediate vicinity of Nova Gorica, Slovenia and covers a total area of 384 ha (forest, meadows, trails), of which 19 ha are under full natural protection. In 1981, the Society of Forestry Engineers and Technicians of the Republic Slovenia and the Forest enterprise SGG Tolmin opened Panovec with a forest learning trail to the general public (access is free). The aim of the trail is to get more visitors (young and adult) in the area in order to educate them about nature in many ways. The trail is also used for recreation (walking, running,...) and commercial uses (exploitation of the forest, transportation of all kinds of material). Thus, the Panovec area is very important for the owners, experts, scientists, and the general public from the economic, ecological and social point of view. But for the sake of simplicity and for illustrative purposes only, the management and investment regarding the Panovec area is presented and treated here in a restricted way. We will only consider here three scenarios/alternatives/decisions (Zadnik Stirn, 2003, 2004):

1. Economically oriented – it should increase economic and recreational development of the area,
2. Educationally oriented – it should increase knowledge about nature and ecological awareness of the public
3. Ecologically oriented – it includes nature preservation and biodiversity, as well as conservation management.

All three scenarios pursue sustainable development of the area, maximum profit, ecological objectives and respect public's acceptance of the management decision. The management scenarios are competitive and only one of them could be selected. Thus, to evaluate and rank the scenarios under consideration, the presented SWOT/AHP/ANP decision support model is used.

For each of the three scenarios the SWOT factors were generated. Because the factors should take into account the socio-economic and environmental effects of the alternative, as well as engineering feasibility and match the characteristics referring to location, physical size and the level of operation, i.e. physical aspects, natural resources, land use, socio-economic, demographic, institutional, local and regional development conditions, a critical concern in identification of all the actors involved in the alternative under consideration was made. The actors were certified by a variety of means, such as educational degrees, professional memberships, peer recognition and even self-proclamation. Two types of actors were identified as potentially useful in generating the SWOT factors. The first type belongs to the representatives of a sub population whose attitudes or actions influence the project under consideration. These types of participants are used, for example, in surveys and in the Delphi-like methods. The second type of participants has an extensive specialist knowledge and experience about the research topic of concern. Methods of discussion, conferences, brainstorming, the Delphi method, and similar methods were used. Here we summarize only the SWOT factors for the first alternative, i.e. the economically oriented alternative (Fig. 3). As presented in Fig. 3, four SWOT factors were generated for SWOT group strengths, three factors for SWOT group weaknesses, four factors for SWOT group opportunities in finally two factors for SWOT group threats. Similar factors were generated for the other two alternatives.

Further, in order to assess the alternatives to be undertaken in Panovec by SWOT/AHP model the experts were asked to make their judgements via pairwise comparisons between four SWOT groups, and within SWOT groups, i.e., pairwise comparisons of four factors of strengths, pairwise comparisons of three factors of weaknesses, pairwise comparisons of four factors of opportunities, and pairwise comparisons of two factors of threats. The estimates from their pairwise comparisons are given in matrices, where group strengths is assigned as S, weaknesses as W, opportunities as O, threats as T, factor financial resources as F, experts with environmental knowledge as E, renewable wood and non-wood products as R, biodiversity in flora and fauna as B, lack of professional management as P, poor knowledge of advertising as K, low values of indirect-use (water, soil,…) as V, public interest – visitors as P, governmental support as G, regularly upgraded development plan as R, investment gap as I, changes in environmental policy as C and increased competition in forest products and recreation as I. Here are shown the data and results of the relative weights $w_{SWOT(AHP)}$ for four SWOT groups, and relative weights w_x for all SWOT factors, according to the AHP theory:

$$\begin{array}{c} \\ S \\ W \\ O \\ T \end{array}\begin{array}{c} \begin{array}{cccc} S & W & O & T \end{array} \\ \begin{bmatrix} 1 & 2 & 1/3 & 4 \\ 1/2 & 1 & 1/2 & 5 \\ 3 & 2 & 1 & 6 \\ 1/4 & 1/5 & 1/6 & 1 \end{bmatrix} \end{array} \rightarrow \cdots \rightarrow \begin{bmatrix} 0.2571 \\ 0.2040 \\ 0.4755 \\ 0.0634 \end{bmatrix} = w_{SWOT(AHP)}$$

$$\begin{array}{c} \\ F \\ E \\ R \\ B \end{array}\begin{array}{c} \begin{array}{cccc} F & E & R & B \end{array} \\ \begin{bmatrix} 1 & 1/4 & 4 & 1/6 \\ 4 & 1 & 4 & 1/4 \\ 1/4 & 1/4 & 1 & 1/5 \\ 6 & 4 & 5 & 1 \end{bmatrix} \end{array} \rightarrow \cdots \rightarrow \begin{bmatrix} 0.1160 \\ 0.2470 \\ 0.0600 \\ 0.5770 \end{bmatrix} = w_{xS}$$

$$\begin{array}{c} \\ P \\ K \\ V \end{array}\begin{array}{c} \begin{array}{ccc} P & K & V \end{array} \\ \begin{bmatrix} 1 & 1/2 & 3 \\ 2 & 1 & 4 \\ 1/3 & 1/4 & 1 \end{bmatrix} \end{array} \rightarrow \cdots \rightarrow \begin{bmatrix} 0.3196 \\ 0.5584 \\ 0.1220 \end{bmatrix} = w_{xW}$$

$$\begin{array}{c} \\ P \\ G \\ R \\ I \end{array}\begin{array}{c} \begin{array}{cccc} P & G & R & I \end{array} \\ \begin{bmatrix} 1 & 2 & 5 & 1 \\ 1/2 & 1 & 3 & 2 \\ 1/5 & 1/3 & 1 & 1/4 \\ 1 & 1/2 & 4 & 1 \end{bmatrix} \end{array} \rightarrow \cdots \rightarrow \begin{bmatrix} 0.3790 \\ 0.2900 \\ 0.0740 \\ 0.2570 \end{bmatrix} = w_{xO}$$

$$\begin{array}{c} \\ C \\ I \end{array}\begin{array}{c} \begin{array}{cc} C & I \end{array} \\ \begin{bmatrix} 1 & 1/2 \\ 2 & 1 \end{bmatrix} \end{array} \rightarrow \cdots \rightarrow \begin{bmatrix} 0.3334 \\ 0.6666 \end{bmatrix} = w_{xT} \, .$$

The results of AHP are shown in Fig. 3 within the groups' and factors' boxes.

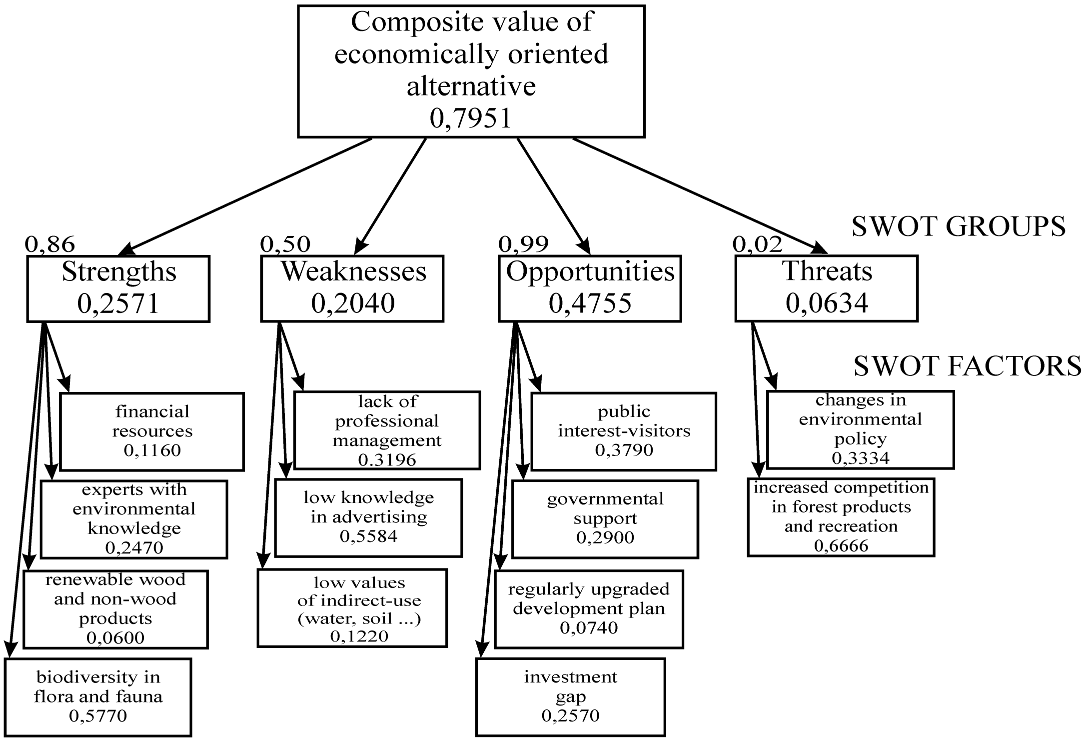

Fig. **3**. SWOT factors and groups for economically oriented alternative and their AHP priorities.

Next, we consider interdependencies among groups. When we think about SWOT groups, we can not concentrate only on one group, but must consider the other groups with it. Therefore, we need to examine the impact of all the groups on each by using pairwise comparisons. Interdependence among groups is shown in Fig. 4. We obtain the weights through expert group interviews (Zadnik, 2004).

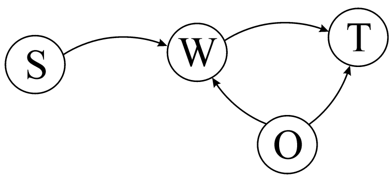

Fig. **4**. Interdependent relations among SWOT groups.

The interdependence matrix of groups is assigned as $w_{SWOT(ANP)}$, where, for example, we see that strength's degree of relative impact for weakness is 0.2, the weaknesses' degree of relative impact of threat is 0.1, and the opportunities' degree of relative impact for threat is 0.4.

$$\begin{array}{c} \\ S \\ W \\ O \\ T \end{array} \begin{array}{c} \begin{array}{cccc} S & W & O & T \end{array} \\ \begin{bmatrix} 1 & 0.2 & 0 & 0 \\ 0 & 0.5 & 0 & 0.1 \\ 0 & 0.3 & 1 & 0.4 \\ 0 & 0 & 0 & 0.5 \end{bmatrix} \end{array} = w_{SWOT(ANP)}.$$

We now obtain the interdependence priorities of the criteria (SWOT groups) s_j by synthesizing the results from AHP and ANP, i.e., $w_{SWOT(AHP)}$ and $w_{SWOT(ANP)}$:

$$s_j = w_{SWOT(ANP)} \cdot w_{SWOT(AHP)} = \begin{bmatrix} 1 & 0.2 & 0 & 0 \\ 0 & 0.5 & 0 & 0.1 \\ 0 & 0.3 & 1 & 0.4 \\ 0 & 0 & 0 & 0.5 \end{bmatrix} \cdot \begin{bmatrix} 0.2571 \\ 0.2040 \\ 0.4755 \\ 0.0634 \end{bmatrix} = \begin{bmatrix} 0.2979 \\ 0.1083 \\ 0.5621 \\ 0.0317 \end{bmatrix}.$$

Finally the overall priority of the alternative (scenario) is calculated. Questionnaires containing twenty questions about the importance of the internal and external factors of Panovec and response forms were distributed to fifty respondents (experts, investors, representatives of NGOs, residents and visitors). The five point Likert scale was used, where in questions connected to strengths and opportunities 1 means that the question is of absolutely no importance to the respondent, while 5 means that the question is extremely important to the respondent, and vice versa in the questions connected to weaknesses and threats. The questionnaire, the answers, and the statistics of the answers are in detail published in Zadnik (2004). Table 1 summarizes the average scores of the factors (x values) according to the alternative and SWOT groups, the values a, b and c, which represent the limit values of the factors with regard to their lowest and their highest observed values (given by experts), f(x) for factors, calculated on base of (3) and (4), and weights w_x. Given the data in Table 1 (f(x) and w_x), and using formula (5), the impacts of SWOT factors on the SWOT groups are calculated: I_1=0.86 for strengths, I_2=0.50 for weaknesses, I_3=0.99 for opportunities and I_4=0.02 for threats. These impacts can be found in Fig. 3 above the SWOT groups. Further, using the weights s_j for SWOT groups and formula (6) the composite value CUV is calculated. It amounts to 0.8675.

Table 1. Calculation of Ij for SWOT groups obtained from 50 respondents (equation (5))

Factor \ Factor values, limit values, function, weight	x	a	b	c	f(x)	w_x
Financial resources	2.17	3			0.72	0.1160
Experts with environmental knowledge	3.69	3			1	0.2470
Renewable wood and non-wood products	3.54	3			1	0.0600
Biodiversity in flora and fauna	2.42	3			0.81	0.5770
Lack of professional management	2.77		1	4	0.41	0.3196
Low knowledge in advertising	2.13		1	4	0.62	0.5584
Low values of indirect-use (water, soil,…)	3.56		1	4	0.15	0.1220
Public interest – visitors	4.12	3			1	0.3790
Governmental support	3.69	3			1	0.2900
Regularly upgraded development plan	2.67	3			0.89	0.0740
Investment gap	4.57	3			1	0.2570
Changes in environmental policy	2.97		0.5	3	0.01	0.3334
Increased competition in forest products and recreation	2.95		0.5	3	0.02	0.6666

The composite values for the other two alternatives which are under consideration in the treated management problem of Panovec were determined according to the same procedure and are as follows:

- For economically oriented alternative 0.8675
- For educationally oriented alternative 0.8962
- For ecologically oriented alternative 0.6120.

Thus, according to the defined SWOT factors, pairwise comparisons in the sense of AHP method, interdependencies in the sense of ANP, and subjective judgements of importance of the factors, derived from experts' interviews, the most preferred alternative is the educationally oriented scenario.

4. Conclusions

The purpose of the paper was to introduce theoretical as well as computational aspects of determining the optimal decision/scenario on activities for an existing forest area. This problem is obviously of great complexity. The conclusion we can draw from the analysis presented is that the problem of determining the optimal management alternative is a problem readily and relatively quickly resolved by means of SWOT analysis, analytic hierarchy process, analytic network process and experts' interviews.

The presented approach is new, as it encompasses the combination of SWOT analysis, analytic hierarchy process, analytic network process, and analysis of the surveys.

The decision support models are, in general, concerned with how to choose from a set of alternatives. Therefore, they usually fall short in framing the problem and setting the goals. In the presented model, this drawback is overcome by an expertise with decision makers, experts, residents and visitors. The interviews conducted with economists, sociologists, politicians, environmentalists, community activists, NGOs, and other experts that emerge through a snowball sampling technique in the case study area, identified the objectives of the individuals or groups and provided input for the generated model. The results obtained by the use of the proposed model confirm the expectations of the decision makers (experts, residents, NGOs, etc.), as their preferences regarding the Panovec area are the development of national parks, natural reserves, and other public good, as well as promotion of education. Further, the optimal alternative derived from the model is also consistent with the Slovenian legislative framework. A substantial component of the Slovenian legislation is dedicated to public participation in decision-making, particularly with regard to spatial planning and environmental matters. The Local Government Act (Official Gazette of Republic of Slovenia, 72/1993) specifies for citizen participation and outlines the protection of air, soil, water, as well as the promotion of education. The results obtained from the model confirm that the presented model is appropriate for practical use when compared with other known optimisation models.

In this paper, we showed a simplified example. In further research, we plan to show an application of more real-world problems. It might be argued that users might not be inclined to use sophisticated methods. Recent surveys indicate that the use of mathematical models is becoming more prevalent with the availability of commercial software packages such as Expert Choice, Super Decisions, Excel, etc.

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BEHAVIOR OF LOCAL COMMUNITY MEMBERS UNDER JOINT FOREST MANAGEMENT REGIME: EXPERIMENTAL EVIDENCE FROM GUJARAT AND HIMACHAL PRADESH, INDIA

Chander Shahi [a] and **Shashi Kant** [b]

Abstract

The behavioral strategies of local community members to protect and conserve public forest resources were analyzed using experimental evidence by repeated plays of the Joint Forest Management (JFM) game. The experiment is designed as an n-person asymmetric game, having two types of heterogeneity among the community members. One is based on the behavioral strategy they follow in using the public forest resources – defectors, cooperators, and enforcers – and other is based on their socio-economic condition – rich, poor, women, and landless. Field experiments were conducted in 38 villages of Gujarat and Himachal Pradesh states of India under four different treatments – no communication, face-to-face communication, light and heavy punishment to defectors and proportionate rewards to enforcers. It is found that both socio-economic conditions and treatments significantly influence the behavior of community members. Face-to-face communication and punishment of free riders is found to be an effective tool to maintain cooperation among all the community members for conserving forest resources. However, economically rich people are not deterred by increased vigilance and generally carry out large illegal removals of forest produce from the resource by equipping themselves better than the enforcers. The results of these field experiments are used to suggest two major policy interventions to sustain the efforts under JFM situations. First to direct the attention of policy makers to meet the subsistence needs of poor villagers, especially women and landless people, before they are expected to extend cooperation for conserving the common forest resources and second to equip the enforcers adequately so as to face the defectors.

***Keywords**: joint forest management, game theory, experimental economics, asymmetric payoffs, repeated games, heterogeneity among community members*

1. Introduction

A large population of local communities in developing countries is dependent on forests for their day-to-day requirements of fuel wood, small timber, fodder and other non-timber forest products. Hence, the exclusion of local communities from forest use is almost impossible, and exclusionary policies have been the main reason of deforestation and forest degradation in these areas (Pacheco, 2004). In the last two decades, many developing countries, including India (Kant, 1996, 2000, Kant and Berry, 2001), Nepal (Mathema, 2004), China (Xu *et al.*, 2004), Mexico (Klooster, 2000), Ethiopia (Gebremedhin *et al.*, 2003) and Cambodia (Marschke and Nong, 2003) have tried to resolve this problem by involving local communities in forest management, and these programs are known as Joint Forest Management (JFM), Co-manage-

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ment, or Community-Based Forest Management[1]. In India, two main features of these programs are (i) forest managers, normally state agencies, seek the cooperation of local communities in forest protection and forest management; and (ii) local communities are ensured, by forest managers, of a share in the final harvest of timber in addition to annual harvest of non-timber forest products and wages for their forest protection and management work. Researchers and forest managers have reported wide spatial and temporal variations, across different communities and different types of forests, in the outcomes of these programs (Baland and Platteau, 2003), but economic rationale behind these variations of outcomes has not been established.

The Ministry of Environment and Forests, Government of India, in tune with the philosophy of empowering people, had implemented the JFM program through a two tier decentralized mechanism of Forest Development Agencies (FDA) at the district level and Forest Protection Committees (FPC) at the village level. This decentralized institutional structure was supposed to allow greater participation of the community both in planning and implementation of the appropriate afforestation programs and protection of forest resources of the country. However, JFM programs have achieved varying degrees of success in different states in India. A number of researchers have analyzed the Common Pool Resources (CPR) programs considering the local community members as homogeneous, following the same behavioral strategy in using the resources. However, the rural communities, dependent on the forest resources for their everyday needs, have a variety of heterogeneity, which leads to different behavior of the community members in using the common forest resources. This is because the behavior of community members not only depends on material gains, but also on a set of non-material incentives from the resource (Crawford and Ostrom, 1995; Ostrom, 2000). Researchers have found that different types of heterogeneity in a group can hinder cooperation, reciprocity and trust (Ostrom, 1998; Varughese and Ostrom, 2001). The heterogeneity among the community members could be either due to their socio-economic status or due to their individual willingness to cooperate. Based on the socio-economic conditions, we divided the community members in four categories of rich, poor, women, and landless and based on their individuals' willingness to cooperate, we divided the communities among cooperators, enforcers and defectors.

In order to analyze the behavior of different community members, we developed an asymmetric game theoretic model, where the payoff of each individual depends on his own actions and on the action of others. The game theoretic models are based on *rationality assumption of the economic agents involved*. However, the rational economic agent-based game theoretic models have suffered from various limitations (Samuelson, 2002), because of the assumption of perfect rationality is not realistic. As a result, in recent years, emphasis of game theoretic models has shifted to learning and imitation portion of human behavior in economic analysis. The repeated plays of a game present a dynamic process where the players adapt their behavior through learning and copying successful strategies. The dynamic process provides the coordination device that brings beliefs into line with behavior through individual learning process; and views equilibrium as the outcome of an adjustment process, a realistic version of human interactions (Fudenberg and Levine, 1997; Samuelson, 1997). In short, large populations of “procedurally rational” players learn and imitate, copy successful strategies of others, and gradually discard unsuccessful strategies (Cressman *et al.*, 1998). In this research, we use

[1] Co-management programs of natural resources are not limited to developing countries. Some examples of co-management from developed countries are: Participatory Management in regional forest planning in Australia (Ananda and Herath, 2003), Community based forest management to improve forest policy in British Columbia, Canada.

repeated plays of the game to analyze the behavior of different individuals of a heterogeneous community.

Most of the CPR experiments relating to the behavior analysis of community members have been conducted in labs, where the subjects were university students and the results of these experiments were simulated to predict the behavior of local communities. Economists have predicted cooperation as equilibrium through these lab experiments (Axelrod, 1984; Ostrom, 2000) and also shown that self-governance can emerge and be sustained (Ostrom, 1990; Ostrom *et al.*, 1994). The experiments conducted in the real field situation by a few economists were, however, based on the assumption of homogenous communities and symmetric payoffs to the community members (Molinas, 1998; Cardenas, 2003). Molinas (1998) used empirical evidence by conducting field experiments in Paraguay and established a nonlinear relationship between cooperation and wealth. Cardenas (2003) studied the effect of poverty and social equality on group efficiency in CPR experiments by conducting field experiments in three rural villages in Colombia and found that the group efficiency improved with communication. To facilitate an understanding of the behavior of heterogeneous community members, we designed an asymmetric payoff matrix based on a game theoretic model and conducted field experiments in two states of India – Gujarat and Himachal Pradesh. These states have a large number of local communities dependent on forest resources and have constituted FPCs under the JFM program. These two states also represent a wide spectrum of socio-economic conditions of the local community members, depicting different situations of JFM program in India. We conducted repeated rounds of games under four different treatments – no communication, face-to-face communication between rounds, light punishment and heavy punishment for defection. Based on the results of our experiments, we suggest certain institutional and incentive structures that affect individual behavior. The policy makers need to consider these recommendations in order to secure cooperation of different individuals of the community for sustainable management of forest resources.

The theoretical model of the JFM game and the design of payoff matrix is presented in section 2. The details of field experimental design are given in section 3. Section 4 discusses the results of the field experiments conducted in 38 villages of Gujarat and Himachal Pradesh states of India and section 5 outlines the conclusions and suggestions for sustainable management of scarce common forest resources.

2. Theoretical model of Joint Forest Management Game

Joint Forest Management Game

JFM is a process of forest management in which representatives of a government agency (forest managers) reach an agreement with the representatives of local community with respect to protection and maintenance of a given public forest area. The agreement defines the rights and duties of both the players (the government and the local community). Generally, the local community receives: (i) a fixed share of the net value of timber harvest at the end of rotation period; (ii) right to collect all non-nationalized non-timber forest products (NTFPs) (such as fuelwood, fodder, edible berries and plants, wild mushrooms, medicinal and herbal plants); (iii) wages for community labor, towards protection and maintenance of the forest resource, from the government. The local community has a duty to practice self-restraint and not to resort to illegal harvesting of timber and over-exploitation of non-timber resources and keep a watch on the forest to protect it from outsiders. In case of community's non-compliance of its duties, such as illegal harvesting, the government collects fine from the community members on being caught. In addition, the government receives the remaining share of the net value of timber harvest at the end of rotation period and an annual return from nationalized[2] NTFPs.

Although the representatives of the community may sign the agreement and decide to cooperate as a group with the government officials for preserving and proper management of forest resources, individual members of the community may not cooperate depending on their economic conditions and social status. Therefore, in the JFM game, the members of the local community are divided into cooperators, defectors and enforcers and the payoff of each member of the local community is calculated based on her behavioral strategy as follows:

1. ***Cooperators***: They are the persons in the community who abide by the JFM agreement and do not resort to practices that are illegal under the JFM agreement. In turn, they get a share from the final timber harvest in addition to a proportional share from all the non-timber forest produce.
2. ***Defectors***: They are the persons in the community who do not abide by the JFM agreement and resort to illegal removal of forest produce that is not allowed under the agreement. However, on being caught, they are not given any share from the final timber harvest, but they cannot be excluded from community development activities because these activities are of public nature. Since collection of non-nationalized non-timber forest products is allowed under the JFM agreement, they collect those products as any other member of the community.
3. ***Enforcers***: They are the persons authorized by the forest protection committee (FPC), who act as watchmen and are responsible for the enforcement of the JFM agreement. They are paid wages for their work. Therefore, enforcers are the persons in the community who abide by the JFM agreement and are also responsible for enforcing the provisions of the agreement on the community by sanctioning the defectors. Each enforcer receives the same payoff as a cooperator. In addition, he gets a reward from the share of fines collected from the defectors, however, he has to bear a cost for sanctioning the defectors.

Suppose R_i is the annual payoff (net of labor cost) from illegal removals of forest produce from forests, R_f is the annual fine (value of forest produce and punishment for theft) paid by an illegal harvester if he is caught, and p is the probability of being caught by a forest manager which is normally very small. The net annual payoff of a person, who removes illegal forest produce from the resource, is $(R_i - pR_f)$. Further suppose R_t is the total annual payoff (an annual equivalent) from final timber harvest, R_n is the total annual payoff obtained from non-timber forest produce, R_w is the payoff of the enforcer from annual wages for protection and maintenance of the resource, R_r is the annual payoff of the enforcer from rewards, and R_c is the annual cost of the enforcer in sanctioning the defectors. The annual cost of the enforcer consists of two components – annual fixed costs (F_c) incurred by the enforcer whether he sanctions a defector or not and variable costs (V_c) per unit catch for extra time spent on catching and sanctioning a defector. Suppose s is the share of the community from the final timber harvest, a part of this share, s_1 is used for providing common infrastructural and other community development facilities to the community and the rest s_2 is equally distributed among the cooperators and enforcers. Further suppose that s_c is the proportion of the cooperators' population, s_d is the proportion of defectors' population and s_e is the proportion of the enforcers' population, such that $(s_c + s_d + s_e) = 1$. The annual payoff of each type of agent is given by:

[2] The state has a monopoly, in terms of collection and sale, over certain non-timber forest products such as Tendu leaves, and in the forest department's terminology, such non-timber forest products are known as nationalized non-timber forest products.

Payoff of a cooperator, $\pi_{c_i} = \frac{s_2 R_t}{(s_c + s_e)n} + \frac{R_n}{n}$, (1)

Payoff of a defector, $\pi_{d_i} = \frac{R_n}{n} + (R_i - pR_f)$, (2)

Payoff of an enforcer, $\pi_{e_i} = \pi_{c_i} + \frac{R_f s_d}{s_e} - (F_c + \frac{V_c s_d}{s_e}) + R_w$, (3)

where $\frac{R_f s_d}{s_e}$ = R_r is the share of reward of each enforcer.

The payoff from illegal felling of the defector, R_i depends on the extraction effort of the defector. The individual's benefits from a forest are increasing on one's effort of extraction of forest produce, but decreasing with aggregate extraction due to a negative externality imposed by the group causing reduction on public goods benefits from the forest. Player i's payoff from illegal felling, R_i can be expressed as:

$$R_i = (ax_i - \frac{1}{2}bx_i^2) + K\sum(x_{\max} - x_{others}). \quad (4)$$

Where *a, b* and *K* are strictly positive and depend on the type of the forest resource. We chose the following parameter values so as to match the scale of other payoffs: *a = 60, b = 5,* and *K = 20*. x_i is the effort exerted by an individual to illegally remove the forest produce from the resource, x_{max} is the maximum effort exerted by an individual and x_{others} is the effort exerted by other players for illegal removal of forest produce from the resource. The concavity of the function indicates diminishing marginal private returns to effort exerted in illegally removing forest products from the forest resource.

Payoff matrix

The game is played among five players (groups of players) and each player can choose an effort level of 0 to 5. The players who choose 0 effort level are cooperators as they do not apply any effort in illegally extracting forest produce from the resource. The players who choose effort levels 1 to 5 (1 is the minimum and 5 is the maximum effort in exploiting the forest resource) are defectors. They are punished and their payoffs are reduced in case they are caught by the enforcers. The enforcers get the same share as cooperators, in addition they also get a reward for catching the defectors proportionate to the cumulative effort applied by the defectors. Their payoffs are reduced by the cost incurred by them in catching the defectors, which is also proportional to the cumulative effort applied by the defectors.

For each village, we designed a payoff matrix for each person depending upon the production capacity (R_t and R_n) of the public forest resource of the village and the number of persons (adults) in the village (which represents 'n'). In the payoff matrix, the cooperator, who applies 0 effort in extracting forest products from the resource gets a proportional payoff from R_t and R_n as per equation (1). The defector who applies an effort from 1 to 5 gets a proportional payoff from R_n only. The defector gets an additional payoff from R_i as per equation (2). In case the defector is caught by the enforcer, the payoff of defector is reduced by (pR_f). The enforcer gets the same payoff as cooperator as she applies 0 effort, in addition she also gets a proportion of award from (pR_f). Her payoff is, however, reduced by a proportion of R_i, which represents the cost of sanctioning to her. All these proportions and parameters *a, b* and *K* are chosen to match the scale in calculations. The whole payoff matrix is then reduced by a uniform scale and presented in whole numbers, so that a villager can easily understand the numbers in it. A typical payoff matrix for a group of five players of a village is shown in Appendix – A.

In each round of the game, the payoff of each player depends on his own extraction effort and the extraction effort of other players in the game. This payoff is obtained by looking at my effort level in columns and the sum of all other players' effort levels in rows in the payoff matrix. For example, if a player applies an effort 2 and all other players apply an effort 4, the payoff of this player is 60, which is obtained by looking against the column of 2 of my extraction effort and against the row of 16 (=4x4, no. of other players x effort of each player) of their extraction effort; whereas the payoff of all other players is 69, which is obtained by looking against the column of 4 of my extraction effort and against the row of 14 (=1x2+3x4) of their extraction effort. The Nash equilibrium in this game is the effort level 5 by each player, which is obtained as the best response to the choice of all other players. However, the social optimum is obtained if all the players apply an effort 0, as it gives the maximum payoff to each one of them (If each player applies an effort of 0 each gets a payoff of 90, if each player applies an effort of 1 each gets a payoff of 81; if each player applies an effort of 2 each gets a payoff of 76, if each player applies an effort of 3 each gets a payoff of 71, if each player applies an effort of 4 each gets a payoff of 65, and if each player applies an effort of 5 each one gets a payoff of 59). The socially optimum payoff is, therefore, different from the Nash equilibrium payoff. It may not be realistically possible by the community members to apply 0 effort, as these communities are dependent on forest resources for their subsistence needs. It is, therefore, necessary to find out the conditions under which the community members apply least effort in exploiting the public forest resource.

3. Field experimental design

The JFM program has been initiated in almost all the states of India. We have conducted these games and collected data about economic and institutional factors that affect the behavioral strategies of members of the community from 24 villages in Gujarat and 14 villages in Himachal Pradesh states of India. These states have a large number of local communities dependent on forest resources and have constituted forest protection committees (FPC) under JFM program. However, in each state, different FPCs have achieved varying degrees of success with the JFM program. These two states represent a wide spectrum of socio-economic conditions of the communities dependent on forest resources. Therefore, these states have been selected as representative sample, depicting different situations of JFM program in India. There are 1734 FPCs in 26 districts of Gujarat and 914 FPCs in 12 districts of Himachal Pradesh (Govt. of India, 2005). We have randomly selected three districts in Gujarat (Sabarkantha, Dahod, and Vadodra) and two districts in Himachal Pradesh (Shimla, and Mandi), where JFM program has been implemented. In each of the selected districts, we have done stratified random sampling of the villages, based on prior knowledge whether JFM program has been successful or not in a particular village. We categorized people in each village as rich (annual income more than Rs. 50000), poor (annual income more than Rs. 25000 but less than Rs. 50000), women, and landless (annual income less than Rs. 25000 and does not own any land in the village). In each village, we conducted the game among five players – four of the players were rich, poor, women, and landless and the fifth player used to be from one of these categories. We found that in all the villages, the players sat in groups of rich, poor, women, and landless and played the game as a group and not as an individual.

Following experimental literature on the use of Common Property Resource experiments, we designed a decision-making exercise, where a group of five players use a forest resource for which there is joint access. Each individual (group of individuals), which represents the community members – rich, poor, women, and landless – makes a choice either to cooperate (exert an effort 0) or not to cooperate (exert an effort from 1 to 5) in the use of this resource. The net gains from choosing a particular individual effort in extracting forest products are read from the payoff matrix of Appendix – A. The game is repeated 10 times for each treatment – when there is no communication between the players, the players are allowed to communicate with each other before each round, a light punishment is enforced after some rounds (representing the probability of catch), and a heavy punishment is imposed after some rounds. In each round, each player allocates an effort in extracting forest products from the forest resource. The decision has to be made privately and individually, i.e. it will never be known to the rest of the group during or after the session. Once the players make their decision and write it on the game form, they hand this to the game organizer, who adds the total group's efforts, which he announces publicly. Knowing this total, each player will be able to calculate her payoff from my effort (column) and their effort (row). Each individual records her payoff in each round in the decision form. The game is repeated for 10 rounds. The players are then allowed to have face-to-face communication with each other before they take a decision in each round for the next 10 rounds. The organizer announces that each player exerting an effort from 1 to 5 is liable for light punishment which will be assigned at random for 3 to 5 rounds out of the total of 10 rounds (representing a probability of catch of 30% to 50%), whereas each player exerting 0 efforts is suitably rewarded. Finally, the game is repeated for 10 rounds with heavy punishment, which is also assigned at random for 3 to 5 rounds. The payoff of each player is again recorded in the decision form in each round. The punishment and rewards under these treatments are announced in advance.

4. Results of field experiments

The data collected by field experiments is analyzed using analysis of variance (ANOVA) using the following linear model.

$$y_{ijklm} = \mu + S_i + D_{(i)j} + V_{(ij)k} + E_l + T_m + SE_{il} + ST_{im} + DE_{(i)jl} + DT_{(i)jm} + VE_{(ij)kl} + VT_{(ij)km} + ET_{lm} + \varepsilon_{(ijklm)}$$

where

- Y_{ijklm} – the effort applied by an individual of a community of the kth village within the jth district within the ith state, having lth economic status under the mth treatment
- μ – the grand mean
- S_i – the fixed effect of the ith state
- $D_{(i)j}$ – the random effect of the jth district within the ith state
- $V_{(ij)k}$ – the random effect of the kth village within jth district of the ith state
- E_l – the fixed effect of the individuals having lth economic status
- T_m – the fixed effect of the mth treatment
- SE_{il} – the fixed interaction effect of ith state and lth economic status
- $DE_{(i)jl}$ – the random interaction effect of jth district within the ith state and lth economic status
- $DT_{(i)jm}$ – the random interaction effect of the jth district within the ith state and mth treatment
- $VE_{(ij)kl}$ – the random interaction effect of the kth village with the jth district within the ith state and lth economic status
- $VT_{(ij)km}$ – the random interaction effect of the kth village with the jth district within the ith state and mth treatment
- ET_{lm} – the fixed interaction effect of the lth economic status and mth treatment.

The higher order interactions are considered insignificant. The ANOVA results for the above linear model are shown in Table 1 below:

Table 1. Results of analysis of variance

Source	df	Sums of Squares	Mean Squares	F-ratio	Prob
Const	1	2213.16	2213.16	492.73	0.0002
S	1	0.72	0.72	0.16	0.7151
D	3	13.48	4.49	1.27	0.3002
V	33	116.57	3.53	6.86	≤ 0.0001
E	3	5.61	1.87	0.83	0.5116
T	3	169.07	56.36	31.95	≤ 0.0001
S*E	3	5.31	1.77	0.78	0.5331
D*E	9	20.35	2.26	1.40	0.1985
V*E	99	159.88	1.61	3.14	≤ 0.0001
S*T	3	13.12	4.37	2.48	0.1275
D*T	9	15.88	1.76	1.45	0.1758
V*T	99	120.10	1.21	2.36	≤ 0.0001
E*T	9	6.87	0.76	1.48	0.1531
Error	333	171.48	0.51		
Total	607	1137.82			

The ANOVA table shows that among the two way interactions, "Villages and Economic Status" and "Villages and Treatments" have a significant effect on the amount of effort applied by an individual to illegally remove the forest products from the public forest resource. Among the main effects, villages and treatments have a significant effect on the amount of effort applied.

Fig. 1 shows the average effort applied by individual community members for different treatments. The effort applied for illegal extraction of forest resource is the maximum when there is no communication or fear of punishment among the community members. This is because, when there is no communication among community members to conserve the com-

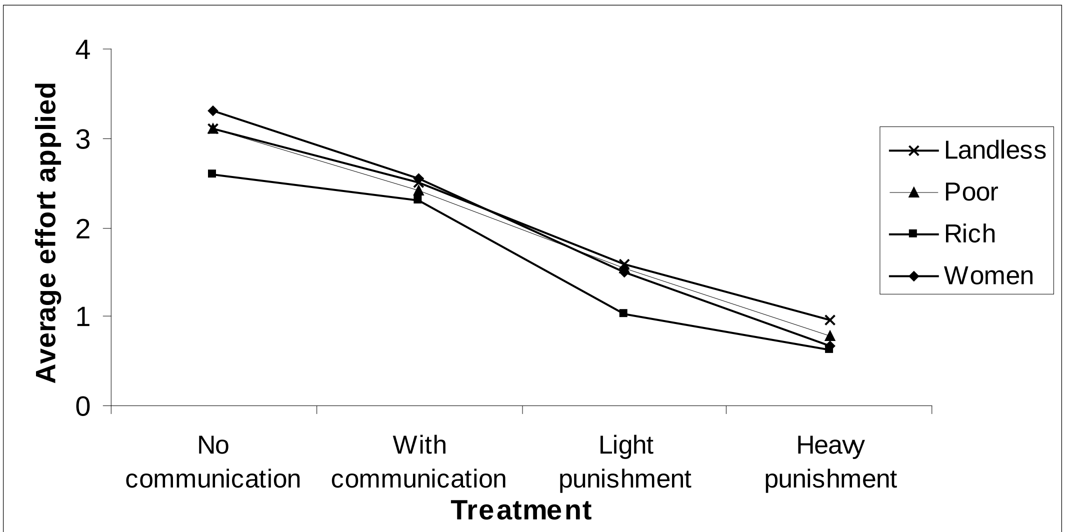

Fig. 1. Average effort applied by community members for different treatments.

mon forest resource, each individual tries to maximize her own private benefits from the resource without bothering about the negative externality imposed on others. However, women, poor, and landless groups apply much higher effort as compared to rich people in extracting forest products from common forest resources. This is because women are primarily responsible for collecting fuel wood and some edible non-timber forest products from the forests to meet the subsistence needs of the family. In addition, it also shows higher dependence of poor and landless people on common forest resources as compared to rich people.

Fig. 2 shows a comparison of the interstate average effort applied by the community members. The comparison of the two states revealed that average effort applied by people in Gujarat is much higher than in Himachal Pradesh without and with communication among community members. This is because of the higher socio-economic status of villagers in Gujarat as compared to Himachal Pradesh. It was also evident from the fact that some villagers were using cooking gas instead of fuel wood and had enough production of fodder for their cattle from agricultural fields. However, the amount of effort applied by individual community members is higher in Himachal Pradesh than Gujarat under treatments of light and heavy punishments. This indicates that people are more law abiding because of fear of punishment in Gujarat than Himachal Pradesh.

The results of 10 rounds of the JFM game with communication indicate that the average effort applied by villagers in using common forest resources in each village decreases with communication. In these rounds, the villagers were allowed to have face-to-face communication with each other before each round. It was also noticed that the economically rich people apply lower average effort as compared to other groups under the treatment of face to face communication. Although women and landless people reduced their efforts with communication, they continued to apply higher average effort as compared to rich and poor people in exploiting the forest resources. The treatment of communication is similar to the situation where the villagers sit together and form a Village Forest Protection Committee (FPC) and discuss the implications of over exploitation of the common forest resources. Although individuals are still tempted to apply higher efforts for over exploitation of the resource, the committee tries to convince them about the long term implications of their actions. Communication is based on the premise that individuals in a community always have some common shared val-

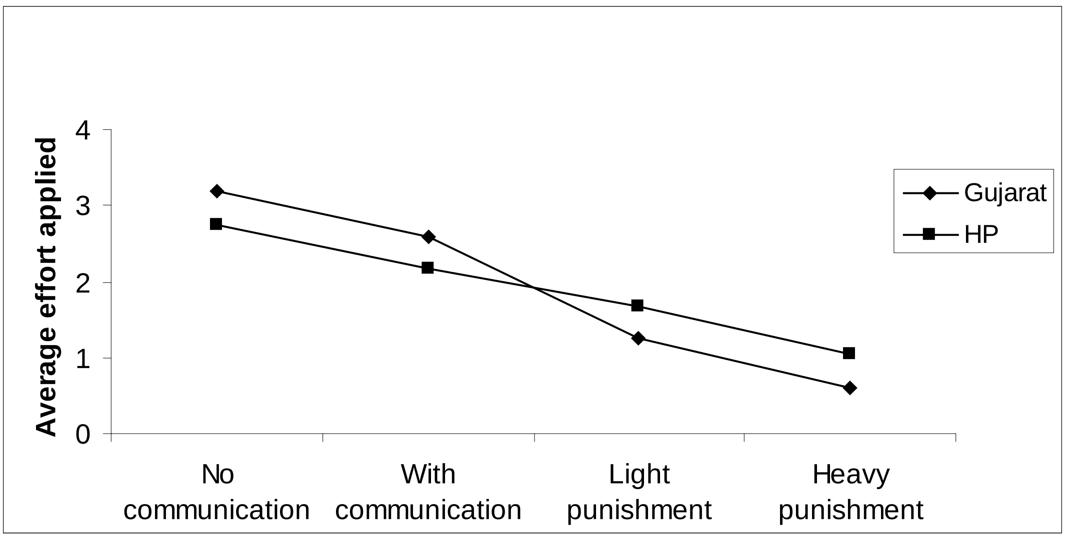

Fig. 2. Interstate comparison of average effort applied by community members for different treatments.

ues and norms. Communication uses these values and norms to establish trust and reciprocity, which are the key triggers of cooperation (Ostrom *et al.*, 1994). The results of our experiment are consistent with most experimental evidence in public goods and common property resource (CPR) lab and field experiments (Axelrod, 1984; Ostrom, 1990; Ostrom *et al.*, 1994; Molinas, 1998; Ostrom, 2000; Cardenas 2003). Axelrod (1984) and Ostrom (2000) predicted cooperation as equilibrium through lab experiments and had also shown that self-governance can emerge and be sustained. Molinas (1998) and Cardenas (2003) used empirical evidence by conducting field experiments in Paraguay and Colombia respectively and found that the group efficiency improved with communication.

A comparison of the results of effort applied by different individuals for treatments of no communication and face-to-face communication between rounds indicates that higher percentage of people reduced their effort after communication than the percentage of peoples who increased their effort or who did not change after communication (Fig. 3). It was also noticed that women outnumbered all other groups in reducing their effort after communication. They were able to better comprehend the long term consequences of depletion of forest resources and as such applied lower effort in exploiting these resources. These results show that face-to-face communication has a strong impact on mobilizing people to cooperate and preserve the common pool resources.

When the treatments of light and heavy punishment for defection are introduced between rounds, everybody takes a calculated risk for defecting. Since the punishment is associated with a probability of being caught, the defectors only lose if they are caught but receive a high pay-off if they are successful in illegally removing the forest produce. The treatment of light punishment is similar to the situation where the FPC appoints watchmen for protection and maintenance of the forest resource. These watchmen are chosen from the members of the community and are assumed to always cooperate. The treatment of heavy punishment is similar to the situation where the watchmen are also assisted by the Forest Guards, who are generally much better equipped and trained to catch defectors. It was observed that all the individuals/groups further reduced their average efforts under these treatment as compared to the treatment of communication, indicating that people cooperate more under threat of punishment.

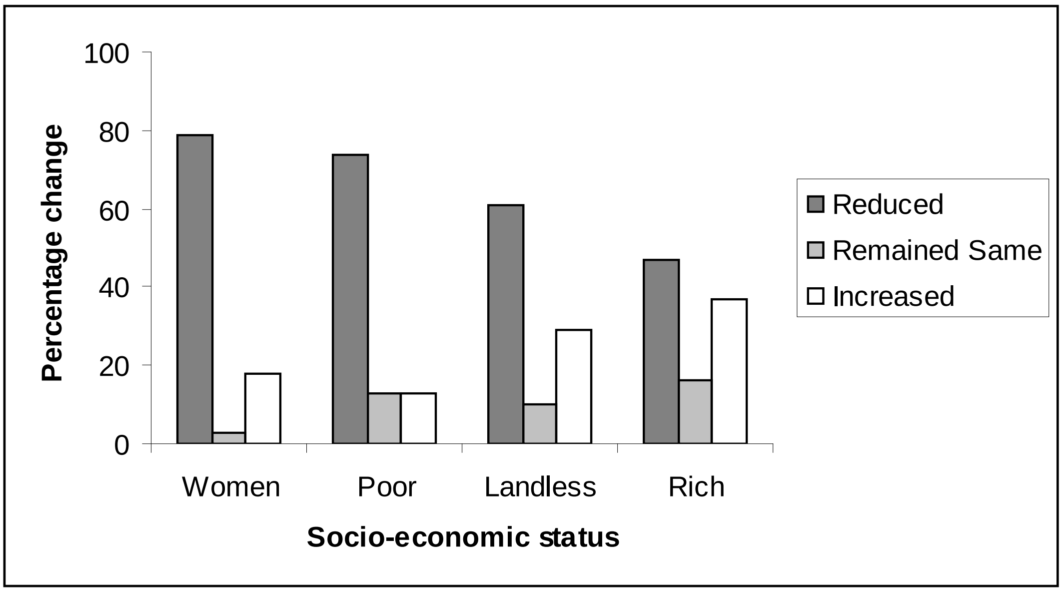

Fig. **3**. Percentage of community members who changed average effort after communication.

These results are similar to those of other researchers found in the experimental lab. Ostrom *et al.* (1994) studied the effects of costly punishment in a repetitive common pool resource game conducted in lab. They also found that there were material incentives for cooperation under the treatment of punishment, since the subjects could develop an individual rapport as they interacted with the same group again and again. Fehr and Gachter (2000) have shown that in the presence of punishment opportunities, there will be less free riding in the context of a public good experiment. The externally imposed regulation increases the private cost of over extraction and, therefore, reduces the incentives for free riding. However, there is an associated social cost of enforcing such regulations. Therefore, policy makers usually evaluate the capacity of enforcers to enforce the rules to achieve socially optimum behavior. Fig. 4 shows a comparison of the average effort applied by individual community members for different probabilities of catch. A comparison of the average effort applied by individuals for different probabilities of catch under the treatments of light and heavy punishments indicates that all the groups, except economically rich people, lowered their effort levels with increase in probability of catch. The rich people of the community are not deterred by the increase in vigil of the FPC but in fact equip themselves better to carry out defections on a larger scale.

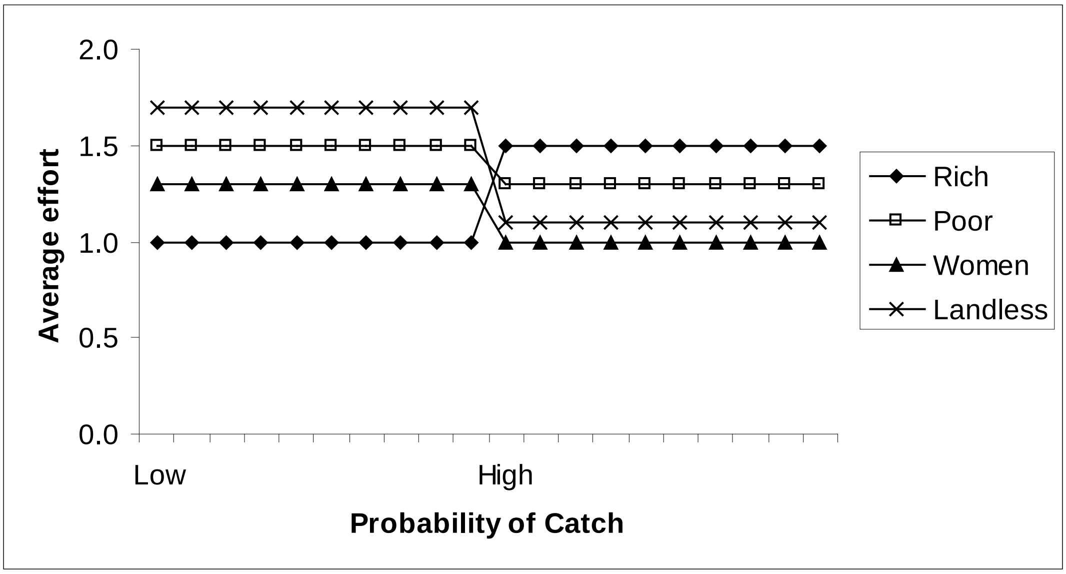

Fig. **4**. Effort applied by individual community members for different probabilities of catch for the treatment of light punishment between rounds.

5. Conclusions

This paper uses field experiments, based on game theoretic models, conducted in two states of India – Gujarat and Himachal Pradesh – to analyze individual behavior of community members using common forest resources. Most of the research related to the behavior of community members using common property resources considers these communities as homogeneous. However, the community members do not behave as a homogeneous group in reality and they want to maximize their private payoffs, without bothering much about the externality imposed on others while exploiting these common resources. The heterogeneity among different community members could be due to their socio-economic status – rich, poor, women, and landless – or due to their behavioral strategies in extracting forest products from the resource – cooperators, defectors, and enforcers. In addition, the non-material incentives also affect individual behavior. The last few decades of experimental economics have converged to the idea of humans having a utility function where factors beyond pure selfish material gains play an important role in economic behavior of agents. Therefore, the behavioral strategy of each individual or group of individuals in using the common property resource is different from each other.

In order to analyze the behavior of community members in using common forest resources, over repeated plays of the game, field experiments were carried out under four different treatments – no communication, face-to-face communication between rounds, light and heavy punishment with different probabilities of catch – were considered. We found that face-to-face communication and punishment of free-riders leads to cooperative behavior on the part of local communities. These results are similar to those of other researchers under lab settings that self-governed solutions can emerge and succeed (Ostrom, 2000). Although full cooperation cannot be achieved and maintained under any of the treatments, it is possible to reduce and limit the extraction effort of local communities so as to protect and sustainably manage these forest resources. It is also observed that the behavioral strategy of different groups of people is also different. This depends more on the social condition and economic status of the individual groups. For example, in the villages of Gujarat and Himachal Pradesh, women have the primary duty of collection of fuel wood and fodder from the forest resource; landless and poor people do not have access to any resource other than common forests to collect fuel wood, fodder, and small timber for their daily needs; whereas economically rich people of the community are not so concerned about the availability of fuel wood or fodder from the resource but they consider it mainly as a source of timber and use it for income generation. We also studied the effects of changing the probability of catch under light and heavy punishment treatments. It is observed that all groups except rich people decrease their effort with increase in vigil for protection of the forest resource. The rich people are not deterred by the increase in vigil by the village forest protection committee and they in fact equip themselves better to carry out the defections on a larger scale. Based on the results of these games, we find that each group should be treated separately by identifying their needs so as to secure their cooperation in the management of common forest resources.

The results form these experiments also support the idea that tragedy of commons is not always the best prediction when a group has joint access to a resource, and that people cooperate in the use of common forest resources if they are ensured of their subsistence needs and then communication and externally imposed regulations play a role to achieve a cooperative behavior. The results also suggest that it may not be possible to achieve a social optimum extraction effort due to the dependence of community members on these natural resources for their daily subsistence needs. However, it is observed that cooperative behavior evolves under certain institutional conditions, which is better than Nash equilibrium based on self-regarding maximization of payoffs in a non-cooperative game. There is a need to pay careful attention to the role that preferences play in human behavior when designing institutions, and the needs of the individual groups to create trust and reciprocity to reduce the probability of free-riding by others. The government (forest managers) needs to build trust among community members by first ensuring them their subsistence needs. This could be done by starting some income generation activities like forming self-help groups of women, providing employment to landless for protection and maintenance of forests and engaging them in collection of non-timber forest produce so that they can become economically independent. In addition, the policy makers need to tackle defections with a heavy hand by equipping the enforcers better to deal with the defectors. A limitation of this study is that it does not consider other regarding behavior of the community members. It needs to be explored through more field experiments that how much individual gains people are willing to sacrifice to maintain the capacity of ecosystems to provide multiple benefits to the society. This can help frame policies for sustainable management of public resources and solve CPR dilemmas by relaxing the strong assumptions of maximizing private payoffs by individuals.

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Appendix – A Payoff Matrix for five players

		My Extraction Effort					
		0	1	2	3	4	5
Their Extraction Effort	0	90	89	92	95	97	100
	1	88	87	90	93	95	97
	2	86	85	88	91	93	95
	3	84	83	86	89	91	93
	4	82	81	84	87	89	91
	5	80	79	82	85	87	89
	6	78	77	80	83	85	87
	7	76	75	78	81	83	85
	8	74	73	76	79	81	83
	9	72	71	74	77	79	81
	10	70	69	72	75	77	79
	11	68	67	70	73	75	77
	12	66	65	68	71	73	75
	13	64	63	66	69	71	73
	14	62	61	64	67	69	71
	15	60	59	62	65	67	69
	16	58	57	60	63	65	67
	17	56	55	58	61	63	65
	18	54	53	56	59	61	63
	19	52	51	54	57	59	61
	20	50	49	52	55	57	59

DO ALTERED PRICES AND LOGGING COSTS FOR LOGS OF SMALL DIAMETERS AFFECT THE OPTIMUM ROTATION OF NORWAY SPRUCE IN MOUNTAINOUS REGIONS?

Hans A. Jöbstl[a]

Abstract

Rotation as the planned average production period of a management unit within the age-class system, and as a central control value for the forest enterprise, has always been a key factor of forest sustainability. It determines, for instance, growing stock, timber yield, tree dimensions and economic success. As a consequence of changes in sawmilling technology, price relations between dimensional assortments of Norway spruce, which is Austria's most abundant tree species, have altered in favour of low diameter logs at least for medium and low quality timber. This trend has been accompanied by advantages in the efficiency of fully mechanized timber harvesting technology for smaller dimension timber in particular.

As early as in the 1990s a first comprehensive analysis of possible consequences of these changes for the rotation period of highest income from the forest came to the conclusion that shortening the rotation period would not be recommendable. A more recent study was designed to consider also the changes of the past 15 years and compare the results with those of the former study.

For calculating the net income excluding costs for harvesting (Contribution margin I) and silvicultural measures (Contribution margin II), the stand development and stand valuation program FOWISIM was applied. The timber prices used were based on forest statistics and expert consultations. Newly available timber harvesting productivity models (Stampfer, 2001) were integrated into the simulation model. The consequences of changes in the rotation period (decrease, increase) for the sustainability of the enterprise (felling quantities, growing stock, finances, etc.) are demonstrated by means of the dynamic transition model FOBSI.

The results of the first study have been fully confirmed. There are only small differences between the net income values around the maximum value, which offers a wide range of two or three decades for the choice of the rotation. The development of price relations for dimensional assortments and harvesting cost relations tends to reduce the optimum length of rotation, while a decreasing timber price level increases the optimum rotation period. However, the changes of the factors investigated during the last two decades were so small that they do not give any reason for decreasing or increasing the rotation period.

Keywords: *Norway spruce, rotation period, economic models, simulation*

1. Introduction

The forest rotation period has always been a key factor of forest sustainability. The management unit model and the rotation period are well-established instruments to secure sustainable timber yield. Diverse criteria have been discussed – mostly controversially – to resolve the issue of the optimal rotation period. Depending on the chosen objective criterion varying results have been found. The integration of financial factors in addition to the timber quantities e.g. costs and revenues into the calculations highly complicated the computations.

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The diversity of factors and influencing variables requires the assistance of simulation models and calculation aids – particularly the normal forest model, the target forest model and the dynamic transition model in conversion situations of the real (uneven) management unit.

At the end of the 1980s new considerations emerged based on the developments in timber markets (new processing technology for logs of small diameters, changing logging cost- and assortment price-relations). Variant studies by means of stand and management class models showed respectively proved that under mountainous conditions actual changes in price relations of diameter classes can not give reason for a decrease of the rotation period (Jöbstl, 1991, 1992a,b, 1997). To cover also the recent development of timber prices and logging costs in the past 10 to 15 years an update-study was implemented (Blaha, 2006). The findings confirmed the results of the former study: long rotation periods are to be preferred in mountains areas especially due to the transition problems.

The production period or rotation

The Rotation is the period which elapses between the formation of a wood and the time when it is finally cut over. It is the first factor affecting the yield. Under clear felling systems it may be an exact and definite period. Under other systems it represents only the average life of each wood in the forest. Within the age-class system it is the planned average production period of a management unit. Under the Selection System it will be the average age at which individual trees reach the diameter or girth required by the objects of management.

Varying types of rotation are recognized, according to the policy to which effect has to be given. These are the (1) Physical Rotation; (2) Silvicultural Rotation; (3) Technical Rotation; (4) Rotation of the maximum volume production; (5) Rotation of the highest income; (6) Financial Rotation (Jerram, 1935, Osmaston, 1968, Speidel, 1984).

The *Physical Rotation* is that which coincides with the natural lease of life of the trees. It is only of importance in park lands and protection forests.

The *Silvicultural Rotation* is the rotation most favourable for natural reproduction. If reproduction is by seed from a shelter wood it may depend not only on the effect of age on the production of a sufficient quantity of fertile seed, but also on the effect produced on the soil conditions by the varying density of the leaf canopy at different ages. For example, with a light-demanding species, unless advantage is taken at an early stage of the production of seed, a growth of weeds may render regeneration very difficult. In the case of coppice the rotation must be below the age at which the trees cease to produce healthy coppice shoots when felled.

The *Technical Rotation* is that under which the forest yields the most suitable material for a special purpose or results in the production of timber of a size which permits of the most economical conversion.

The *Rotation of the Maximum Volume Production* is the rotation at which the mean annual increment (M.A.I.) culminates.

The *Rotation of Highest Income* is the rotation that yields the highest average net income. This rotation is also known as the rotation of the highest forest rental. It should be noted that no regard is paid to the amount of capital used in earning the income.

The average net annual income or rental (F_r) obtained from a stand of trees is expressed by the formula:

$$Fr = \{Y_r + \sum T_r - C - \sum e\} / R,$$

where Y_r is the net money value of the final felling, T_r is the net value of all thinnings during the rotation, C is the cost of formation of the stand, e is the annual cost of administration during the rotation and R is the rotation.

The *Financial Rotation* is defined as that rotation which is 'determined by financial considerations, e.g. that yielding the highest interest'. A simpler but nevertheless wide definition is: 'the rotation which is most profitable'. In the current context the words 'most profitable' must imply the greatest financial profit or advantage which requires an assessment of the monetary gain, derived from the investment made in the activity. But even that concept can be combined in more than one way in forestry. Two approaches may be mentioned: (a) *The expectation value of the land*, i.e. the value based on the net income which it is expected will be obtained from it and calculated at a selected rate of interest; (b) *The financial yield* - i.e. the rate of interest, or mean annual forest percent, which the forest enterprise yields on the money invested in it.

2. Presentation of the problem

At the beginning of the 1990s problems with sales of logs of large diameters emerged in the market and more and more smaller assortments were requested. The consequence was the shift of price relations towards logs of small diameters. Does that imply a change to the production of logs of small diameters in shorter period of time respectively can the supply-demand-problem be solved in the short- or medium-run through the decrease of the rotation period? Which long-run consequences of a change in rotation with regard to sustainability have to be kept in mind? These and other issues are to be studied with the help of model studies.

Actual situation in Austria

- Norway spruce makes up about 60 % of the Austrian forests, predominantly in mountains.
- Longer rotation periods (80-150 years) and, therefore, logs of larger diameters are usual.
- There is excess of old timber and logs of large diameters, respectively.
- In practice, 80 % of spruce forests belong to the age class system – in spite of new silvicultural concepts (e.g. selection forest) and conversion efforts. Conversion will still take many decades.
- Roundwood price levels are declining.
- The demand for logs of small diameters is rising – as a consequence the *price relation between diameter classes* is changing in favour of logs of smaller diameters (Fig. 1).
- *Logging cost-relations* have changed due to modern logging practices (Fig. 2).

3. Methodology

Studies of variants using stand-growth models (calculation of the result parameters growing stock, increment, timber revenue, etc. – on a quantity and a value basis) and calculations on a normal forest basis.

$$E = f\,(x|z)$$

(x|z) as input is to be transformed into output E with the help of the Model ***f***.

Input is characterized by the relevant influencing factors, data (z) and action (x) parameters. Output (E) is determined by the evaluation criteria.

Factors affecting the rotation

The rotation period is affected by a variety of factors. The consequences of the following influencing factors are to be analyzed:

- yield tables (growth areas)
- yield class (site productivity)
- logging conditions
- stand treatment
- red deer forest damage
- costs for establishment of stands
- transition probabilities (calamities, preterm final cutting)
- assortment price profile
- "standard deviation" and "diameter interval"
- level of prices, and
- level of costs.

The most decisive factors are, besides species and site, price level, price relations, and cost functions.

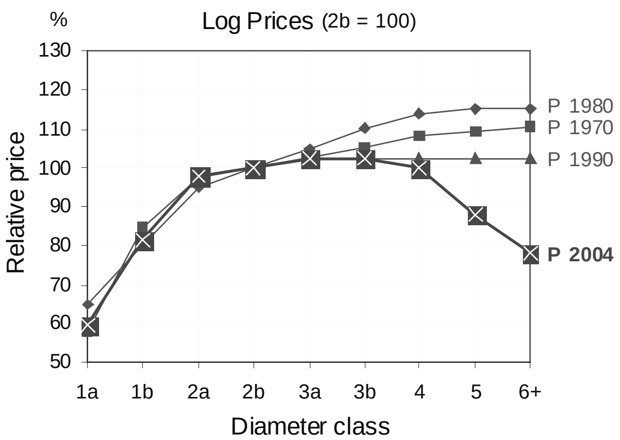

Fig. 1. Log prices by diameter class in 1970, 1980, 1990, 2004.

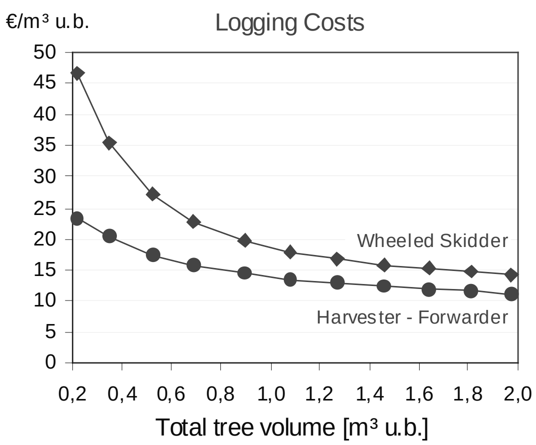

Fig. 2. Logging costs as a function of diameter.

Evaluation criteria

Evaluation criteria are to be derived from the objectives and are reflected in the different types of rotation. The maximum net income is primarily of interest, in connection with the following criteria:

- timber yield
- net income
- volume of growing stock
- asset value
- target diameter
- sustainability of states and results.

The question for the maximum of a goal criterion (e.g. net income per hectare) can be studied on the level of the normal forest management class.

Simulation models FOWISIM and FOBSI

For the calculations both simulation models FOWISIM and FOBSI are available. FOWISIM and FOBSI have been described in detail in literature (see e.g. Jöbstl, 1995, 1997).

FOWISIM is a calculation model for deriving economic indices on stand-growth and allows normal forest management class oriented computations. It consists of several modules (stand development, assortment calculation, harvesting cost calculation, etc.) and delivers besides stand and management class oriented values the input parameters for FOBSI (Fig. 3).

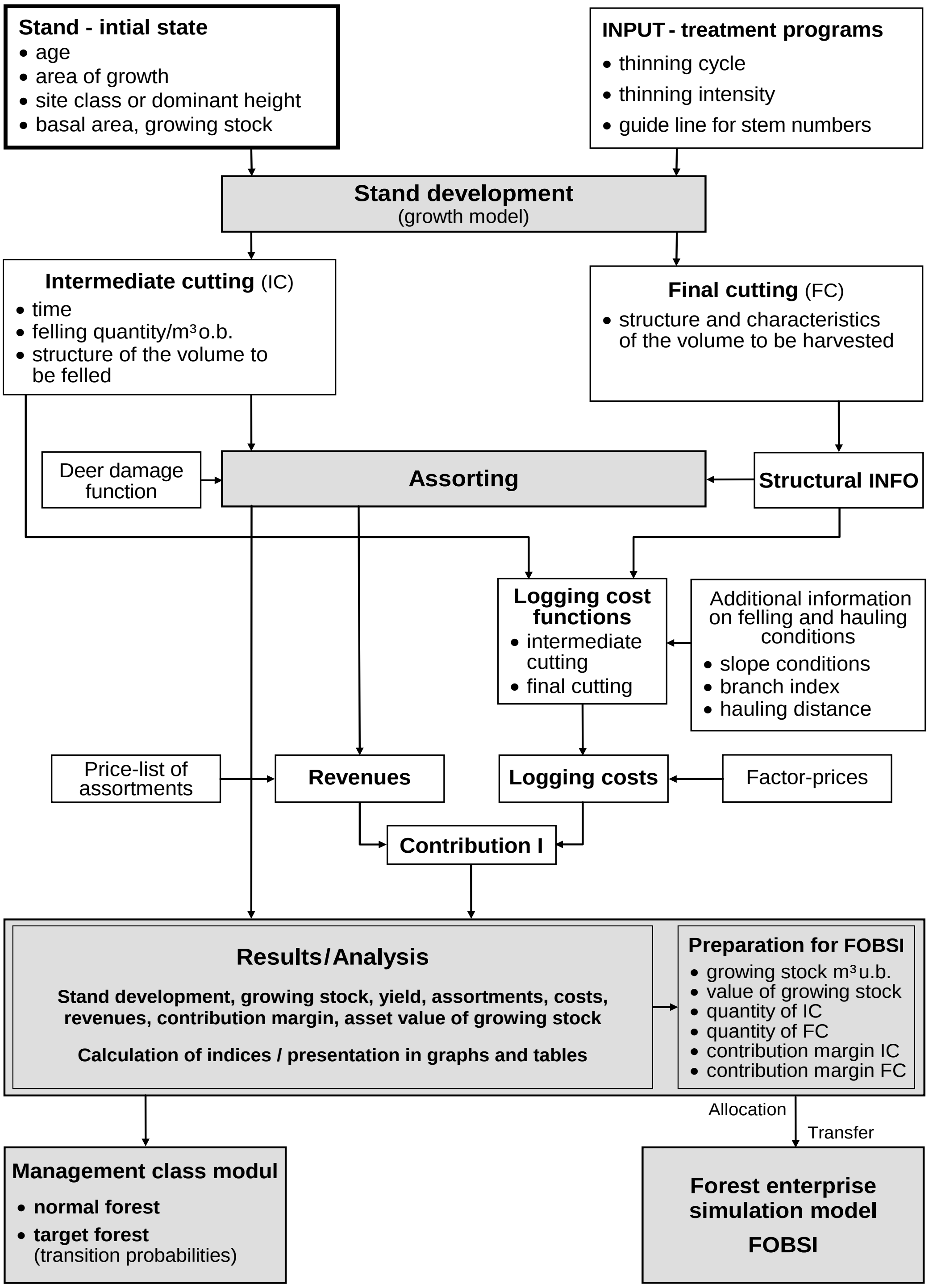

Fig. 3. Outline of the model system FOWISIM.

FOBSI is a model to display the development in the long-run of a management class respectively of a real enterprise, it also provides support for the sustainability planning and control, for forest asset valuation, etc. Basically, it consists of a *module for inventory*, a *strategy module* and a *module for updating*. The management strategies (set of activities) together with a time controller and growth models change the present state of the management class in the direction of the (final) target state. So, FOBSI presents the transition from the actual to the target state (e.g. from longer to shorter rotation periods and vice versa).

Conversion problems

Questioning or challenging the rotation period entails *transitions*, changes from one state to another, as well as consideration of time lapse (duration) = dynamic development => model simulation.

The fundamental problem of an increase respectively a decrease of rotation in view of sustainability is outlined in Fig. 4.

Two schematic examples will be shown:

- reduction of the rotation period from 120 to 80 years
- increasing (extending) the rotation period from 80 to 120 years.

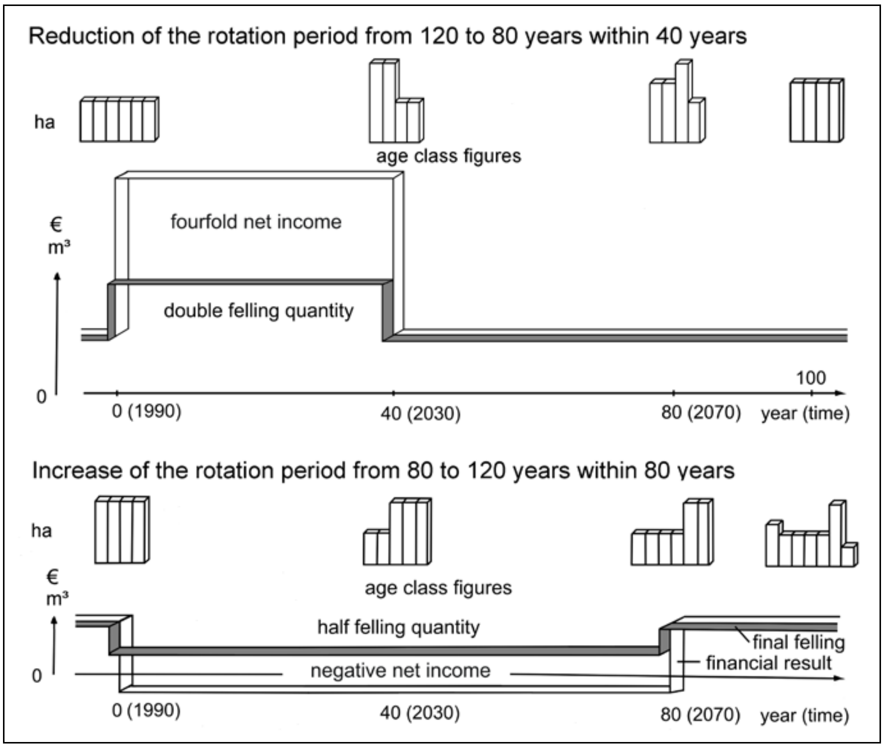

Fig. 4. Schematic presentation of a change in rotation period. Course of age-class-structure, final felling quantity and financial result in case of reduction/increase of rotation period for 40 years.

Decreasing the rotation period means multiplying the owners income and reduction of old timber reserves. Re-inclination (re-increase) is almost impossible.

Model studies can prove that it is relatively *easy to reduce* the rotation period (and thereby the growing stock); but *the return to longer rotation periods* demands long-term renunciation of revenues and it requires a lot of time.

3. Results

In the following a selection of results out of the large number of examined variants will be presented. These are:

- 3 variants of price levels
- 2 variants of logging practices (logging costs)
- 2 variants of price relations.

Each of them will be displayed for 2 or 3 different yield classes (5, 9, 14) and illustrated by the following criteria:

- average contribution margin/ha/y
- increase of contribution margin/ha/y.

The maximum of the curves represents the optimum rotation period of the highest income. In all cases it is above 100 years, at lower yield classes no maximum is reached in the examined interval from 60 to 150 years.

The different roundwood price relations show almost no effects at the optimum (Fig. 5).

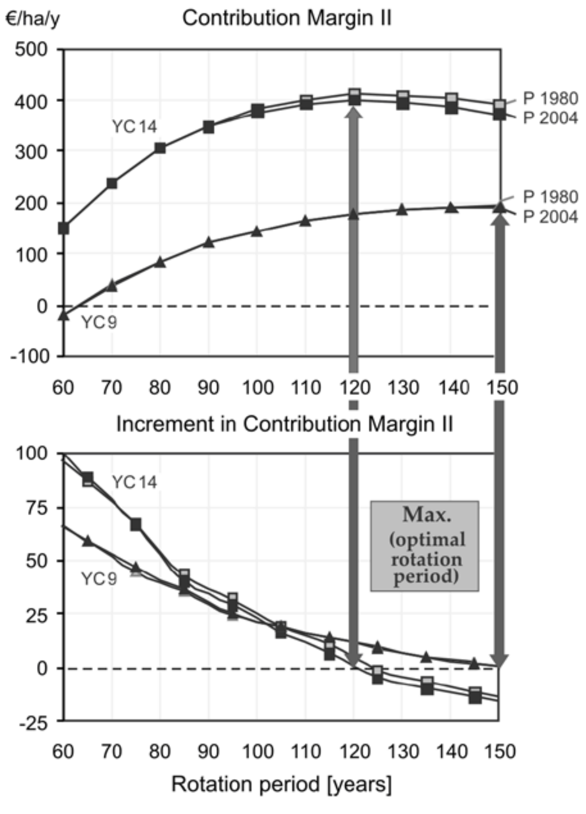

Fig. 5. Two variants of roundwood price relations, yield classes 9, 14, prices 1980, 2004.

The roundwood price level affects the break-even point by 10-20 years, but has hardly any effect at the optimum (Fig. 6). Yield class 5 – in one Fig. also yield class 9 – just reach a positive value at a rotation period of 80 or 70 years, respectively, where they intersect with the zero line (break-even-point).

Similarly, the effects of logging costs at the maximum are low (Fig. 7); a little bit higher in steep terrain, where cable yarding is used. The arrival at the break-even point is affected by 20 years.

- Almost all examined factors show some effects on the length of the rotation period of highest income. Yield class and area of growth come first, followed by deer damage, level of fixed costs and absolute price level.
- Differences are most distinctive in the range of the break-even point. However, effects of the altered assortment price- and logging cost-relations are relatively low.
- Value differences in the range of +/– 20 years around the maximum are relatively small so that the optimum rotation period can be chosen within a scope of 20-30 years.
- A further decrease of the rotation in the direction of production of logs of small diameters can not be concluded from the computations.

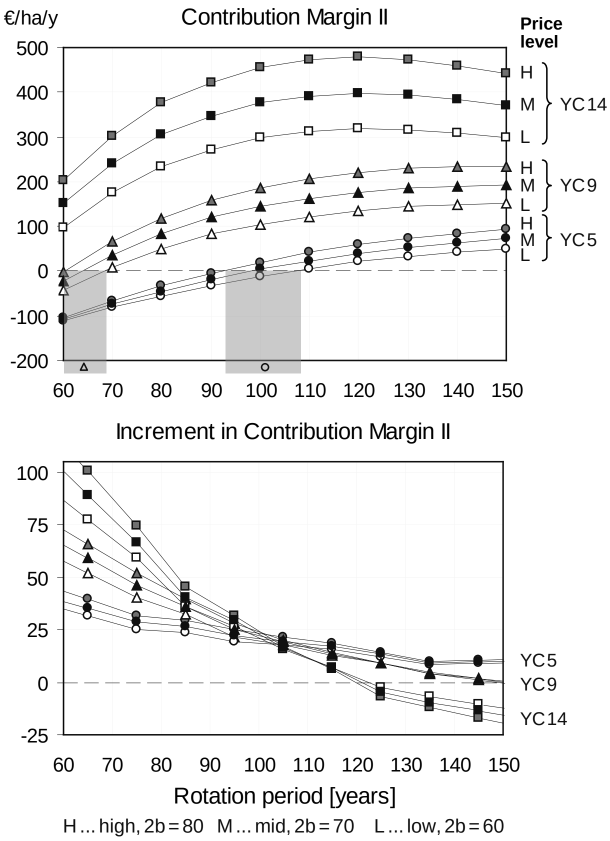

Fig. **6**. Three variants of roundwood price level, high, mid, low, yield classes 5, 9, 14.

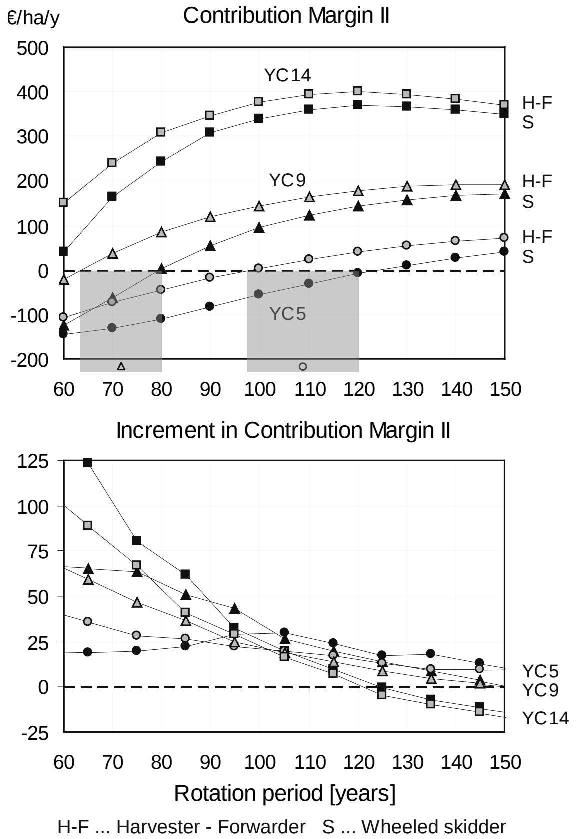

Fig. **7**. Two variants of logging costs, yield classes 5, 9, 14.

Capital invested and internal rate of return

Growing stock and its asset value rise with the length of the rotation period.

If the owner strives for maximum profitability of the capital tied up to timber growing stock, for example, significantly shorter rotation periods will be the result. E.g., the internal rate of return of the realizable (harvestable) timber growing stock at yield class 14 reaches the maximum of 3.9 % already at 80 years, whereas it falls to 2.5 % after 120 years and to 1.7 % after 150 years. In yield class 9 the maximum interest rate is higher (8.1 %) but it is not reached before 90 years and falls to 2.3 % after 150 years.

An increase of rotation by 1 year from 80 to 81 years in yield class 14 results in an interest rate of the capital tied up to timber growing stock of 0.96 % p.a., the increase from 120 to 121 years delivers only 0.07%. However, a decrease of rotation to 80 (YC 14) and 90 (YC 9) years, respectively, will reduce the mean annual income by one-third (YC 14) to two-thirds (YC 9).

Conversion situations

The problems arising from conversion for the sustainability of the entire enterprise have already been mentioned and illustrated schematically. Fig. 8 shows extracts of the results of the calculations with FOBSI illustrated by the criteria of growing stock, asset value of growing stock, felling quantity and contribution margin.

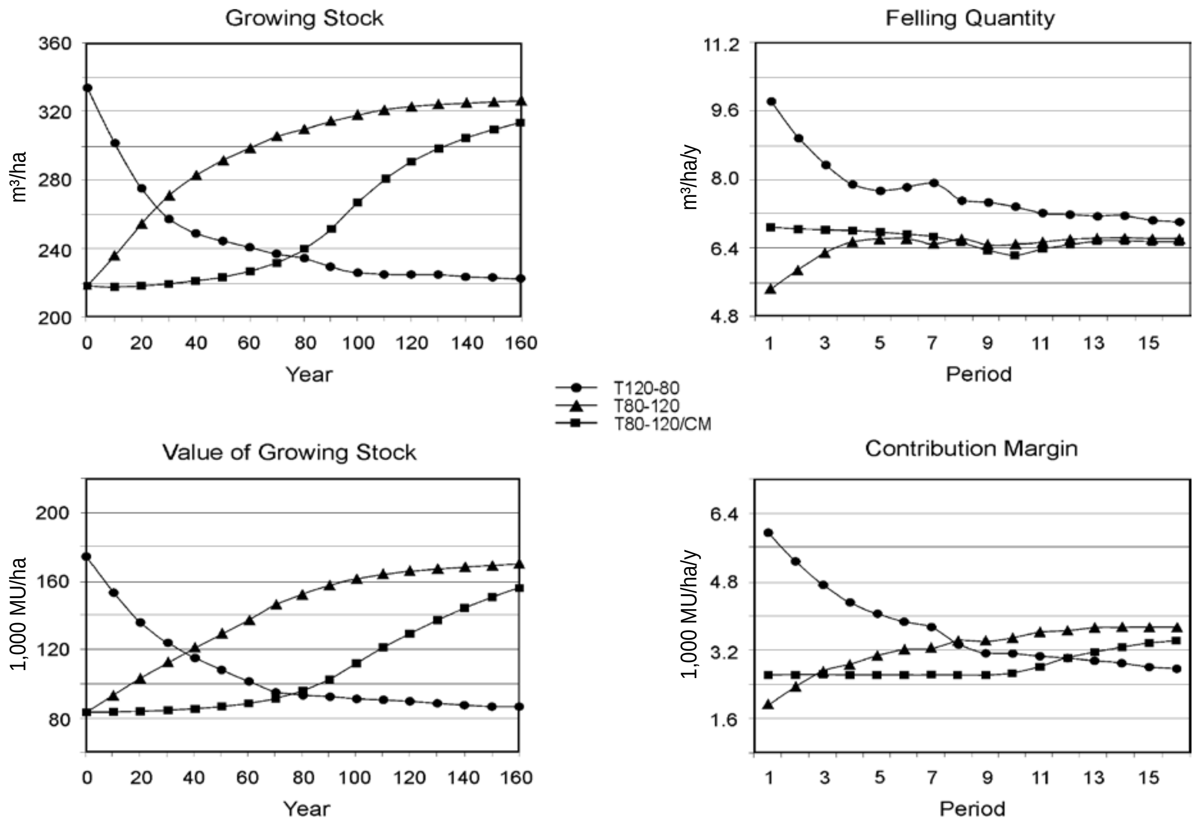

Fig. **8**. Computation of change of rotation period with FOBSI: Variants showing a reduction of rotation period from 120 to 80 years [T120-80] and an increase from 80 to 120 years [T80-120]. Variant [T80-120/CM] contains a prescribed minimum of contribution margin II. *(Graphs: volume of growing stock, value of growing stock (forest assets), felling quantity, contribution margin).*

For the forest owner a **decrease** in rotation is most convenient and advantageous in the following 30-40 years (high additional revenues through reduction of the growing stock). However, it would be extremely difficult and inconvenient to **increase** rotation again in case of a higher demand for logs of large diameters in the future.

The arrangement of the transition period is especially difficult when simultaneously assuring sustained yield. As a consequence of introducing a *prescribed minimum of contribution II in Fig. 8 (Variant T80-120/CM)* a re-increase of rotation would take significantly longer.

4. Conclusions

The calculations confirm the results of the study of the 1990s and show that changes in logging cost relations do not have much influence on the rotation period of Norway spruce under mountainous conditions either.

The main findings are summarized below:

- Recent changes in price relations of diameter classes do not justify changes in economic rotation periods. However, in the short- and medium-run, improved adaptation to the market, more customer-oriented differentiation in bucking, sorting, classification and lotting, and finally, in the pricing, are to be recommended.

- A decrease of the rotation period in order to increase the supply of logs of small diameters would be counterproductive under current market conditions (difficulties with logs of large diameters!). The consequences would be an excess supply of logs of large diameters and a further decline in prices. Therefore it is advisable to wait until new technologies in timber processing are available. With regard to the adjustment possibilities the much shorter cycle of technological innovation has to be kept in mind. The forest enterprise with its (long-term biological) production cannot react to (medium-term) technological changes in timber processing in the short- and medium-run. However, as mentioned above, forest enterprises can in the short-run adjust their actual cut, within certain limits, to changing demand situations.

- In order to increase the supply of logs of small diameters other measures have to be taken, e.g. intensification of thinning afforestation of less productive agricultural land, etc. so as to comply with the wish of a Styrian timber industrialist for "young pink piglets” (meaning high-quality timber of small diameters). An excess supply of logs of small diameters can only be regulated via the market price.

- Obviously, as the current market price does not offer a sufficient stimulation, a higher domestic supply of logs of small diameters is either not really demanded or the Austrian forest sector cannot compete internationally with logs of small diameters. Such supply would have to be ensured – if considered economically necessary (to meet the needs of the timber industry, intensify forest thinning) – by taking external control actions (subsidies; price support for logs of small diameters from thinning; taxation).

- The main influencing factors point at longer rotation periods. In mountainous areas logging costs are the dominant factors. The law of mass per piece makes long rotation periods necessary! Also recent observations showing that current increment in higher age classes is considerably higher than the yield table values point into this direction. The same result is derived from the higher production risk of short rotation (higher proportions of stands such as plantations and pole crop are susceptible to damage; no nature-oriented regeneration; fewer reserves, less growing-stock; more serious effects of damage and calamities) and from the increasing demand for infrastructural services (even if there exist no revenues for forest enterprises yet).

- For the sake of risk spreading by diversification in forest enterprises it is still advisable to consider short rotation periods for part of the acreage. However, in enterprises that practice sustainable forest management this part should not exceed 20-50% of the area, depending on the size of the enterprise, its geographical position, natural site conditions, etc. The transition has to be planned holistically in the long-run – by means of development simulation. It has to be kept in mind, however, that a decrease of the rotation period is much easier to put into practice than an increase.

- The current problem with logs of large diameters is certainly not primarily a question of planned high rotation periods, but rather the consequence of *unscheduled over-maturation*. Therefore, it is not the *planned value* of the rotation period that has to be revised, but the actual forest management (production period), which has to be adjusted more closely to the (planned) rotation period.

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Session 2. Forestry in transition

GLOBAL FOREST COMPARISONS: DEVELOPING A FOREST INDEX FOR THE YALE ENVIRONMENTAL PERFORMANCE INDEX

Lloyd C. Irland, **Tiffany Potter** and **Daniel C. Esty**[a]

Abstract

Monitoring progress toward SFM at a national level is an emerging level of international concern. The release of the FAO's 2005 Global Forest Resources Assessment provided an updated dataset for analyzing the world's forest estate. Several groups of analysts have employed this dataset to understand various aspects of forest change. The Yale Center for Environmental Law and Policy is one of them. In past years, the Center has developed a Yale Environmental Policy Index, collaboratively with Columbia University and others. In 2007, the Center is releasing its Pilot Yale Forest Index, which will integrate data-based comparisons of forest conditions into its next revision of the Environmental Policy index. This Index is one of many efforts to supply numerical indexes to enable cross-country comparisons of many kinds of variables. They are used, for example, in assessing progress toward the millennium Development Goals, and can be applied for other purposes as well. This paper summarizes the process employed, and lessons learned about cross-national comparisons using this kind of data, and highlights major conclusions.

***Keywords**: Yale environmental policy index, country comparisons, sustainability, global assessment*

Monitoring progress toward sustainable forest management at a national level is an emerging level of international concern. The release of the FAO's 2005 Global Forest Resources Assessment provided an updated dataset for analyzing the world's forest estate. Several groups of analysts have employed this dataset to understand various aspects of forest change. The Yale Center for Environmental Law and Policy is one of them. In past years, the Center has developed a Yale Environmental Policy Index, collaboratively with Columbia University and others. Environmental health and ecosystem vitality are gauged using 25 indicators tracked in six policy categories: Environmental Health, Air Pollution (effects on ecosystems), Water (effects on ecosystems), Productive Natural Resources, Biodiversity and Habitat, and Climate Change. The EPI utilizes a proximity-to-target methodology focused on a core set of environmental outcomes linked to policy goals. The 2008 EPI includes 149 countries based on data availabil-

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ity. The EPI process also includes comparisons of indexes and components for a range of country peer groups, by region, income level and other categories.

In 2007 and 2008, the Center revised its Forest Index, which adds a data-based comparison of forest conditions into the 2008 update of the Environmental Policy index. This Index is one of many efforts to supply numerical indexes to enable cross-country comparisons for many kinds of variables. They are used, for example, in assessing progress toward the Millennium Development Goals, and can be applied for other purposes as well.

To develop the Forest Index, the group reviewed regional systems of Criteria and Indicators for sustainable forestry, and sought advice from a number of experts. An extensive effort was made to assemble data on a short list of preferred indicators, including forest area change, the balance of growth and cut, adjusted for illegal logging, and the percent of forest area in reserves. On review of the data, it was found that for many countries the information required was not reliable. As a result, it was decided to employ a more simplified approach relying on estimates of forest growing stock to serve as an indicator. It is recognized that even this dataset has weaknesses for many countries. It was necessary to estimate growing stock change from regression data to provide and estimate for 22 of the 149 countries included.

The forest biome also appears in the EPI indexes for conservation performance, developed using sophisticated data bases by The Nature Conservancy. In those indicators, the purpose is to depict how well major biomes are protected as reserves to conserve natural processes and biodiversity.

Another source of cross national comparisons is the WWF's Living Planet website, which provides useful graphic summaries and data. The Report is updated annually. It compares biological capacity to human demands, and finds that the earth has been overshooting carrying capacity since the late 1980's. Comparative data are provided (from the same sources) for more than 100 countries. A Forest Footprint is estimated by comparing a nation's consumption of wood products to the average productivity of an average global acre of forest.

We believe that efforts to develop cross-country comparisons of environmental performance are valuable in calling attention to environmental conditions and trends, motivating nations to improve their policies, and identifying weaknesses in our knowledge of such conditions. It has been gratifying to find that each successive revision of the EPI has been met with increasing worldwide public and scientific attention.

The most important result of this effort was to learn how weak the information is on the globe's forests. In preparing for the 2010 Assessment, the FAO has obtained funding to provide for a major campaign of remote sensing to refine forest area and other data. We must hope that this effort is fully funded and successful. Certainly, until national data on forests can be improved, there will be little scope for Criteria and Indicators systems to indicate trends in sustainability of forest management.

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ECONOMIC TOOLS OF ECOLOGICALLY SOUND FORESTRY IN CONTEXT OF SUSTAINABLE DEVELOPMENT IN UKRAINE

Pavlo Kravets[a]

Abstract

Economic tools for ecologization of forestry are proposed to classify on the basis of influence value: “potent”; “medium”; “soft”. “Potent” tools be characterized by direct effect at the management system and providing economic limitation and sanctions.

Combination of groups of economic tools determines direction and character of the economic development for a country at least: technogenical; weak sustainability; strong sustainability. Existing legislation of the country provide the possibility for formation of sets and combinations of economic tools enough for guarantee of weak sustainability. However analysis of its actual state are evidenced low level of efficiency and development. Most part of the actual tools conducts compensation and fiscal functions which do not promote forming motivation for ecologization in forestry. Principal reason of this situation is absent market transformation in forestry. Capacity building of the supporting institutional structure, limited liberalization of the governmental regulation system, increase of ecological responsibility for the natural resource users should accompany development of market system.

The main directions for establishment of economic tools are: stimulation of the development of a market for environmentally sound goods and services; creation of a system for ecological crediting, financing and allotment; differentiation of the tax legislation under sustainable development principles; redistribution of the tax duty from common taxes to special payments and fees for the natural resources use and pollutions.

Creation of the economic tools for ecologization of forestry should be supported by the development of an adequate ecological management system, transformation to environmental sound forestry in operations and implementation system of regulation ecological capacity of a territory.

***Keywords**: Economic tools, forestry, forest policy, ecologization*

1. Introduction

Forestry activity traditionally is considered as directed to regeneration and multiplication of forest resources and useful properties of forests, i.e. improving abilities of forests to reduce negative results of nature phenomena, to protect soils from erosion, to protect environment from pollution and to clean environment, to regulate water flows, to improve human health (Zakon Ukrainy, 2006).

Negative results from wrong strategy of nature resource use on the global level have caused urgent demand in ecologically sound production as inalienable part of sustainable development conception. Ukraine like other European countries has negative consequences of forest resources use which are deterioration of productive and ecological functions of forests, reduction of high conservation value forests, decrease of biodiversity.

Different types of forest policy tools are proposed for implementation. Ukraine relies mostly on mandatory tools which are common for a country in transition. Despite of activities to implement tools with economic character, total efficiency of the forest policy tools is decreasing.

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The aim of this investigation is to analyse ecological conditions of Ukrainian forests, classification of economic tools for forestry ecologization, assessment of their efficiency according to the principles of sustainable development and making proposals for their improving and development.

2. Background and methodology

2.1 Material studied and methodology approach

Material studied was state statistical and forestry reports, which describes the ecological state of forests of Ukraine. Criteria of ecological state were selected under the next approach: verifiability; simple estimation and interpretation; long term usage and continuity. In accordance with above mention criteria only state forests which were managed under the State Forestry Committee umbrella were analyzed. It is more than 65% of all forests in Ukraine. It allows data collection and analysis for a span more that 50 years.

Legislative and normative documents were analyzed that form the frame of economic tools for forest policy. Methodology of research was based on a use of general methods of analysis, synthesis, system analysis and expert assessments. As a basis for theoretical investigations a system approach to analysis and interpretation was used.

2.2 About definition of "ecologization"

Mishenin (1998) rightly notes that the issue of rational use of forest resources in most cases is considered in the context of rational forest harvesting: increasing volume of valuable assortments from felling; minimizing impact on understory vegetation etc. For example in forest harvesting the following types of ecological damages are common: damage of forest soils, damage of vegetation, pollution of environment and infringement resource getting (Vrublevska, 1995). Systematic character of interaction between human and environment demands complex and interregional approach to solving problems of harmonization of social and economic development and saving biosphere-reproductive quality of the environment. Ecologization not only in forest harvesting, that is considered as main destructive reason for forest systems condition, but in reforestation becomes actual question now (Koval *et al*., 2002).

There is not a common theoretical and methodological approach regarding ecologization of substance production among scientists, and that is natural taking into consideration complicated and diverse aspects of this issue. From our point of view, *ecologization* should be understood as a process of continual and consecutive improvement and implementation of systems of technological, organizational, managerial and other decisions that allow to increase efficiency of natural resource use, guarantee at the same time the high quality of the environment on the different levels of social production.

3. Results and discussion

3.1 Ecological state of forests in Ukraine

Imperfect strategy of forest harvesting stipulate for forming "planting-harvesting" agricultural approach in forest management. Reductive and schematic decisions, that do not take into consideration the whole complexity of managed object, led in particular to worsening of sanitary condition of forests, anthropogenic transformation from natural to semi-natural and artificial forests, decreasing of biodiversity in forests.

One example of this approach could be a dynamics of ratio between share of clear and selective felling under final cuttings for period of more than half of the century (Fig. 1). Character of the investigated trend has more anthropogenic than natural reasons. Share of selective cuttings in final harvesting ranges within 5-20 percents with exception of 60th of last century. Despite the considerable increase in area of forest with multiple functions (protection, recreation, reserves etc.) the technology of main forestry operations, that have most influence on forest ecosystems, stays the same – clear cuttings. Increase in ecologically-oriented cuttings in 60th has no confirmations from natural regeneration in that period (Fig. 2). Conversely in this period maybe the biggest reduce of forest natural regeneration happened.

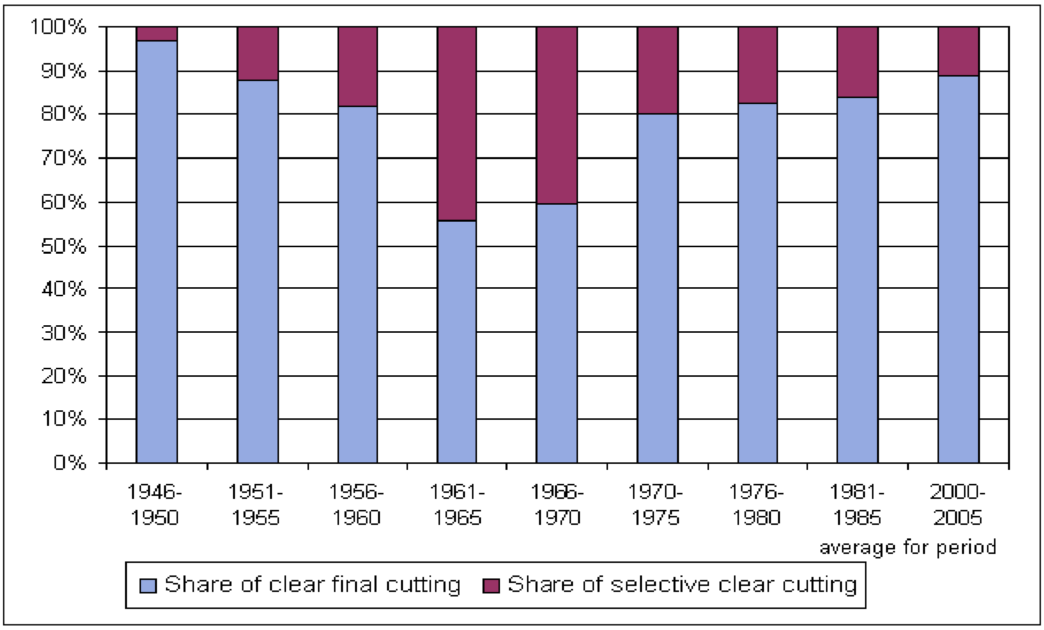

Fig. **1**. Ration of clear and selective cuttings in final harvesting.
Source: Materials from State Committee of Forestry.

Also in this period the share of timber that was harvested under final harvesting cuttings (in commercial forests) and intermediate cuttings was changed considerably: from 0.83:0.17 in 50th of last century to 0.44:0.56 in beginning of present one. This is indirect indication of re-orientation of timber harvesting from commercial forests to all forest stock independently from functional purpose of the forests. Additional evidence of this may be dynamics of share of sanitary cuttings in total timber harvesting, which in 50th of last century was 5-10 percent but in last years it stably exceeds 30 % level (Fig. 3).

Triple enlargement of share of sanitary cuttings is pointer on situation, which may be characterized as negative and extreme sanitary condition of forests. Low efficiency of measurement, that implements to improve sanitary condition, is proved by fact that in period from 80th of last century to present time the area of forests died from negative biotical and abiotical reasons and wildfires has increased also by three times. Thus fulfilling of sanitary cuttings means the liquidation of results but not prevention of the events that lead to worsening of ecological conditions of forests.

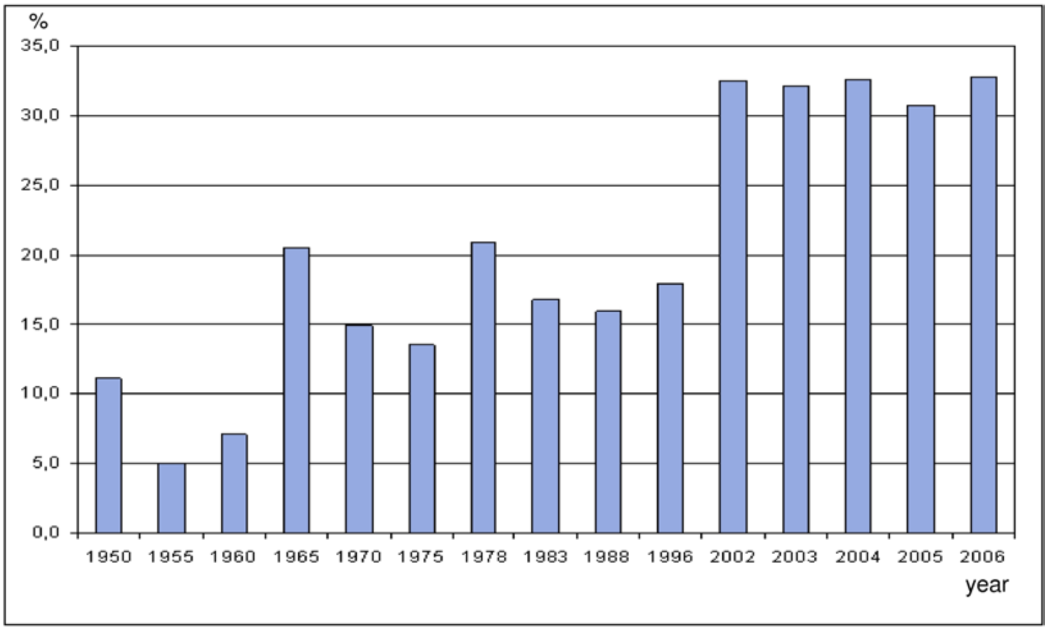

Fig. **2**. The dynamics of natural regeneration in forests of Ukraine.
Source: Materials from State Committee of Forestry.

It observes the graduate transformation of natural forests into anthropogenic ones through the replacement of forest stands of natural origin by forest stands of artificial origin. For period from 1940 to 2002 the share of planted forest has increased from 25% to more than 50% (Fig. 4). According to Popovich (2002) such replacement of many-dominant native forests by derivative mono-dominant planted forests with unstable cenosis structure has induced destruction of ecological ties, simplification of cenosis structure, decreasing floristic composition and led to a disppearance of rare species.

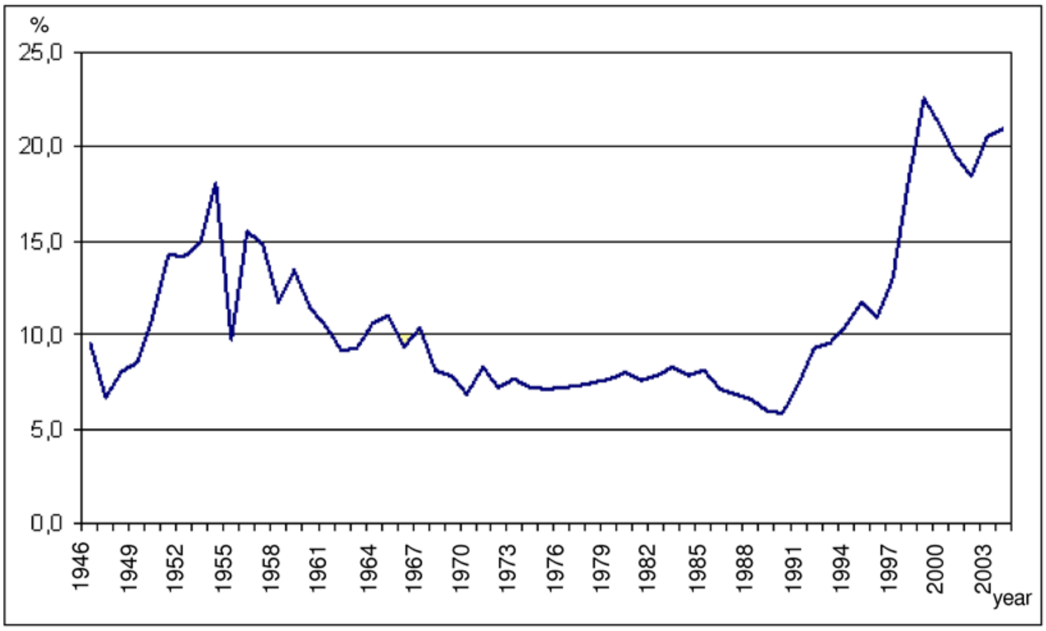

Fig. **3**. Share of sanitary cuttings in general harvesting structure.
Source: Materials from State Committee of Forestry.

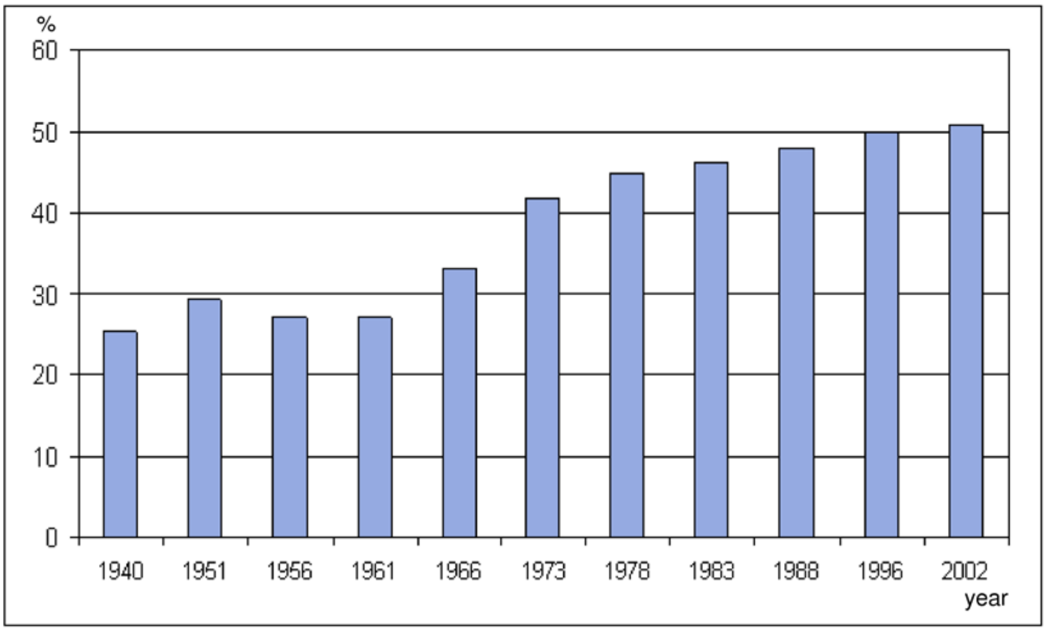

Fig. **4**. The dynamic of share of forests of artificial origin.
Sources: Materials of State Committee of Forestry and Forest Cadastre.

Confirmation of this is fulfilled evaluation of biodiversity in forests for the main part – tree layer. As you can see from Fig. 5, among the forests of artificial origin the main share (40%) is occupied by tree layers where only one species is presented, at the same time in forests of natural origin tree layers with two species (32%) is prevailed. In general forests of natural origin differ from artificial forests by a bigger share of tree stands where two, three, four and more species in composition are presented.

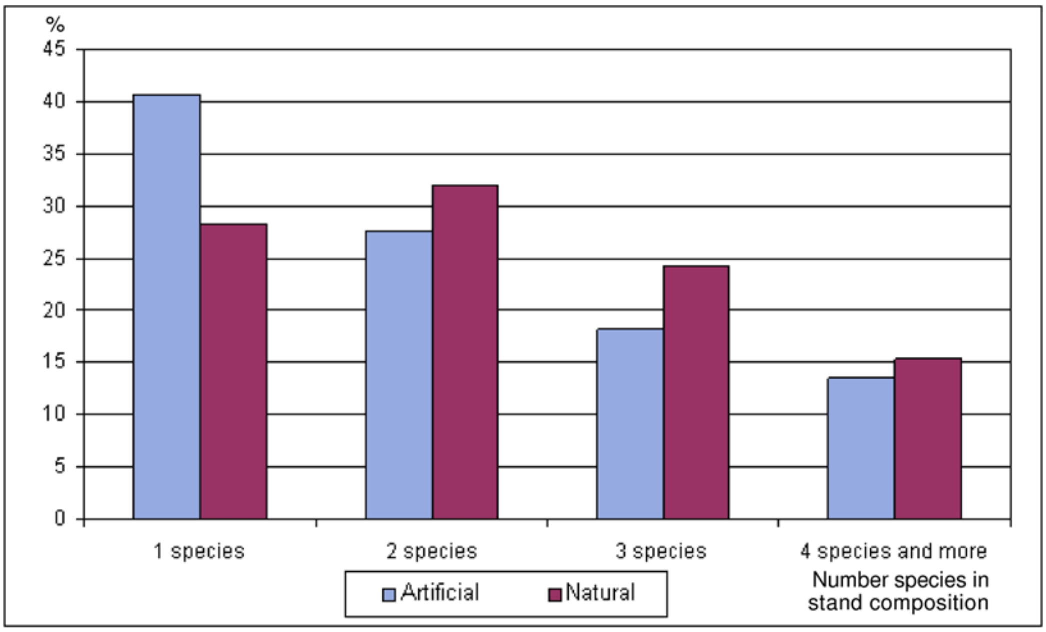

Fig. **5**. The characteristics of biodiversity in forests by number of species in tree layer composition. *Sources:* Database "Forest Resources of Ukraine" (actual at 01.01.1996).

3.2 Economic tools for ecologization of forestry

The preparation and making decisions regarding directions, character and intensity of ecologization of social production are under influence and in close interaction with such spheres of regulation like state, market, persuasion. State sphere is connected with intervention of executive management structures in the system of economic relations between producers and other subjects of nature use to achieve a row of social interests. Market system foresees the existence of mechanisms of self-regulation on the base of demand and supply of goods and services. Sphere of persuasion deals with development of mechanisms of taking into account interests of stakeholders. Last two spheres play insignificant role in forestry because of insufficient development of market and democratic institutions. Our argumentation concerning leading role of regulative spheres at the forming of the system of forest policy tools corresponded with classification in other researches. Merlo and Paveri (1997) classify the set of possible forest policy tools into legal-mandatory, economic-financial, market and persuasive. Mayers and Bass (1998) distinguished five main types of tools for implementation of forest policy: regulatory, economic/market; informational; institutional and contracts / agreements. Two above mention types closely connected with regulative spheres.

Forest policy tools can be identified in different ways concerning goals, priorities, main objects and strategy of its implementation. They are criteria which play a key role for identification and classification of forest policy tools. We proposed to divide all forest policy tools on two groups: economic and non-economic ones. Economic tools mean elements of impacting system at the economic linkage with the aid of limitation, sanction, motivation, stimulation and orientation and which is formed and implemented as a part of economic regulation system. To consider such peculiarities of forestry production like very long period of production of timber and other products and goodness of forest (from 40 to 120 and more years), insignificant part of material and people capital in creation of products of forestry, production of considerable amount of products and goodness that have non-market values, it is proposed to classify economic tools for ecologization of forestry according to size of influence on economic system: “potent”, “medium”, and “soft”. In its part significance of influence stipulates a character of tool action, time of respond of its action, defines an appropriate type of management system etc. (Table 1).

Table 1. The classification of economic tools for ecologization of forestry by size of influence

Influence	Action	Time of respond	Management system
Potent	Direct	Short-term	Crisis management
Medium	Direct and indirect	Medium-term	Operative management
Soft	Mediate	Long-term	Strategic management

Tools of “potent” influence are characterized by a direct action on managing system and assume establishing direct economic limitations and sanctions: fixed prices; export and import duties; compensation of environmental wastes, damages and losses. This group has limited use and is applied as logical continuation of administrative-control tools of forest policy. It is implemented, as a rule, in the system of crisis management, when the aim is an achievement of fast respond of economic system under conditions of inefficient and unsustainable nature use.

The group of tools of “medium” influence connected to creation of a system of incentives and motives for economic behaviour of economic subjects in medium-term strategy of ecologization and presented by traditional economic meanings: payments for special use of nature resources (stumpage fee); payments for environment pollution; crediting; funding; ecological deposit; fasted amortization. This group takes a significant part in a system of economic tools of forest policy, although in their practice the payments of special use of nature resources and funding are speeded.

„Soft" tools are means of impact that stipulate development of environmentally sound market of forest products and services: market system of tradable rights; forest certification. This group is connected with preparation and realization of long-term strategy of nature use, efficiency of which will be dependent on development of institutional structure for its support.

The combination of group of economic tools defines the direction and character of economic development of the state. The implementation of tools of mainly potent and medium influence defines technogenical type of economic development, for which "compensative" character of tools is resided. They are oriented more to compensation of negative results from economic activity than to prevention of their appearance. Domination of medium and soft tools of influence has caused the forming of type of economic development – "weak sustainability". For this type the "stimulative" character of tools is appropriate. It becomes apparent in simultaneous motivation of environmentally sound production and development of consume markets of ecology safe products and services. The combination of tools of potent and soft influence defines type of economic development as "strong sustainability". Strong sustainability distinguishes the type of tools in action that causes limitation for economic growth.

Current legislation of Ukraine provides possibilities for forming set and combination of economic tools that are sufficient for maintaining weak sustainability. Nevertheless analysis of their current development testifies their low level of efficiency and evolution. Majority of existing tools fulfil compensative and fiscal functions that do not help to form system of incentive and motives for ecologization of forestry production. For example, existing stumpage fee regulation (Postanova Kabinety Ministriv Ukrainy, 1997) allows use of 20 % discount rate connected to environmentally sound forestry only in single case – implementation of selective cuttings under final harvesting. Implementations of other technological and organizational measures do not impact on the fee structure of special use of forest resources.

New version of the Forest Code provides an economic stimulation in forestry only in the case of arranging measures for widening afforestation through the compensation of costs and faster amortization, when the issue of improving qualitative condition of forests is the most relevant.

It is a paradox, but the main reason of inefficiency of current system of economic tools for ecologization is absence of market transformation in the forestry. It corresponds with conclusion that reform process in forestry of Ukraine slowed down because of it almost came to a half (Nordberg, 2007). As it was mentioned before, the implementation of forestry measurements that are characterized by low economic and often ecological effects are common. Market conditions make impossible situation when spent costs will not be accompanied with getting of positive economic, social and ecological results from activity within the system of ecological restriction. Development of market relations should be accompanied by development of institutional structures for its maintaining, reviewing of role of state regulation from hard administration of state forestry system to limited liberalization in forestry relations, in particular through increasing share of market tools. This will mean redistribution of responsibility for management decision making from national to regional and local levels, improving their efficiency and flexibility, renunciation of implementation of inveterate and inefficient technological and organizational schemes in forestry production.

4. Conclusions

Main directions of development of economic tools in Ukraine should become: stimulating of development of ecologically-oriented market for forest products (forming of demand for certified products); creation of the system of ecological crediting, funding, provision and fastening amortization; differentiation of the system of tax legislation to take into account ecological aspects in forestry; redistribution of tax liabilities, resource payments and fees towards creating of the tax system based on natural resource rent value.

Proposed system of improvement of economic tools for ecologization may be realized in the case of its synchronization and adaptation with the separate management, technological and normative aspects of forestry.

Management aspect provides the transformations in the forestry system as a totality of economic measures that directed to forming of tree stands with given parameters before the implementation of frame principles for creation of integral management systems. They laid in the realization of management decision methodology on the basis of cycle “plan – fulfil – control – correct”.

Technological aspect of forestry improvement is connected to issues of transition from technical and technological solutions for minimization of impact on environment to the system of adaptive (ecology oriented) forestry, in particular: conservation of forest biodiversity; adherence to natural processes of forest ecosystem development; imitation of natural damages (mechanical injure of soil vegetation, regulated fires on the cut areas etc.).

Normative aspect is connected to conceptual issues of ecology norms. Each element norms of anthropogenic and technical pressure (maximal area of cutting, damage of under-canopy vegetation, limits for harvesting etc.) must be replaced by a system of complex norms of ecological capacity of the territory that takes into account cumulative, synergetic and other effects proper to dynamic nature systems.

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Session 3. Economic models in decision-making towards SFM

ECONOMIC MODELS FOR MANAGEMENT OF EVEN-AGED, UNEVEN-AGED OR IN-CONVERSION FOREST STANDS

Jean-Luc Peyron[a] and **Seyed Mahdi Heshmatol Vaezin**[b]

Abstract

The forest economic analysis is based on the models of biological, economic and social nature, and in particular, on three basic models which are the stand dynamic model, the price model and the decision model. Theses models are often calibrated for only one stand structure (even-aged or uneven-aged). However, because of changes in environment (global changes), in economy (energy prices), in human society (social expectations), the forest manager has more and more to manage stands that are in transition between even-aged and uneven-aged structures, and forests with stands of different structures. This is why it becomes necessary to model the management of even-aged, uneven-aged and in conversion stands, in the presence of catastrophic risk or not.

A first step of this approach studies successively the stand dynamic model, the price model and the decision model in risky situations and even or uneven-aged stand structures. It then articulates these models to constitute an overall theoretic model, suitable for applying, with the help of an adapted calibration, for various species on diverse sites. An example comes to illustrate the theoretical analyses in the case of the beech in the North-East of France and to give an idea of the potential results on the scales of the stand and tree. The illustrations on the stand scale consist in studying the case of the even-aged and uneven-aged stands, and the case of conversion, in presence or absence of risk. In order to show the interest of these combined models at the tree scale, an illustration relates to the economy of the tree, placed in various environments: different productivities, presence or absence of risk and different price-size curves.

One interest of this approach is in the will to take of growth modelling only what seems very necessary to the economist. Another interest consists in avoiding the classic dichotomy between even-aged and uneven-aged stand structures. This work makes it possible to carry out a certain number of progresses on integration of volume and value functions, on change of economic management scale (of tree to stand) and on uneven-aged, even-aged and in conversion stand management.

Keywords: *growth model, price model, price-size curve, Faustmann formula, rotation age, risk management, simulation, optimisation*

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SIMPLE MODELS TO IMPROVE THE INSIGHTS INTO THE EVALUATION OF EFFICIENCY IN FOREST PRODUCTION

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Abstract

The question of efficiency of bounded resources in the silvicultural (biological) production strikes a central question of forest economics, because it concerns the rationality in the forest business. In the past a large variety of economic decision criteria, such as the maximisation of the forest revenue or the soil rent, the land expectation value, the increment percent, Pressler's indication percent, etc. have been developed. Such decision criteria have to help decision-makers finding economically optimal or rational silvicultural treatments, but in Germany the forest practice is still confused by the variety of criteria, so that they are seldom used in forest management.

Using simple model calculations this paper tries to order the multitude of economical decision criteria by assigning them to various types of decision situations. Thereby the premises of availability of resources play a central role. These premises concern the scarcity of productive forest land as well as the shortage of capital funds. In this context internal restrictions such as sustainability have to be considered.

By means of actual examples, which demonstrate different decision situations in a very simplified way using Excel frames, the coherences between the premises and the various decision criteria are displayed to make them easier to identify and better interpretable. Using strongly simplified forest production models, varying the thinning intensity and the harvesting age and taking the restriction of sustainability into account, it is interesting that economic decision criteria, which consider scarcity of land and financial funds, can explain practical silvicultural decision behaviour in a suitable way.

By this means this contribution wants to show, that silvicultural principles and economical rationality are no antagonists, as it is supposed often in the German forest practice. On the contrary, commonly observed concepts of forest management can be interpreted and explained with rational economical means.

***Keywords**: Simple decision model, efficiency of the forest production, Excel calculations, restriction of sustainability*

1. Introduction

It will not lead to far to say that the forming of forest stands in an efficient way can be considered as the central task of forest management. But this task is not simple, as trees are not normal financial or industrial investments, which generate well definable benefits every year:

- Trees are natural objects (natural factors – like sun, rain, natural hazards – control their slow growth and survival or mortality).
- Trees are parts of dynamic systems (they interact with each other, they compete for nutrients, water and light and they also can aid one another, for example against wind).
- Trees are individuals (they have different genetic codes, individual differences in terms of quality, growth-rate, etc.).
- Trees are versatile useable (they can satisfy different human demands).
- Trees are long living (under normal conditions in Germany, between planting and harvesting, a period longer than the lifespan of a human being passes by with a lot of uncertainties).
- Trees are immobile.

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On the other hand almost every decision concerning forest management is associated with a capital budgeting. We have to spend quite a large amount of money to establish forest stands and within forest stands, quite a lot of capital is bound for very long times. Thus, efficiency is the claim of rationality and decision models are needed to support the forest management under this objective.

In forestry decision models on the basis of investment theory have a long tradition. But there is still quite a lot of confusion about adequate economic methods to ensure efficiency in the forest production – symptomatic for this is the title of the Dissertation of Navarro (2003): "On 189 Years of Confusing Debates over the König-Faustmann Formula" – and until today these debates are going on! In Germany we have a very special situation: The soil rent theory, which was founded by Faustmann (1849) and laid the fundamentals of dynamic investment theory, is still traumatising the forest practice (Möhring, 2001). Since that time there is a great reservation towards all economical calculations in the context of forest management decisions. From this point of view, the challenge is to improve the insights (especially of the junior staff and forest practitioners) into the economic concepts of forest management.

Even simple forest decision models have to take three specific characteristics of the forest production into account:

- There are interactions between forest stands of following generations (stands are not independent investment objects), the conservation of an existing stand delays the establishing of a new stand.
- There are also interactions within forest stands (also single trees are not independent investment objects). Competition leads to relations between present stockings and the current growth of the stand.
- Forest enterprises normally are not seen as "open economic systems". Often there are restrictions in terms of sustainability to preserve the growing stock, so that management decisions can only be made within these borders.

It is the intention of this paper to present an extremely simple model, which fulfils these characteristics and links forest production to economic evaluation on the basis of a single Excel-spreadsheet. This leads to the following advantages:

- All calculations can immediately be seen and the influences of varying input data become clear, there is no "black box".
- Methods of identifying the optimum are accessible with the help of simple MS Excel features.
- Insights into economic relations by means of "learning by doing" become possible. This makes this type of models important for teaching purposes.

It is not the intention to describe silvicultural realities or even to give recommendations. However, the general coherences between the economic decision models and silvicultural reality will hopefully become clear.

This methodical concept can be located between two traditional types of models dealing with forest management decisions:

1. **Algebraic models**, which use the common terminology of analysis (derivations, points of equilibrium), and which therefore are hardly comprehensible for many people. However, they have the advantage of delivering general solutions (e.g. Johannson and Löfgren, 1985).
2. **Complex forest production models** (**especially single tree models**). They are mainly developed to model different silvicultural treatments by means of complex single tree-growth simulators (e.g., in Northwestern Germany the simulation model BWIN is wide spread, see Nagel and Schmidt, 2006) – but due to the complexity (sometimes even random number generators are integrated into the simulation process), the economic relations often are not obvious.

2. Modelling the management of spruce stands

Modelling forest growth and yield of a spruce stand, we used only four non-linear functions (see Fig. 1):

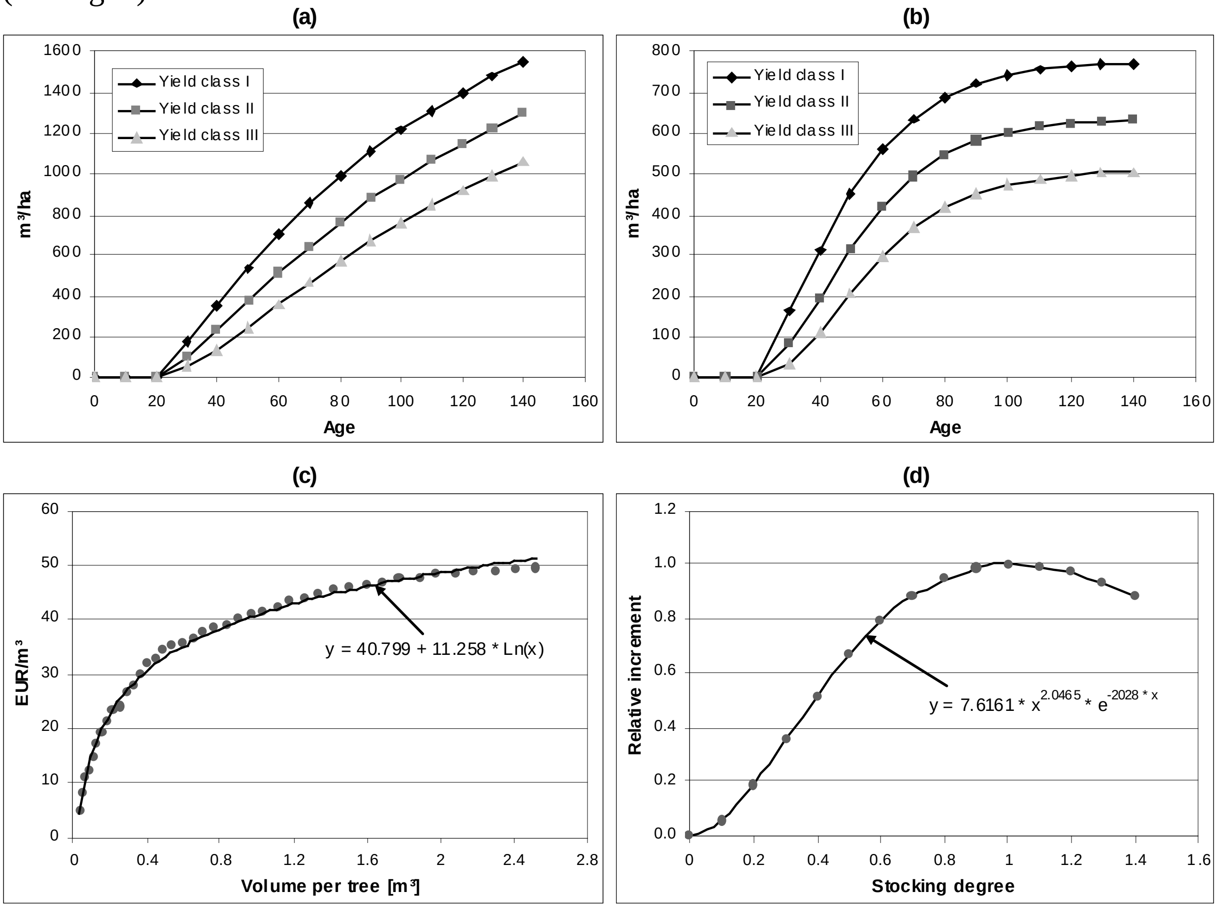

Fig. 1. Functions used in the Excel calculations in order to model growth and yield of spruce stands:
(a) Total production of timber volume against age and yield class,
(b) normal growing stock against age and yield class,
(c) value per cubic meter against volume per tree,
(d) increment reaction depending on the stocking degree (according to Lower Saxony´s management direction).

- **Growth-function** *f(yield class age)*; it was developed by Schmaltschinski (2001) on the basis of the traditional and widespread yield table from Schober (1995) and is needed for the calculation of normal total production of timber volume per hectare.
- **Function of normal growing stock** *f(yield class age)*; it also was developed by Schmaltschinski (ibid.) on the basis of the yield table from Schober (ibid.). The normal growing stock is needed as a reference for the adaptation of the current increment of timber volume.
- **Value-function** *f(single tree volume)*; it describes the value of harvested timber in EUR/m³ against timber volume per tree. The logarithmic regression-function was calculated on actual data using the software HOLZERNTE (“timber harvest”) developed by the Forest Research Station of Baden-Württemberg (Schöpfer *et al.*, 2003).
- **Increment-reduction-function** *f(stocking degree)*; it is used in the practice of forest management in Lower Saxony in a simplified way and describes the relation between stand density and current increment of stand volume, whereas reduced stand densities reduces the increment subproportionally.

Some additional input data are needed such as the number of stems at the starting point at age 30 (in this case 2500 stems), the planting costs (1000 EUR/ha), costs of silvicultural treatment (250 EUR/ha), fixed costs (83 EUR/ha and year), the factor for conversion from standing timber volume into harvested timber volume (0.8) and the ratio of relative removals of standing volume and stem number (1, which means, that the mean dimensions of the removed and remaining trees are equal; thus, the type of thinning is unselective). As decision variables, we defined the age of final harvest and/or the intensity of thinning during the time of stand development.

Using the growth functions and the input data explained above for yield class II leads to the following flexible yield table (Table 1). This yield table is constructed for 10-year periods, assuming normal stand density. It contains data for the total stand, thinnings, residual stand and growth. Using this kind of yield table and assuming a specific harvest age, the cash flow can be calculated and evaluated using traditional investment criteria for even-aged forests (see Klemperer, 1996, or Buongiorno and Gilless, 2003) like

- Net Present Value,
- Annuity (gross soil rent),
- Land Expectation Value (Willingness to pay for bare land).

Table 1. Flexible yield table for a spruce stand with yield class II and stocking degree

Years	20	30	40	50	60	70	80	90	100
Total stand									
Number of stems (N/ha)	2500	2500	2142	1966	1834	1681	1510	1340	1184
Standing volume (m³/ha)	13	95	211	337	456	550	615	656	680
Removed stand									
Proportion of stems (%)	0.0%	14.3%	8.2%	6.7%	8.4%	10.2%	11.3%	11.6%	11.5%
Number of stems (N/ha)	0	358	177	131	153	171	170	156	136
Standing volume (m³/ha)	0	14	17	23	38	56	69	76	78
Harvested volume (m³/ha)	0	11	14	18	31	45	55	61	63
Net revenue at harvest (EUR/ha)	0	16	170	332	691	1154	1562	1846	2010
Remaining stand									
Number of stems (N/ha)	2500	2142	1966	1834	1681	1510	1340	1184	1048
Standing volume (m³/ha)	13	82	194	315	418	494	546	580	602
Harvestable volume (m³/ha)	11	65	155	252	334	395	437	464	482
Net revenue at harvest (EUR/ha)	-220	98	1888	4646	7563	10163	12312	14043	15437
Growth									
Stocking degree	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mean annual increment (m³/ha/a)	8.2	12.9	14.4	14.1	13.2	12.1	11.0	10.0	9.1
Mean annual value increment (EUR/ha/a)	33	196	309	361	375	371	358	340	322

3. Results

Determination of the optimal financial rotation age

The determination of the optimal financial rotation age often is regarded as the central problem of forest economics. Thus, this simple model firstly is used to answer the question: What is the optimal rotation age from the viewpoint of economics?

Fig. 2 shows the way to identify the optimal financial rotation age, here by means of maximising the annuity (the gross soil rent before diminishing the fix costs), which is equivalent to maximising the land expectation value. But the annuity as investment criteria has the advantage that it is less sensitive to the interest rate and can also be determined for an interest rate of zero (see Möhring *et al.*, 2006). It is obvious, that increasing interest rates reduce the absolute amount of the annuity and shift its maximum towards younger stand ages.

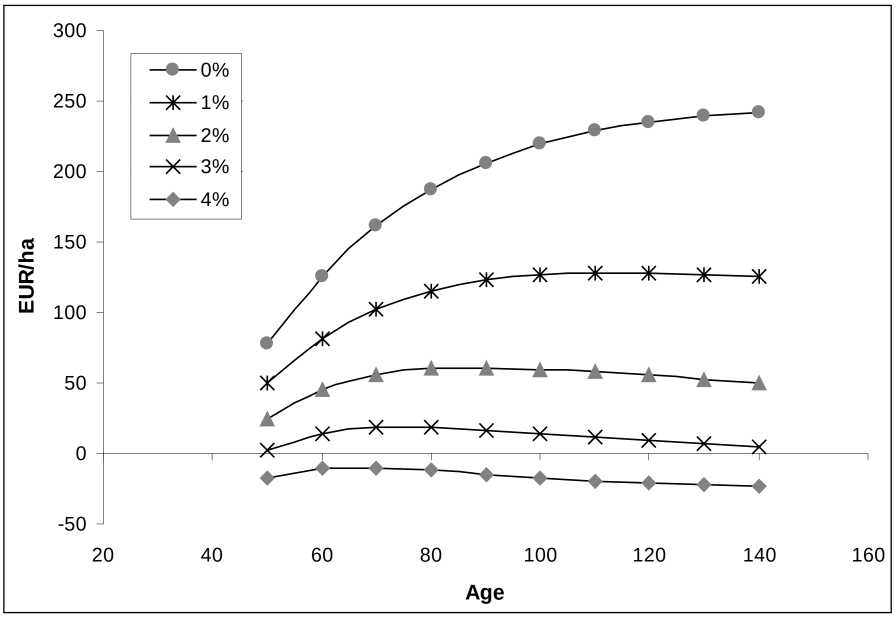

Fig. **2**. Annuity (gross soil rent) of a spruce stand with yield class II for different rotation ages in dependence of different interest rates.

The traditional rotation problem can also be explicated from a different point of view. Based on an existing stand, the question has to be answered whether it is mature and should be harvested and replaced by a successor or whether it is more profitable to wait and let the existing stand grow further on. In this context it can easily be shown, that scarcity is an important premise to identify the optimal action, whereas, for the harvest decision, scarce resources are productive land and/or capital bound in the stand. The results of the corresponding model calculations are shown in Fig. 3.

Under the assumption of scarce productive land but unlimited financial funds, it is rational not to harvest the stand as long as its annual value increment exceeds the benefit (net margin) of the following stand. This corresponds with the maximum of highest revenue, in our example reached at the age of 140 years. Assuming only scarcity of capital bound in the forest stands (here expressed by an interest rate of 2 %) maturity is given when the annual value increment equals the “stand holding costs”. Here this point is reached at an age of app. 100 years. Finally, looking at the situation of scarce capital and land, whereas scarcity of land is expressed by the gross soil rent at an interest rate of 2 %, we find the economic optimal maturity when the annual value increment equals the sum of stand and land holding costs, in this example at an age of app. 80 years.

On the basis of these simple spreadsheet calculations, it seems quite easy to teach students the concept of financial maturity of forest stands. The economic results can also easily be interpreted from a silvicultural point of view. A stand should primarily be harvested, if

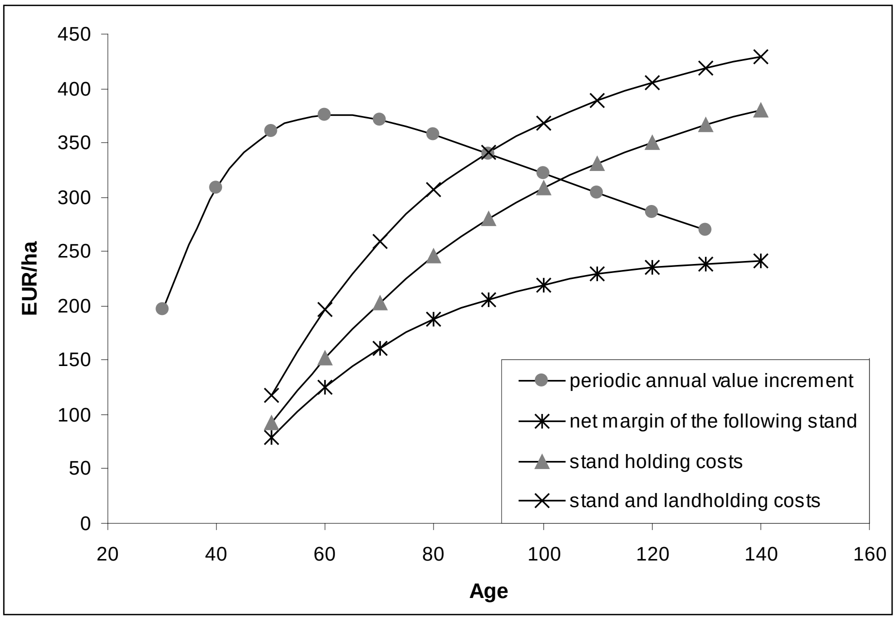

Fig. **3**. Stand and land holdings costs (separately and combined) compared to the periodic annual value increment and the net margin of the following stand for spruce, yield class II.

- the annual value increment is small,
- the capital bound in the stand is high,
- the following stand promises high benefits.

Simultaneous search for the optimal thinning intensity and final harvest

In addition to the problem of final harvest, we now want to show an example of how thinnings and final harvest can be optimised simultaneously, due to the fact that thinnings play an important role in forest practice in Germany. In this simple calculation model thinning was formally described as a schematic reduction of stands' basal area (neither high, nor low thinning, see section 2), whereas the residual stocking degree influences the current growth (according to the non-linear increment-reduction-function).

Under the objective of maximising the gross soil rent - using the MS Solver - different optimal stocking degrees can be found, depending on stands age and scarcity of capital (see also Wippermann, 2005, for similar calculations for pine stands) The calculations lead to following results (see Fig. 4):

- the smaller the interest rate (smaller degree of capital scarcity),
- the stronger the thinnings in young stands,
- the higher the growing stock in elder stands,

the later the time of harvesting the stand.

Higher interest rates (higher degree of capital scarcity) lead to

- weaker thinnings in young stands,
- stronger reductions of stocking degrees in the elder stands,
- earlier final harvests.

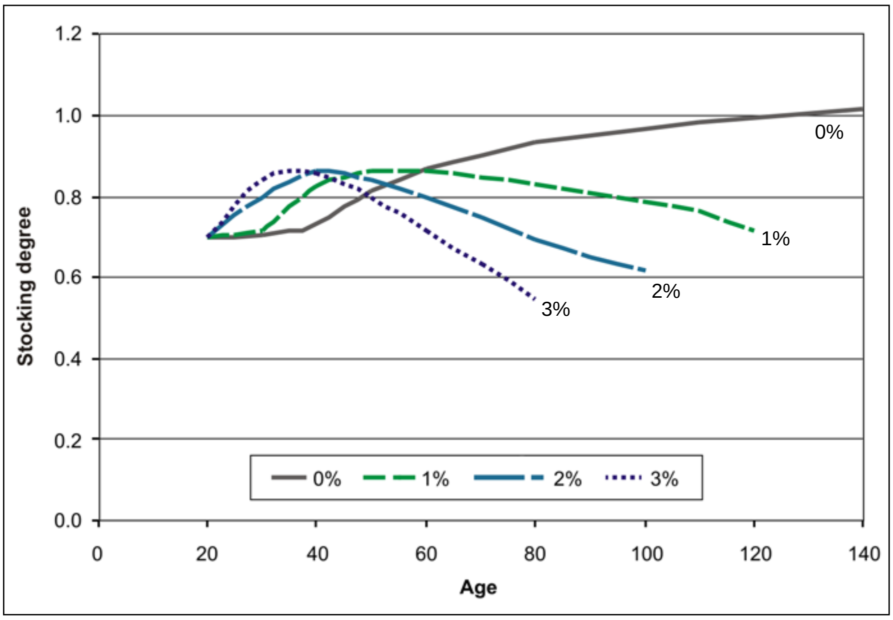

Fig. 4. Economic optimal stocking degree of a spruce stand yield class II, depending on the level of capital scarcity (expressed by different interest rates).

In the silvicultural reality in Germany, there are certain parallels with these results. Especially in private forests enterprises, where higher degrees of financial scarcity can be assumed, we find lower thinning intensities in younger stands but higher intensities in elder stands and shorter production cycles than in state owned forests.

Optimisation under the restriction of sustainability

Finally we want to show how restrictions like sustainability can be considered within this simple calculation model. In Germany, forest holdings are usually not considered as financial open systems, where unlimited capital can be detracted in order to be invested in alternative assets or unlimited capital can be gained on the capital market to be invested in forestry. Instead, a central goal of forest management is sustainability. This goal usually demands to maintain the growing stock within the forest enterprise. Under such a restriction, the character of management decisions changes and we have to identify the optimal combination of different actions by internal comparison.

In the following we want to give a brief example of how this kind of internal comparison can be realised using the simple calculation model. As initial model situation we start with two management classes of different productivity (yield classes I and III), both are managed with a rotation age of 80 years and all age classes are fully stocked (stocking degree 1.0). Together they generate sustainable positive revenue. The forest manager could be satisfied. However, from the point of economics the question is, if it is possible to produce higher revenues from the present asset on the basis of undiminished value of the growing stock.

Again we used the MS Solver to vary the thinning intensity and harvest age simultaneously in both management classes, maximising the net revenue under the maintenance of the value of growing stock. The results are quite interesting (see Table 2): The maximisation of net revenue under the restriction of capital maintenance leads to a new capital allocation within the forest enterprise. The harvest age in yield class I is reduced (to 73 years), in yield class III it is increased (to 110 years).

Table 2. Key data of a forest enterprise with two spruce management classes of different productivity

Forest enterprise	Unit	Initial Situation	Optimised
Rotation age I and III		80 and 80	73 and 110
Total area	ha	200	200
Standing volume	m³/ha	247	224
Value of standing volume	EUR/ha	4263	4263
Growth and Yield			
Mean rotation age	Years	80	91
Mean annual increment	m³/ha/a	9.7	9.6
Mean annual value increment	EUR/ha/a	207.3	219.3
Thinnings	m³/ha/a	1.6	3.0
Final harvest	m³/ha/a	6.2	4.6
Total harvest	m³/ha/a	7.8	7.6
Net revenues from harvest	EUR/ha/a	207.3	219.3
Costs of stand establishment	EUR/ha/a	12.5	11.4
Costs of precommercial thinning	EUR/ha/a	3.1	2.9
Net margin	EUR/ha/a	191.7	205.5
Fix costs	EUR/ha/a	83.0	83.0
Net revenue	EUR/ha/a	**108.7**	**122.1**

Looking at the key data, we see that the mean production cycle is lengthened, the thinning intensity is expanded and the net revenue is increased. But we also see, that "trees do not grow into heaven". The chance to enhance the economic success by optimal capital allocation within the forest estate is relevant, but the overall improvement of the net revenue is only 13 EUR/ha/a (12%). Here we find the optimal capital allocation with undiminished value of the growing stock at a marginal (real) interest rate of 1.9%. This is an indication that in terms of profitability investments in German forestry have quite small interest rates (somewhere between 1 and 3%, see Möhring, 2001).

4. Conclusions

The introduced model-calculations, which can be located between the traditional economic analysis using the abstract language of mathematics and the complex forest growth and yield simulations, followed the objective to illustrate the relations between forest production and economic evaluation in a very simplified way.

The main results of these simplified calculations have some parallels with the forest practice. The objective of maximising the economic success under the restriction of limited capital demands to harvest productive stands earlier than less productive ones. This leads to a harmonisation of the medium volume of harvested stems and therefore confirms the method of target diameter harvest, which is widely spread in Germany. The calculations also postulate the reduction of stocking degree with age, which also can frequently be found in the forest practice in Germany. Even though this means loss of stand volume increment, due to the fact that most tree species loose their ability to (over)compensate reductions of stocking degree by an accelerated single tree growth (caused by greater growing space) at older stand ages (cf. Röhrig *et al.*, 2006), from the viewpoint of capital reallocation this is not a misadventure, rather it can be interpreted as a rational reaction of scarcity of capital.

However, from this kind of simple calculations there may not be expected too much. Since we only used four nonlinear functions and some input data, they can not describe forest production at its full complexity. But this approach may underline, that stringent model simplification also has some advantages. It enables us to explain the main relations between forest production and economic decision models in a simplified and transparent way. Therewith we

- can point out the influence of changing premises and parameters onto economic results,
- can help to identify an optimum (even under restrictions), and
- can show that the economic concept of comparison of increasing and decreasing marginal benefit can help dissolve even complex management decision.

Since (not only) students like to play with this kind of simple calculation models, there is hope, that they can deliver insights into the concept of forest economics, searching efficiency in forest management under the restriction of sustainability, and that they can support decision makers in understanding the complex economic reality of forestry and allow them to handle forest management problems in a more efficient way. But nevertheless, it should be mentioned, that model calculations can never replace responsible decision-making!

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METHODOLOGICAL PROPOSAL OF CALCULATION OF ECONOMIC LOSS AND COMPENSATION CAUSED BY FOREST MANAGEMENT RESTRICTIONS: CASE OF THE CZECH REPUBLIC

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Abstract

In multifunctional forestry the economic efficiency of forestry is gradually more and more affected by growing public requirements for forest environmental non-market services. Therefore, timber as an environment friendly and sustainable material becomes less competitive or even uncompetitive with other less environment friendly and unsustainable materials on the market.

Some of economic losses are already being partially reimbursed in the form of subsidies and tax concessions but the compensations are insufficient and non-transparent in the Czech Republic (CR). It is highly important to separate the loss reimbursements from subsidies and payments for environmental services, and to treat them individually.

As the practice requires a unified system of calculations and simple calculation procedures of economic losses, the proposed framework methodology is based on simplified pragmatic approaches calculating present enhanced or extraordinary costs and present values of future income losses. The time factor must be incorporated into the calculations of the income losses. Some economic losses can be considerably high.

There were identified 10 basic kinds of socio-economic losses in the CR. The methodology of economic losses and damages calculation was applied in the frame of pilot case studies to the CR, and in a more detail to the area of Forest Plant Židlochovice (22,500 thousand ha of forest land) belonging to the State Enterprise Forests of the Czech Republic.

For example, the average economic loss of forest stands rotation period prolongation for 20 years under average production conditions in the CR and 2% interest rate reaches almost 4 thousand EUR/ha of forest. Even higher economic loss results from the forest stands leaving to spontaneous processes, which amounts to more than 6 thousand EUR/ha under average production conditions in the CR. The highest economic loss, more than 9 thousand EUR/ha, comes from the forests stands preterm felling (reconstruction) with simultaneous tree species change of coniferous tree species for broadleaved tree species. The highest economic loss in the area of Forest Plant Zidlochovice was caused by enhanced overhead (administrative) costs spent for the performing of non-market forest services for the public. The results of application of the economic losses calculation system in individual case studies prove its feasibility.

Keywords: *forestry restrictions, economic losses and reimbursements calculations, methodology, Czech Republic*

1. Introduction

Under multifunctional concept of forestry and forest management, the economic effectiveness of forestry can be considerably affected by claims of intensification of non-market forest services. Forestry as a timber production activity can be restricted to a great extent for different reasons, but especially for enhancement of non-market forest environmental services.

It becomes more and more evident that forest market production (especially timber production) and all forest market services will not be able to finance increasing demand of socie-

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ties (public) in individual countries for non-market forest services. The supplying of such services usually enhances costs of production and reduces incomes from timber supplies. Therefore, timber as an environment friendly and sustainable material becomes less competitive or even uncompetitive with other, less environment friendly and unsustainable materials on the market.

If we consider forestry as a part of market economy based on different types of ownerships and not budget economy based on the state ownership only, then we must identify all factors increasing market (timber) production costs and income losses caused by catering of society (public) with non-market forest services. We will have to set up effective systems of promotion (of them especially economic instruments) of such services tailored to individual socio-economic and nature conditions of respective countries in a short time. Otherwise, we take the risk of disappearing of many producers (forest owners and entrepreneurs) or even total sectors based on timber production service from market and from respective national economies with all negative impacts on socio-economic state of rural areas. But also the respective manufacturing sectors elaborating timber could be affected by this situation in the primary production sector to a great extent in the respective countries.

From the point of view of forest owners, tenants and managers, a possible decrease of economic efficiency of their business and properties can be expected as a result of claims of intensification of various non-market forest services at the expense of market services, of them especially the timber-production one. The financial loss should be reimbursed to the above-mentioned subjects to keep their competitiveness on the market.

Some of the losses are already being partially reimbursed in the form of subsidies and tax concessions, but the reimbursement is insufficient and non-transparent. It is highly important to separate the loss reimbursement from subsidies and payments for environmental services, and to express them individually. It would improve the system of sources allocation and transparency of forest management financing, not only in the framework of the CR.

2. Frame methodology proposal of calculations of particular types of economic losses caused by forest management restrictions

In the case of compensations, there can be calculated the following basic kinds of economic losses caused to forest owners, tenants and managers in the CR:

- income loss caused by enforced prolongation of the rotation period (forest stands, individual trees, site),
- income loss caused by enforced leaving the property to spontaneous processes (forest stands, individual trees, site, lying wood on the ground after felling),
- income loss caused by enforced change in the stand composition in the process of reforestation,
- income loss caused by enforced reduction of stand density,
- economic loss caused by enforced preterm felling (forest stand rehabilitation),
- income loss caused by enforced change in the site quality,
- income loss caused by enforced postponement of felling in the respective year (usually between seasons); loss caused by unrealised business,
- additional costs spent on young forest stands (reforestation) in case of an enforced change in stand composition,
- increased overhead (organisation and administrative) costs.
- other additional costs.

These economic losses should be reimbursed if we want to ensure normal functioning of the enterprising entities in the framework of market economy, not of the state budget social mechanism.

Calculation of economic losses is complicated especially if future losses in incomes are treated. In many cases it is difficult to forecast precise future income losses that can occur several tens of years later after the forest management restrictions take place. They are e.g. income losses caused by enforced prolongation of the rotation period, by leaving the property to spontaneous processes, by the change of the tree species composition in the process of reforestation, etc. Nevertheless, the economic losses obviously occur and should be reimbursed to forest owners, tenants and managers.

The proposed framework methodology is based on simplified pragmatic approach calculating present enhanced or extraordinary costs and present values of future income losses resulting from individual restrictions. It should be considered the economic loss can even reduce present value (price) of respective properties. But as practice requires unified system of calculations and simple calculation procedures the individual assumed most important economic losses in the case of the CR have been proposed in the frame of research projects as follows (Sisak, 2006, Sisak *et al.*, 2005).

2.1 Income loss caused by enforced prolongation of the rotation period

2.1.1 Forest stands and their parts

Calculation of the loss by the equation:

$$IL = \left(SP_{us} - c\right) - \frac{SP_{up} - c}{1.02^{up-us}},$$

Where:

- IL – income loss,
- SP_{us} – value of the forest stand at the age of standard rotation period (us) for commercial forests (stumpage price),
- C – established young forest stand costs (reforestation),
- SP_{up} – value of the forest stand (stumpage price) at the age of a prolonged rotation period (up),
- 1.02 – discount factor by the forest interest rate at stable prices in the CR = 2%.

Reasons for the use of the time factor for calculation of the loss

Income loss caused by prolongation of the rotation period is calculated as a financial loss, i.e. the difference between the revenue from forest stand final cut carried out in a standard rotation period and the revenue from the forest stand final cut in a prolonged rotation period, with the regard to the time factor. The time factor expressed by transferring future value of the revenue of the postponed felling to the present value must be included in the calculation of the loss because the stated higher value will be ready for the forest owner or forest manager in future years. The owner or manager is forced to realise production later. The forest owner or manager therefore cannot use financial means obtained from the cut for financing current forestry production. He cannot use them for enterprising, is deprived of the interest or income and is subject to real financial loss.

The financial loss must be reimbursed to the forest tenant or manager as it lowers the current real economic result. As the affected subject in forestry will obtain the financial means from production many years later, it is necessary to calculate the present value of the future value and reimburse the difference between the current attainable yield and the present value of the attainable yield in the enforced prolonged rotation period. It is necessary to calculate the interest of the future value by the interest rate on the level of so-called forest interest rate of 2% at stable prices (not influenced by inflation) in the particular period “us”–“up”.

Final felling income should be calculated as the difference of the mature forest stand value (SPu) in rotation age (u), i.e. stumpage price and costs that must be spent for reforestation after final cut, roughly at the level of the costs of established young forest stand (c). Any other treatment not considering the time factor misleads and distorts calculation of the economic, financial loss. The longer prolongation of the rotation age, the bigger losses occur.

Reasons of calculation of income loss in the form of “SPu–c”

The owner, tenant or manager obtains by the felling of stand not the “SPu” value (stumpage price in rotation age) but – in the current socio-economic, forestry and legal situation – the value reduced by the costs caused by the felling. The costs have to be paid for the subsequent stand rehabilitation, i.e. at least the costs of established stand “c”. Therefore, not only “SPu” values need to be considered, but also values reduced by the costs (c).

The above-mentioned total (lump-sum) income loss (IL) can be transferred to the annual income loss (IL_a) for the period us-up by the equation:

$$IL\_a = IL \times \frac{1.02^{up-us} \times 0.02}{1.02^{up-us} - 1}.$$

In that case, IL_a would be paid annually in the ub–up term.

2.1.2 Individual trees and their groups

Data and calculation process of IL and IL_a are in principle the same as in 2.1.1, but multiplied by “Z” coefficient, which is calculated as a quotient expressing the share of number of the trees left standing from the number of all trees in the stand at the “us” age.

2.2 Income loss caused by enforced leaving the property to spontaneous processes (elimination of the production function)

2.2.1 Forest stands and their parts

Calculation of the loss by the equations:

a) For the forest stand: $$ILfs = \frac{SPu - c}{1.02^{u-a}}$$

b) For the forest land: $$ILfl = \frac{r}{0.02},$$

Where:

ILfs – income loss from the forest stand,
Spu – value of the forest stand (stumpage price) at the rotation age (u),
c – established young forest stand costs,
a – the stand age,
ILfl – average total (lump-sum) income (rent) loss from the forest land,
r – average annual income from the forest land (rent).

The above-mentioned total (lump-sum) income losses can be transferred to the annual ones by the equations:

$$ILfs\_a = ILfs \times 0.02$$

$$ILfl\_a = r\ .$$

In such case, both values are paid annually with no time limitations. The values of payments can change with every change of values in future.

2.2.2 Individual standing trees and their groups

Calculation of the loss:

a) For the trees: ad 2.2.1a) x Z,

b) For the forest land: ad 2.2.1b) x Z.

The "Z" coefficient of the forest stand and the land is calculated as the quotient expressing the share of number of the trees left standing from the number of all trees on the area at the age of "u" (presuming that the trees left to spontaneous processes are mature trees).

2.2.3 Timber left lying after felling on the ground, later reforested

Calculation of the loss by the equation:

$$EL = (SPu + FC) \times Z\ ,$$

Where:

EL – economic loss,

SPu – value of the forest stand (stumpage price) at the rotation age (u),

FC – felling costs,

Z – the coefficient calculated as the quotient of the number of trees left standing and the number of trees on the area in the forest stand at the "u" age.

Annual value (EL_a) is possible to calculate by respective equations.

2.3 Income loss caused by enforced change of the stand tree species composition

Calculation of the loss by the equation:

$$IL = \frac{SPu_1 - c_1}{1.02^{u1}} - \frac{SPu_2 - c_2}{1.02^{u2}}\ ,$$

Where:

SPu_1 – stumpage price in the u1 rotation period of prevailing stand composition of commercial forests,

c_1 – costs of established stand with the respective stand composition,

SPu_2 – stumpage price in the u2 rotation period of the changed stand composition enforced by demanded intensification of non-market forest services,

c_2 – costs of established stand with the changed stand composition.

In case the difference is in the negative, there is no loss. The above-mentioned total (lump-sum) income loss (IL) can be transferred to annual values (IL_a).

- In case of a period limited to rotation (u2), the equation is:

$$IL\_a = IL \times \frac{1.02^{u2} \times 0.02}{1.02^{u2} - 1}.$$

  It is paid annually throughout the whole “u2” period.

- In case of an unlimited period, the equation is:

$$IL\_a = IL \times 0.02.$$

  It is paid annually for an unlimited time.

2.4 Income loss caused by enforced reduction of stand density

Calculation of the loss by the equation:

a) For the forest land:

$$ILfl\_a = r \times (Z_1 - Z_2),$$

Where:
ILfl_a – annual average income (rent) loss from the forest land,
r – average annual income (rent) from the forest land on a reduced area not used for production,
Z_1 – standard stand density,
Z_2 – reduced stand density.

ILfl_a is paid annually throughout the period of the reduced stand density.

- The total lump-sum value for an unlimited period (ILfl) is calculated by the equation:

$$ILfl = \frac{ILfl\_a}{0.02}.$$

- The lump-sum value for the limited period of “t”years of the reduced stand density is calculated by the equation:

$$ILfl = \frac{ILfl\_a \times (1.02^{t} - 1)}{1.02^{t} \times 0.02}.$$

b) For the forest stand (reduction of quality):

$$ILfs = \frac{SPu \times (1 - Kri)}{1.02^{u-a}} \qquad Kri = \frac{TPr}{TPs},$$

Where:
ILfs – lump-sum (total) income loss,
SPu – forest stand value (stumpage price) at the rotation age “u”,
Kri – coefficient of reduced income from timber sale,
TPr – reduced timber price (caused by timber knottiness),
TPs – standard timber price
u-a – difference between rotation period (u) and stand age (a).

2.5 Economic (income and costs) loss caused by enforced preterm felling (forest stand rehabilitation)

Calculation of the loss by the equation:

$$EL = \frac{SPu - c}{1.02^{u\text{-}a}} - (SPa - c),$$

Where:

EL – economic loss,
SPu – forest stand value (stumpage price) at the age "u",
c – established young forest stand costs,
SPa – forest stand value (stumpage price) at the age "a".

If necessary, the difference of reforestation costs of the tree species composition of the reconstructed forest stand and the new one is used.

The total (lump-sum) economic loss (EL) can be transformed into annual economic loss (payments) by respective equations of the essence mentioned above depending on the chosen period of "t" years.

2.6 Income loss caused by enforced change of the site quality (e.g. change of water regime)

Calculation of the loss for the forest land by the equation:

$$ILfl\_a = r_1 - r_2,$$

Where:

ILfl_a – annual income loss from forest land,
r_1 – average annual income (rent) from the forest land before the change,
r_2 – average annual income (rent) from the forest land after the change.

ILfl_a is paid annually throughout the period of the site quality change. The calculated annual loss can be transferred to the lump-sum income loss (ILfl) by respective equations of the essence mentioned above, depending on the period of the change.

ILfl = ILfl_a x (1.02^t – 1)/(1.02^t x 0.02) when limited to time "t", or: ILfl = ILfl_a x 0.02 when time-unlimited.

2.7 Income loss caused by postponement of felling in the respective year (usually between seasons), loss caused by unrealized business

Calculation of the loss by the equation:

$$IL = I_1 - I_2,$$

Where:

IL – income loss,
I_1 – income that could have been attained if felling took place in the favourable season for the producer,
I_2 – income attained after the realization of the postponed business.

A kind of specific loss, dealt with individually based on the difference between revenues got after the realization of the postponed business and the revenues that could have been attained if felling took place in the season favourable for the producer.

2.8 Additional costs spent on young forest stands caused by enforced change of the stand tree species composition

Calculation of the additional costs by the equation:

$$AC = c_1 - c_2 ,$$

Where:

AC – additional costs,

c_1 – costs of established young forest stand with standard stand composition,

c_2 – costs of established young forest stand with changed stand composition enforced by the stressing of non-market forest services.

The reimbursement is paid annually in the 1^{st} – 5^{th} year of the young forest stand according to the year when the difference occurs.

2.9 Enhanced overhead (administrative) costs

Calculation of the enhanced costs by the equation:

$$EnC = H \times OC ,$$

Where:

EnC – enhanced costs,

H – number of administrative and managing hours spent on non-market activities requested by various societal organs and organisations,

OC – unit overhead costs (per hour of managing and administrative work).

2.10 Specific additional costs and extraordinary costs

Calculation of the costs by the equation:

$$AC/ExC = C ,$$

Where:

AC/ExC – additional costs and extraordinary costs,

C – costs spent on individual *specific* measures (eg. on silvicultural and logging operations – forest stands reconstructions, amendment of terrain, water streams, roads reconstructions and maintenance, employment of special materials) requested by various societal organs and organisations, and not incorporated into above items.

3. Frame results of some economic losses items in the CR

In the frame of research projects, there were investigated economic losses in several pilot NATURA 2000 areas in 2005. Qualitative requirements, proposed measures restricting forest management and affecting economic effectiveness, varied to a great extent. Only several measures restricting forest management could be identified in pilot areas, and income losses and/or additional costs calculated. The economic losses were calculated per calculation units on the level of average data of the CR. The following Table 1 shows average unit economic losses divided to total losses (lump-sum losses) and annual losses calculated uniformly per period of 50 years (see the following table).

Table 1. Examples of unit total and annual economic losses by some proposed measures in pilot NATURA 2000 areas in the frame of CR

Item		Unit	Economic loss (Euro/unit)	
			Total	Annual
2.1	Forest stands rotation period prolongation	ha	3,958	126
2.2.1	Forest stands leaving to spontaneous processes	ha	6,298	200
2.2.2	Individual trees (2-3/ha) leaving to spontaneous processes	ha	55	2
2.2.3	10% of felled timber leaving to spontaneous processes on ground	ha	1,449	46
2.5	Forests stands preterm felling (reconstruction), tree species changed	ha	9,292	296
2.5	Forests stands preterm felling (reconstruction), tree species hanged	ha	7 392	235
2.8	Additional costs spent on change in tree species composition	ha	1,750	56
2.10	Specific additional costs – young forest trees protection against game	1,000 pc	138	4
2.10	Specific additional costs – young forest stands fencing	100 m	269	9
2.10	Establishment of special forest stands for water infiltration, etc.	ha	5,691	181
2.10	Timber skidding by cable systems	ha	2,260	72
2.10	Timber skidding by horse	ha	392	12
2.10	Fragmentation (reduction) of clearcutting plots to less than 0.20 ha	ha	2,230	71
2.10	Timber waste chipping and spreading on clearcutting areas	ha	626	20

4. Applications – case study on the area of Forest Plant Židlochovice

The proposed methodology of the economic loss and compensation calculation system was applied to concrete conditions on the area of Forest Plant Židlochovice in 2005-2006. The Forest Plant Židlochovice is situated in the southeast part of the CR. It administers 22.5 thousand ha of forests in an area important for different forest services. There are especially timber production forest service, hunting and game management (many game preserves and pheasantries), nature protection forest service (floodplain forests in the area of conjunction of Morava and Dyje rivers), recreational forests (Lednice-Valtice Area), nature protection forest service (several important protected natural preserves from national and international point of view), and other services. Therefore, the forest management can be considered as typical multipurpose forest management in the CR.

On the Židlochovice Forest Plant area, the following items of economic losses were identified:

- 2.1 Income loss caused by enforced prolongation of the rotation period – forest stands and their parts
- 2.2.1 Income loss caused by enforced leaving the property to spontaneous processes (elimination of the production service) – forest stands and their parts
- 2.4 Income loss caused by enforced of stand density reduction
- 2.9 Enhanced overhead (administrative) costs
- 2.10 Specific additional costs and extraordinary costs

Totally, the average annual economic losses of the Forest Plant Zidlochovice caused by restricted forest management due to delivering non-market forest services or improving them by needs of the society reached 107.9 thousand EUR (3,130 thousand CZK). Other additional measures performed by the Forest Plant Zidlochovice for improvement of forest services cost annually 48.3 thousand EUR (1,399 thousand CZK). The share of individual items in the presented figures is as follows:

- ***Item 2.1: Income loss caused by enforced prolongation of the rotation period – forest stands and their parts***

The mentioned economic loss is one of the most frequent losses on the area of Forest Plant Zidlochovice. It occurs especially in Protected Landscape Areas (core zones I) and in National Natural Monuments where the rotation ages are prolonged to 150 years because of nature conservation forest service. The area of actually restricted forest management reaches 127.77 ha. The average annual economic loss amounts to 15.1 thousand EUR (439 thousand CZK).

- ***Item 2.2.1: Income loss caused by enforced leaving the property to spontaneous processes (elimination of the production service) – forest stands and their parts***

The economic loss occurs in three following National Natural Preserves: Ranšpurk, Cahnov and Soutok. Total area of giving up timber production service amounts to 36.42 ha. The average annual economic loss reaches 4.6 thousand EUR (132 thousand CZK).

- ***Item 2.4: Income loss caused by enforced stand density reduction***

The economic loss was identified mainly in forests of the Lednice-Valtice Area, the World Cultural Heritage UNESCO. The forests are of a park nature on the area of 61.26 ha. The average annual economic loss caused by improvement of recreational services of forest reached 1.2 thousand EUR (34 thousand CZK).

- ***Item 2.9: Enhanced overhead (administrative) costs***

There were identified organisational and administrative activities requested by different societal organs and organisations (meetings, visits, excursions, maps, information, data and other materials elaboration). The average annual economic loss reached 87.1 thousand EUR (2,525 thousand CZK).

- ***Item 2.10: Specific additional costs and extraordinary costs***

Recent years, the Forest Plant Židlochovice spent comparatively big amounts of financial means for different activities improving non-market forest services, especially nature conservation and recreational services. Revitalisation measures cost 9.7 thousand EUR (280 thousand CZK) in 2005. The Program 2000 (improving non-market forest services) cost on year average 38.6 thousand EUR (1,119 thousand CZK) in 2002 – 2004. It is true that the spent financial means can be considered more as costs of performed services by the Forest Plant for the society than economic losses caused by forest management restrictions. Nevertheless, the costs should be calculated and published. The public should be informed about financial means spent by the Forest Plant Židlochovice for improvement (for intensification) of non-market forest services.

5. Conclusions

Finally, it can be said that the state must guarantee rational economic compensations of economic losses caused by requirements of the society to enhance impact of non-market forest services. The state and society should secure competitiveness of timber producers and timber production as a very important environment friendly and renewable material on the market compared to other materials.

It is necessary to separate compensations from subsidies and from purchase of different non-market forest services in demand by the society and delivered by forest owners, tenants and managers.

Some economic losses can be considerably high. In calculation of the economic losses, time factor must be incorporated into the calculations as most losses are related to the future, especially income losses. Therefore, the present value of income losses performed in the future must be known and calculated by standard principles of financial mathematics.

Proposed calculations can be substantially simplified retaining used methodological principles.

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Acknowledgements

The paper was prepared in the frame of research project supported by the Grant Agency of the Czech Republic (GACR) No. 402/06/1100 “Accounting systems and sustainability reporting and their application at microeconomic level (systemy ucetnictvi a reportingu udrzitelneho rozvoje a jejich aplikace na mikroekonomicke urovni)”.

SURVEY ON PUBLIC NEEDS AND MARKET DEMANDS FROM FOREST LAND USE IN HUNGARY

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Abstract

In the framework of a FAO project, the Institute of Forest Assets Management – recently renamed as Institute of Mathematics and Economics – (University of West Hungary) carried out a research on monitoring the eco-tourist use of Hungarian forests from several aspects. An important role within these can be assigned to the investigation of the demand side.

Four different questionnaires were developed such as questioning of forest visitors, questioning of tourism enterprises, questioning of tour operators, and questioning of urban population. The project had tight schedule: three months from developing of questionnaire to finalizing of the research report. At present, this study focuses on aspects of forest visitors (23 questions) and urban population (40 questions). These questionnaires were filled out in 9 big cities in Hungary. These are partly the biggest cities, partly those lying close to the pilot area, namely: Debrecen, Miskolc, Salgótarján, Szeged, Pécs, Székesfehérvár, Budapest, Győr and Sopron.

Each question was not only analysed separately, but compared with relevant ones. In case of urban population, the following statements can be summarised as part results: a, people visit forest areas in summer time with greatest frequency (67.5% at least monthly), while the least in winter time (33% at least once per month), b, visiting rate is somewhat higher for female than male, c, people from 40-60 year-old age-group are the most characterized forest visitors, as long as above 60 years old are the smallest visitor group, d, visiting rate is in direct ratio to educational level and incomes, as well. e, 37.8 % of forest visitors spends less than an hour in the forest, but the rate for visitors who spend more than half day is comparatively high (26.2 %), f, females stay longer time than males in forest, g, middle-aged people stay the shortest time in forest. Aged people usually spend 2-4 hours, but under 30 generation spend the longest time for forest trips. h, generally, people who take short (half an hour) visits in forest have lower qualification than average.

***Keywords**: ecotourism, forest land use, urban demand, public need, questionnaires*

1. Introduction

In the framework of a FAO project, the Institute of Forest Assets Management - recently renamed as Institute of Mathematics and Economics – (University of West Hungary) carried out a research on monitoring the eco-tourist use of Hungarian forests from several aspects. An important role within these can be assigned to the investigation of the demand side. The main basis for the investigation is the questioning of the urban population. This gives possibility to explore the general Hungarian opinion and only this way one can elicit the opinion of those who do not visit forest.

Most of the forest's visitors arrive from great cities as it had been proven unanimously by previous investigations. The number of cities over 100 thousand people is significant therefore any selected forest is closer than 100 km from a bigger town. It is also important that focusing on the urban population will allow to collect information from people who do not visit forested areas. Moreover higher population density makes the research simpler and more efficient.

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2. Methodology

Four different questionnaires were developed such as questioning of forest visitors, questioning of tourism enterprises, questioning of tour operators, and questioning of urban population. The project had tight schedule: three months from developing of questionnaire to finalizing of the research report. At present, this study focuses on aspects of forest visitors (23 questions) and urban population (40 questions). These questionnaires were filled out in 9 big cities in Hungary. These are partly the biggest cities, partly those lying close to the pilot area, namely: Debrecen, Miskolc, Salgótarján, Szeged, Pécs, Székesfehérvár, Budapest, Győr and Sopron.

Within the cities inquiries were done in big shopping malls. Because of the change in shopping habits inhabitants of cities do their shopping in shopping malls, so we could easily get into contact with them.

On the other hand, pilot areas of the research were Lovasberény and Buják, two Hungarian villages. On these areas the forest recreation is still in a developing phase. Also due to the limitations of the given contract the time schedule of the research was tight, and data collection was limited to March which is not the high season of tourism in Hungary. As a result, only a lower number of responses were collected which is below than statistically required. To improve the number of responses another sample was collected in Sopron forest district which is one of the most visited recreational areas of Hungary.

Final Figures of the measurement of forest visitors are as follows:

Table 1. The primary sites for the visitors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sopron	133	73.5	73.5	73.5
	Lovasberény	26	14.4	14.4	87.8
	Buják	22	12.2	12.2	100.0
	Total	181	100.0	100.0	

Locations of measurement of forest visitors

As it can be seen from the Table 1 almost 75% of the total responses were collected in Sopron. Concerning gender, a little bit more, than half of the respondents were women. This is in accordance with the overall average in the country, though the difference is smaller in our sample. In case of forest visitors the gender distribution is 1:1.

Analyzing the distribution by age one can observe an overrepresentation of the younger ages. It is interesting, that more than one third of the respondents are younger than 30 years. This can be explained by the entertaining, pass-time function of the shopping malls which is more attractive to younger people. In our opinion this bias considerably influences the results; therefore we applied a correction to the sample.

The highest proportion concerning education is of those having high school degree. In the second biggest group there are people with higher education. The proportion of people with lower education is relatively small. We did not find data on education on the HCSO website therefore we can only assume, that the distribution by education is somewhat better than the average in the country. The same order is valid for the group of forest visitors, while the differences are more significant, and the number of visitors with a primary education is practically insignificant.

A big part of the respondents belongs to the group 65 – 160 thousand HUF, which interval also contains the Hungarian average salary. One third of the respondents have a salary which is less than the minimal salary. Most of the retired persons can be finding in this group. Only 14.5 % admitted to have a salary more than 160 thousand HUF.

The average size of households was 3.11 persons. Most of the people live in 2 person households (29.1%). The proportion of the families with more than 4 members (the so-called 'big families') is low (14.1%). A logical consequence of the facts above is the low numbers of children (0.61 children/household) in nearly 2/3 of the households are no children.

In almost two third of selected household there is no child under 18. This fact goes back to the age distribution of the sample: there is a lower representation of age group 30-40.

From the last question characterizing the respondents one can conclude that only a minority (5.6%) is member of some environmental or nature protection organizations. It is interesting that there is a difference between the two samples: city inhabitants show a definitely higher membership rate (5.6%) compared to forest visitors (1.9%). We can conclude that a higher percentage of the members of environmental NGOs are not involved in activities connected to forests in reality.

3. Results

3.1 Frequency of forest visits

During the preparatory phase of the project we accepted the assumption, that the forest visiting habits depend on weather and therefore on seasons. According to this we analyzed the seasons separately.

Spring

The biggest part, more than one third (36.3%) of the respondents visited the forest only once in spring. The frequency histogram has a relatively ordinary shape, proportionally less people visit the forest more often.

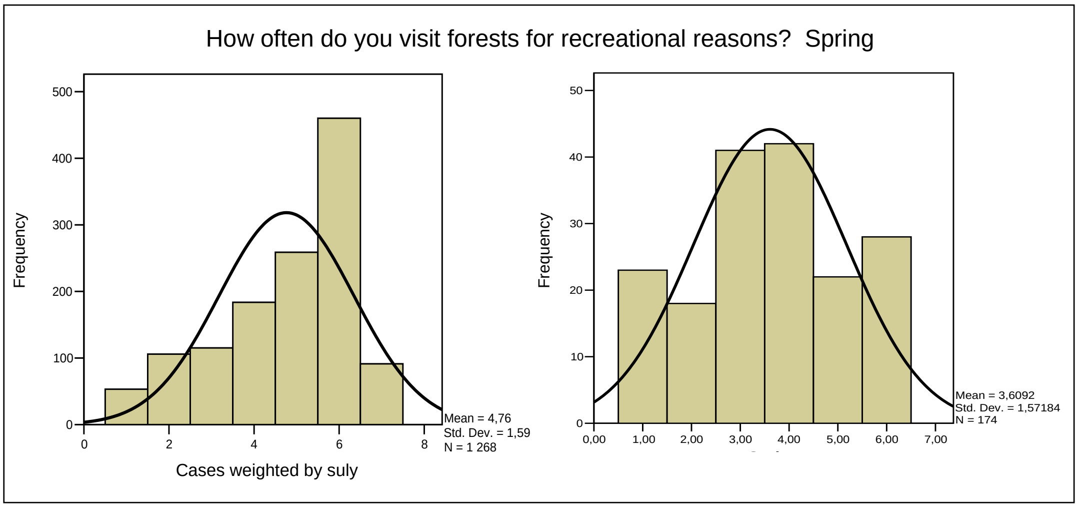

Fig. **1**. Frequency of visits in spring (Left: cities, right: visitors).

Obviously sample of forest visitors showed a higher frequency than city inhabitants. Most of the visitors go to the forest every week, every two weeks. Moreover, 13.2% of them visit the forest daily.

Summer

People visit the forests mainly in summer. More than one third of the visits fall to this season. The histogram is balanced; the proportion of the more frequent visits is bigger. More than 14% of the people go at least twice the week to the forest, while 28.8% of forest visitors go to the forest several times a week.

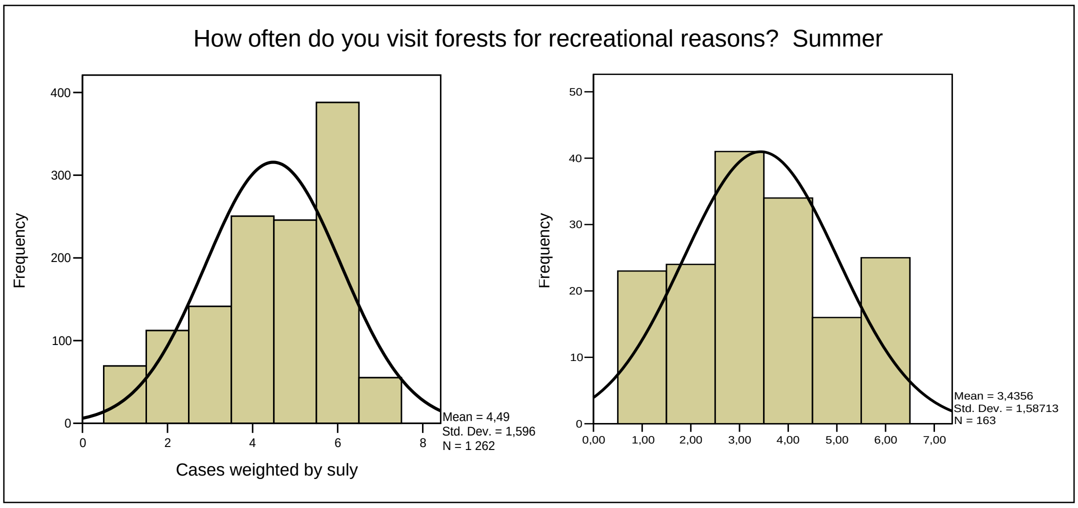

Fig. 2. Frequency of visits in summer (Left: cities, right: visitors).

Autumn

The histogram showing number of visits in the autumn is similar to the histogram of spring, it is even more balanced. The total number of visits is less, than in spring.

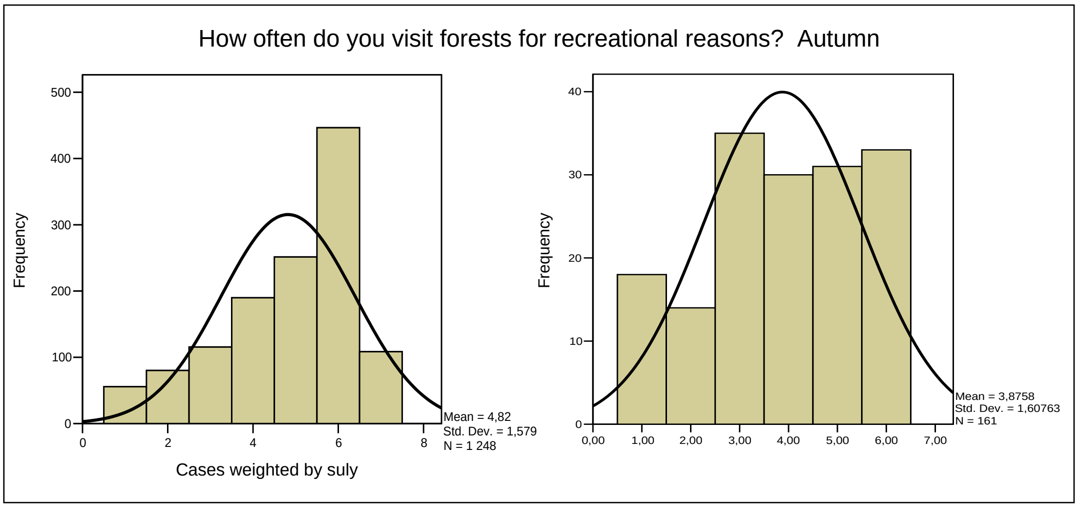

Fig. 3. Frequency of visits in autumn (Left: cities, right: visitors).

Winter

It is not surprising that the tourist intensity is lowest in the winter; the total number of visits is only half of the number in summer. The frequency histogram is very abnormal. More than one quarter of the population does not go to the forest at all, the majority goes only once, and a proportion of frequent visitors is about 7%.

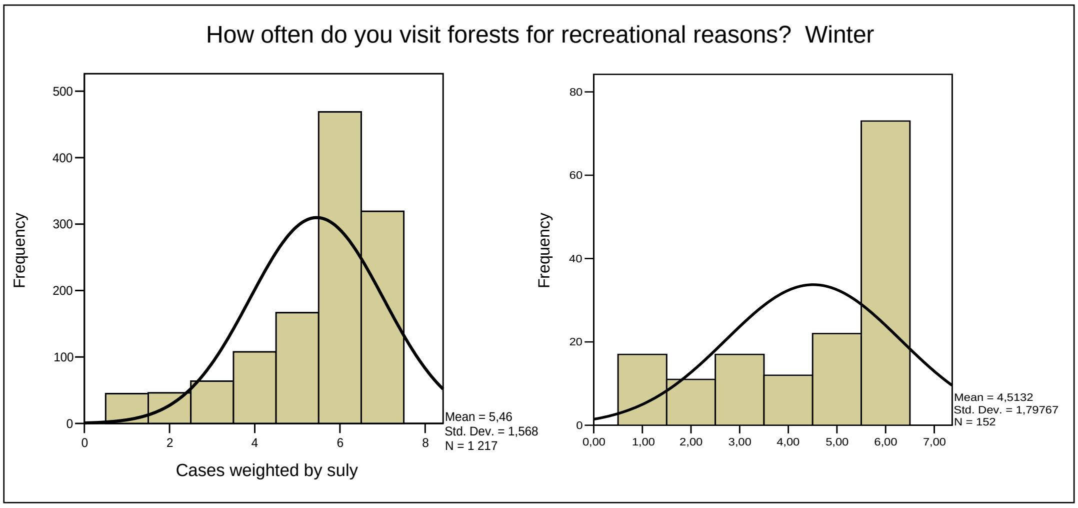

Fig. **4**. Frequency of visits in winter (Left: cities, right: visitors).

Based on the survey the total number of annual visits can be calculated. In order to do this we have to assign numbers to the verbally stated visiting frequencies. This frequency is subdivided by seasons. For the answer ’daily’ we assume 3 visits in a week, and calculate 32 visits in a quarter. The answer ’several times weekly’ is less than this, but more than the ’weekly’ category. In our opinion a weight number of 16 in a quarter is realistic. The frequency ’weekly’ can also be not interpreted strictly. A realistic estimate could be 8 visits in a quarter. The ’several times monthly’ category is more than just the number of months. Here an appropriate estimate would be 4 times quarterly. The ’monthly’ category is estimated with 2 visit in a quarter. We assumed, that respondents stating to visit the forest less frequently also visit the forest once in a quarter.

Travel time

Nearly one fifth of the respondents lives near the forests and can reach them within 15 minutes. The bigger part of the population falls into the category ’within 30 minutes’ which travel can be done every day. The overwhelming majority can reach the forests within an hour. In case of forest visitors the histogram gravities to the left: they need less time in average to reach the forest. More than 60 % of them will arrive to the forest less than half an hour.

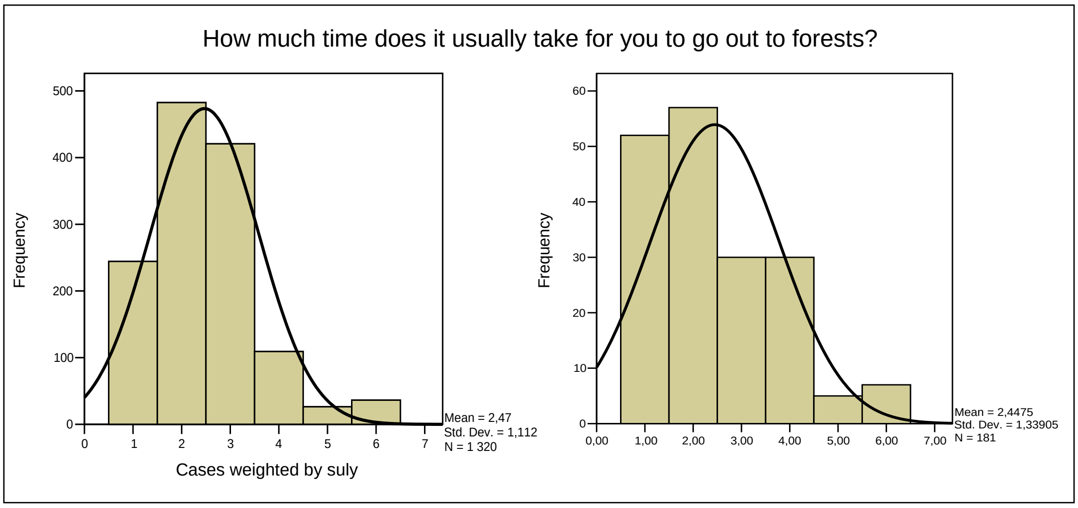

Fig. **5**. Travel time (left: cities, right: visitors).

Time spent for recreation

Only few of the people stay less than half hour or more than 8 hours in the forest. The number of respondents is distributed evenly amongst the other categories. In case of forest visitors there is different graph but this goes back to the different order of responses. In the third column one can see the shortest visits less than one hour. (13.4%) Most frequent option is the visit between one-two hours. Second most common option is the visit with 2-4 hours.

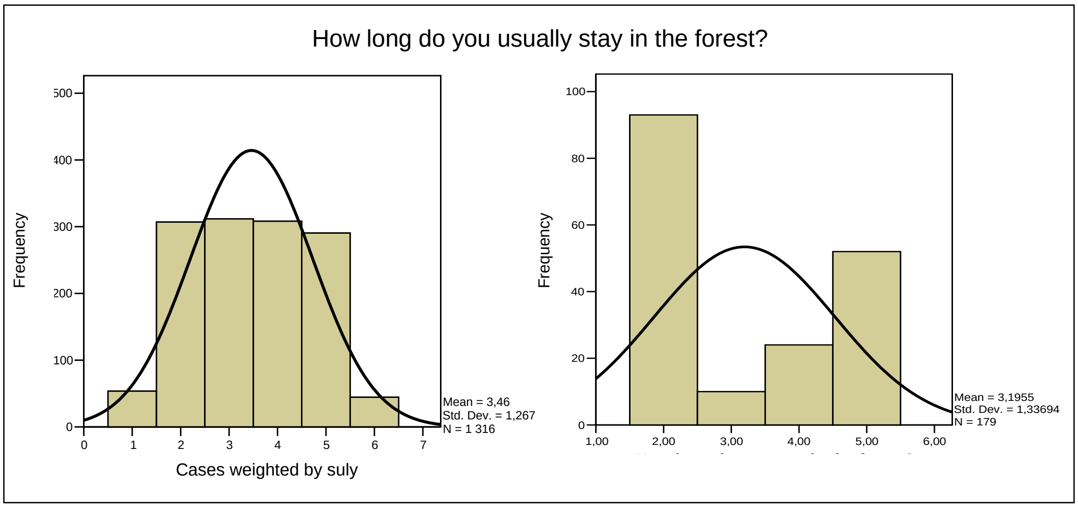

Fig. **6**. Time spent for recreational purposes (left: cities, right: visitors).

3.2 Valuation of forests recreational abilities

It is highly important for the forest manager to know the needs of the visitors. Unfortunately it costs several hundred million HUF that in the last third of the previous century special investment for recreation were made with good intent but without knowing the real needs. To get information on these needs the question 'To what extent are the following factors important for your trips to forests?' was raised. The scale of judgment was the same as at the previous question.

Landscape

Nice scenery and landscape was considered as an extremely important attracting factor of the forests by the majority of people (44.4%). Only very few (4.5%) considered that this is not important.

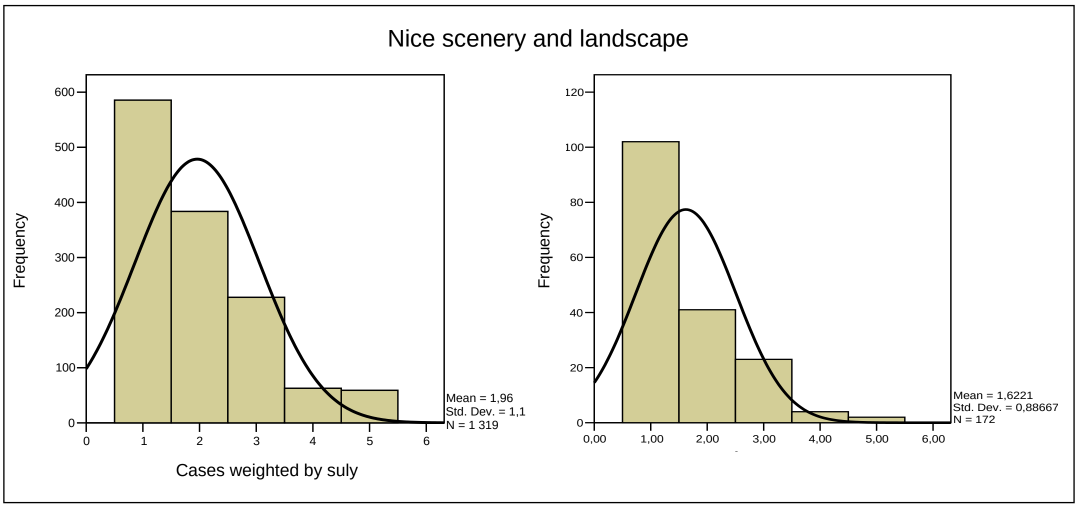

Fig. **7**. Importance of landscape (left: cities, right: visitors).

Peacefulness

Similarly but in even bigger proportion (51.4%) did they consider peacefulness as important.

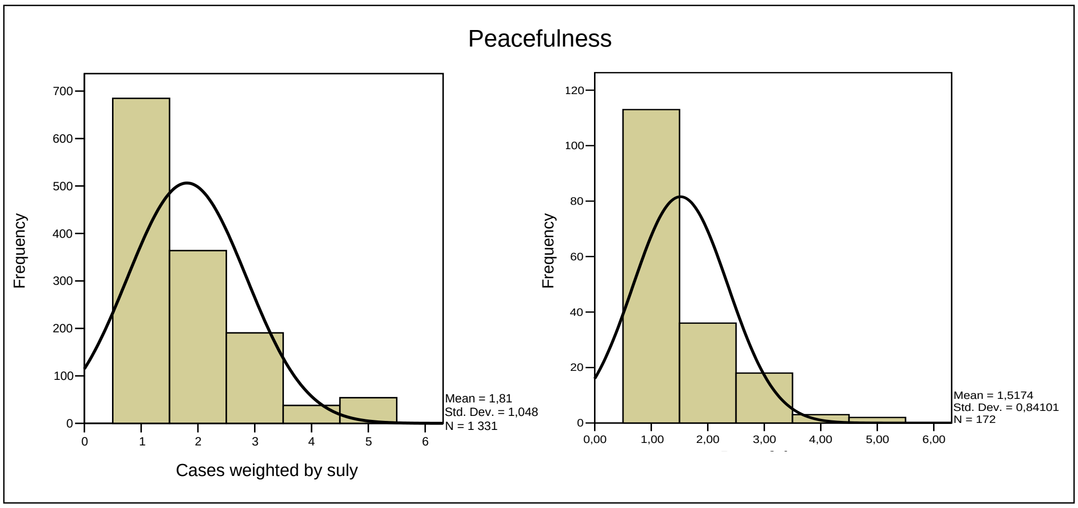

Fig. **8**. Importance of peacefulness (left: cities, right: visitors).

Air quality

According to our research the most attractive factor of the forest is good air quality. This was considered as outstanding by 58.5 % of the respondents.

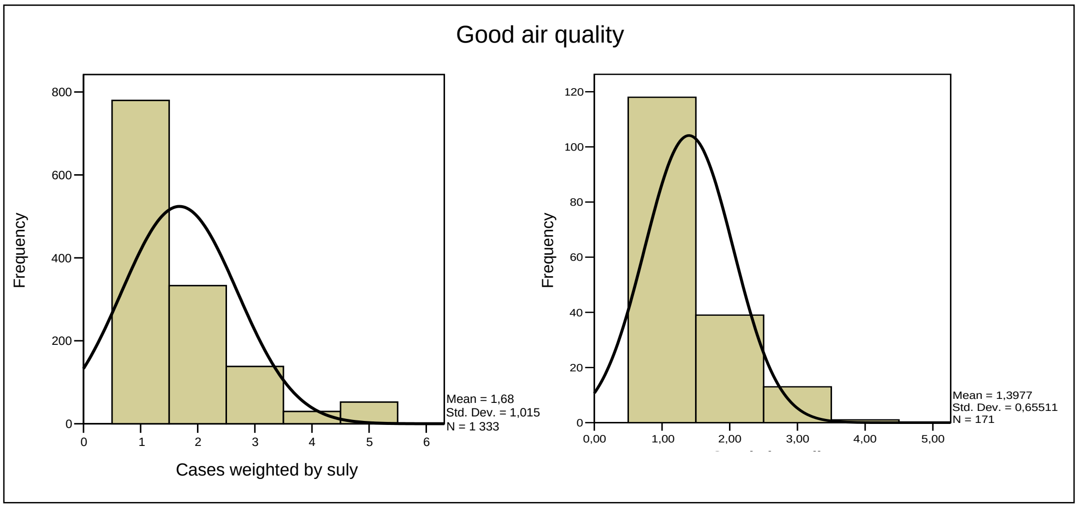

Fig. **9**. Importance of air quality (left: cities, right: visitors).

View points

The look-out towers or viewpoints, especially acknowledged in the literature, are considered only important in the middle of the value scale. Within the group of forest visitors the importance of this question is more significant: they scaled look out towers as outstanding significant in 31.8% while very significant and significant categories were selected with almost the same results.

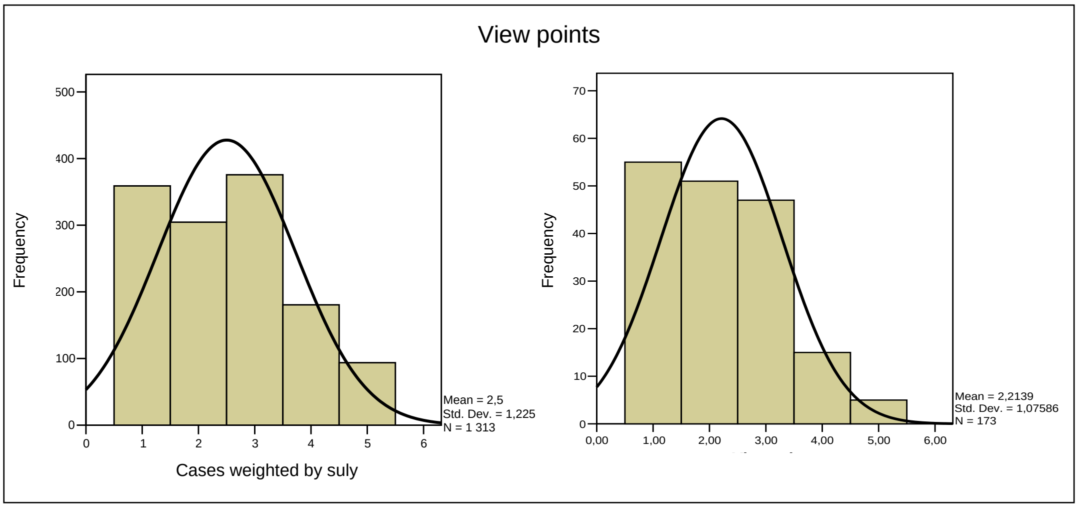

Fig. **10**. Importance of view points (left: cities, right: visitors).

Springs and water access

Water surfaces were considered outstanding by many of the respondents, but its average rank was considerably lower, because the opinions were different in the judgment.

The lowest importance was given to the artificial facilities. The majority of the respondents gave an average rank to it, but many considered these as less important.

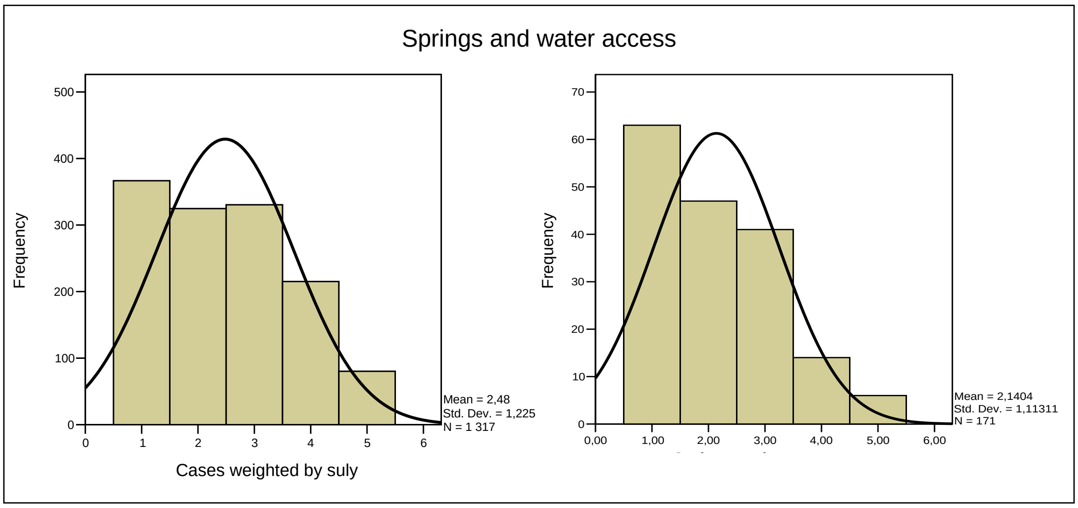

Fig. **11**. Importance of water access (left: cities, right: visitors).

3.3 Financing forest ecotourism

It became evident by today, that recreation is not an automatic effect of the forest which is provided as a side-product but a result of a conscious, high level special activity. As such similarly to other products it requires sacrifice from its producer, thus the producer has costs. These costs are in big part not refunded to the forest manager by the society, so these costs can only be covered from income by selling wood, which is of course paid by the user of wood. This situation is both theoretically and practically unacceptable.

Forest furniture

Theoretically, because the production of recreational services is not done in the interest of wood production, so it is not part of the costs of this production. If someone covers these costs from wood sales (because there is no other resource available) it harms the demand-supply balance and causes additional damages in the woodworking industry.

Raising the costs of wood production with the costs of recreation is practically also unacceptable, because this is not recognized by the market and this leads to difficult situations for forest companies, managers (what is typical for today's forest management in Europe). Difficulties in the management of forest companies strike back to the production of recreational services.

Forest management has been looking for a solution to these problems for a long time. One of the possible solutions is to attract additional financing resources. We aimed at supporting the solution of this problem with our study.

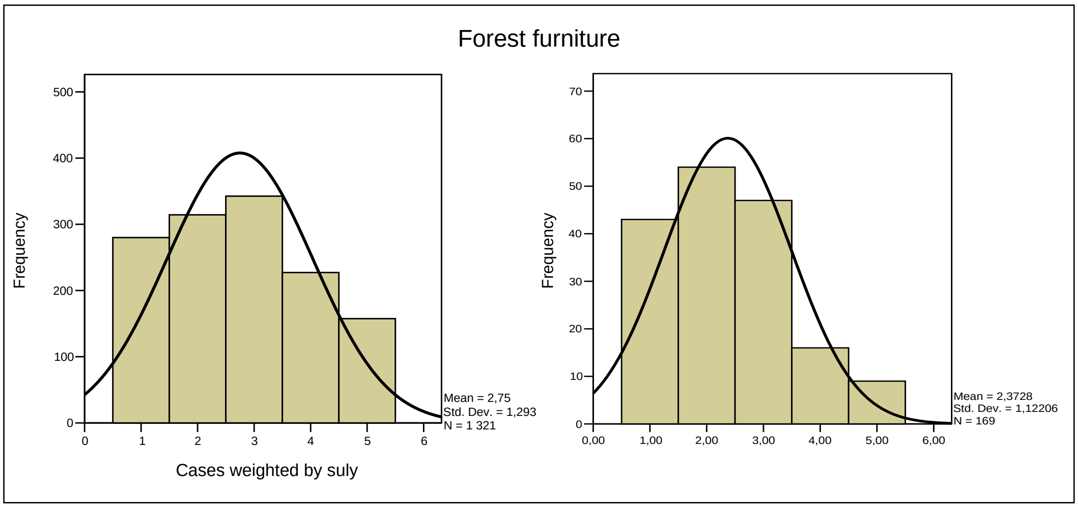

Fig. **12**. Importance of forest furniture (left: cities, right: visitors).

Financial support for forest foundations

The graph shows that only very few people (15.1%) would be willing to contribute to a foundation developing forest tourism. Forest visitors show a higher commitment toward providing financial support and every third of them expressed their willingness to pay an amount.

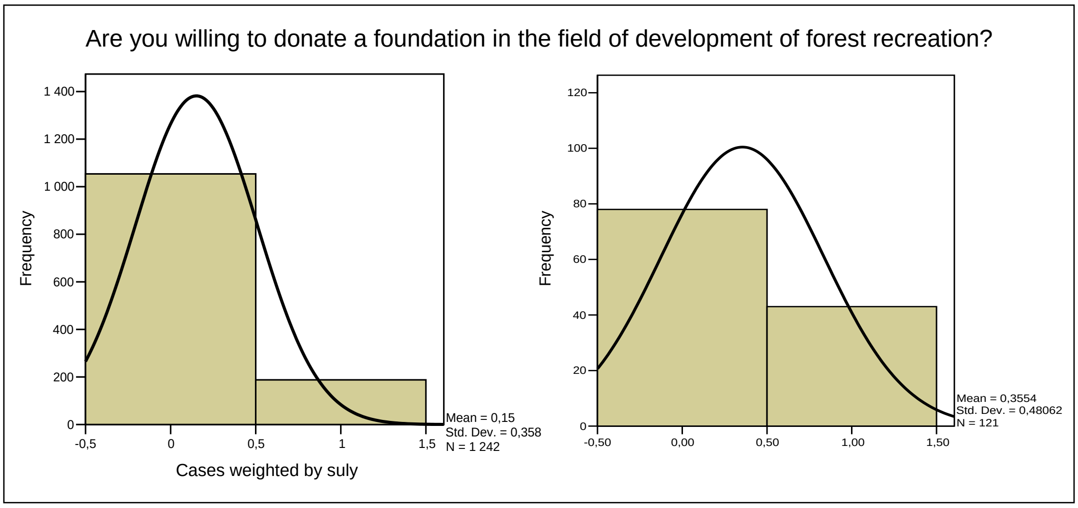

Fig. **13**. Willingness to donate a foundation of forest recreation (left: cities, right: visitors).

1% share of income tax

There was a very positive response to the question about offering 1% of their tax for these purposes. The reason for this is that this solution has been in use in Hungary for several years with success, so people got used to it. The problem here is that the majority of people already has a preference to give this one percent, and they can hardly be diverted from the old foundation, and the 1% can only be given to one organization.

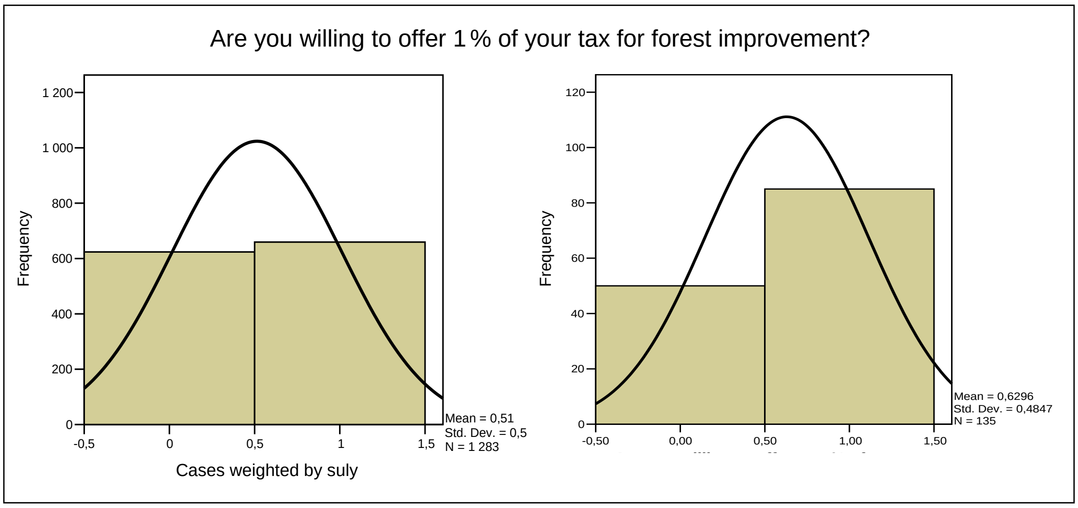

Fig. **14**. Willingness to offer 15 of income tax for recreational purposes (left: cities, right: visitors).

Direct payment

As the graph shows people strictly object to pay directly for recreational services. What used to be free should remain free. Forest visitors show a friendlier attitude but this means that only 86.9 raised objection.

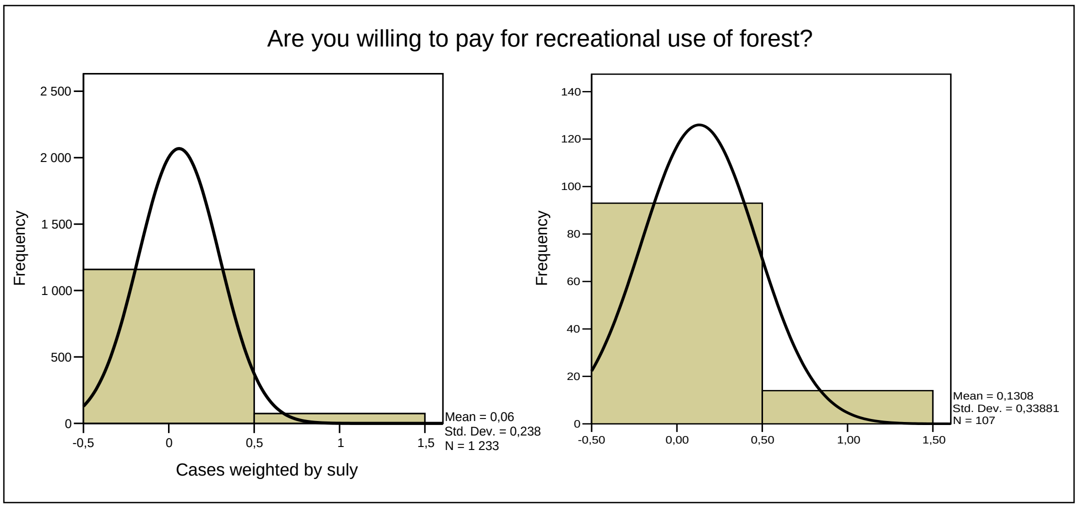

Fig. **15**. Willingness for direct payment (left: cities, right: visitors).

Volunteer work

The importance of the question and of the goal is acknowledged by the relatively high number (32.8%) of respondents who would be willing to support the recreational function of the forests by his/her own work. It is not a small task and amount of money to organize such activities but in spite of this it would be worthwhile to organize these in order to increase the recognition of forestry in the public.

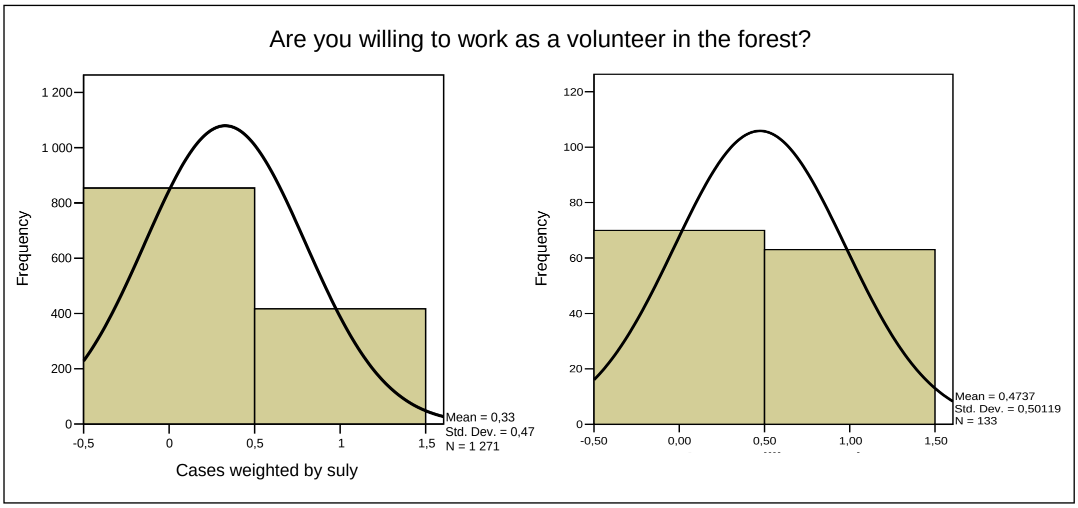

Fig. **16**. Willingness to work free of charge (left: cities, right: visitors).

4. Conclusions

The most important conclusions which can be summarized from the research:

- the sample differs a little from the population but still can be declared as representative,
- function of wood production was declared as insignificant, while most of the respondents decided that nature protection is the most important function of Hungarian forests.
- the total number of forest visits is over 12 million occasion per year in Hungary, more than one third of this amount is carried out in summertime. Half of the total visits is executed by a small minority of 5% of the total population.
- costs of forest recreation should be covered by the state. Tourists' willingness to pay is practically insignificant.
- People are against the direct payment of recreational services, however they agree to offer one percent of their income tax for this purpose. One third of the people are ready to work as a volunteer in the forests.

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FOREST CERTIFICATION IN EUROPE AND NORTH AMERICA

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Abstract

Forest certification is increasing in extent and importance throughout the world, with about 295 million ha certified as of January 2007, or about 7.5% of the world's forests. Certification is intended to ensure that forests are managed in an economically, environmentally, and socially desirable manner. The two largest forest certification systems in the world are Forest Stewardship Council (FSC) and Programme for Endorsement of Forest Certification (PEFC). FSC was the first international system, with 84 million ha as of January 2007. It was begun and still promoted by environmental nongovernment organizations (ENGOs). PEFC, with 194 million ha as of 2007, is actually an organization that approves individual country systems, which have been promulgated by private landowner, industry, and conservation interest groups. Recent evaluation studies have found that forest certification does prompt changes in forest management, improve interaction with communities and workers, and enhance environmental performance. Studies in Europe indicate that costs for certification may range from $0.15 to $1.50 per ha per year depending on the country and forest size; a U.S. study found costs to maintain certification that ranged from $0.80 to $9.50 per ha per year. Forest certification adoption has been associated with export of forest products, forest area per capita, gross domestic product, and income per capita. Forest certification will continue to increase moderately in area in the future, as well as lead the discussion about market mechanisms to foster sustainable forest management.

***Keywords**: forest policy instruments, forest certification, forest certification systems, market mechanisms, sustainable forest management*

1. Introduction

In the second half of 20th century, environmental challenges increased throughout the world. Deforestation and degradation of forests, especially of tropical forests, and large volumes of illegally obtained wood in world markets prompted efforts to overcome these problems. Other threats included the loss of biological diversity, adverse climate change, and overconsumption of natural resources. These issues made it obvious that development of the world economy required new approaches to provide natural resources and healthy environment for present and future generations.

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With the purpose of overcoming environmental challenges important conferences were organized at the international level − Stockholm (1972), Rio de Janeiro (1992), Kyoto (1997), and Johannesburg (2002). These conferences adopted plans of action to reduce environmental and forest threats, and the paradigm of sustainable development was developed and approved. Problems related to sustainable forest management (SFM) were considered in the framework of Helsinki Process at the conferences of ministers of forestry of the European countries in Strasburg (1990), Helsinki (1993), Lisbon (1998) and Vienna (2003), and in the framework of Montreal process for much of the other temperate forests in the world. Of the nine SFM criteria and indicator initiatives in the world, the Montreal Process is geographically the largest, encompassing most of the world's temperate and boreal forests, and 60% of all of the world's forests. The Montreal Process signatories include Argentina, Australia, Canada, Chile, Japan, the Republic of Korea, Mexico, New Zealand, the Russian Federation, the U.S.A., and Uruguay. Member countries have agreed on a comprehensive set of seven criteria and 67 indicators for the conservation and sustainable management of temperate and boreal forests (Montreal Process, 2003a, b).

The Helsinki and Montreal Processes defined criteria and indicators (C&I) for SFM and identified key C&I. The Helsinki Process recognized the importance of information and monitoring on the state of forests and forestry, and discussed forest certification, which is based on C&I and monitoring. Certification has since become one of many strategies employed by environmental groups over the last few decades to influence forest industry practices, from the local to international level (McDermott and Hoberg, 2004).

Forest certification began in 1989 when Rainforest Alliance conducted first certification audits of forest management units (FMUs) in Indonesia and Brazil. Development of forest certification sought "environmentally sound" timber production, which would be provided with the proper documentation of wood origin and prohibition of export of forest products from countries where forest management did not conform the set standards (Kovalyshyn, 2002). Certification discussions expanded until introduction of Forest Stewardship Council (FSC) certification in 1993. From that time forest certification has expanded to cover about 295 million ha or about 7.5% of the world's forests. Forest certification is a voluntarily initiative, however many countries in the world began actively to promote it to build trust with society regarding national forest policy and to improve market access for forest products.

Initially, forest certification was intended to prevent illegal harvests and unsustainable forest management in tropical forests. Later this process spread to boreal and temperate forests. Thus, forest certification became the means to prevent unsustainable forest management to market products based on the premise that certified products come from forests where management was carried out in conformity with the requirements of standards. Thus forest certification helps to satisfy environmentally conscious buyers, and provides evidence to the various stakeholders in the chain-of-custody process that these products will have access to a market, and possibly will bring additional profit (Upton *et al.*, 1996).

2. Forests in Americas and Europe

Land and forest statistics in the countries of Europe and Americas are shown in Table 1. Forests in the Americas and Europe have quite different types and species composition. The largest share of forests in Europe is in boreal forests, which cover 73% of all European forests. The large share of boreal forests in Europe is mainly due to the Russian Federation and Scandinavia. In Europe, 22% of the forests are classified as temperate and 5% as subtropical.

Table 1. Land, Forest and Macroeconomic indicators for major forested countries in Europe and Americas, 2005

Country/area	Land area	Total forest 2005			Certified forest area	Export of forest products	Import of forest products	GDP
		Area	Percentage of land area	Area per capita				
	000 ha	000 ha	%	ha	000 ha	$ 1000	$ 1000	$ billion
Austria	8 273	3 886	47.0	0.5	3 929.91	5 517	2 657	241.5
Belarus	20 748	9 402	45.3	0.9	2 501.5	258 422	211 295	59.4
Belgium	3 282	728	22.2	0.1	250.27	3 898	4 700	293.8
Croatia	5 592	1 783	31.9	0.4	1 988.48	274 851	285 776	49.6
Czech Republic	7 728	2 632	34.1	0.3	1 969.62	920 672	833 227	167.8
Denmark	4 243	455	10.7	0.1	14.49	391 487	1 939 581	170.4
Estonia	4 227	2 060	48.7	1.5	1 064.13	533 332	205 651	18
Finland	30 459	21 935	72.0	4.2	22 376.7	12 074 778	1 279 079	142
France	55 010	15 341	27.9	0.3	3 996.31	6 304 778	8 111 889	1632.1
Germany	34 927	10 740	30.7	0.1	7 574.01	12 918 669	13 192 772	2279.1
Greece	12 890	3 599	27.9	0.3	31.53	112 427	929 389	213.3
Hungary	9 234	1 840	19.9	0.2	188.69	582 026	963 572	147.5
Ireland	6 889	659	9.6	0.2	438.36	424 481	845 762	145.2
Italy	29 406	10 003	34.0	0.2	623.19	3 693 339	8 418 377	1559.6
Latvia	6 205	2 923	47.1	1.2	1 723.79	860 716	191 563	23.2
Lithuania	6 258	1 994	31.9	0.5	1 055.19	301 382	242 691	38.9
Netherlands	3 392	375	11.1	n.s.	136.38	3 294 015	5 055 886	476.9
Norway	30 683	8 868	28.9	2.0	9 236.80	1 789 079	1 081 603	169
Poland	30 442	9 047	29.7	0.2	6 254.88	1 685 500	1 918 700	443.9
Portugal	9 150	3 666	40.1	0.4	100.27	1 524 197	961 295	188
Romania	23 034	6 448	28.0	0.3	1 124.41	701 756	387 940	160.3
Russian Federation	1 688 851	851 392	50.4	5.8	12 748.6	4 934 453	954 073	1318.8
Slovakia	4 808	2 177	45.3	0.4	162.90	723 601	432 653	72.5
Spain	49 945	14 370	28.8	0.4	499.90	2 478 792	5 062 200	915.1
Sweden	41 162	27 134	65.9	3.1	17 070.5	11 006 990	1 853 453	238.7
Switzerland	3 955	1 199	30.3	0.2	427.12	1 819 478	1 776 334	221.7
Ukraine	57 935	9 584	16.5	0.2	1 353.4	519 162	643 885	264.6
United Kingdom	24 160	2 794	11.6	n.s.	1 667.80	2 084 593	9 725 766	1606.9
Total Europe	2 259 957	1 039. 3	46.0	1.43	96 654.2	72 222 391	67 511 769	13257.8
Bahamas	1 001	842	84.1	2.8	-	-	-	-
Canada	922 097	244 571	26.5	7.9	84 603.1	24 062 029	4 261 247	963.6
Costa Rica	5 106	1 968	38.5	0.5	52.30	21 668	245 399	38
Guatemala	10 843	2 850	26.3	0.3	522.87	31 569	197 344	50.7
Honduras	11 189	5 383	48.1	0.9	37.28	43 109	100 505	18.5
Mexico	190 869	55 205	28.9	0.6	706.53	197 472	2 407 369	934.6
Nicaragua	12 140	3 278	27.0	0.7	16 727	38 980	87 568	34
Panama	7 443	2 876	38.6	1.0	12.24	12 271	68 964	19.3
United States	915 895	225 993	24.7	0.8	59 997.1	14 182 184	24 548 627	10 870
Total North and Central America	2 136 966	549 304	25.7	1.15	162 658	38 589 282	31 917 023	12928.7
Bolivia	108 438	53 068	48.9	6.5	2 042.86	28 462	35 514	22.9
Brazil	845 651	543 905	64.3	3.2	3 532.15	2 830 024	728 253	1371.7
Chile	74 881	15 536	20.7	1.0	1 975.98	1 698 943	259 308	161
Colombia	103 871	49 601	47.8	1.2	58.44	142 829	415 446	301.2
Ecuador	27 684	10 557	38.1	0.9	21.34	95 213	270 931	48
Paraguay	39 730	23 372	58.8	4.4	61.33	46 138	65 367	43
Peru	128 000	65 215	50.9	2.6	59.57	93 905	234 316	143
Suriname	15 600	14 113	90.5	34.0	-	-	-	-
Uruguay	17 481	1 292	7.4	0.4	134.41	131 077	62 634	28
Venezuela	88 206	49 506	56.1	2.1	139.65	98 277	190 898	125.4
Total South America	1 754 741	885 618	50.5	2.60	8157.17	5 033 791	2 521 293	2 688.8

Source: FRA, 2005; FAO, 2003, 2005; WTO, 2005; Certified Programs Web Sites.

Most other European countries have 100% temperate forests. Subtropical forests are presented in Southern European countries as in Italy (84% of all forests), Spain (80%), and Greece (97%). There are no tropical forests in Europe.

Conversely, 19% of North and Central America forests and 96% of South America forests are tropical forests. Only 40% of North America forests are boreal and almost 80% of them are in Canada. Subtropical forests comprise 16% of North and Central America and 2% of South America. Canada has 26% temperate and 76% boreal forests; the U.S.A. has 37% subtropical, 48% temperate, and 15% boreal; and Mexico has 70% tropical and 30% subtropical. Most of the countries in South America have 100% of their forest area classed as tropical forest. The only major exception is Chile, with 54% subtropical and 45% temperate forests. Brazil has 2% subtropical forests and Argentina has 5% subtropical and 4% temperate, with the rest classified as tropical, surprisingly (FAO, 2003).

Europe has about 46% of its total land area in forests. The Russia Federation has the greatest amount of forests in Europe and the world with 851 million ha, or 50.4% of its land area. They are followed distantly by Sweden with more than 27 million ha (65.9% of land area), Finland with 21.9 million ha (72% of land area), France with approximately 15 million ha (27. 9% of land area), and Spain with 14.3 million ha (28.8% of land area). Other large forest countries in Europe include Germany with 10.7 million ha, Ukraine with 9.5 million ha, Byelorussia with 9.4 million ha, and Poland (9 million ha). Most forests in these countries are mixed and coniferous temperate forests.

A large share of the total area is forested in Slovenia (55.0%), Estonia (48.7%) and Latvia (47.1%). Iceland, Ireland and Republic of Moldova have the smallest shares of forested land in Europe with 0.3%, 9.6% and 9.9% accordingly. The forested area of majority of European countries varies between 20% to 40% except in a few countries with more than 40%. The percentage of forest land of some other countries (Ukraine, Hungary, and United Kingdom) is very small − from 10% to 20% of total land area (FRA, 2005).

South America has about 45% of its total land area in forests. Brazil has the greatest extent of forest in the Americas, with about 477 million ha, or 56% of its land base. Uruguay has the smallest share of forested land in the Americas at 8.6%. At 34%, Mexico surprisingly has slightly more of its total land area classified as forested than the U.S. and Canada. In South America, the northeastern countries of French Guiana, Guyana, and Suriname have the highest percentages of their land base under forest cover, ranging from 70% to almost 95%. The northwestern countries of Colombia, Ecuador, and Venezuela, as well as Bolivia, have a smaller share of their area classified as forests, though still more than North America, at 39% to 54%. Argentina has 33 million ha of forests, which comprise only 12% of the land cover in the country (FRA, 2005).

The Russian Federation has the most forest area per capita (5.8 ha per capita), then Finland, Sweden and Norway (respectively 4.2, 3.1, and 2.0 ha per capita). The share of the forests per capita in the other countries of Europe, is much less than 1.0 ha per capita. Only Estonia and Latvia have slightly more than 1.0 ha of forests per capita.

In North and Central America the largest amount of forests per capita is in Canada (7.9 ha per capita), Belize (5.7) and Bahamas (2.8). The share in U.S. is only 0.8 ha per capita due to the large population of this country. The data for South America are startling. There are 45.6 ha of forests per capita for French Guiana, 34 ha for Suriname, and 19.7 ha for Guyana, while Brazil has less at 3.2 ha of forests per capita.

The largest quantity of timber volume in the world (89 136 million cubic meters) is concentrated in Russia. So is about 80% of world stock of coniferous forests, with the largest share of them in the Asiatic territory of Russia. France, Sweden, and Germany, with 2 927 million, 2 914 million and 2 880 million cubic meters, take a distant second, third and fourth place. The rest of European countries each have less than 2 billion cubic meters of total timber volume each (FRA, 2005).

FAO data (2003) indicate that Brazil has 64% of the timber volume in South America with 71 billion cubic meters, followed distantly by Peru, Venezuela, Bolivia, and Colombia, ranging from 10 billion to 5 billion cubic meters each. The rest of the South American countries each have less than 2.5 billion cubic meters of total timber volume each. In contrast, Canada has 29 billion cubic meters of timber volume, the U.S.A. has 31 billion, and Mexico has 3 billion.

The forest cover for ten-year period (1990 – 2000) in Europe was increasing on average at 0.1% per year. Increases occurred the most in countries as Russia, Spain. Portugal, Greece. At the same time, forest cover in Albania, Belgium, Serbia decreased every year at 0.1% on average (FAO, 2000).

In the Americas the loss of forest area from 1990 to 2000 was greatest in percentage terms in Central America, at –1.47% per year, although this rate dropped to –1.23% per year from 2000 to 2005. From 1990 to 2000, South America lost 0.44% per year. The rate of forest loss in South America increased to 0.50% per year between 2000 and 2005. There was no significant loss of forests in North America from 1990 to 2000, only –0.01% per year from 2000 to 2005, virtually all in Mexico. In total, South America lost an average of 4.3 million ha of forests per year from 2000 to 2005 (FRA, 2005).

3. Forest certification schemes

The largest forest certification scheme in the world is the Programme for Endorsement of Forest Certification, which endorses forest certification schemes developed in individual countries and is presented both in Europe and in the Americas. In total, PEFC has recognized 196 million ha as certified, including 57.4 million ha in Europe and 138.6 million ha in the Americas. The Forest Stewardship Council (FSC) is the only scheme that has unified world principles and governance, and has about 84.3 million ha. In Europe there are two forest certification schemes – FSC with 39.5 million ha and PEFC with 57.4 million ha certified forests, while in the Americas there are at least seven certification systems. The major forest certification systems in the Americas and Europe are presented in Table 2.

Major forest certification systems in the Americas as of January 2007 include FSC (36.9 million ha in the Americas), the Sustainable Forestry Initiative (SFI, 54.3 million ha), and the Canadian Standards Association (CSA, 73.4 million ha). Certficación Forestal (CertFor) in Chile and Certificação Florestal (CerFlor) in Brazil, which are recognized by PEFC, have 1 531 239 ha and 762 657 ha enrolled, respectively.

Table 2. Major Forest Certification Systems in Americas and Europe, 2007

System	Distribution	Area (ha)
Programme for Endorsement of Forest Certification (PEFC)[1]	World	196 050 829[1]
Forest Stewardship Council (FSC)	World	84 291 464
Sustainable Forestry Initiative (SFI)	Canada, USA	51 600 000
American Tree Farm System (ATFS)	USA	12 238 191
Canadian Standards Association (CSA)	Canada	69 200 000
Certificación Forestal (CertFor)	Chile	1 531 239
Certificaçao Florestal (CerFlor)	Brazil	762 657

[1] Includes 73.4 million ha of CSA in Canada, 54.4 million ha of SFI in U.S and Canada, 1.5 million ha of CertFor in Chile, 0.8 million ha Cerflor in Brazil, 8.5 million ha in Australia, 56.5 million ha in Europe.

Sources: www.aboutsfi.org, www.fsc.org, www.pefc.org.

Forest certification was largely developed as a means to encourage sustainable forestry in the tropics. However, about 95% of currently certified forest area is in the northern hemisphere of the world. In the Americas, only about 5% of the certified area is in Central and South America. Until the Brazilian and Chilean certification schemes were initiated in 2002, forest certification in Latin America was only provided by FSC. As of February 2007, the Forest Stewardship Council (FSC) had provided 875 certificates covering more than 84 million ha in 76 countries. This included 383 certificates and 36 947 860 ha in 20 countries in America (Forest Stewardship Council, 2006). FSC is generally considered the "greenest" of the various systems based on its strong focus on environmental protection and social concerns, as well its support from environmental nongovernmental organizations (ENGOs) such as the World Wildlife Fund and the Rainforest Action Network. Brazil and Bolivia have the largest FSC certified areas in South America, followed by Mexico.

With the implementation of the Brazilian and Chilean certification schemes, many areas of industrial forests, mostly plantations, have been certified in those countries. CerFlor in Brazil and CertFor in Chile are strongly supported by the forest industry in each country (Cubbage *et al.*, 2006).

Forest certification in Europe also has developed the two principal schemes of the Forest Stewardship Council (FSC) and Programme for Endorsement of Forest Certification (PEFC). The PEFC scheme began in Finland, Germany, Norway, Czech Republic, and was initially termed the Pan-European Forest Certification system. The name change was made when it began to recognize individual country systems throughout the world. FSC certification began as an international system and has been introduced in majority countries of Europe (Table 3). PEFC was initiated by some companies and forest owners associations.

Some observers believe that FSC is more appropriate for large forest management units (FMUs) and companies, either public or private. FSC has extensive support from the major ENGOs such as the World Wildlife Fund (WWF) and Friends of the Earth. Forest Stewardship Council does not audit certification practices directly. It gives accreditation and authority for auditing certification to separate certification bodies.

PEFC has often been preferred by small FMUs and forest owners, which form cooperative groups for carrying out certification procedure. It also has

Table 3. European forests certified by certification schemes, at the end of 2006

Country/region	Certification area (ha)	
	PEFC	FSC
Austria	3 374 000	5 039
Belarus		2 501 501
Belgium	248 789	9 636
Bosnia & Herzegovina		20 841
Bulgaria		21 427
Croatia		1 988 480
Czech Republic	1 976 000	22 267
Denmark	26 880	589
Estonia		1 064 004
Finland	22 144 082	9 490
France	4 256 740	15 325
Germany	7 193 844	578 679
Greece		31 526
Hungary		193 166
Ireland		438 360
Italy	637 846	22 108
Latvia	37 860	59 475
Liechtenstein		7 372
Lithuania		1 069 122
Luxembourg	21 630	
Netherlands		162 324
Norway	9 231 700	5 100
Poland		6 579 417
Portugal	50 012	73 612
Romania		1 124 412
Slovakia	336 396	162 899
Spain	565 832	132 055
Sweden	6 943 403	10 444 880
Switzerland	380 846	428 351
Ukraine		1 353 149
United Kingdom		1 692 525
Total	57 425 863	39 509 819

Source: Certified Programs Web Sites

accredited most of the major certification schemes supported by the forest industry associations and organizations in the world.

FSC certification is based on 10 Principles and Criteria (FSC P&C) of sustainable forest management. The first five have socio-economic focus and the remainder an ecological focus. The FSC principles and criteria of SFM were introduced in 1994. However, principle 10, forest plantations, was ratified later. That was due to the absence of experience in certifying forest plantations, disputes around possibility of their certification, and difficulty of exactly determining sustainability of plantations.

The individual principles cover (Forest Stewardship Council, 2000): (1) compliance with laws and FSC principles, (2) tenure and use rights and responsibilities, (3) indigenous people's rights, (4) community relations and worker's rights, (5) multiple benefits from the forest, (6) environmental impacts, (7) management plans, (8) monitoring and assessment, (9) maintenance of high conservation value forests, and (10) plantations. FSC Principles and Criteria are used for all types of forests: tropical, temperate and boreal. These principles can be applied to the forests, which are fully or partly created by artificial regeneration. Principles of Forest Stewardship Council are developed mainly for the forests that are used for producing wood products, although they also can be applied to forests for the production of non-wood forest products or other purposes.

FSC delegates authority to accrediting organizations to develop temporary national or regional standards. Once they are approved, regional and national standards are used by the accrediting organizations, based on its Principles and Criteria. In many countries of Europe, including Russia, Ukraine, Poland, Sweden, and Germany, national working groups have been formed which elaborate national standards of forest certification. In the Russian Federation there is a national working group and also regional working groups, which are engaged in development of standards for individual regions - for example, working group which develops the standard for Komi Republic or Krasnoyarsk region.

As of June 2006 there were 39 FSC national initiatives in the world and 10 applicants, most of them in Europe. There are also 26 endorsed forest management standards and 6 applicants, mainly in northern countries, under FSC scheme. There were 640 FSC members in 79 countries as of June 2006; 16 certification bodies had FSC accreditation plus 10 applicants.

The PEFC certification scheme is similar to FSC. It also applies functional approach and is based on criteria of sustainable forest management. PEFC certification was first developed based on criteria of Helsinki process, so is more consistent with the international SFM C&I format. Some observers believe that the application of PEFC forest certification scheme is cheaper than FSC, at least in Europe. In several European countries with many small domestic FMUs, PEFC was promoted as a more practical alternative because it was oriented more to small forest owners (Khannu, 2000).

The PEFC scheme unites the national certification systems of the European countries. Now it also recognizes American Sustainable Forest Initiative (SFI), Canadian Standards Association (CSA), Australian Forestry Standard (AFS), CertFor in Chile and CerFlor in Brazil certification systems. It also consolidated main structure bodies of forest sector of Europe (Confederation of European forest owners, European confederation of woodworking industry, Confederation of European Paper Industry, European Association of Forest Trade, Union of European Forestry). PEFC created conditions for mutual recognition of the national certification systems and the individual countries. It is a voluntary initiative of private sector, which is directed on sustainable forest management at national level. PEFC certification confirms management and use of forests in accordance with Pan-European criteria of sustainable forestry. When the national system implements minimum requirements of PEFC, an applicant on certification in the country can get a certificate and acquires right for PEFC logo use.

4. Impacts of forest certification

All the forest certification standards have environmental protection as a major focus - perhaps the major focus. There is a plethora of standards designed to protect the environment and biodiversity during forest operations, require the use of best forest science, and monitor impacts of forest practices. Empirical evidence about the impacts of forest certification systems is modest, since they are new and estimating regional impacts is difficult.

Two recent surveys of certified forest lands in the United States found that environmental practices were better under forest certification schemes. The Texas Forest Service found that implementation of best management practices (BMPs) was statistically higher when the timber was delivered to a Sustainable Forestry Initiative (SFI) mill. A Manomet Center for Conservation Sciences study found that landowners who were certified sustainable under either SFI or FSC had significantly stronger biodiversity practices than landowners not certified. Furthermore, they concluded that there was no difference between FSC and SFI in terms of the overall biodiversity practice scores. Rickenbach and Overdevest (2006) assessed certification expectations and satisfaction with FSC certification in the U.S. The found that "signaling" benefits of getting better recognition for one's forest practices and public relations were ranked highest with the highest satisfaction, exceeding expectations. Participants had the greatest expectations for market benefits, but received less satisfaction with those. The category of "learning" about new forest management practices ranked third in expectations and satisfaction. However, the differences among these categories were moderate (Cubbage *et al.*, 2006).

Several international studies have examined the effectiveness of forest certification of FSC and PEFC. This includes a series of World Wildlife Fund European Forest Programme studies in Latvia, Estonia, Germany, Russia, Sweden, and the UK. These include individual country reports, and are summarized in a recent newsletter (WWF, 2005). In total, they analyzed 2817 Corrective Action Requests made in those countries, covering 18 million ha of forests. The WWF summary concluded that FSC certification improved the conservation status and enhanced biodiversity levels in forests. This included consistent implementation of Environmental Impact Statements (EISs); identification, mapping and management or protection of natural areas and biotypes; increased deadwood levels; more natural regeneration to favor species diversity; and restoration of threatened forest types. Better economic outcomes included better game management; better planning and long-term sustainability; better monitoring of objectives; improved marketing and product tracking; and improved recreational, cultural, and historical benefits. Social benefits included better implementation of health and safety legislation; better equipment training; and public safety improvements (Cubbage *et al*., 2006).

The WWF (2005) International reports indicated that FSC certification has saved and increased biodiversity, mostly through the identification and improvement of high conservation value forests (HCVFs) and other natural habitats protection. Consequently, old-growth forests will not be irretrievably lost because of poor forest management. Certification also resulted in the improvement of rare, threatened, and endangered species protection because of registration of Red List species and increase of general level of forest workers knowledge. FSC certification resulted in the improved estimation of ecological influence and introduction of planning of economic activity at landscape level based on ecosystem approach, which is new in many Eastern European countries. Soil and water resources protection improved, as did utilization and less wood waste in timber harvest areas. Certification improved the level of knowledge and protection of forest workers concerning the use of chemicals. Chemical wastes related to the timber cuttings now are gathered and taken out with the use of environmentally sound technologies.

Social improvements with FSC certification have been introduction of better labor and health protection at level of cutting areas. Forest industry remains one of the most dangerous industries, so health and safety is a key element of socially sustainable forest management. Another important improvement became involving of all stakeholders and local people in the process of planning of forest management activity. Observance of FSC certification requirements at local level is provided with additional training of personnel on proper questions for community involvement and interaction (Artemjev *et al.*, 2006).

Basic economic effects of FSC certification are improved planning quality, including keeping of the proper documentation, monitoring and confirmation of reduced timber harvests in the long-term. A benefit in Russia has been an observance of legislative requirements and timely tax payments (Artemjev *et al.*, 2006).

The first certification efforts conducted in Ukraine and some other countries of former USSR found some general issues that exist in forestry, such as: high level of centralization of forest management functions; conservatism of forest legislation, which have strict formal norms and rules of forest management and forest use; and problems of adaptation of part of forestry workers, which are trained on principles of the socialistic planned-distributive system, to conditions of market economy (Kravets, 2002).

At the same time, potential advantages and stimulus of introduction of forest certification in Ukraine were identified. Some of them are: integration of forest policy of Ukraine into Pan-European process of forest conservation; internal and external motivation of improvement of forest management practice; orientation of marketing policy of state forestry enterprises on foreign markets of forest products; long-term relationships with foreign companies, which are recommended as reliable partners, including investment obligations; and aspiration to collect confirmation of high level forest management from independent international organization (Kravets, 2002).

Experience of forest certification in the Ukraine, in accordance with the requirements of FSC standards allowed us to find out both positive and negative components of certification of national forestry enterprises (Kovalyshyn 2006). Positive components are:

- *socio-economic*: conformity with national legislation in forestry; presence of the proper ownership and use rights and absence of conflicts which are related with forest lands ownership; free access of local communities to resources of the common use (brushwood and non-wood forest products); good theoretical training of forestry workers in relation to requirements for health and safety regulations; ensuring of workers' rights to organise and negotiate with employers and existing of trade-union organizations of forestry workers; and that harvest volumes do not exceed an annual increment;
- *ecological:* a presence of good natural regeneration in the forest; a presence of the different protected territories within every forestry enterprises; absence of chemicals use in many forestry enterprises; limited use of exotic species; genetically modified organisms are not used; presence of the standardized forest management plans; and high-quality monitoring of the sanitary state of forests.

At the same time, there were some non-conformances in forest management of national forestry enterprises and FSC P&C:

- *socio-economic*: a presence of considerable volumes of illegal cuttings; absence of publicly accessible documents about forest management and information about forest policy that is carried out by forestry enterprises; absence of a wide process of stakeholders consultations during process of drafting of forest management plans; poor condition of forest roads; and insufficient use by forestry enterprises of non-wood forest products and recreational possibilities;

- *ecological*: absence of a system on data collection about the presence of rare and threatened species of flora and fauna; ignorance of these species by most workers which work in forest; ineffective protection of streams, especially in mountains; occasional presence of considerable soil erosion as a result of forest operations; and absence of monitoring of rare and endangered species of plants and animals and the influencing of forest operations on them.

Obviously, subsequent efforts in forest management systems in the Ukraine need to be directed toward the removal of the non-conformances, strengthening positive practices, and liberalization of forest management process.

5. Forest certification costs

Certification costs influence certification adoption and the value of forest products and forest land. The lack of transparent and clear information on certification costs often discourages potential users. Some observers feel that certification costs are so high that it will be economically unprofitable, but others contend that costs will not influence on total costs of forest products.

Costs depend on factors such as the certification scheme, an enterprise's production structure, the FMU and forest ownership size, protected area and HCVFs, type of certification, auditors, and natural factors, especially the geographical location of forests. Costs for the areas of a few thousand hectares can be a fraction of those for areas of a few hundreds hectares. Areas of mostly HCVFs often cost less than more intensively managed forests to certify. Individual certification is usually more expensive than group certification per ha. Also, foreign specialists and auditors increase costs compared to local expertise.

Artemjev *et al.* (2006) note that economic impacts can be divided into direct and indirect. Indirect impacts on forest management are difficult to measure, but some studies have begun to address this. Costs of conducting forest certification in Europe range from $U.S. 0.15 to $U.S. 1.50 per ha depending on a country and factors mentioned above. Forest certification in Eastern Europe has incurred costs ranging from $0.10 to $0.40 per ha, depending on the above mentioned factors and also on competitiveness of forest certification services market (Kovalyshyn, 2006). The more certification bodies work in a market, the less are costs of certification audits.

PEFC certification in Europe is considered cheaper than FSC, and that is why it is more acceptable for small forest owners. At the same time, large-scale logging companies or state forestry enterprises, which harvest substantial volumes of wood, often prefer FSC certification. FSC certification is considered economically effective when the area of the highly productive forests under certification exceeds 100 ha and low productive – 10 000 ha (Upton, 1996).

FSC also offers special certification for small, low intensity managed forests (SLIMFs), and uses simplified, less formal procedures. SLIMF forests must have a small forest area (100-1000 ha) and low intensity of forest operations (use of calculated cutting area on no more than 20% of the forest).

The cost of forest certification depends on cost of three constituents: (1) forest management certification audits (direct costs); (2) improvement of level of forest management and timber harvesting to the necessary standards (indirect costs); and (3) certification of chain-of-custody. The direct costs on forest certification depend on the availability of national or nearby certifiers and audit organizations. Conducting a high-quality certification assessment depends on the quality of the forest enterprise or forest owner, and the developed and transparent forest management system. An effective environmental management system reduces the amount of audit preparation and decreases expenses of certification.

Practice shows that direct costs of certification are similar in the American countries and in Europe. At the same time, indirect costs on the improvement of forest management level are often higher in developing countries and countries with economy in transition, in particular Eastern Europe. In closing out of non-conformities to meet SFM P&C, forest enterprises and forest owners often have to modernize a timber harvesting practice, build forest roads, buy a necessary protective equipment for workers, and improve many other facets of the operations. This results in considerable additional costs.

In Russia approximately 25% of all costs of company on certification are for conducting of audits. About 75% of the costs cover various improvements to satisfy the certification requirements. About half of these cover capital expenses (modernization of technologies and protective equipment, utilization of wastes and other), and the rest are spent on different consultations and preparation of new documents for forest management, which are necessary for the certification process (Artemjev *et al.*, 2006).

We certified our state and university lands in North Carolina, USA. Our monitoring of this experience indicated that total direct and indirect costs for forest certification for such relatively small ownerships were significant and much greater than those cited above for Europe. Total costs were about $1.25 per ha to $9.16 per ha for initial certification, and $0.61 to $4.53 per ha per year to maintain certification. Initial certification costs ranged from $0.73 to $9.23 per ha for the audits. We found that other U.S. organizations had initial certification audit costs ranging from $0.31 per ha to $3.30 per ha, for ownership sizes ranging from 225 000 ha down to 64 000 ha.

Average total costs per acre for the North Carolina forests were inversely related to land ownership size (1 800 ac to 11 000 ha). The costs of certification were greater for small forest owners (North Carolina State university and Duke University) than the large state Division of Forest Resources land area because auditing and preparation costs were spread over fewer acres. In all these cases, the costs for both FSC and the industry sponsored Sustainable Forestry Initiative (PEFC) system were similar (Cubbage *et al.*, 2007).

Forest certification efforts can be paid by external sponsors (grants) or by the organizations seeking certification. In Ukraine and Russia, as a rule, forest enterprises paid for forest certification with their own funds. In other cases, foreign companies, which co-operate with national enterprises and which buy their forest products, have paid for certification.

Forest certification is being developed by private business. However, in order to protect the interests of domestic producers, the state could render political and financial support for independent certification bodies. Examples are the Canadian government initiative of introduction of national system of certification (CSA), Finnish government support for their country's own forest certification system, and support of the FSC initiatives by the government of Netherlands.

6. Computing certification costs

From the studies reviewed above on forest certification in Ukraine, Russia, Poland (and North Carolina), one can conclude that the costs of forest certification may be computed using the formula (Kovalyshyn, 2006):

$$C_{total} = C_{pa} + C_{ma} + \sum_{i=1}^{n} C_{sa} + C_{is} + C_{tm},$$

Where:

C_{pa} – costs of previous audit

C_{ma} – costs of main assessment

C_{sa} – costs of surveillance audit

n – number of surveillance audits (as certificate is issued, as a rule, for 5 years, than number of surveillances is four)

C_{is} – one-time payment for issuing of certificate

C_{tm} – payment of technical support of certification body.

If an enterprise is reassessed after 5-year periods, then costs of pre-assessment are excluded of this formula because of absence pre-assessment in reassessment certification process.

The cost of previous audit includes: preparation costs of auditors' team; traveling costs of auditors' team; food and accommodation of auditors' team; assessment costs (which includes field visits, documentation review, and stakeholder consultation); costs on preparation of report from pre-assessment. Costs also depend on the number of the attracted auditors and local experts. As a rule, there is one auditor and one local expert, who is a specialist in forestry or ecology, who is involved in the previous audit.

If certification audits are conducted by non-local certification bodies, there are often added costs on translating of documents into the national language. On the other hand, there are costs of translation on one of the official languages, which are used by Forest Stewardship Council, if certification is conducted for this scheme.

The cost of main audit includes: costs on preparation of the adapted checklist; traveling costs of auditors team; stakeholder consultation process; food and accommodation of auditors team; assessment costs (which includes field visits, documentation review); costs on preparation of main assessment report; costs of peer-reviewers. As well as during previous audit to the general costs often include translation costs. Surveillance audits, as a rule, include those costs, for that and the previous audit.

For reducing of costs it is possible to offer following recommendations: reduction of participation of external experts in the process of preparation to certification and subsequent realization of corrective actions; use of group certification; and use of SLIMF certification with simplified procedures of audit and monitoring for small forest owners. Application of SLIMF will be allowed once or twice, reducing costs on certification.

As mentioned above, the greatest costs maybe for improving the level of forest management. At the same time, an increase in the efficiency of forest management and forest use as result of forest certification may allow greater production and pay for some expenses. In some countries, for example in Poland, costs of improving forest management during certification were less than the benefits from certification. The WWF Russian representative's office provided costs of forest certification for an average forestry enterprise in Russia with area of 160 000 ha, and a harvesting extent of about 180 - 200 thousand cubic meters. Average certification costs were 1 - 1.5 Russian roubles per cubic meter of round wood and in 2 – 2.5 times per cubic meter of pulpwood. Cost of certified wood was 5% to 10% more than for non-certified wood. Sociological survey data indicate that up to 40% of users agree with such additional cost are worthwhile (Rusova *et al.*, 2001), although they may not pay the costs for higher products.

Experience of certification in the European countries shows that a gradual increase in prices of certificated timber (5%-10%) has occurred. At the same time, prices on the certified products of timber industry grew less (2%-3%). Thus less benefit of certification appears to be conveyed by the Chain of Custody (CoC) process. The small increase of price of eventual products in CoC process in many cases is covered due to the decline of incomes of producers who manufacture furniture, carpentry, etc.

Artemjev *et al.* (2006) affirm that forest certification can also benefit enterprises by cutting of production costs (by way of more effective planning of harvesting, better location of cutting areas etc.); reducing of additional costs (decline of ecological fines and penalties by way of improvement of forest management); increase of profitability of forest management (increase of productivity of forests by way of intensification of forest management and multipurpose forest use); cutting of social costs (increase of efficiency of personnel work, for example reduction of number and duration of outages); increase of labor productivity (by way of higher level of personnel qualification, creation of better labor conditions, decline of employee turnover); and increase of living level of local population.

Preliminary research results indicate that in the first five years, investments in forest management certification will probably exceed return from improved forest management and forest use insignificantly, but in medium-term and long-term prospects on income will exceed costs of certification.

7. Analysis of factors that influence forest certification development

In order to examine which factors influence on development of forest certification in the world, we carried out a simple correlation analysis between the area of certificated forests (y) and independent variables (x_i), which represent potentially important forestry and economic indexes. So, forest certification may be represented as:

$$y = f(x_i),$$

Where:

y – area of certified forests in every country
x_1 – total forested area, 000 ha
x_2 – forests per capita, ha
x_3 – share of public forests, %
x_4 – population, million people
x_5 – GDP, $ billion
x_6 – income per capita, $/year
x_7 – export of forest products, $ 000
x_8 – import of forest products, $ 000.

A sample of 58 countries of the world with forest certification was used. Some of necessary data were presented in Table 1. Data were taken from FAO, WTO and certification programs web sites.

For analysis we made simple regression model, which is described by a linear function:

$$\hat{y} = b_0 + b_1 x,$$

Where:

y – dependent variable
x – independent variable
b_0, b_1 – parameters of regression model.

The results of correlation analysis are presented in Table 4.

Table 4. Correlation connection between certificated forests area and chosen independent variables

Correlation coefficients, r_{xy}	Independent variable, x_i							
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
	0.3918	0.5604	0.0084	0.0720	0.4597	0.4199	0.8659	0.4159

The analysis indicates that export of forest products (x_7), forest area per capita (x_2), gross domestic product (x_5) and incomes per capita (x_6) are positively correlated with the area of forest certification. The area of certificated forests is associated less the total forest area and import volumes of forest products. The area of certificated forests was not significantly correlated with the share of state forests or the population of the country, perhaps suggesting that certification is more closely related to private sector activity. Certification area was relatively largest in countries that export the most forest products.

Consequently, it goes out that the factors of population and state forests share little influence on introducing of forest certification in the world. This proves the statement that in certification of forests is interested mainly private business. Certification spreads the most rapid rates mainly in countries, which export forest products, otherwise the most requirements to certificate put countries which mainly import forest products.

8. Certification merits and debates

Forest certification involves several sectors – producers or forest owners, consumers, and the certification body. Being a market tool, forest certification is called to provide support and better access to the markets. Significant attention is paid to ecological characteristic of products; to protect access of producers to resources and capitals; to decrease ecological, economic and social risks. Additionally, introduction of forest certification can increase of competitiveness of products and profitability of forestry; application of new more accomplished management technologies; users trust of certified products; support by national and international environmental NGOs, and formation of favorable investment climate in the forest sector of economy (Kovalyshyn, 2002).

However, forest certification has plenty of controversy. Some people believe that forest certification is non-tariff trade barrier, especially in European countries (Synyakevych, 2001; Strakhov,1998). It also can appear as discriminatory factor in relation to developing countries (Synyakevych, 2001). Through prevalence of forest certification mainly in the developed European and North American countries it is often called “rich man’s club” (Nussbaum *et al.*, 2005). The organizations that finance FSC and some other international non-government nonprofit institutions, which are engaged in forest certification process, may include leading international companies – producers of aluminium, plastics and new composition materials for building and joiner's production, which seek to price wood out of world markets (Strakhov, 1998).

Some discussion suggests that firms or governments in developing countries feel that certification is being promoted or required by developed countries so that the developed countries can compete better, due to their presumed technological and managerial advantages (Cubbage *et al.*, 2006). Another concern is that high fixed costs of certification put smaller landowners at a disadvantage compared to large, industrial producers. There are large debates about the social values included in forest certification standards, at least with FSC; the environmental rigor of different systems; what practices are regulated and how much; and the on-the-ground

impacts or improvement in forest practices. A fundamental critique from environmentalists is that some systems are merely "greenwash" to cover up the same old practices. On the other hand, some industrialists suggest that they are substantive, but only required due to "greenmail" direct action campaigns and protests at a firm's stores, which extort adoption of certification systems to prevent loss of sales or damage to corporate image (Cubbage *et al.*, 2006).
As basic drawback of certification we should reiterate its relatively high cost. Also certification has not been able to spread significantly in the regions of the most catastrophic destruction of forests.

9. Conclusions

Forest certification is new market tool of forest policy, which was based on environmental programs for providing of sustainable development of forestry. Initially, this policy instrument was developed to combat catastrophic destruction of tropical forests and to limit illegal wood in the world market. The application of forest certification quickly spread to temperate and boreal forests, which now comprise more than 90% of the certified area. Forest certification is widespread now in the developed European and North American countries. In Europe, certified forest products are required often from countries with limited forest resources. Export of forest products is the most significant factor associated with development of forest certification.

A primary role in promoting forests is played by public associations, non-government organizations, forest owners unions, and business representatives. The influence of governments in development of forest certification has been limited, with a few exceptions. Government agencies are mainly responsible for conservation of forests, protection of biological diversity, establishment of best practice standards, but not responsible for certification process of forest use and forest products, which are conducted by private business.

Forest certification costs include direct audit costs and indirect forest management changes and correction of non-conformances with the standard. Indirect costs may be as much or more than the direct ones. Major expenses in indirect costs are training and technique improvement, building of forest roads, buying of health and safety protective equipment, preparing the forest management plans, and maps and geographic information systems.

At the end of 2006 North and Central America, with its 162 658 million ha of certificated forests, had leading positions in the forest certification. Europe, with 96 654 million ha, ranked next. Forest certification in Europe is being developed for two schemes – FSC and PEFC, while as in Americas there are at least six main forest certification schemes. In many countries of Americas and Europe, forest certification has developed parallel schemes. The process of joining PEFC is protracted, as it is necessary to develop and approve the national system of certification first, and then seek approval from PEFC. Initially, Pan-European Certification was developed for small private forest owners in Europe, but later it expanded all types of FMUs and owners, as reflected in its new name of Programme for Endorsement of Forest Certification. The FSC scheme can be used at once in countries or regions seeking to do so. It is considered to be more expensive than PEFC in Europe, but seems to be similar to the other systems in North America. FSC in Europe was initially directed more to FMUs with large industrial volumes of timber harvesting, but has expanded to large public holdings in Eastern Europe now. Within the framework of 10 principles and criteria, FSC allows development of national standards of forest certification.

In Europe, Finland has the most certified area with 22 377 million ha, of which almost all is certified for PEFC. In the Americas certification is largest in Canada, followed by the USA. These two countries have approximately of 85% of Americas' certified forests. In Europe, the most increase in introduction of forest certification has occurred in Russia, where for period from 2001 to 2006 the area of certificated forests grew six-fold, and also Byelorussia, where 2 501 501 ha were certified in 2005 to 2006, or one-fourth of its forested area.

Based on current trends, forest certification in Europe and Americas will continue to develop and be adopted at a moderate rate in the future. The most prospective European countries are Russian Federation, Byelorussia, Romania, Bulgaria, and Slovakia. In spite of various debates about forest certification, it is possible to affirm that it is the appropriate instrument of forest practices improvement and sustainable forest management. Within 15 years, it has grown from only a concept to the dominant method to identify, measure, monitor, and ensure sustainable forest management in Europe and North America. And forest certification will be extended more to the neotropics in South America, and to Eastern Europe. Improving the effectiveness of forest certification and its implementation will be an opportunity and challenge for the forest resource profession for decades.

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POLICY TOWARDS SFM AND WELL-BEING OF LOCAL COMMUNITIES IN THE UKRAINIAN CARPATHIANS

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Abstract

The well-being of rural local communities in forested mountain regions of the Ukrainian Carpathian Mountains depends directly on sustainable development of forestry. The main steps, which should be done towards strengthening SFM and the local economy in this region are: recognition of unique environmental value of Carpathians and its important role for local communities on official level; improving existing mountain policy and mountain law, development of a sound conceptual framework for forest policy in new political and economic conditions; rethinking role of forest administration from covering all the areas of activities in forest sector to keeping leadership in the most important professional areas; state support of SFM by creating system of new economic instruments; stimulation of economic activity, which doesn't have the harmful influence on environment and oriented on new jobs creation for local communities, compensations for environmentally sound economic activity and payments for ecosystem services.

***Keywords**: participatory forest policy, mountainous communities, sustainable forest management, Ukrainian Carpathians*

1. Introduction

The forested area of Ukraine is unevenly distributed between four distinct temperate forest regions: the Carpathian mountain forests, the northern forests (*Polissiya*), the forest steppe and the steppe. The dry mountain forests of the Crimea proceed towards Mediterranean climatic conditions and are often classified as a separate forest region.

The mountains are home to a wide array of natural resources, biological diversity and rich cultural heritage. The location of the Carpathian mountain forests has global environmental significance for the densely populated and highly urbanized European continent. The Ukrainian Carpathian Mountains are found at the center of the "European-Mediterranean Mountain Mixed Forest" which is among the WWF's Global 200 Ecoregions. The Carpathians, covering only 4% of the country's territory, produce a third of the forest resources of Ukraine, what is especially important for local economy development.

2. Threats to forest sustainability and local communities' challenges

During 18-19 centuries the older mixed wood forests on large areas were replaced by the monocultures, which cannot fulfil the same important ecological role, especially for water catchments and erosion control. In 1950th after the World War II harvesting exceeded sustainable rate two-three times (Gensiruk, 2002). This resulted in the decrease of water-protective functions of the Carpathian forests, intensified erosion processes, decreased endurance of spruce stands and contributed to the occurrence of floods and windfalls in the mountains. In the 19th

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century there were 6 floods in the Carpathians, in the 20^{th} century – 17, and one flood has already caused serious damage in the 21^{st} century. In the last decades, direct annual loses from floods comprised nearly 2.23 million euro yearly, with 73 million euro in 1998, and 43.8 million euro in 2001 (Lycur, 2003).

Today the tendency is to decrease logging in the Carpathians. However, the forests are still threatened in some cases by logging practices without appropriate modern equipment, over-harvesting in the past, overgrazing, chemical contamination and atmospheric deposition resulting in the decline in forest health and vitality, in soil erosion, destruction of native vegetation, degradation of wildlife habitat and the subsequent loss of biodiversity. Although recent forest policy has aimed at restoring forest resources potential, the emphasis has been given to the creation of forest plantations, which are less stable ecologically. Consequently, the decreasing increment of monoculture spruce plantations is particularly observed in matured and over matured stands. Moreover, intermediate and selective timber cuttings often do not respond to the principles of sustainable forest management (Nijnik, 2004), and the use of manual logging or mechanized extraction with obsolete equipment often results in damage of natural regeneration and in soil compaction (Bihun, 2005).

Recent national forest policy has aimed at restoring the unfavourable condition of the timber resource and subsequent reduction of the annual felling volumes, a larger emphasis has been given to expansion of the forest area, and replacing the clear cuttings systems by selective shelterwood systems.

Many social, environmental and economic problems exist in the region: high rate of unemployment, migration of population, and weakening of rural communities. Economic problems include the loss of job opportunities, the loss of value-added manufacturing, illegal logging, export of raw material, and depopulation of rural areas. Other problem is land acquisition and non-regulated development of recreational areas.

3. Legal instruments on mountain areas

Several European laws include legal and policy mechanisms for improving well-being of mountain communities by law mandating resource transfer, investment in health and education, reinvestment of profits from the exploitation of mountain resources, diversification of economic activities, and incentives for the development of the appropriate technologies. Legally mandated investments in livelihood strategies could strengthen local communities and reduce out-migration and pressure on fragile resources such as forests and farmland. In Ukraine "The Law on the Status of Mountain and Human Settlements, January 12, 1995" seeks to protect the material security of vulnerable mountain population by ensuring the social and economic development of mountain settlements. The law calls for provision of subsidies, loans, additional payments (20% from basic payment) to student's scholarships, pensions from central government, as well as technical and financial infrastructure development.

The government of Ukraine initiated and together with governments of Rumania, Serbia, Montenegro, Hungary, Slovakia, Czech Republic has signed Carpathians Convention "About protection and sustainable development of Carpathians". As a model for this document the Alpine Convention was chosen. Today it provides the protection of natural resources with a broad public involvement in a neighbouring mountain region. Signing the Convention the sides decided to cooperate for the protection and sustainable development of the Carpathians with the goal to improve the life quality, consolidation of local economies and communities, saving natural resources and cultural heritage. In the Article 13 of this Convention the participants have agreed to carry out the policy, aimed at increasing of environmental awareness and improvement of public access to the information concerning protection and sustainable development of Carpathians and assisting in educational arrangements and programs. The participants of Convention are carrying out the policy that guarantees the participation of the local people in decision-making concerning protection and sustainable development of Carpathians.

4. Forest management

The mountain forests are important source for economic and social development (wood and non-wood products, renewable energy resource, recreation) and ecological significance (watershed protection, erosion control, biodiversity conservation), which is taking first priority now.

The conditions for natural forest regeneration in Carpathians are better than in other regions of Ukraine but afforestation and reforestation (Table 1) is widely used to achieve better tree composition to restore the original types of forests and to form uneven aged forests.

Forest fires don't make serious damages in the region. They more often happened in the South of Ukraine. But last year the special forest service troops from all the regions of Ukraine (including Lviv region) made big efforts to restore burned forests in the Kherson oblast (south of Ukraine). Illegal cuttings are still a problem. In 2007 it was registered 2129 cases of illegal logging with 7485 cubic meters harvested in four Carpathian oblasts.

Table 1. Reforestation and afforestation in the Carpathians, 2007

Oblast	Forest restoration, total, thousand ha	Planting, thousand ha	Natural regeneration, thousand ha
Transcarpatia	2.3	1.5	0.8
Iv.-Frankivsk	2.5	1.1	1.4
Lviv	3.2	2.4	0.8
Chernivtci	1.5	0.6	0.9
Totally, Carpathians	9.5	5.8	3.7
Totally, Ukraine	**117**	**63.7**	**53.3**

As it can be seen from data of forest inventory in 1996 an 2002 during this period the state of the forests (area, growing stock, age structure etc.) improved.

The activities of forest enterprises in all the parts of Carpathian region are financially profitable (Table 2). Because of introducing new machinery and technologies the economic efficiency has increased during the last years. It's seen from the data on amount of products sold. As we can see in the Table 2 the internal sources are the main sources of financing for the state forestry enterprises.

As one of the follow-ups of the Concept (National Strategy) of Biodiversity Conservation in Ukraine (1997), the Pan-European Biological and Landscape Diversity Strategy, as well as the Law of Ukraine "On the state Program of Development of National Ecological Network for the Years 2000-2015" have been approved by the Parliament (2000). In 2004, the Parliament of Ukraine adopted the new act "On the Eco-net in Ukraine" which establishes the principles of the creation, conservation and use of the ecological network of nature protected territories.

Table 2. Financial results of state forest enterprises in the Carpathians, 2007

Oblast	Area, ha	Products sold		Financing of forestry, thousand hryvnya	Sources of financing, th. hryvnya				Profitability, %		Net financial results, thousand hryvnya	
		Thousand hryvny	2007 to 2006, %		Own sources	Natio-nal budget	Spe-cial fund	Local bud-gets	All acti-vities	Pro-ducts sold	All activities	Loss
Transcapatia	497.3	149823.9	122.2	70989.1	65284.8	5558.3	116.0	30.0	1.9	5.3	2851.7	0.0
Iv.- Frankivsk	468.9	130554.8	126.5	69326.9	59075.3	9216.3	1035.3	0.0	3.2	4.3	3317.5	0.0
Lviv	521.0	215325.1	123.5	68260.2	57316.5	7439.1	3251.5	253.1	6.5	5.8	4547.1	0.0
Chernivtsi	176.5	110480.1	134.2	29716.1	27004.3	2662.5	49.3	0.0	6.4	8.6	2108.8	196.4
Totally	1663.7	606183.9	125.7	238292.3	208680.9	24876.2	4452.1	283.1	-	-	12875.1	196.4

The total number of nature protected areas has increased by nearly double, primarily because of the creation of protected areas of relatively new types – biosphere reserves, national natural parks and regional landscape parks. Today, there are 7140 nature protected areas in Ukraine, with a total area of 2776 thousands ha (4.6 % of total area), and many of them are located in the Carpathians (Table 3). The core nature protected areas in the Carpathians are the national parks the main part of which are opened to public, biosphere reserve, and nature reserves, which have more strictly limited access.

Table 3. Core nature protected areas in the Ukrainian Carpathians (Nijnik *et al.*, 2007)

Type of nature protected areas	Name	Year founded	Area, hectares
Biosphere reserves	Karpats'kyi	1968/1992	57 800
Nature reserves	Gorgany	1996	5 344
National parks	Karpats'kyi	1980	50 303
	Synevir	1989	40 400
	Vyzhnyts'kyi	1996	7 928
	Skolivs'ki Beskydy	1999	35 684
	Uzhanskyi	1999	39 159
	Gutsulschina	2002	32 271
	Galytskiy	2004	14 685

The diversity of protected areas helps to protect different landscape and biodiversity values. Considerable part of this protected areas are created on the forest areas.

5. Forest certification and SFM measures

In 2005 “SGS QUALIFOR” started the forest certification process in Lviv region according the FSC criteria and principles and in 2006 all state forest enterprises received the certificates.

The similar situation is in Transcarpatia (Zacarpattya) oblast. These two regions are leading with forest certification not only in Carpathians', but generally in Ukraine.
Rich international experience shows that forest certification is an appropriate instrument of sustainable forest management, but in case of Ukraine not all the expectations of direct benefits are fully realized. The main challenges concerning the forest certification are:

- Low public level of awareness about what really means that forests are certified
- Forest certification process is expensive, but it didn't bring real financial benefits to the state forest enterprises as it was expected
- Innovative marketing strategies should be introduced to get "green premium" from forest certification.

According to the Lviv Regional Program of the Forestry Development the state forest service gives a priority to the following silvicultural and conservational measures in mountain areas:

- Restoration of original types of forests
- Creation and restoration of protective associations on the upper belt of forest
- Afforestation of the small rivers' banks
- New technologies for eroded mountainsides afforestation
- Damaged forests restoration
- Development of shelterwood systems
- Environmentally friendly technologies of harvesting and lumber transportation
- Forest roads network development (up to 10 km/1000ha)
- Nature protected areas network development.

6. Conclusions

The need to not only protect highland environments but also to ensure the economic and social well-being of mountain communities is more and more recognized internationally, but it is not as widespread as it is needed for sustainable development of mountainous territories around the world. The rural communities' sustainability in mountain regions – in Ukraine it's first of all Carpathian Mountains – depends directly from sustainable development of forestry sector.

The list of challenges includes the loss of jobs, low income, and limited possibilities for education, depopulation of rural areas, illegal logging, and decrease of forest productivity. Other important problem is non-regulated development of the recreational areas by non-local business structures, land acquisition that ignore local cultural traditions including traditional landscape planning and land use systems.

The main steps, which should be done towards building new forest governance system and strengthening the local economies on the conditions of Ukrainian Carpathians, are the following:

1. Development of a sound conceptual framework for the governance in forest policy in new political and economic conditions. Such conceptual framework should take into account regional policy peculiarities, the main policy actors' challenges, responsibilities, assumptions, preferences and policy positions.

2. The rethinking role of Forest Service from covering all the possible areas of activities in forestry sector to keeping leadership in the most important political and professional areas.
3. The recognition of unique ecological value of Carpathians and its important role for local communities on official level by improving existing mountain policy and mountain law.
4. State support of SFM by creating system of new forest policy instruments.
5. Stimulation of economic activity, which doesn't have the harmful influence on environment and oriented on new jobs creation for local communities, and at the same time compensation for environmentally sound economic activity and payments for ecosystem services.

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SUSTAINABLE FOREST MANAGEMENT DECISION-MAKING IN THE HYRCANIAN FORESTS OF IRAN

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Abstract

The Natural Broadleaf Forests of Iran (i.e. the Hyrcanian Forests of Iran) are located in North of Iran near the Caspian Sea. These forests cover 1.8 million hectares and are completely natural and deciduous. Decision making on forestry management in these forestlands started about 10 years ago. This new concept of forest management is distributed nearly to one million hectare while other forestry planning will move to this way in early future. Statistic data shows that these new forestry management models were not only close to sustainable forest management, but forest management costs also reduced. In this paper, sustainable forest management decision making in the Hyrcanian Forests of Iran during last decade is discussed in details.

Keywords*: Sustainability, decision making, forest management, Hyrcanian forests*

1. Introduction

The total forest cover in Iran is 12 million hectares, which amounts to 8% of total land area. About 1.8 million hectares of these forests are located in North of Iran (Hyrcanian Forests) on the northern slopes of the Alborz Mountains overlooking the Caspian Sea (Fig. 1). The length of this forests strip is about 1,000 km with a width of about 30 km. The forest type and dominant species change as the elevation increases (Fig. 1). The Hyrcanian Forests consist of mixed broadleaf deciduous species (Table 1). Commercial harvesting operations are carried out in northern forests, while all other forests in Iran are non-commercial.

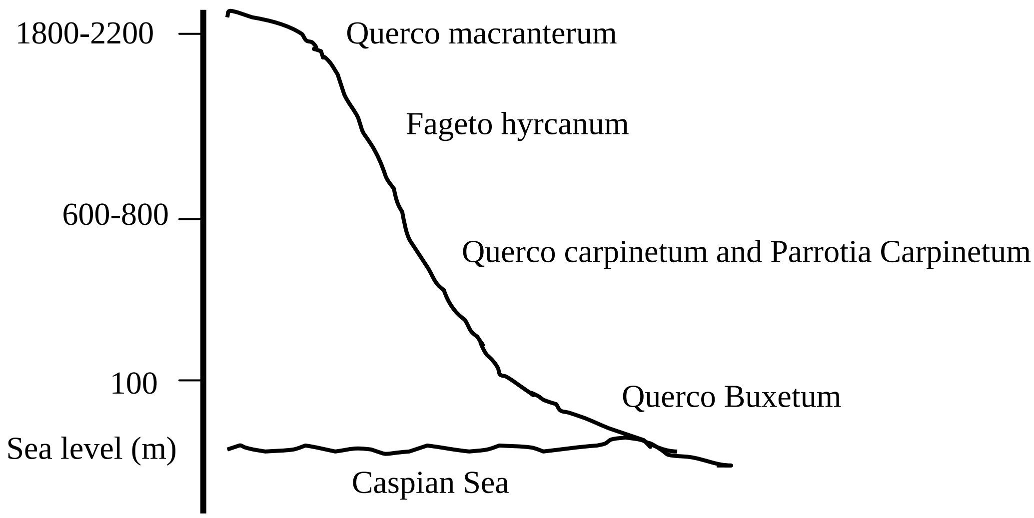

Fig. **1**. The vegetation type associated with elevation in the Hyrcanian Forests of Iran.

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Table 1. Species composition of the Hyrcanian Forests of Iran

Species	Percentage of area
Beech (Fagus orientalis)	33
Hormbean (Carpinus betulus)	31
Oak (Quercus castanaefolia)	8
Alder (Alnus sp)	8
Maple (Acer sp)	7
Persia (Parrotia persica)	4
Lime (Tillia begonifolia)	3
Other species	6

The average standing timber volume is about 210 m³/ha. These forests have an uneven topography and very steep slopes. The region with slopes greater than 100% have been designated as protected areas, where harvesting operations are prohibited. Clear cutting operations are prohibited, except for small areas which are nearly flat.

2. Forest management decision making

50 years ago, all forest and rangelands in Iran were given to government. For this reason, there are no private forestlands in Iran. The scientific forestry planning started nearly 40 years ago with introduction of shelterwood and selection methods. This new managing system, distributed in whole forest regions nearly 20 years. The new concept of natural resource management decision making started ten years ago. The main objectives of this project are as follows:

- forestry management based on sustainable development;
- joining of rural families to forestry activities, conservation and harvesting operations;
- attending to all forest potential sources instead of timber products only.

2.1 Silvicultural system

Two main silvicultural systems introduced in the Hyrcanian Forests of Iran are the shelterwood and selection systems. Both of them put emphasis on natural regeneration; the shelterwood system is trying to regenerate even-aged stands and the selection system is used in uneven aged stands.

By the new concept of forest management decision making, the selection system covers nearly 80% of forestlands while it was only 20% before (Fig. 2). One of the main reasons of this change is finding a silvicultural system which is familiar to natural conservation.

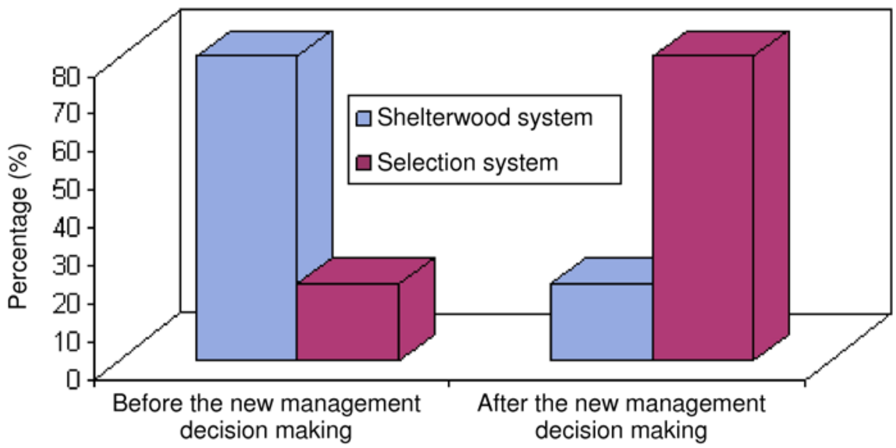

Fig. 2. Silvicultural systems developed in the Hyrcanian Forests of Iran (before and after of new Forest management decision making).

2.2 Harvesting operations

The harvesting operations in these forestlands are divided into two sections: non-mechanized logging system and mechanized logging system. Before the new concept of forestry management nearly 70% of harvesting operations were carried out as non-mechanized system (Fig. 3). In this case, after cutting, felling and delimbing, logs are cut to saw log, quadrangular pieces and fire wood. All of these products were extracted by animals like horses, donkey and mules (Fig. 4).

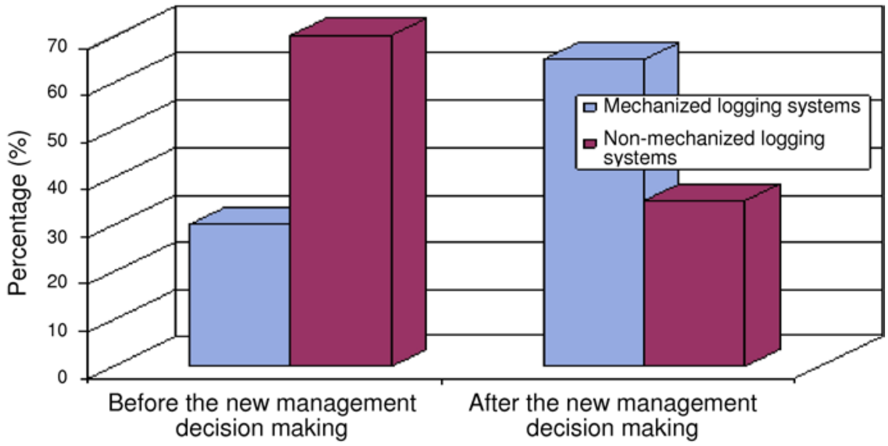

Fig. **3**. Harvesting operations systems in natural broadleaf forests of Iran.

After the new concept of the forestry decision making, the harvesting system moved toward the mechanized system (now its ratio amounts nearly 65 %). In this case the major timber products are logs which are extracted by skidders (Fig. 5). By this new extracting system, it is not only possible to offer the fresh timber products for consumers but the timber values also increased.

Fig. **4**. Non-mechanized logging system.

Fig. **5**. Mechanized logging system.

2.3 Socio-economic situation

More than one million people are living in these forest areas distributed in small villages. The main job of them is animal husbandry and their cattle are grazing in these forestlands. This is very harmful for the future forest stands because natural regeneration will be hindered. For many reasons the Iranian Forestry and Range Management Board decided to move all cattlemen out of forest zones and settled them down in a new complex (Fig. 6-7). In return, by the new law, state and private forestry companies have to employ these people (cattlemen) in their companies as laborers.

Fig. 6. The previous residence of cattle and cattlemen in the Hyrcanian Forests of Iran.

Fig. 7. The new residence of cattle and cattlemen in the Hyrcanian Forests of Iran.

3. Conclusions

Decision making in forest management in the Hyrcanian Forests of Iran started nearly ten years ago. By this new phase of forest management, not only the quality of timber products were developed, but rural families are interested to join the forestry activities and participate in the forest conservation. By following this strategy, it is expected to develop the sustainable forestry management with the lowest risks.

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Session 5. Multidimensional Forestry

EXPLORING OPPORTUNITIES OF FORESTRY IN BRITAIN TO MITIGATE CLIMATE CHANGE

Maria Nijnik and **Bill Slee** [a]

Abstract

Climate change is widely recognised as the most serious environmental threat facing mankind, which has diverse local, regional and global consequences. Many climate policy and research initiatives that focus on carbon uptake are directed towards both woodland expansion and using wood as a substitute for fossil fuels. However, there is a knowledge gap with respect to the socio-economic aspects of carbon sequestration forest policy activities. It is important to identify projects which will be coherent, effective, efficient, widely accepted by the public, and consistent with other aspects of policy for sustainable development. From an interdisciplinary perspective and based on the ideas of ecological economics, this paper addresses the necessity of reconciling sustainable development with carbon sequestration forest policy initiatives. It identifies the importance of placing forestry and biomass production for carbon sequestration in the general context of land use in Britain, where policy reforms and contemporary agricultural change will likely be influential.

Keywords: *Climate change, mitigation, carbon sequestration, forestry*

1. Introduction

Climate change is one of the most important environmental policy issues facing the planet. The Kyoto Protocol (KP) to the United Framework Convention on Climate Change (UNFCCC) was adopted in 1997 and has become legally binding (on its 128 Parties) in 2005 (UNFCCC, 2004). In the light of the KP, the Parties have committed themselves to actions directed towards stabilizing of atmospheric Greenhouse Gas (GHG) concentrations, including those of Carbon Dioxide (CO_2), and the overall reduction target of 8% was distributed on a differentiated basis to individual Member states (EC, 2002a). This target is to be achieved by reducing emissions (reduction of sources) and removing GHG from the atmosphere (enhancement of sinks). Article 3.3 of the KP states that biological sources and sinks enhanced through afforestation[1], reforestation and the decreasing of deforestation rates since 1990 should be used for

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[1] Afforestation is an expansion of forest on land, which more than 50 years ago contained forests, but later, has been converted to other use. Reforestation is a restoration of degraded or recently (20-50 years ago) deforested lands (IBN-DLO, 1999). In this paper, we do not make this distinction.

meeting the commitments during the stipulated period. Since the Conference of the Parties (COP-7 in 2001), afforestation, reforestation, forest management and soil carbon (C) have become eligible climate change mitigation policies. Important carbon sequestration (CS) activities involving forestry also include the increase of area of forest plantations, regeneration of secondary forests, and the production of wood for fuel.

The CS land use activities in Europe are supported by afforestation schemes (EC, 1992) and rural development regulations. The principal forest policy initiatives that increase carbon sinks are recognized as maintaining and/or enlarging existing carbon pools by improving existing forest, its protection and sustainable management, expanding forest area through afforestation (with species adapted to local conditions), replacing fossil fuels with fuel wood from sustainable managed forests, and replacing high energy products with industrial wood products (EC, 1998). Aid for woodland development is provided by the programmes of each Member state, as well as by the EU initiative, in which the European Agricultural Guidance and Guarantee Fund finances up to 75% of the costs. The initiative focuses mainly on marginal agricultural land, 1Mha of which were afforested in 1994-1999 (EC, 1992). The area of EU forests (113Mha) has extended by 3% over the last decade and, if this trend continues, the CS potential of 3.84 Mt C/yr can be achieved during the first commitment period. Taking into account 25 Member states, a technical sequestration potential of 34Mt C/yr can then be reached in the long term (ECCP, 2004).

Moreover, the European Commission (EC) adopted the White Paper that stresses the necessity to raise energy production from renewable sources from 6% in 1998 to 12% in 2010 (EC, 1997), including the increasing use of woody biomass in energy production. Successful implementation of this policy option contributes to carbon sinks provided by standing forests, and also adds to the reduction of CO_2 concentrations in the air from using wood instead of fossil fuel, after timber is harvested.[2] The potential to sequester carbon from short rotation timber plantation (SRTP) development and from substitution of biomass for fossil fuel is in the range of 4.5–9 MtC/yr (ECCP, 2004). Depending on the scale of SRTP development, even higher carbon savings can be achieved in the long run. However, this would require proper incentives and links between the Common Agricultural Policy (CAP) and CS policy measures, particularly concerning changes on set-aside and marginal lands (EC, 2002b). All these activities are supposed to assist countries in coping with the changing climate (and in meeting of their KP targets). In practice, however, existing opportunities are not used in full.

A case study of Britain is considered in this paper. This is a desk-based analysis which is supported by official documentation, including DEFRA (2001; 2006; 2007), FC (2001) and the literature available on this topic (Crabtree, 1997; Milne, 2000; Cannell, 2003). The paper extends the work already done by others by contributing to the examination of carbon sequestration potential within institutional settings of forestry in the UK. We aim to suggest whether it makes sense to encourage carbon sequestration activities in this country and which policy measures might best be adopted. The first section presents carbon sequestration policies. Then, carbon uptake potential is analysed. The importance of proper institutions and public and stakeholders involvement in the development of conditions for creating carbon offsets is considered. The paper concludes by offering some insights into the connection between feasibility of responding to the KP and the level of institutional development in the analysed country, as well as with some ideas for future research.

[2] A continuous process of forest growing, harvesting and regeneration, whilst using of harvested timber as a substitute for fossil fuel, is considered. If energy required for harvesting and processing of wood is not taken into account, the use of timber as a substitute for fossil fuel is a carbon neutral process. The net gain here is the amount of CO_2 that would have been released by burning fossil fuel if not replacing it with wood.

2. Carbon sequestration policies

The UK has one of the best records in the world in coping with GHG emissions. In 2005 UK GHG emissions were 15.3% below base year levels, with CO_2 emissions fallen by 6.4% (DEFRA, 2007a). The commitment of the UK under the EU burden-sharing target is 12.5% GHG emissions reduction for 2008–2012, relative to the base year. Further, a domestic goal of a 20% reduction of CO_2 emissions by 2010 was introduced (EC, 2002a).[3] The goal is to increase the use of renewable energy sources to 10% (currently, about 2.8%) and pay more attention to the expansion of forest and SRTP, in combination with further use of timber as a construction material and as a substitute for fossil fuel (ECCP, 2004). The UK is on track to meet, and surpass, its Kyoto targets. Its emissions in 2010 are predicted to be 23.6% below base year levels, 11.1% lower than required by Kyoto (DEFRA, 2007b). The draft Climate Change Bill is the first of its kind in any country. The Bill and accompanying strategy set out a framework for moving the UK to a low-carbon economy. The documents demonstrate the UK's leadership in coping with the changing climate, and emphasise an importance of investment in low-carbon fuels and technologies, such as wind, wave and solar power, as well as carbon capture and storage (DEFRA, 2007c).

The dynamics in sources and sinks from forestry activities and land use changes in the UK are summarized in Table 1.

Table 1. Trends in emissions due to land use changes and forest activities

Millions tC/year	1990	1995	2000	2005	2010	2015	2020
Forest sink (a)	2.6	2.8	2.9	3.2-3.3	3.1-3.4	2.7-3.0	2.4-2.8
from planting since 1990 (b)	0	0.2	0.3	0.5-0.6	0.6-0.8	0.9-1.2	1.2-1.6
Emission from land use change (c)	8.7	7.3	6.5-8	4.9-7.8	4.1-8.2	2.8-8.4	1.4-8.3

Source: DEFRA (2002) a – carbon accumulation in biomass, soil, litter and in wood products; b – entries from woodlands planted since 1990, excluding in timber products; c – net emissions caused by land use changes.

The UK has one of the lowest percentages of wooded land (11.8%) in Europe, compared with the EU average of 38%[4], but it has significantly expanded its wooded cover in the last hundred years (currently 2.85 Mha, FAO, 2005). The policy of woodland expansion is supported by direct financial instruments in four different programmes, which subsidise between 60% and 90% of the costs. The payment varies across land categories, tree species and distance of the land from settlements. An annual payment also encourages farmers to convert productive land and receive compensation to offset the foregone agricultural income. Subsidies are usually given for 10–15 years, when broadleaved or local provenances are planted, and wood is not harvested for 30 years (Carboninvent, 2004). Individuals, family and charitable trusts and companies own approximately 64% of forestland in the UK, and both on these private lands and on publicly owned forest land, much attention is given to the enhancement of GHG sinks and reservoirs through land use CS activities, including in forestry projects.

[3] A series of clear targets for reducing carbon dioxide emissions have been set out - including making the UK's targets for a 60% reduction by 2050 and a 26 to 32% reduction by 2020 (DEFRA, 2007b).

[4] And to compare with other European countries, such e.g. as Finland 65%, France 23%, Germany 30% or Poland 28%. Only a few countries in Europe, including Ireland, Denmark and the Netherlands have lower shares of wooded area. Share in percentage to the land area in Scotland (16.9%) is higher than the UK average (FC, 2001).

In addition to afforestation initiatives, new woody fibre based crops grown for energy are under development in the UK. Biomass is increasingly being recognised as a renewable energy source with low GHG emissions (Elsayed *et al.*, 2003; RCEP, 2004; Matthews and Robertson, 2003) that can make a valuable contribution to the UK objective of tackling the drivers of climate change (Andersen *et al*., 2005). Biomass is also viewed as an environmentally beneficial land use alternative to conventional food crop production. Greater use of forest-derived biomass for energy is seen as a means of improving woodland management and stimulating rural development (SDC, 2005). The Bioenergy Infrastructure Scheme funded by the DEFRA and administered by the Forestry Commission (FC) was set up to provide grants to farmers, foresters and businesses to help in developing the supply chain required to harvest, store, process and supply energy crops and wood fuel to end-users.

3. The potential for carbon uptake

The maximum rate at which the forests expanded in the UK during the 20th century was about 40kha/yr in the early 1970s, primarily in the uplands (Cannell and Dewar, 1995). However, the establishment of 1.3Mha of mainly monoculture conifer plantations during the 20th century met with considerable objection due to their impact on visual, ecological and environmental components of landscapes (Cannell, 2003). Consequently, from 1950 to 1990 the average rate of forest expansion went down to 19kha/yr. In the future, it will be likely to expand at this steady rate, whilst subsidies will continue to be given to encourage planting of broadleaved species (Carboninvent, 2004). The age structure of forests and declining availability of land suitable for afforestation, as well as public preferences for multifunctional land use, suggest that the net rate of carbon uptake in British forests peaked in 2005.

Today, about 3MtC is sequestered annually by forests in the UK, with 0.5Mt C from trees planted since 1990 (DEFRA, 2001). Carbon sequestration rates per hectare of forests are comparable or slightly better than those in other countries in Europe (Fig. 1), and annual C uptake in excess of 4tC/ha can be attained mainly in fast growing conifer stands and in SRTP.

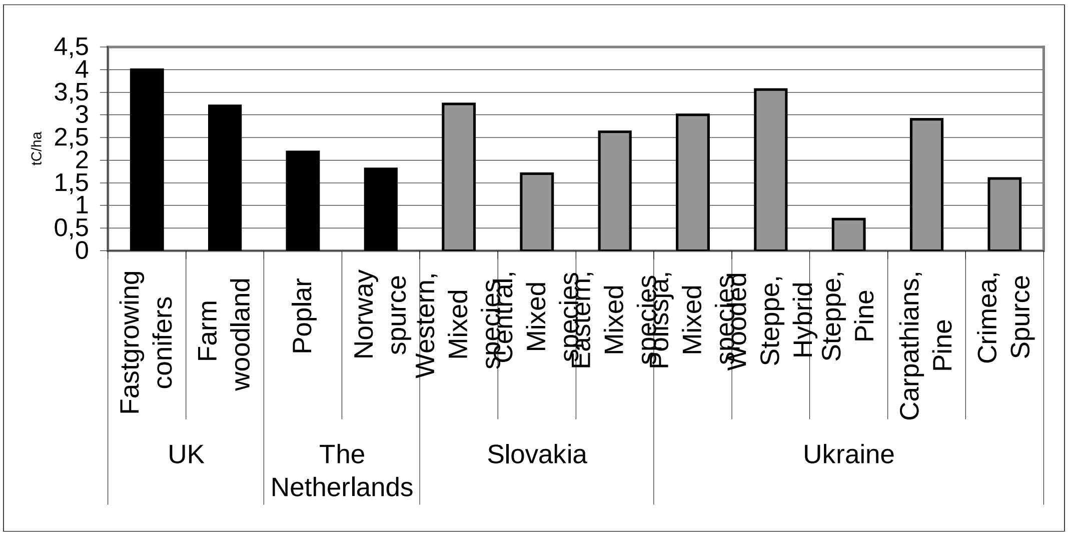

Fig. **1**. Comparison of carbon sequestration rates across countries (mean annual tC/ha)

Source: Based on DEFRA (2001), Crabtree (1997), Slangen *et al*., (1997), Bizikova (2004) and Nijnik (2005).

The largest carbon pools in the UK are in soils (Chapman *et al.*, 2001) and litter which together store some 10Gt C. Total C stock in vegetation is 119Mt, with 95 Mt in woodlands (above ground) (Table 2).

Table 2. Stock of carbon in vegetation in the UK

UK	Vegetation carbon (Mt)	%	% area
Semi-Natural	12	10	32
Agriculture	12	10	47
Woodlands	95	80	11
Other	0	0	9
TOTAL	119		

Source: Milne (2002).

Given an increase of woodlands at a rate of 10kha/yr of conifers and 20kha/yr of broadleaved, the forest sink would be 3.1MtC/yr in the year of 2020, storing over the two decades an extra 50MtC (DEFRA, 2001). The projections indicate that the potential for carbon savings from forestry, timber production and bio-energy could enable avoidance of emissions of about 8MtC/yr in fifty years from now (Tipper *et al.*, 2004, Fig. 2).[5] This estimate comes close to 10% of the amount that is needed to halve UK emissions by the year 2050. To reach this target the UK would require an expansion of woodlands towards 25% of land cover, in combination with use of timber for construction and wood for energy. The target of woodland expansion by itself (6.2Mha, 50% broadleaved and 50% conifer) could provide a carbon sink of about 4MtC/yr for most of the second half of this century (ECCM, 2004).[6] The increasing proportion of timber used in civil construction and engineering could annually create an additional 2MtC sink. The establishment of 125kha SRTP for bio-fuel could enable the production of 10% of electricity from renewable sources, and consequently save nearly 0.6MtC/yr, by the year 2010.

4. Carbon sequestration costs

Van Kooten *et al.* (2004) performed a meta-analysis of studies that estimated CS costs and identified their huge variability across the world. Under baseline conditions of forest conservation for CS, the costs were in the range of €35 – €199/tC and, when opportunity costs were taken into account, the cost range increases to €89 - €1069/tC. An example of CS work in the UK is an economic analysis of willow production in England and Wales (Boyle, 2004). The research provides evidence that SRTP cannot be economic unless grown on set-aside, with establishment grants of £1600 and with yields at or above 10 odt/ha per year. Similar findings were presented by Dawson *et al.* (2005) in Northern Ireland and by Booth *et al.* (2005) in Scotland. Going beyond SRTP and when annual rate of C retention achieved through farm

[5] These projections are largely based on the assumptions that concern the expansion of forest cover and land use changes. They do not account for a broad range of uncertainties, associated with forest sink and soil carbon estimates, as well as with the rates of possible C uptakes or losses etc.

[6] Cannell (2003) and FC (2001) provide higher estimates of the potential for land-based C sequestration.

woodland planting is 3.2tC/ha, Crabtree (1997) obtained the estimates of mean annual cost savings of €4.6 – €30/tC.[7]

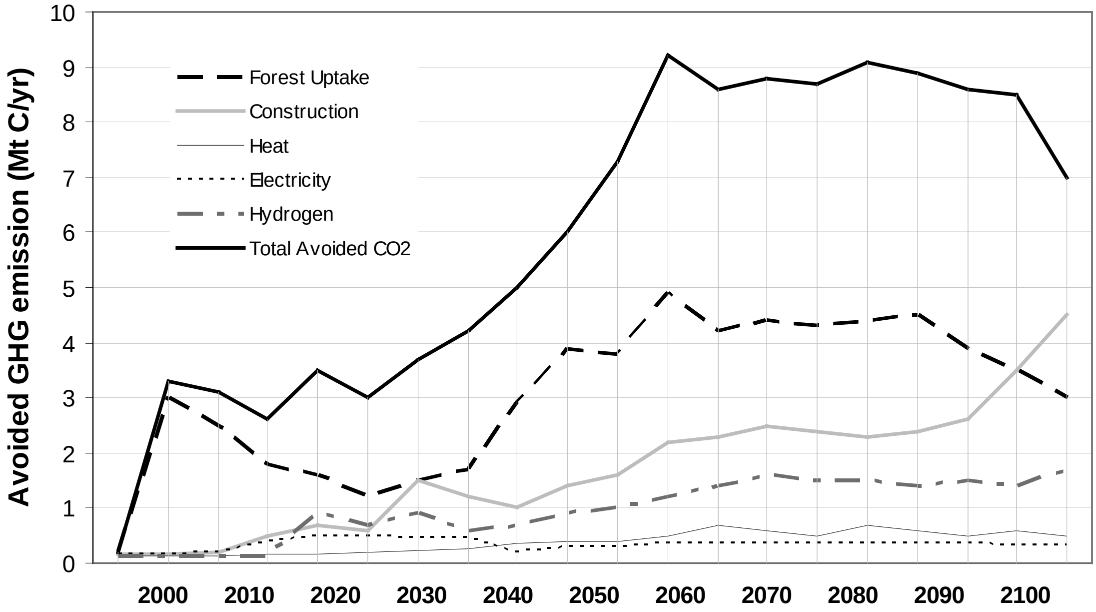

Fig. **2**. Potential carbon benefits of a strategy to increase forest cover to 25%, plus the programs to promote bioenergy and the substitution of carbon intensive materials.

Source: Tipper *et al.* (2004).

The last few years have been an upsurge in the number of reports addressing different aspects of CS through forestry in the UK, especially by use of wood for biofuel. The Carbon Trust (2005) published an analysis of the economics of different biomass options. A report by Bauen *et al.* (2004) proposed a strategy for the generation of electricity from biomass sources, while the potential of biomass for renewable heat was reviewed in a report of AEA Technology (2005). More specific reports have assessed the GHG impacts of different bio energy systems (Elsayed *et al.*, 2003), the environmental impacts of bio-fuel crop systems (Turley *et al*., 2004) and the relevance of biomass options in regional contexts (Booth *et al*., 2005; Towers *et al*., 2004). The most recent SEERAD report on this topic highlighted that the main difficulties associated with the use of biomass for energy have been policy-oriented and socio-economic rather than fuel-related and comparative indicators of the cost-effectiveness of alternative mitigation strategies are needed (Galbraith *et al.*, 2006).

To provide estimates indicating whether forests offer a low-cost opportunity for CS, which exactly forests (their species composition, age structure and management regimes etc.) and where in Britain, the easiest way is to start with the estimation of afforestation costs per hectare of the woodland. Then, based on the simulated amount of the sequestered C (in physical terms) and on the estimated costs, it is possible to compute the present value (PV) of costs per tonne of C for each policy scenario (Van Kooten, 2004; Nijnik, 2005). The estimates will provide benchmarks for prospective cross-comparison of different CS forestry scenarios and for

[7] For the data to be comparable across countries the estimates were converted to €, using exchange rates seen at http://www.xe.com/ucc/convert.cgi.

their comparison with other climate change policy alternatives.[8] Initial results of the economic assessment of opportunities to respond to the KP through forestry suggest that this policy measure is likely to be competitive with other means of removing C from the atmosphere and that choosing the right species and management regimes is important to save economic costs. However, the economics of CS in forestry is an area that merits further attention both in the UK and worldwide.

The scope for socio-economic analysis of the role and place of forestry to mitigate climate change is especially relevant to Scotland. Scotland has a substantial potential for forestry development, and cost-benefit analysis (CBA) of afforestation and of using wood in renewable energy projects and wood products is therefore a highly relevant topic. The reports by the Sustainable Development Commission for Scotland (SDC, 2005) and by Rippengal (2005) for Scottish Enterprise have provided much information on the potential of the wood fuel market and on competitiveness with fossil fuel alternatives. A rough economic assessment of different wood fuel scenarios was carried out by the Fraser of Allander Institute (2006). A Review of Greenhouse Gas Life Cycle Emissions, Air Pollution Impacts and Economics of Biomass Production and Consumption in Scotland has been published by SEERAD (Galbraith *et al.*, 2006). The reports provide a broad picture concerning technological aspects, GHG life cycle emissions, air pollution impacts of biomass production and consumption in the UK. The SEERAD report (Galbraith *et al.*, 2006) also includes a review of economic problems associated with biomass production and consumption. However, a full economic appraisal (e.g. CBA) of different policy options of using forestry projects to mitigate climate change, similar to that which has been done for the Netherlands (Van Kooten and Bulte, 2000), and for Ukraine and Slovakia (Nijnik and Bizikova, 2007; 2008) is necessary to add weight to these findings.

5. Institutional aspects

Forestry measures to increase carbon sequestration require a long-term perspective. The optimum offset policies tend to link long-term CS in forestry with a long-term substitution of wood for fossil fuel in renewable energy projects (Cannell, 2003). Tree-planting activities in the UK have a long history. Afforestation has been implemented successfully over the last century (Mather, 2001), and although terrestrial CS largely comprises the temporary removal of C from the atmosphere (Marland *et al*., 2001), it is important as it postpones climate change and allows time for adaptation, learning and technological innovation.[9]

The EU regulations and national programmes supporting the conversion of land back to forest focus largely on remote rural areas (e.g. uplands in Scotland). These programmes are embodied in regional policies, and some of the available options provide multiple benefits. The enhancing of CS on marginal land, especially in combination with an increased use of

[8] Land use and forestry activities can help to reduce CO_2 concentrations in the air by increasing biotic carbon storage, decreasing the emissions and producing biomass as a substitute for fuels. Major potential activities include reducing rates of deforestation, forest regeneration, agroforestry, improving forest and land-use management, and growing energy crops. Also, the costs per tonne of C locked-up/removed must be compared with the costs of decreasing its stocks in ways other than through forestry and land-use activities, e.g. by the regulation of industrial sources.

[9] The temporary nature of C sinks in forests can be dealt with in different ways: via partial credits for stored C; insurance policy, etc. The concern over non-permanence amplifies due to the fact that the removed C could be released because of forest fires, disease, etc. before the project ends. Even when projects that promise indefinite CS are concerned, the mechanisms for assuring that the associated emissions reductions are long-lived are to be adopted. For more discussion on permanence of forestry projects, on their "additionality" and "leakages" see e.g. Chomitz (2000), Subak (2003), Schlamadinger *et al.* (2003), Van Kooten (2004), UNFCCC (2004).

bio-energy may represent a sound opportunity for remote rural areas in the UK, but only when the links between different policy areas are mainly captured and attention is given to the provision of long-term initiatives in support of CS activities, including bio energy production and consumption.

The UK Climate Change Programme (DEFRA, 2000; 2006), which is under the responsibility of the devolved governments, sets out policies and priorities for action. It supports co-operation across regions of the country and between different sectors of the economy. The targets are linked across climate policy objectives, such as those of CS forestry projects, of the increased use of renewable energy, an increase in energy efficiency and the encouragement of SRTP. Policy changes under CAP reform will likely lead to the increase of land suitable for CS projects. Forest expansion for carbon uptake is therefore foreseen in combination with the using of timber as a construction material and as a substitute for fossil fuels (EC, 2003).

The development of renewable energy from woody biomass is a relatively new policy option, and coherent polices to maximise climate change mitigation forestry opportunities are not yet in place. Still, they are among the priorities in the EU carbon sequestration strategy (EC, 1998), and in that in the UK (DEFRA, 2006). The rising importance of renewable energy initiatives can be explained by the fact that the effects for avoidance of C release through the replacement of wood for fossil fuels are repeatable.[10] Therefore, social benefits of renewable energy projects in the long run are expected to be higher than under the strategy of carbon fixation (e.g. carbon storage in trees[11]). Moreover, a systematic promotion of renewable energy industries, services and technologies offers great opportunities for innovation, development of energy markets, with locally and regionally oriented value chains and thereby, provides new employment opportunities (EC, 1997). This is recognised in Britain, whose renewable energy policy may serve as an example for Europe as a whole.

Carbon sequestration policy measures through forestry projects in the UK are linked together within the forestry sector and beyond. However, there is a division between environmental, economic and social issues of climate change and sometimes between different sectors of the economy (ME, 2001). Thus a more complete incorporation of land-use policies in the regional schemes of sustainable integrated rural development, where socio-economic, environmental, visual, and climate-change related components of land use will be considered jointly, is needed (Nijnik and Bizikova, 2007). As it is emphasised in the European programme for climate change, the effective measures should aim for “win-win” situations, which would benefit rural development, people, the economy and the environment both, at a national level, and internationally (EC, 2003).

In terms of the environment, forestry is viewed as a basis for production, as a sink for pollution, as a means of watershed protection, and as habitat for wildlife. The practices that sequester the most carbon, however, are not directly the practices that reduce net emissions of CO_2 to the atmosphere the most. Carbon sequestration activities can lead to changes in fossil-fuel use and can cause changes in land use and land cover that further impact the atmospheric CO_2 pool. Alternative land uses have differential impacts in contributing to carbon emissions, and sink enhancement measures through forestry can be understood as an instrument for the formulation of climate change mitigation goals and as an indicator for the selection of optimal abatement policies (Nijnik and Bizikova, 2007).

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[10] As long as a continual process of tree growing, harvesting and regeneration, with the use of harvested timber for energy is maintained.

[11] The carbon storage policy option (strategy of C fixation, e.g. in conservation or nature protection projects) presumes one-time tree planting, without considering future use of wood and land.

The policies are most likely to be implemented if they are consistent with wider programmes (such e.g. as Rural Development Programmes) focusing on other dimensions of rural policy (Huq and Reid, 2004). Many scholars support this view, emphasizing the opportunities that forest-related CS policies can provide to biodiversity conservation and rural development (Klooster and Masera, 2000). Efficient and feasible climate policies need to be well embedded in existing policy areas and, if economic instruments and flexible mechanisms are implemented, considerable scope exists for multi–functional land use, where carbon sequestration, production of sustainable energy and sustainable agriculture are – at least –partially combined.[12] Policies and measures for mitigation of climate change can then be integrated within spatial planning, agricultural and forest policies and policies for sustainable energy systems. One of the examples of bringing these policies together is the support for SRTP on agricultural land. This policy measure, together with the replacement of fossil fuels by renewable energy sources, is one of the main priorities in the EU forest strategy (EC, 1998) and in the UK climate policy (DEFRA, 2006).

Furthermore, together with the integration of different sectors of the economy, it is important to link CS policies with the policies dealing with regions that are affected by regional disparities. While providing support for land use change on marginal land, even more attention should be given to agricultural and environmental linkages and to climate change related measures (Gatto and Merlo, 1997), as well as to the inclusion of CS policies into rural and regional development schemes. Existing incentives in forestry need to be scanned to assess their influence on climate change and measures enhancing forest sinks need to be based on the principles of sustainable forest management and on the recognition of the multifunctional role of forests (ECCP, 2004). Tree-planting for multiple purposes rather than solely for CS will enlarge total benefits and prevent potential conflicts relating to trade-offs between biodiversity and CS, or between landscape amenity values and those of CS. Although it may result in lower rates of CS, multifunctional forestry is expected to be more attractive to people because in the majority of cases it will provide additional benefits and promote sustainable rural development (Nijnik and Bizikova, 2008). Afforestation for multiple purposes can also be seen as a sustainable way of restoring the productivity of abandoned land (Naka *et al.*, 2002), whilst utilization of biomass can provide employment opportunities and create new options for land development.

The identification and targeting of potential multiple benefits from CS projects involving forestry is likely to increase public support of CS policy measures, as well as their cost-effectiveness. These co–benefits will then be attained by combining the strategies to mitigate climate change, improve the environmental situation, enlarge governance capacity and enhance social and economic development in remote rural areas (Nijnik and Bizikova, 2008). The optimum offset policies will be those which capture the opportunities to link long-term carbon sequestration with long-term fossil fuel substitution (Cannell, 2003), and those which will successfully develop capabilities to link rural development priorities, those of climate change and various other issues of sustainable development with the contribution of major stakeholders, local actors and general public (DEFRA, 2002).

Thus, the development of CS policies and their impact assessment should be conducted in close collaboration with all major stakeholders, and substantial efforts should be put into the increasing climate change awareness of farmers, land users, managers and decision makers (Olsen and Bindi, 2002). In the UK, a high level of participatory democracy is manifested in the development and implementing of CS land use initiatives (e.g. through planting trees to

[12] The case for a deeper economic analysis that takes on multifunctionality is sound but still not unproblematic.

sequester carbon), in the involvement of the public in environmental decision-making, and in the extension of information and education pertaining to climate change.

6. Conclusions

The activities enhancing CS in forestry contribute modestly to the UK emissions reduction, and carbon sink of forests that could be accounted under the KP is modest. Nevertheless, forestry projects do have relevance for carbon budgets. Their inclusion in climate policy activities is logical and viable, especially when the projects target win-win situations by bringing together integrated RD and climate change mitigation, and maybe even by combining them with the enhancement of nature and rural landscape.[13] Nonetheless, we should not overstate the virtues of the UK as a ‘switched on’ carbon sequesterer through forestry, but the initial analysis suggests that over and above other climate change mitigation policy measures, the enhancement of carbon "sinks" and "reservoirs" by forestry projects is meaningful in the UK.

In suggesting the use of sinks as a flexible mechanism for addressing the KP, it is important to measure carbon uptake and release, as well as to develop economic and market conditions for creating and trading terrestrial carbon credits.[14] The KP has established flexible mechanisms known as joint implementation (JI), the clean development mechanism (CDM) and emissions trading (ET) designed to help Annex B countries to meet their emissions reduction targets at least cost (UNFCCC, 1998). The efficiency and effectiveness of CS policies are strongly linked to institutional developments (Merlo and Paveri, 1997). Many countries, however, have low levels of social capital (e.g. networks, trust between actors, competencies, experience and/or motivation) and institutions (both formal and informal) to develop serious markets for CO_2 trading.

The results of a preliminary analysis conducted across a number of countries (Van Kooten 2004; Nijnik and Bizikova, 2007; Nijnik and Bizikova, 2008) have shown that among the reasons for market and governance failures of countries to meet their emission reduction targets are their proclivity to rely primarily on administrative measures and voluntary actions, i.e. common values and norms. Consequently, the costs of CC mitigation appear to be higher than they need to be, and these high costs lower the efficiency of KP implementation. Therefore, the focus of action needs to turn towards climate change economics (Van Kooten, 2004; Nijnik, 2005). It is important to examine the economic case for CS policy in Britain to mitigate climate change, and determine which policy plans are economically sound and suggest which of them should be implemented and where and how.

The cap-and-trade system that includes carbon offsets from forestry faces serious challenges regarding the creation and acceptability of carbon trading exchanges. The cost per tonne of carbon locked-up/removed must be compared with the costs of decreasing its stocks in ways other than through forestry and land-use activities. When only CO_2 emissions are considered, the emissions cap is set equal to the KP target. When, in addition, carbon offsets are the matter of concern, a cap is not only required on emissions, but also on permissible offsets. In the light of carbon trade negotiations, the conversion factor or exchange rate needs there-

[13] But such integrated land use planning is often problematic, is costly in transaction costs and tends to deny self interested landowners the right to determine their own land use preferences which are often not economically optimal (i.e amenity related landowning ‘self indulgence’ is quite common). So the institution of private ownership and the extent of amenity land purchase must be understood too.

[14] We limit ourselves in this paper primarily to the discussion of climate change opportunities in forestry. Carbon trading schemes go beyond our focus.

fore to be set, and the fact that the sequestered carbon remains in the sink forever is to be ensured (Van Kooten, 2004). The valuation and inclusion of carbon offset credits in a trading system is difficult because of the high transaction costs associated with assessing and monitoring carbon, and due to the temporary and ephemeral nature of terrestrial carbon sinks. Given that, more attention in the UK is to be paid to analysing the role of carbon uptake credits from forestry in climate change mitigation and to bringing them into an emission trading system.

Examination of the extent of carbon sinks in wood products is also an issue that merits further attention. This policy option provides multiple benefits by enlarging the supply of wood and adding to the total carbon sink. Wood substitutes raw materials implicated in GHG releases and can be used in construction, engineering and in production of household goods. In all these cases, wood acts as a sink of carbon, with the duration of the sink equivalent to the life of the goods (Sikkema and Nabuurs, 1995).[15] While carbon uptake and storage in trees[16] has a one time effect, and eventually, through the decay of wood or forest fires etc. the carbon is released back to the atmosphere, the product substitution strategy and that of using wood for fuel are repeatable (with timber rotations). Thus in the long run, use of more wood products is a more sustainable means of carbon management.[17]

A major topic meriting economic research pertaining to opportunities of forestry in Britain to mitigate climate change is the justification of renewable energy options, including that of using wood for bio-fuel (Nijnik, 2005; Galbraith *et al.*, 2006). There is still a great deal of uncertainty on how to define sustainability of afforestation and biomass production in a broadly acceptable way; how to translate sustainability requirements into policy guidelines; how to overcome market limitations of carbon sequestration projects and where to place biomass production in the general context of land use, where reform of CAP and contemporary agricultural change will be likely influential.

To conclude, it is very important to further involve the public and key stakeholders in CS policy making, decision-taking and policy implementation. There is a need for more information campaigns, training facilities and pilot schemes to demonstrate forest management possibilities and make them attractive for forest and land owners. It is important to consult people as to what climate policy alternatives are most acceptable and desirable for them and to get to know why this is so, as well as to develop understanding of public perspectives on the role and place of land use change and forestry projects in the mitigation of climate change. This research is under development (Nijnik, 2006) with the view of offering further insights into the connection between the UK land use CS policy and its strategy to promote integrated sustainable rural development.

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[15] Oxidation rates for wood products are roughly 0.02 per year. There is also the opinion that wood products made from deciduous species release their C back to the atmosphere after 30 years of use, while wood products made from coniferous species do that after 40 years (Van Kooten and Bulte, 2000).

[16] See footnote 12 explaining carbon storage option. For more information see Van Kooten (2004).

[17] Among important preconditions for its effectiveness is a long lifetime of the products and time horizon under consideration, an extension of which provides more useful outcomes, as a continuous process can then be shown.

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DEEPER INSIGHT OF STAKEHOLDERS' VALUES AND PREFERENCES REGARDING FOREST ECOSYSTEM SERVICES

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Abstract

More than four hundred million people live in or around forests, they enjoy and benefit from forest goods and ecosystem services. So, one of the forest decision-making priority is meeting demands of all stakeholders with paying attention to the improvement of the livelihoods of forest-dependent people as a precondition to achieving Millennium Development Goals. Success of SFM-initiatives implementation depends on their acceptance and support by whole society, but the particular role in this process belongs to stakeholders. World of their twisted interests, sometimes contradictory and confronted, needs to be explored because they shape and drive forest management practice according to their own values and insights. In this paper we developed a forest values universe using Conceptual Content Cognitive Mapping Technique. Set of cognitive maps of preferences (generated by individual, own groups, and external evaluators) is examined applying non-parametric statistic methods. These maps provide decision-makers with comprehensive information for comparison of values systems identified by respondents both from an individual and a group points of view, highlighted behavioral and value reasons for particular decisions lobbying in conditions of weak markets and ill-defined property rights, on a background of possible and real-world conflicts and on possibilities for their mitigation. These maps highlight clash of interests among different stakeholders concerning *Local values*, which are of prime interest for forest-dependent people.

***Keywords**: forest ecosystem services, stakeholders, conceptual content cognitive mapping, non-parametric statistical analysis, cognitive map, and co-management*

1. Introduction

Achieving the Millennium Development Goals challenges forest policy makers and practitioners, all direct and indirect users of forest ecosystem services to find new ways and means for ensuring economic, social and environmental sustainability, to adopt a new ethic of a conservation and stewardship (UN, 2000). As it comes from the decisions, taken by UN Forum on Forests in February 2006, to attain these ambitious goals four shared Global Objectives on Forests should be met. One of them seeks to "enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest-dependent people" (UNFF, 2006). Increase of sustainably managed forest areas, reduce of forest degradation, and enhancing benefits of forests for the sake of meeting demands of future and present generations with a particular interest to indigenous people and local communities are considered as the main tasks of forest policy and management.

In this context recognition of the importance of traditional knowledge, cultural values and historic perspective will play an essential role. Traditional cultures are not necessary naïve, static and subsistent-dependent, but sometimes they are sophisticated and even innovative (Price, 2006). This recent shift in forest policy and practice towards cultural heritage and particularly local knowledge (IUFRO, 2006) needs a deeper insight into a twisted world of all stakeholders' preferences regarding forest ecosystem services. Individuals' preferences may differ from

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their own groups' favorites, self-assessment not always coincides with an external evaluation, and some values could be quite unintelligible for other competitors of this non-excludable but sometimes rival biotic resource (Daly and Farley, 2004). This paper views these propositions in the context of economic and social environment of Western Ukraine.

2. Ecosystem services

Ecosystems as natural systems that include all variety of interactions between living organisms and the components of non-living environment within which the organisms are found, are highly complex and dynamic entities. They sustain economic systems, providing them with renewable resources, the elements of ecosystem structure, and ecosystem services, which can be defined as 'the ecosystem functions of value to humans and generated as emergent phenomena by the interacting elements of ecosystem structure' (Daly and Farley, 2004). Quoting Costanza *et al.* (1997) we can say that ecosystem services are '*conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfill human life'*. Exhaustive list of seventeen different goods and services generated by ecosystems are described in the mentioned paper (Costanza *et al.*, 1997, Table 2).

Forest ecosystems play the crucial role in functioning the global ecosystem. They provide almost all of these goods and services. Daly and Farley (2004, Table 6.1) give a comprehensive list of relevant examples of services provided by forest ecosystems. Wide range of the services – from environmental quality to human safety and cultural needs covers this list: gas, climate water and disturbance regulation, water supply, waste absorption, erosion control, soil formation, nutrient cycling, pollination, biological control, refugia, genetic resources, recreation and cultural values. Most of them are vital and nonsubstitutable. And the question we discuss here is how people feel, identify and accept them, because this insight, implicit but persistent dives forest resource use in a quite explicit way.

3. Methodology

To achieve an efficient allocation environmental economists have suggested two approaches which now became large sets of techniques: (1) extending market to catch non-market goods and services through valuation and (2) position analysis through numerous methods of elicitation and prioritization preferences regarding assets in question.

Rational homo economicus tries to measure all elements of natural capital, to attach them monetary equivalent and, at the end, to deal with them in decision-making like with ordinary elements of manmade capital. Both revealed and stated preference valuation techniques are in a sense an extension of a market valuation, aimed to assign a monetary measure to all components of total economic value – use and existence values. Multitude of valuation techniques, which have been proposed for today, and measurement studies (Arrow *et al.*, 1993; Bateman *et al.*, 2002; Bishop and Romano, 1998; Dixon *et al.*, 1994; Hanley and Spash, 1998; Jacobsson and Dragun, 1996) and a huge amount of sober reflections on them (Arrow *et al.*, 1993; Carson *et al.* 2002; Freeman, 2003; Hausman, 1993; Kriström, 1990; Portney, 1994) evidence, that valuing nature is very important and complicated task simultaneously. These studies give us numerous examples of careful investigation of willingness to pay for the environmental goods and services but it is hardly ever to develop a holistic perspective from this picturesque mosaic of relevant studies. Obtained results are sensitive to developed questionnaires (Callan and Thomas, 1996), to techniques applied for gathering data and collected data analysis, to general socio-economic environment (Sisak, 1999; Kriström, 1990). Although they provide useful information for environmentalists and decision-makers particularly in a case of absence of market for some private and public goods (Bishop and Romano, 1998, Jacobsson and Dragun, 1996), questions of their methodological validity and interpretation are strongly discussed in modern economic and philosophical literature (Kant, 2003; Daly and Farley, 2004; Etzioni, 1988).

To avoid integrating non-meaningful monetary valuation into decision-making, which could lead to wrong decisions from inter- and intra-generation perspectives, social choice approach has been developed and applied. Canadian scientists S. Kant and S. Lee ground use of a 'multi-group social choice method' as an extension of social choice approach, which features such peculiarities of SFM as a joint production of goods and environmental services and inter- and intra-generational (inter-stakeholder groups) distributional issues (Kant and Lee, 2004). Besides, this approach much better deals with continuum of use and non-use values because it considers an individual as a rational and responsible citizen that follows not only own profit and pleasure considerations (Etzioni, 1988).

According to SFM paradigm all stakeholder should be involved into decision-making process, hence their needs and preferences should be scrutinized and understood. To identify values, stakeholders associate with forest ecosystem services, we used the technique known as a *Conceptual Content Cognitive Mapping* (3CM), proposed by R. Kaplan (1973) to predict environmental preferences and developed to catalog and to map stakeholders' attitudes to SFM in US Pacific Northwest (Kearney *et al.*, 1999) and Northwestern Ontario (Kant and Lee, 2004). This method does not bring respondents and scientists to a dead end corner of a monetary valuation of non-market goods and services. On the contrary it provides a respondent with a space to express (verbalize) his own preferences and considerations regarding other stakeholders' interests concerning multifunctional role of forest ecosystems services. Thus a researcher can capture the breath of preferences and perceptions regarding object or process in question.

Indeed, the social choice approach has own limitations. There is a possibility to unintentionally narrow the choice or mistakenly interpret recorded preferences because of cognitive tokenism rather then genuine preference (Price, 2006). But information-generative power of this approach is widely accepted.

Logical framework of 3CM is well described by Kant and Lee (2004). Eight steps for the 3CM exercise – 1) introduction to the 3CM task, 2) visualization exercise, 3) identification of own preferences (values) regarding topic in question, 4) grouping (organization) of verbalized preferences, 5) labeling organized groups, 6) ranking the groups, 7) identification of own perceptions regarding own group and other stakeholders' values and finally 8) completing the task.

The 3CM task was performed for such stakeholders – local population, forest industry, environmental non-governmental organizations (ENGOs), and city population. These stakeholders were identified using such criteria as responsibility, impact, relationship, dependence, representation, and relevance (Hotulyeva *et al.*, 2006).

Carrying 3CM task respondents assigned a value like '1' – 'the first' (the most important forest value), '2' – the second (less important then the first one but more important then rest and so on). Therefore data, collected and organized using 3CM, were considered as ordinal data and were examined by non-parametric statistical methods. To test the statistical significance of similarities and differences in the generated cognitive maps we used the Friedman and the sign tests (Newbold, 2003).

The study area for this research is Lviv region consisting of Zhovkva, Mykolaiv and Yavoriv administrative districts (Western Ukraine).

4. Discovering stakeholders' preferences regarding forest ecosystem services

This study was aimed to deepen insight of attitudes regarding regular forest ecosystem services. Four groups of stakeholders were identified in the study: Local population, Forest industry, environmental NGOs and City inhabitants. 25 individuals from each of these groups were interviewed. Age distribution of the respondents for different stakeholders groups is illustrated by Fig.1. The forest values universe, designed by respondents' answers is presented in the Table 1. Respondents identified nine themes and 37 sub-themes. All these sub-themes where identified, grouped and ranked by stakeholders according to their opinion.

Results of the Friedman test for checking statistical confidence of forest values differentiation by each stakeholder group proved the fact of existence of priorities regarding forest values. In case of nine themes for a 5% significance level for each stakeholder calculated Friedman statistics values are much greater then the relevant critical value χ^2 (Table 2).

Table 1. Forest Values Universe

Dominant Theme	Sub-theme
1. Environmental	- Air purification, Oxygen supply - Climate regulation - Biodiversity - Water regulation - Nutrient cycling
2. Recreational	- Rest - Hiking - Picnics - Pastime with friends
3. Economic	- Income and benefits from forest industry spin off - Timber and other marketed products - Employment and relevant satisfaction - Options for tourist and recreational business development
4. Local values	- Non-wood forest products - Wild animals meat and furs - Firewood - Fodder
5. Educational	- Education and training - Science and research - Observations and monitoring - Educational activities
6. Health care and recovery	- Health improving - Medical herbs - Vitamins - Relaxation
7. Tourist	- Hunting - Rock-climbing - Tourism - Sports competitions
8. Aesthetic	- Picturesque landscapes - Wildlife observation - Decorative items - Scents and sounds
9. Cultural and Emotional	- Spiritual, cultural and historical values - Quietness, solitude, solitariness - Inspiring, stimulation creative ability - Attitude towards wildlife

Table 2 .Testing statistical differences in preferences regarding forest using the Friedman test* values

Stakeholders	Local population	Forest industry	City inhabitants	Environmental NGO
Calculated Friedman statistics value, *Fr*	468.00	593.57	477.20	445.00

* The critical value χ^2 for a 5% significance level in case of nine themes equals $\chi^2_{k=9-1;\, p=0.95} = 15.51$.

Integrated cognitive map of stakeholders' preferences concerning forest ecosystem services is presented in the Table 3. The cognitive map of individual preferences (the first number in a numerator) is quite uniform.

Table 3. Integrated cognitive map of stakeholders' preferences regarding forest ecosystem services

Themes / Groups of stakeholders	Environmental	Recreational	Economic	Local	Educational	Health care	Tourism	Aesthetic	Cultural and Emotional
Local population	1 / 4 3, 4, 3	2 / 4 5, 4, 3	2 / 2 2, 2, 2	1 / 1 1, 1, 1	5 / 6 6, 6, 7	4 / 4 6, 5, 6	5 / 5 6, 5, 6	4 / 3 4, 3, 4	3 / 3 4, 3, 4
Forest industry	1 / 3 3, 2, 4	2 / 1 2, 2, 3	3 / 1 1, 1, 1	5 / 6 6, 6, 6	5 / 5 6, 5, 5	3 / 3 5, 3, 4	5 / 4 2, 3, 3	5 / 6 4, 4, 2	4 / 2 4, 4, 2
City inhabitants	1 / 1 1, 2, 1	1 / 2 1, 1, 3	4 / 4 4, 4, 5	6 / 6 6, 6, 6	4 / 5 5, 6, 6	2 / 1 2, 1, 2	5 / 3 4, 5, 5	3 / 3 3, 3, 2	1 / 2 2, 3, 2
Environmental NGOs	1 / 1 1, 1, 1	1 / 2 3, 3, 3	2 / 4 2, 4, 2	5 / 6 5, 6, 6	3 / 4 1, 1, 1	4 / 3 3, 3, 3	6 / 5 4, 5, 4	4 / 1 1, 2, 2	2 / 2 3, 2, 2

Explanation to the data in cells in the Table 3: Each sell indicates five perspectives, namely:

- in numerator: individuals' / groups' ranking;
- in denominator: opinion of other stakeholders regarding appropriate group's ranking, namely:
  - Row "Local population": Forest industry, City inhabitants, Environmental NGO;
  - Row "Forest industry": Local population, City inhabitants, Environmental NGO;
  - Row "City inhabitants": Local population, Forest industry, Environmental NGO;
  - Row "Environmental NGOs": Local population, Forest industry, City inhabitants.

Explanation to the lines in the Table 3:

- - - - - - Themes with the highest priorities
——— Themes with the highest differences in individuals' and groups' preferences
— · · — · · Themes with the highest differences in self- and external assessment.

In individual preferences the most of all respondents appreciate *Environmental and Recreational* values, *Cultural and emotional* services are put on the third position. *Economic services* hold places from second (for local population and ENGOs) to the fourth position (City inhabitants), *Health care* and *Aesthetic* values follow them. A very interesting picture one can find for the theme *Local values*. Undoubtedly they are of the highest priority for local population and on the last or next to it position for other stakeholders. Environmental NGOs are more attentive to *Educational theme* whereas other respondents indicated them with a very low rank. The last place belongs to *Tourist values* – only the sixth or fifth position.

The maximal divergence in individual preferences regarding forest ecosystem services one can see concerning *Local values*: for Local population they are of primary interest whereas other stakeholders do not pay any attention to them (last and next to last positions). For almost all other themes differences in individuals' rankings do not exceed two points.

As it comes from the **cognitive map of groups' preferences** (the last number in a numerator in cells of the Table 3) differences in the favors among different stakeholders become sharper. There is no theme with the same rank across all stakeholders, as we see for *Environmental values* in individuals' cognitive map. Almost for all themes divergences in ranks make up at least 2 points. The only exclusion is *Cultural and emotional* values, which gains the second ranks from all stakeholders except *Local population*, who consider them to be the third. As one can see, ranks for this item are the most homogeneous in this map.

The first positions belong to *Environmental* and *Recreational* values, but *Local population* considers them as the fourth item. All stakeholders rank *Cultural and emotional values* as a second item except *Local population* that set them on the third position. *Economic values* are a little bit behind them: *Forest industry* and *Local population* treat them as the most important and very important accordingly, but two other stakeholders see them as fourth ones. *Health care* and *Aesthetic values* follow them. *Tourist values* seem to be of less importance, *Educational* and *Local* values lag them and bring up this line.

The highest misunderstanding among stakeholders can be easily predicted for *Local values*. As in individuals' cognitive map a *Local population* disagrees with other stakeholders' appraisal, here this clash of opinions reveals even more pointed: *Local population* put only these values on the first position, whereas all other stakeholders are unanimous in their decision: the last place, the least interest.

All six items except *Educational*, *Tourist* and *Cultural and emotional values* have the highest rank at least for one of stakeholders and in the same time their typical scattering is four points (from the first to the fourth rank). And the only *Local* and *Aesthetic values* have the highest and the lowest ranks simultaneously.

Comparison of individuals' and groups' preferences gives us another interesting piece of information. When *City inhabitants* and *ENGOs* identify in quite similar manner both individuals' and groups' preferences regarding almost all themes (the only exception are *Educational* values), *Local population* and *Forest industry* change their priorities more seriously: as values of the highest priority in individuals' preferences Local population mention *Local* and *Environmental* values, and then *Economic* and *Recreational.* But in the groups' preferences map the first position is assigned to the *Local values*, the second – to the *Economic* ones and only the fourth – to the *Environmental* and *Recreational*. In much the same way Forest industry changes individuals' priority *Environmental*, then *Recreational* and later on *Economic* themes on *Environmental* and *Economic* (the highest rank) and then *Recreational* values as the third one.

Identification of themes with the highest differences between self-assessment maps of preferences and **maps**, **developed by external respondents**, brings another piece of information for the further reflection. For example from the *Local population*, *City inhabitants*, and *ENGOs* point of view *Tourism* values should have higher rank for *Forest industry* than the representatives of this industry state it. But the most quarrelsome across all stakeholders reveals *Environmental NGOs:* for five themes the difference between self-assessment and external assessment equals two points and more. But this example can serve as an exclusion from the general picture, because mainly external evaluations coincide or approximate with individuals' or with groups' ones.

5. Conclusions

More than four hundred million people live in or around forests, more then 60 million of them are Indigenous People, whose culture, spirituality and subsistence are indissolubly and intricately intertwined with the land they habitat (Patosaary, 2006). They enjoy and benefit from forest goods and ecosystems services. So, the one of the forest decision-making priority is meeting demands of all stakeholders with paying attention to the improvement of the livelihoods of forest-dependent people as a precondition to achieving Millennium Development Goals of alleviating poverty and ensuring sustainable development.

Forest ecosystems are highly complex, sensitive and inert systems per se. They have a lot of users for their resources and services and these stakeholders' preferences sometimes reveal as discrepant and alternative (FAO, 1992). Sustainable forest management has emerged to incorporate all breadth of forest values and stakeholders' preferences regarding them. To facilitate creative polylog among all beneficiaries from forest ecosystem resources and services it is necessary to identify whole demand for resources in question and understand real priorities of all interested groups.

To capture all variety of forest ecosystem values we applied the Conceptual Content Cognitive Mapping technique and non-parametric statistic methods that allows us to obtain overall and well-structured cognitive maps of preferences with 5% level of significance. In this way we avoid market-oriented approaches and get representative universe of values and sets of their priorities, which could be impossible to synthesis using monetary measurements.

Forest values universe consists of nine dominant themes and more then 37 sub-themes. The dominant themes are: *Environmental, Recreational, Economic, Educational, Health care, Emotional and Aesthetical*. There is not strong difference between forest values universe, developed by Ukrainian and stakeholders' preferences regarding forest ecosystems services explored by Canadian scientists Kant and Lee (2004). The forest values universes are organized little bit in different ways probably due to using different methods of data structuring, but all of them reflect the breadth values – environmental and socio-economic regarding forest ecosystems resources and services.

The highest controversy across stakeholders and full unanimity in self- and external evaluations features *Local values* theme: for *Local people* they are of the primary importance and all stakeholders recognize it, but in almost all other stakeholders' sets of ranks they have the lowest rank and *Local people* recognize it. Hence the question of improvement of the livelihoods of forest-dependent people remains open: how to incorporate *Local people preferences* into values of other stakeholders.

Traditional knowledge, which display 'ancient techniques and practices of a territory passed on through the generations and used for water harvesting, soil management, use and protection on natural resources, … an extraordinary source of knowledge and cultural diversity from which appropriate innovations can be derived today and in the future' (Laureano, 2006), unfortunately were not mentioned among the sub-themes by our respondents. And this was a bit unexpected for us, because in case of urban forest we noted quite a strong interest to this item (Zahvoyska, 2008). It seems, that these invaluable cognitive resource is in danger and a global program launched by UNESCO on gathering/protecting historical knowledge and promoting/certifying eco-innovative practice based on re-proposal of traditional knowledge will be appreciated by society (TKWB, 1998; IPOGEA, 1993).

In conditions of transition to a market economy, when there is no land market and property rights are not well established, the stakeholders' interests conflicts are more common and so called "political rent" becomes a powerful instrument of their settlement. Indeed, in this case the short-term individuals' or groups' financial interests do not drive society towards sustainable development. Therefore such exploration of society's attitude concerning vital ecosystems resources and services provides society with an important message, which let avoid nontransparent decision-making and sharp conflicts among stakeholders.

We examined multifaceted issue of different stakeholders' attitudes toward forest ecosystem services with the aim to bring light into elusive world of implicit and twisted preferences (Nijnik, 2009), which transform into explicit decisions with long-term consequences. Cognitive maps provide a comprehensive background for developing framework of natural recourse co-management and decision-making based on common understanding and responsibility. Approaching the full world (Daly and Farley, 2004; Lawn, 2006) where welfare from economic services increases while benefits from ecological ones diminishes we should avoid tremendous use of natural resources. And this research of preferences and perceptions regarding forest ecosystems services assists a lot in searching consensus and mitigating conflicts towards incorporating sustainable forest management as an integrated ecosystem management paradigm.

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VALUING FOREST RECREATION
WITHIN A MULTI-DIMENSIONAL CONTEXT:
AN APPLICATION TO COASTAL FORESTS IN THE GIRONDE AREA

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Abstract

This paper relates to the use of a multi-attribute extension of dichotomous choice Contingent Valuation called the Multi-Program Contingent Valuation Method. Such a method is devoted to the study of substitution/complementarity relations in the demand for environmental goods and we propose to implement it when recreational uses take place in a multi-dimensional context. A new way to design policies *via* criteria and pictures is needed therefore. The field study concerns the French South-West coastal forests where various natural assets "cohabit". Our results prove that residents' mean Willingness-to-Pay for management policies ranges from 2.50 to 6.65 euros per person per visit depending on where recreation quality is supposed to be maintained. A bivariate probit proved to be relevant, showing that choices are non independent one from another. In a special case, the three natural assets appear to be valuated independently. But, it is still difficult to conclude on a more general basis.

Keywords*: Coastal forests, economic valuation, multi-attribute approach, multi-program contingent valuation method, outdoor recreation, residents*

1. Introduction

Outdoor recreation is certainly one of the greatest sources of welfare provided by forests (Dickie and Rayment, 2001). Under particular conditions, these benefits can be converted into an economic value. Nevertheless, as this value cannot be observed on a market, it is difficult to take it into account in environmental accounting. This situation leads to an imbalance that usually favours market goods and services over non-market ones. But, according to many authors, the valuation of the latter can be a way to enhance our perception of the natural capital (Costanza *et al.*, 1997). It should in consequence help to the definition of sustainable forest management (Buttoud, 2000; Pearce, 2001).

Heterogeneity of recreational experiences (which is frequently associated with quality purpose) is one of the many features that severely hinder the valuation process. According to McConnell (1985) indeed, visitors are looking for both natural resources and material equipments in order to achieve a recreation trip. All these characteristics certainly do not have the same importance for users, which consequently raises many difficulties for valuation purpose. First, economic values may vary a lot among the sites. Rather than using generic references elaborated in a very different context, dedicated estimates have to be implemented. Second, these variations rarely come from a unique origin and many features may intervene simultaneously. From a technical viewpoint, this latter point is particularly tricky (Hanley *et al.*, 2003). Third, valuation studies are of greater help when scenarios are connected to concrete and feasible management actions. If not, users' needs shall never be completely satisfied.

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In this paper, we try to handle the problem by estimating recreation demand in a multi-dimensional context. We employ the Multi-Program Contingent Valuation Method (MPCVM), an innovative approach based on Hoehn's (1991) and Hoehn and Loomis' findings (1993) and Santos' protocol (1998). We apply it to stated-owned coastal forests in the Gironde area (France). The paper is structured as follows. In the first section, we set out the theoretical basis of the MPCVM. The second section relates to methodological issues and presents some descriptive statistics, mainly used to test the pertinence of the protocol. The third part is devoted to econometric results. Finally, we conclude by discussing the implications of our findings.

2. Multi attributes approaches and multi-program contingent valuation method

The MPCVM is based on the Lancaster's multi-attribute approach (1966) that states that the individual utility U_{ip} raised by the consumption of a good (or a service) p does not come from the good per se but from its features $p_1, p_2 ... p_G$ called "*attributes*":

$$U_{ip} = \beta_{i1}.U_{p_1} + \beta_{i2}.U_{p_2} + \beta_{i3}.U_{p_3} + ... + \beta_{iG}.U_{p_G}. \tag{1}$$

In order to get the value of p, this approach consists in estimating separately the value of each attribute p_g, with all other attributes held constant at their current (or initial) level, and to sum them up. This procedure is consequently called "*Independent Valuation and Summation*" (IVS) (Hoehn, 1991). In recreation demand analysis, this approach has been considered relevant for a long time (Hanley *et al.*, 2003). But, Lancaster's IVS hypothesis is not always adopted: according to Hoehn (1991) it may overestimate the value of the good if the different characteristics of the latter are substitutes in the demand function.

Explicitly, let the indirect utility function and the expenditure function depend on the income y, a bundle of market goods z and a bundle of environmental services q. These environmental services are supposed to be produced by a policy agenda p composed of G different programs p_g. Each program is thus an attribute of the policy agenda. Hence, $q = q(p)$ and $U_{ip} = U(z, q(p), y)$. If one program is first implemented and affects the quality of the environment, the implementation of a second program will have two effects on the individual's welfare (Hoehn *et al.*, 1993):

(a) A consumption effect, always negative; and

(b) A direct effect, whose sign depends on the relations between the environmental services produced by the two programs[1].

If (a) is smaller than (b), programs are said to be substitute in valuation since the marginal valuation of one decreases when the other gains in value. If (a) is greater than (b), they are complements in valuation (Hoehn, 1991).

The MPCVM we propose here aims at studying these relations between the programs i.e. if the Willingness-to-Pay (WTP) "*for a good varies depending on whether it is evaluated on its own or as a part of a more inclusive category*" (Kahneman and Knetsch, 1992).

[1] These environmental services may be substitute, independent or complementary in utility.

3. Study design and implementation

Gironde is a department located in Southwest France on the Atlantic Ocean. Its coastline stretches over 126 kilometres, of which more than 100 kilometres remain "natural" i.e. forested. Even if more than 91% of forests in the area are private[2], coastal ones belong in their great majority to the State. There, the Atlantic Ocean, the sandy beaches and the state-owned forests constitute one sole recreation site. Schematically, recreation planning is supervised in forest by the French National Forestry Office and on the beach by the communes whereas water quality mostly depends on (national as well as European) off-site actions.

This diversity in policies (and consequently in responsibilities) prevents any global valuation of costs as well as of benefits (Dehez, 2004). However, a better knowledge and understanding of visitors' preferences could help to define management priorities for each wilderness area as well as on a larger scale.

3.1 Questionnaire design

The problematic lies in the relations between the ocean, the sand and the forest. Three programs were in consequence defined and each one was assigned to one natural setting. The policy agendas could thus be composed of one, two or three programs (Table 1). Namely, they could maintain the recreation quality on one, two or the three areas.

Table 1. Composition and percentage of acceptance of the policies

Programs \ Policy	A	B	C	D	E	F	G	Status quo
Ocean	1	0	1	1	0	1	0	0
Sand	1	1	0	1	0	0	1	0
Forest	1	1	1	0	1	0	0	0
Acceptance	58.87	66.13	60.48	73.39	37.90	58.87	51.61	

Note: Each program equals 1 if it is contained in the policy agenda and 0 if not.

Four criteria described each program[3] and photographs were used to illustrate recreation quality changes (Figures 1 and 2) in order to ensure that respondents were all valuating the same service. The status quo or "reference program" stood for what may happen in the near future without conservation (Santos, 1998). It was in consequence a no-program policy.

Each valuation question opposed this status quo to another policy (A to G) and respondents were asked to choose their preferred one. Thus, respondents had to make seven choices since each question was a separate dichotomous choice occasion (Santos, 1998). As in Choice Experiment studies, different orders of appearance of these valuation questions were randomly created, in order to avoid fatigue, learning biases due to choice repetition and order bias (Kahneman *et al.*, 1992). We opted for a sequential non-ordered procedure and only imposed to first present the two-programs policies (Boschet *et al.*, forthcoming).

[2] Source: French National Forestry Office.

[3] A pre-survey conducted in April 2006 mainly aimed at determining these criteria. 93 responses were acquired.

Fig. **1**. Status quo presented to the respondents.

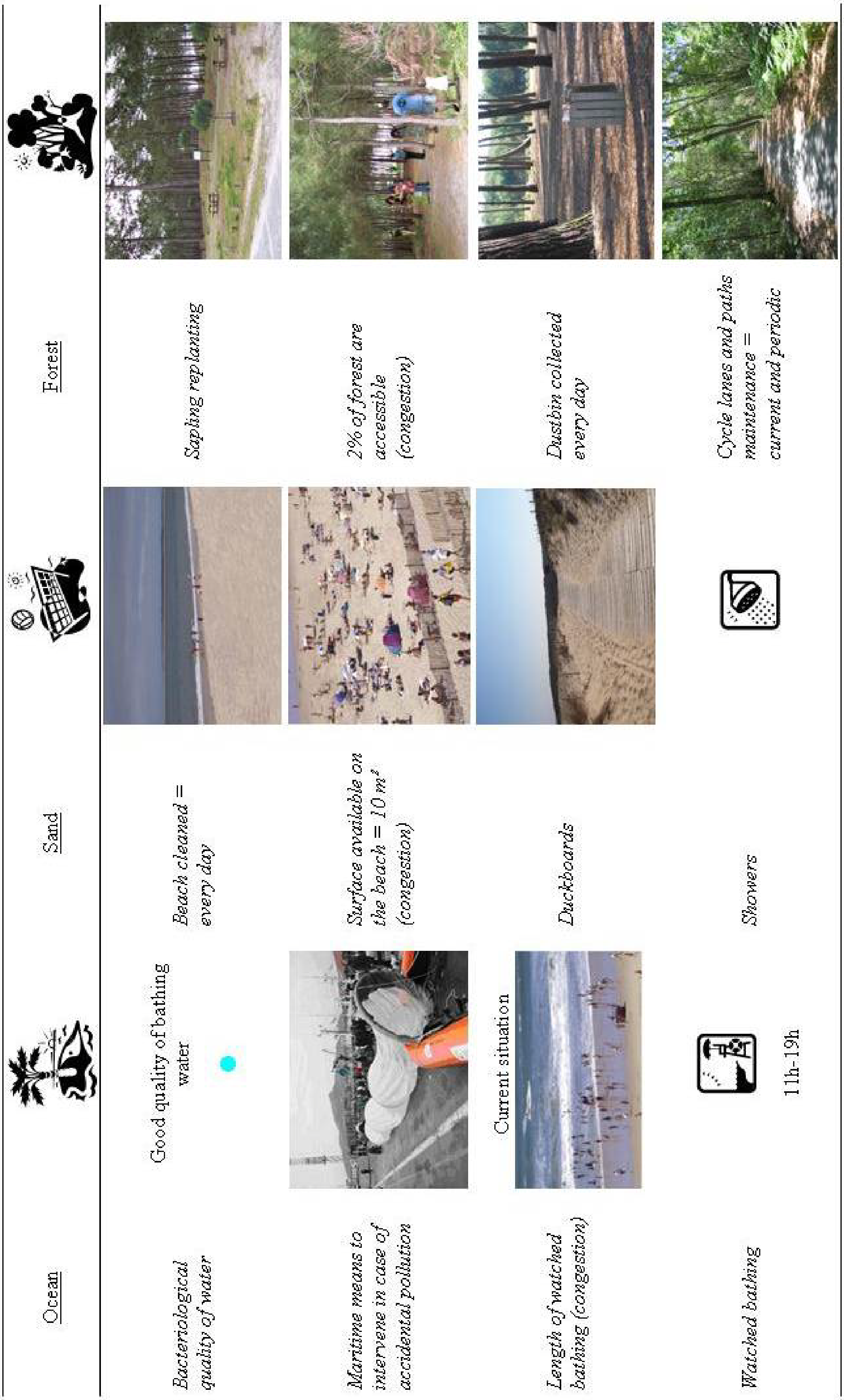

Fig. 2. Complete policy presented to the respondents

A referendum approach was preferred to an open-ended WTP format because of the biases of the latter (Arrow *et al.*, 1993). The price was in consequence revealed through a dichotomous choice process. Five bid levels were generated (Hanemann and Kanninen, 1999) and randomly affected to respondents.

The payment vehicle was expressed as an extra-distance to cover, outward and return, to reach another site where policies A to G were supposed to be implemented. The reference program was in consequence free of charge. Policies described by the same number of programs were proposed at the same price (Hoehn *et al.*, 1993; Santos, 1998). Since more than 90% of respondents came by car, using the distance as a proxy of the cost was not problematical. The cost of one-program policies ranged from 10 to 50 kilometres that is to say respectively the distance to the nearest cities and the distance to the main urban area in Gironde (i.e. Bordeaux). Actually, almost 43% of residents come from the latter (Fig. 3). The cost of the two-programs policies was imposed to be 33% higher than the cost of the policies composed of only one program and 20% lower than the cost of the complete policy.

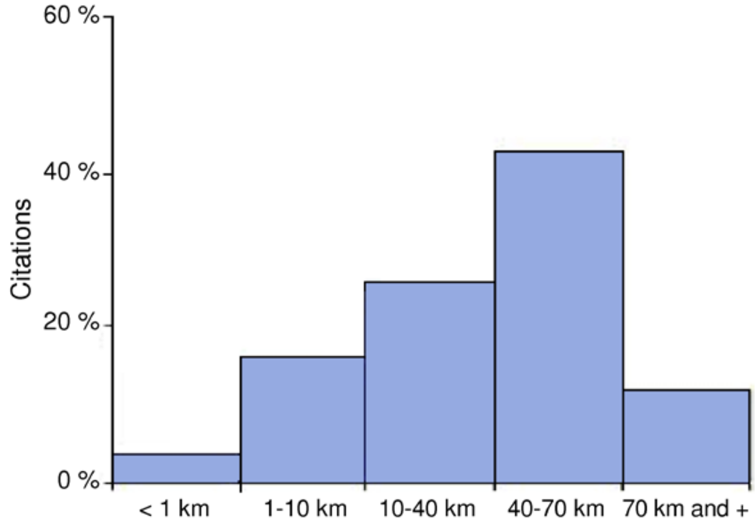

Fig. **3**. Percentage of respondents by distance traveled.

Finally, the questionnaire was constructed as follows:

(1) Questions concerning recreational uses (means of transport, number of visits, time spent on site and in each area, substitute sites, activities, composition of the group…);

(2) Questions relating to general recreational purposes (general activities, restrictions in leisure activities, budget, frequency of holidays…) and general commitment to environmental issues (usual frequentation of the forest, risks that the worldwide environment faces nowadays…);

(3) Valuation and follow-up questions;

(4) Traditional socio-economic data collection (sex, age, education, resources, occupation…).

3.2 Data collection and first overview of users' characteristics

The target population of the survey was main and secondary residents visiting the area. We conducted on-site in-person interviews in summer 2006 on a random-kind basis. 185 usable answers were acquired. This allows econometric treatments on a rather valuable data base (185x7=1,295 observations).

3.2.1 Testing the pertinence of the questionnaire design

The proportion of respondents refusing the first valuation question grows with the bid levels, confirming that bid sets was performing properly (Fig. 4)[4]. Following Arrow *et al.* (1993) we ask respondents to specify the reasons for their "no" answer since the latter can indicate that (Santos, 1998):

(a) The respondent is willing to pay less than the proposed bid amount;

(b) The respondent refuses the valuation process;

(c) The scenarios are not credible[5].

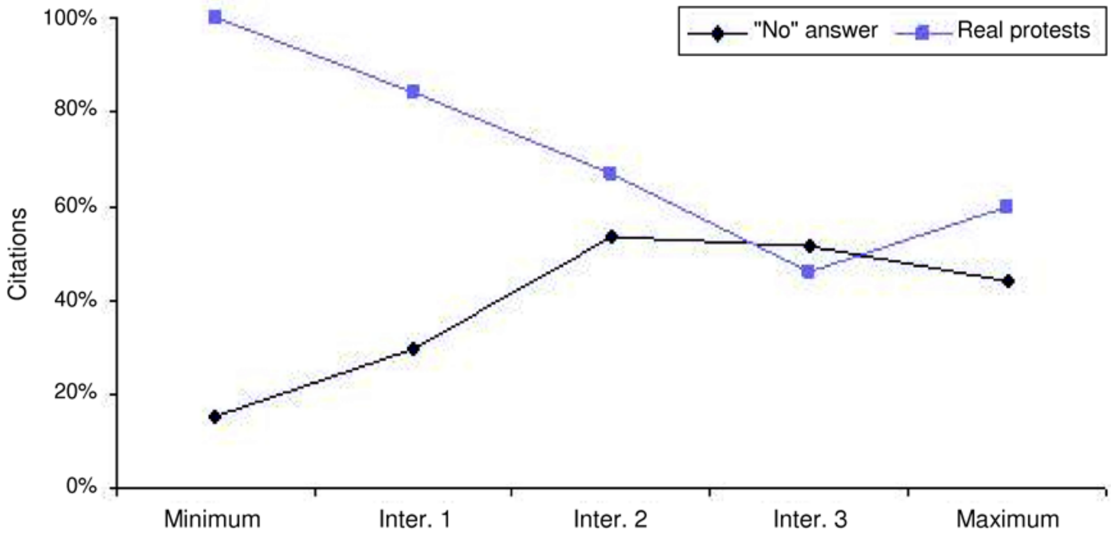

Fig. 4. Percentage of "no" answers and percentage of real protests by bid level.

The proportion of (b) and (c) (called "real protests") depends on the bid level: the greater the bid level, the smaller the number of "real" protests; on the contrary, economic reasons to refuse like the cost in terms of money or in terms of time of an extra-distance to cover, increased. Finally, "false protesters" who were presented all valuation questions did not accept them in the same proportion (Table 1). As expected, they more refused to go elsewhere when the recreation quality was maintained only in one natural area (and especially only in the forest). But one can also note that residents less accepted the complete policy that conserves the recreation quality on the entire site than the two-programs one. This observation will have repercussions on the related WTP.

3.2.2 Recreational uses

Practices on site give a first evidence of users' preferences since more than 83% of respondents cited "swimming or water sports" and 68% "having rest or tanning" (Fig. 5). The "traditional" uses of forests (like cycling or birding) come afterwards. On site time distribution tends to confirm this idea: actually, residents spend on average 4h40 on site of which 1h27 in

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[4] One should note that extreme bids concern only few respondents so that these answers may look irrational compared to the others.

[5] Only five persons said they do not believe that the proposed scenarios will really happen.

the water, 2h20 on the sand and 54 minutes in the forest. Consequently, one can expect higher values for water and sandy beaches than for the latter.

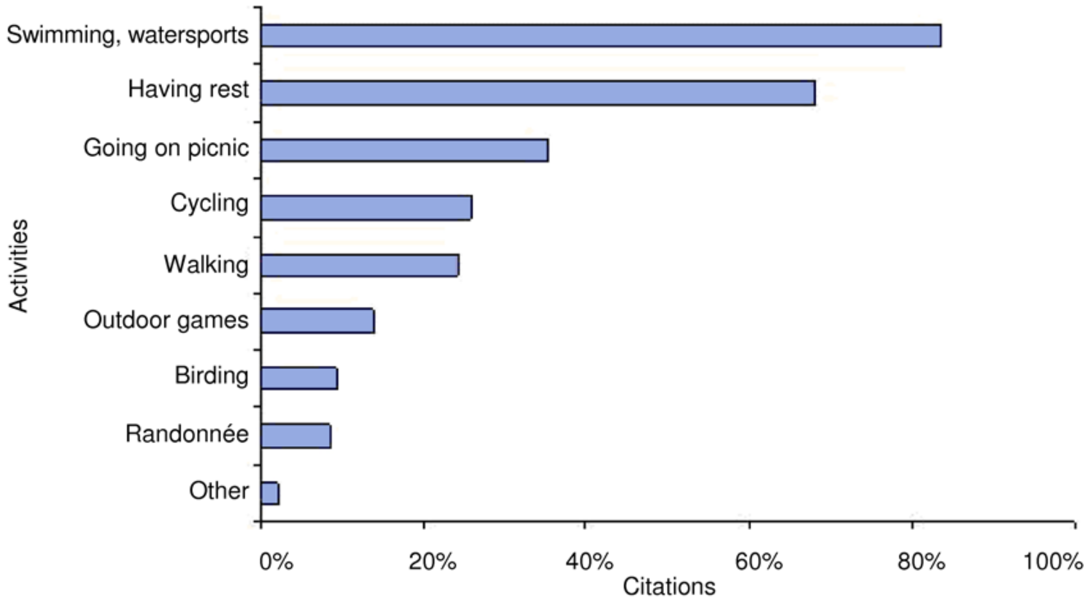

Fig. **5**. Percentage of visitors participating in recreational activities (as more than one response was possible, the total is higher than 100%).

The intensity of uses does not seem to be connected with seasonal variations. Whatever the number of visits (i.e. more or less than ten per year), their seasonal distribution remains identical (Fig. 6). But the Figure also shows that sites are frequented all year long[6].

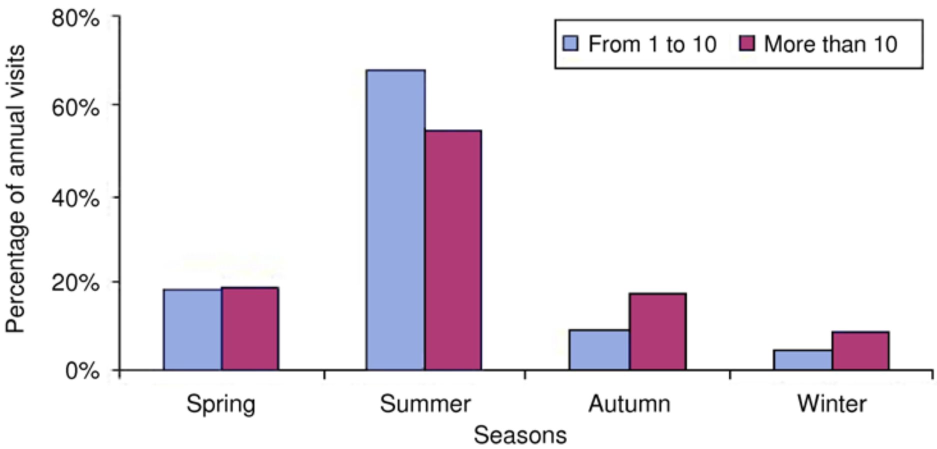

Fig. **6**. Seasonal distribution of the visits.

Activities are of course not ranked in the same way depending on the season even if, for each wilderness area, they remain identical. Furthermore, only 24% of residents come indiscriminately whatever the day of the week (Fig. 7). 39% said that "it may vary" depending on

6 Notwithstanding the obvious bias of the surveying period (summer holidays).

whether they are on holidays or not. This could be seen as another sign of time constraints relevance (see further).

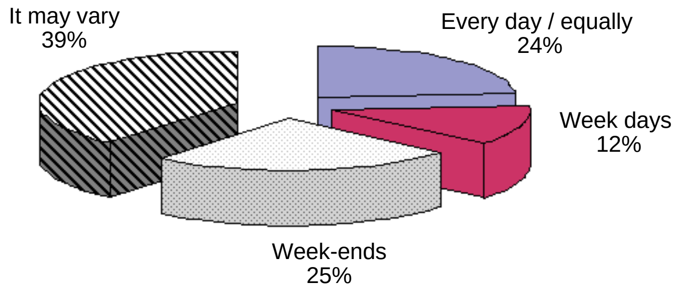

Fig. **7**. Usual day of visit.

Regarding substitutes, interviewees surprisingly do not favour "natural" beaches but seaside resorts (Fig. 8). As a matter of fact, the supposed "green" value-added of beaches located on forest's edges is not as strong[7] as expected. Once again, forests do not appear as a crucial factor of attractiveness.

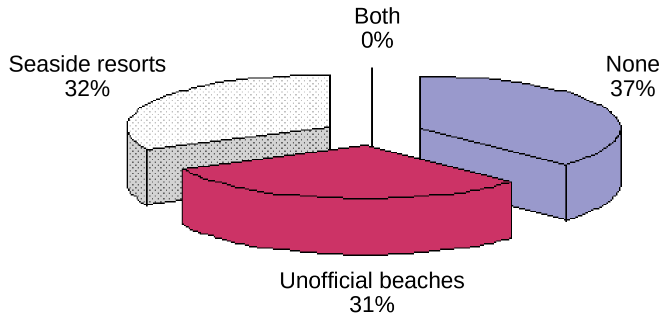

Fig. **8**. Types of recreational sites frequented in summer.

3.2.3 The issue of "direct" payments

Many recreation valuation studies use parking or entrance fees as a payment vehicle (e.g. Glazer and Niskanen, 1992; Bowker *et al.*, 1999). But, the access to coastal sites in Gironde area is free of charge almost everywhere and the implementation of parking fees would be difficult to organise because of the huge size of the sites. Moreover, the many visitors who come by foot from the camp-sites located in the close vicinity would not be affected. During our pre-survey 57% of respondents said they would not come to these sites anymore if they had to pay. In consequence, refusals to the valuation questions could have been more related to this rejection than to our valuation process. For all these reasons, we abandoned the idea of using parking fees and turned to distance[8].

But, since we recognize that choosing this payment vehicle may have implications, we wanted to get more information on that point. We consequently kept the purpose of direct payments in the final questionnaire and asked respondents if they thought that they should

[7] Remember that seaside resorts do not have any forest in the close vicinity.

[8] Distance also has the advantage to concern both tourists and residents so that the same payment vehicle can be used during a survey for both populations.

financially (directly) participate to conserve the recreation quality of the area. They were also questioned about the reasons for their answer.

56.65% of respondents refuse the idea of paying directly, mainly for free of guilt reasons like "Local governments should pay" and "Cities which get visitor's tax should redistribute it" (Fig. 9). It is important here to note this percentage is very similar to the one obtained during the pre-survey.

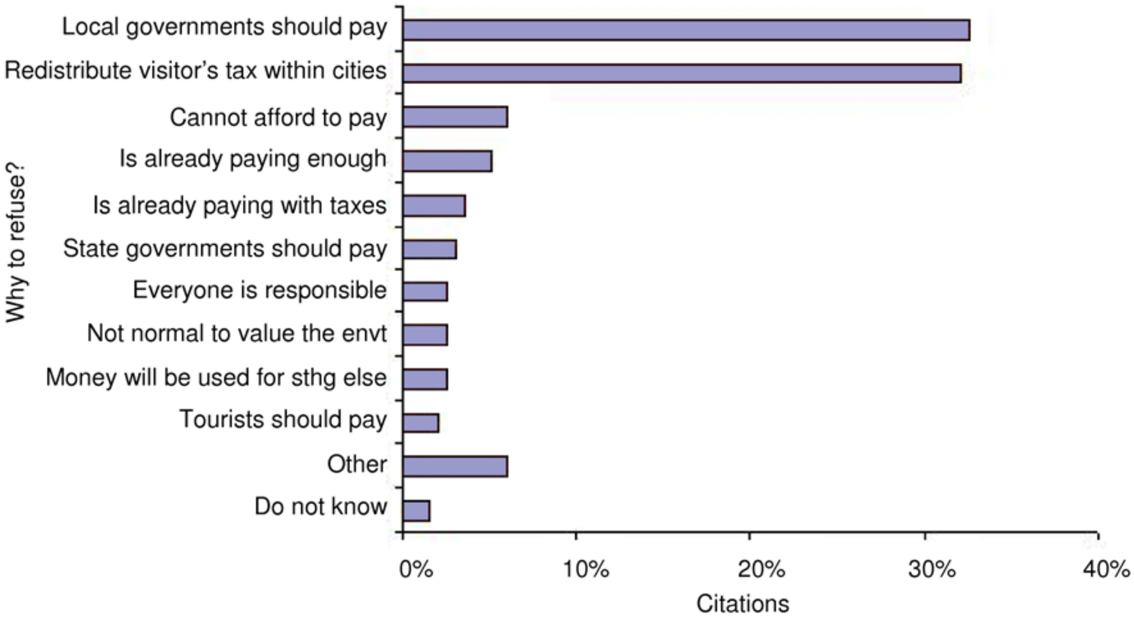

Fig. 9. Reasons why visitors refuse to pay.

Reasons to accept are much more divided (Fig. 10). The two main important are respectively "It is important to maintain this site for future generations" and "I care about environment" [1].

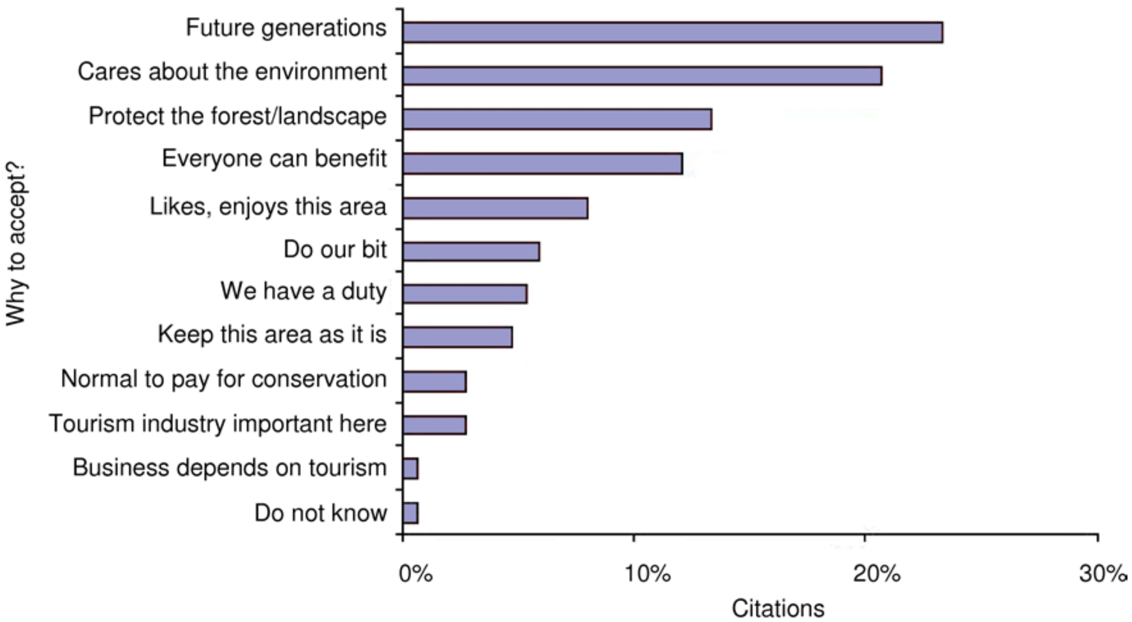

Fig. 10. Reasons why visitors accept to pay.

More interestingly, the two main statements important are respectively "It is important to maintain this site for future generations" and "I care about environment"[9]. This result stresses the importance of non-use motivations (77% of citations) whereas recreation mainly relates to (actual) use ones (Fig. 11)[10]. Using the distance (that refers to the trip that is to say to the actual use of the site) rather than the parking fees (that refer more to the use than for instance an increase in council tax but may also include non-use values) or a donation to a Trust fund for management seems, ad-hoc, to have been a better choice.

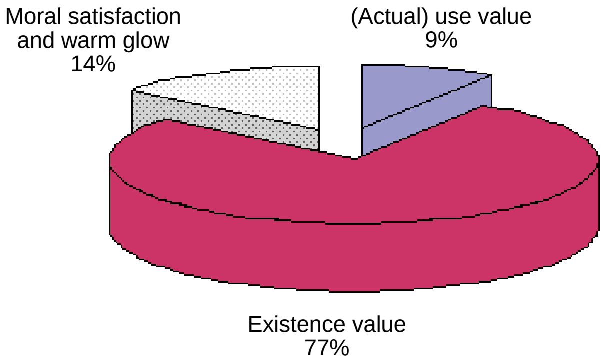

Fig. 11. Types of value linked with the acceptance to pay.

4. Model estimation and results

4.1 Model formulation

The individual utility function U_{ip} depends on the characteristics of the policy p (where $p=0$ for the reference program) and on socio-economic characteristics x_i and income y_i of the respondent i. Then, assuming a random utility specification (Manski, 1977), the utility raised by the policies A to G and the utility raised by the status quo are respectively

$$\begin{aligned} U_{ip} &= V_{ip}(p, y_i, x_i) + \varepsilon_{ip} \\ U_{i0} &= V_{i0}(0, y_i, x_i) + \varepsilon_{i0}. \end{aligned} \tag{2}$$

Then, i's WTP (denoted W_{ip}) is such as.

$$V_{ip}(p, y_i - WTP_{ip}, x_i) + \varepsilon_{ip} = V_{i0}(0, y_i, x_i) + \varepsilon_{i0}. \tag{3}$$

Under the utility maximisation principle, i will accept to pay a bid B_p for a policy p only if his WTP is superior to that bid, i.e.

$$\Pr(\text{individual willing to pay}) = \Pr\left[W_{ip}(p, x_i, y_i, \varepsilon_{i0} - \varepsilon_{ip}) \geq B_p\right]. \tag{4}$$

Assuming a linear in all parameters WTP function and $\eta = \varepsilon_0 - \varepsilon_p$, (4) becomes (Hanemann, 1984):

$$\Pr(\text{individual willing to pay}) = \Pr\left[\alpha_p - \beta B_p + \lambda y_i + \gamma x_i + \eta_{ip} \geq 0\right]. \tag{5}$$

[9] The latter is very similar to the third modality that is to say "It is important to protect the nature, the forest and the landscape" so that both together were cited by 34% of respondents.

[10] The relative importance of citations relating to both moral satisfaction and warm glow is not surprising since recreation is in fact here a public service (Kahneman and Knetsch, 1992).

Different models may be used. We wanted to test whether the theoretically separated choice occasions are perceived as such by respondents and therefore used a bivariate probit.

Bivariate probits are simultaneous equations models that consist in regressing jointly a "*selection equation*" that estimates the probability to accept or "falsely" refuse the first valuation question and the WTP equation that estimates (5) only if the respondent is a "false" protester[11] (Eklöf and Karlsson, 1997). The joint probability is

$$\Pr\left(\text{"false" protest , individual willing to pay}\right) = \Pr\left[\left(\alpha' + \gamma' x_i\right), \left(\alpha_p - \beta B_p + \lambda y_i + \gamma x_i\right), \rho\right] \quad (6)$$

where ρ is the correlation parameter of the error terms. Vella (1992) proposed a test dedicated to the study of the consistence of bivariate probits. Conducted with our data, it proves that, even if our protocol insists on the fact that respondents must answer each valuation question without taking into account their previous answers, the reality was somewhat different.

4.2 Regression

According to the Wald test, ρ is significantly different from zero, i.e. that the bivariate probit is relevant and well specified (Table 2). The goodness of fit is illustrated by correct predictions' percentage that amounts to 65.37%[12].

The **"***exclusion variables***"** identified in the selection equation influence the response to the first valuation question. For instance, people who already travelled over many kilometres to reach the site the day of the interview feel less concerned by the extra-distance to cover and thus have a higher probability to accept the first policy or to "falsely" reject it. On the contrary, respondents who have more children have a higher probability to reject the first policy, probably because travelling with children is uncomfortable (and they cannot leave them at home). Leisure activities on site also have an impact on the first response. Water sports players for instance have many substitute sites in Gironde whereas forests in this area are well adapted to hiking.

In residents' WTP equation, the extra-distance to cover is significant and has a negative coefficient. This is in accordance with the theory since it represents a cost. All policies are significantly valuated, except forest and sand when they are alone. This result can be related to the fact that more than 52% of the respondents that preferred the conservation of recreation quality on one asset when they made their choices one asset privileged the ocean, 37% the sand and only 12% the forest.

D's coefficient is higher than the one of the complete policy. This result is important since the scope usually intervenes in valuation studies. The forest seems in consequence to act as an economic bad when it is added to the couple ocean-sand since residents are willing to pay less when recreation quality is maintained also on that asset. They may probably be very aware of the presence of various substitute sites dedicated to forest recreation in the area; but this result remains difficult to explain.

In addition to its mean value, residents allocate B (sand-forest) a significant extra-premium when it is presented first. Those who especially attach importance to one asset also accept to pay more for the maintenance of recreation quality on site. Finally, residents who also frequent substitute sites have, as in the selection equation, a lower probability to accept, which is not surprising. In the same order of idea, people who are never or nearly never going on holidays are willing to pay less than the others.

[11] A Principal Components Analysis did not show any significant difference between "false" protesters and the total population. Estimating residents' WTP using the censored sample of "false" protests is thus not problematical.

[12] This is correct in practice although Cameron's recommendations (1988).

Table 2. Results of the bivariate probit

Selection equation	Coeff.	t-stat	
Intercept	-0.38	(-1.63)	
Does often or very often go to forest during his release time (0-1)	-0.54	(-6.21)	***
Does not feel restricted in leisure activities (0-1)	-0.21	(-2.34)	**
Km covered the day of the interview to reach the site	0.01	(4.57)	***
Less than 26 years old in 2006 (0-1)	0.65	(4.59)	***
Came by cycle the day of the interview (0-1)	-1.65	(-5.25)	***
More than 100,000 inhabitants in the city of the main residence (0-1)	0.50	(4.97)	***
Is not working (0-1)	-0.22	(-2.16)	**
Number of persons in the household	0.12	(2.66)	***
Number of children less than 13 years in the household	-0.56	(-7.22)	***
Goes on holidays[a]			
Several times a year	1.03	(6.66)	***
Nearly every year	1.25	(7.84)	***
One year out of two	0.85	(3.89)	***
Less often	1.12	(5.14)	***
Usual activities on site[b]			
Cycling (0-1)	0.08	(0.69)	
Outdoor games (0-1)	0.17	(1.06)	
Walking (0-1)	-0.18	(-1.68)	*
Going on picnic (0-1)	0.50	(4.84)	***
Hiking (0-1)	0.98	(5.41)	***
Swimming, watersports (0-1)	-0.81	(-5.77)	***
Birding, wildlife recreation (0-1)	-0.36	(-2.42)	**
Policy presented first[c]			
Policy C presented first (0-1)	0.39	(3.82)	***
Policy D presented first (0-1)	0.55	(5.22)	***
WTP equation			
Policy A (0-1)	1.16	(3.20)	***
Policy B (0-1)	0.96	(2.75)	***
Policy C (0-1)	0.99	(2.85)	***
Policy D (0-1)	1.39	(3.88)	***
Policy E (0-1)	0.17	(0.53)	
Policy F (0-1)	0.70	(2.14)	**
Policy G (0-1)	0.52	(1.61)	
Policy B when presented first (0-1)	0.79	(2.69)	***
Extra-distance to cover (cost)	-0.02	(-7.57)	***
Goes to seaside resorts or unofficial beaches (0-1)	-0.20	(-2.01)	**
Homemaker (0-1)	-0.72	(-3.14)	***
Hours spent in water on site	-0.10	(-2.51)	**
Does not especially attach importance to one asset (0-1)	-0.17	(-1.73)	*
Birding, wildlife recreation (0-1)	-0.41	(-2.41)	**
Goes on holidays[a]			
Several times a year	0.34	(1.68)	*
Nearly every year	0.69	(3.24)	***
One year out of two	0.66	(2.28)	**
Less often	0.60	(2.36)	**
Number of observations / number of uncensored observations	1,274 / 875		
Log likelihood function	-1,156.956		
Wald $\chi^2(18)$	135.60***		
Correct predictions	65.37%		
$\rho(1,2)$	0.41		
Wald test ($H_0 : \rho = 0$): $\chi^2(1)$	4.04**		

Notes: [a] The reference is “never or nearly never”
[b] The reference is “having rest”
[c] The reference is “policy B presented first”.

* stands for "significant at 1% level"
** stands for "significant at 5% level"
*** stands for "significant at 10% level"

Income does not intervene in the WTP equation. This result is not that surprising since, according to McConnell (1990) “for many resources, changes in the access to recreational facilities do not bring large changes in the marginal utility of income”. The budget constraint seems in fact to be replaced by a time one since, on the contrary, time spent in water has a negative impact on the probability to accept to pay for a policy. If we agree with this assumption that in fact is not so implausible since we valuate recreation demand (Bockstael *et al.*, 1987), recreation in water then becomes an inferior good[13].

4.3 Welfare analysis

The implicit mean value of each policy p is the marginal rate of substitution between the policy and the distance (Hanemann, 1984):

$$E\left(W_p\right) = -\alpha_p / \beta \tag{7}$$

with

$$Var\left(W_p\right) = \left(1/\beta^2\right) Var\left(\alpha_p\right) + \alpha_p^2 Var\left(\beta\right) - 2\left(\alpha_p/\beta\right) Cov\left(\alpha_p, \beta\right). \tag{8}$$

Its unit of measurement is a kilometre. Since we suppose that the whole group has to take the car to go to the site where recreation quality is conserved and benefit from the policy agenda, we can consider that respondents reveal a WTP per household per visit (Table 3). Multiplied by the marginal cost of motoring (0.40 euros per kilometre according to the French Automobile Club), it can be converted into euros. Divided by the mean group size as (3.4 persons according to Martres (2000)) it then becomes a WTP per person per visit. Finally, one can also take into account the opportunity cost of time. In France, the Ministry of Transportation’s norm is 5.5 euros per hour travelled[14].

Finally, is it important to analyse whether the WTP for each policy are statistically different that is to say whether respondents really take care of the scenarios they were presented. This can be conducted through a Wald test (Table 4)[15].

Table 3. Mean WTP per visit per household

	Km	St. error	t-stat	€ per household	€ per person	€ per person (CT)
A	47.38***	14.79	3.20	18.95	5.57	9.92
B	39.02***	14.20	2.75	15.61	4.59	8.17
C	40.51***	14.23	2.85	16.20	4.77	8.48
D	56.51***	14.58	3.88	22.61	6.65	11.83
E	6.81	12.78	0.53	n.s.[a]	n.s.	n.s.
F	28.75**	13.45	2.14	11.50	3.38	6.02
G	21.24*	13.19	1.61	8.50	2.50	4.45

Notes: [a] Not significant.

This test shows that residents do not valuate A, B or C differently. Moreover, ocean-sand is significantly more valuated than the other combinations of two programs but is significantly

13 Bonnieux and Rainelli (2002) already come to this conclusion.
14 We assumed the mean travel speed to be 60 kilometres per hour.
15 The statistic of the test is compared to a χ^2 (1) with H_0 : both values are identical.

similar to the complete policy. Agenda F, which contains only one program, is significantly different from both A and D. Finally, the premium allocated to B when presented first is not significantly different from policies' mean value. In conclusion, residents were not very sensible to the composition of the policies: the addition of a new program does not systematically generate a rise in valuation.

Table 4. Wald test on difference in valorisation between programs

	A	B	C	D	F
B	1.35				
C	1.07	0.04			
D	1.85	5.90**	5.79**		
F	7.23***	2.03	3.08	16.91***	
B 1st	0.72	0.13	0.23	1.89	0.04

Notes: E is not presented here since it was not significant

4.4 Substitutes or complements?

Beside the conventional inference of residents' WTP, another way to study the composition of the value of the recreational site relates to the substitution/complementarity relations between the programs. These relations are analysed using a Wald test. This test compares the estimated coefficient of the two-programs policies and of the complete one to the sum of the estimated coefficient of the policies that compose them (i.e. the IVS' result)[16].

Since in our study E and G are not significant, we can only examine the composition of A through (B+F)[17]. In this way, B+F=0.96+0.70=1.66 is not significantly different from 1.16, the estimated coefficient of A[18].

In this special case, residents consider the three programs as **independent** in valuation. These results are in contradiction with Hoehn's findings (1991) who states that "*substitution occurs consistently across all valuation contexts*" and with Santos' ones (1998) since, according to him, programs implemented on one single site can behave as complements in valuation.

5. Conclusions

This paper shows that economic valuation of recreation is still a challenging process, especially when forests and other wilderness areas are adjacent. Whenever possible, it is useful to sort out their specific impacts on users' satisfaction in order to give practical information to managers. We consequently propose to adapt traditional CVM by introducing three programs, each referring to a particular natural asset (i.e. forest as well as non-forest setting). Actually, the effects of one policy affecting one asset are easier to apprehend than the effects of a global

[16] A may be (B+F), (C+G), (D+E) and (E+F+G). B can be decomposed into (E+G), C into (E+F) and finally D into (F+G). The test may in consequence be conducted seven times.

[17] Our result must in consequence be considered cautiously.

[18] The value of the test (1.96) is compared to a χ^2 (1).

policy as studied with traditional CVM (Hanley *et al.*, 2003). In our work, coastal forests proved to be a good example of a multi-dimensional resource.

WTP for management policies ranges from 2.50 to 6.65 euros per person per visit depending on where recreation quality is supposed to be maintained. One shall here remember that our study aims at evaluating the effects of the hypothetical variations of several attributes that turn to have an influence on the total recreation value and not the total value by itself. To achieve this goal, other techniques (such as count data models) have to be implemented. Quality may hardly be taken into account then (Hanley *et al.*, 2003). Contrary to Hoehn (1991) and Santos (1998), we find here that assets tend to be independently valuated by residents. This is a counter-intuitive conclusion because they constitute one spot. Nevertheless, it can be used for environmental accounting. Since the value of the site is proved to be the strict sum of the values of the three natural settings, benefit transfer protocols focusing on a single asset can, in theory, be applied[19]. As we have seen, more general relationships (covering every possible combination) cannot be asserted.

At the present time, the use of economic valuation in designing sustainable forest management is still an open question (Wang, 2004) but it surely needs strong theoretical and methodological basis and a well defined accounting system. In our particular case, it means that off-peak season visitors' as well as tourist's demand(s) must be incorporated. Stakeholders who bare the charges of management programs (foresters, private owners, local governments, cities…) also have to be examined.

Acknowledgements

This research was funded by the Regional Council of Aquitaine as part of the project "Services récréatifs et multifonctionnalité des forêts en Aquitaine".

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[19] Nevertheless, since forest alone is not significant, these procedures may not be applied to estimate its sole value whereas they can be used at a higher scale.

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Session 6. Accounting towards sustainability

INSTRUMENTS FOR SHAPING FOREST ENTERPRISES' RESPONSIBLE BUSINESS STYLE

Lyudmyla Maksymiv[a]

Abstract

To make robust decisions for a long term perspective managers should relay on relevant and reliable information both regarding ecosystem development trends and on environmental profile of own activity. Forest accounting, in particular environmental accounting should provide a reliable information background for running enterprises in a responsible way. Modern approaches and tools of forest accounting, like environmental accounting and eco-balances, which provide decision-makers and society with relevant information on genuine environmental profile of an enterprises activity are considered in the paper.

Keywords: *forest accounting, environmental accounting, eco-balances, sustainable development*

1. Introduction

Taking care about interests of present and future generations, post- Brundtland society forces entrepreneurs toward responsible behavior both from a producer and a consumer perspective. The representatives of world business caught up the idea of sustainability, coined in 1987 (World Commission) that led to appearance of new management standards. Among different instruments aimed to implement enterprises' sustainable development considerable attention is paid to voluntary ones like environmental management and environmental audit. Ukraine encourages these new trends too: in June 2004 "Environmental Audit Law" was adopted in our country (Zakon Ukrainy pro ekologichnyy audyt, 2004).

Development of the effective systems of environmental management and environmental audit is impossible without creation a proper information background. At the level of an enterprise its basis is formed by an enterprise accounting system, which supports decision-making process (UN, 1996).

The purpose of this article is highlighting proposals for development an environmental accounting system according to imperatives of sustainable development**.** Hence our tasks are:

- to generalize experience of countries advanced in the field of applying environmental accounting systems for enterprises, who's activity has substantial impact the environment;
- to analyze the legislative and normative base for environmental accounting system implementation both at international and national levels;

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- to elaborate proposals for extending systems of traditional financial and managerial accounting to highlight environmental of enterprises activity.

2. Accounting, environment and well-being

Recent human activity has changed the environment in an unprecedented way. Ecosystems, being main elements of the environment, have complex sets of positive and negative feedbacks and hence can answer in a non-predictive way. Variety of ecosystems services (supporting, provisioning, regulating and cultural) impacts a lot a human well-being. Some of them are crucial for human security, life quality and health. To make robust decisions for a long term perspective managers should relay on relevant and reliable information both on ecosystem development trends and on environmental profile of own activity.

Indeed, demanded shift to environmentally sound activity induces enterprises' costs for environmental improvement. In the same time Intergovernmental Working Group of Experts on International Standards of Accounting and Reporting (ISAR) declares that despite greater necessity in more precise data about environmental impacts, there is no relevant reflection in enterprises' annual reports (International Standards of Auditing, 1999).

For instance, form and structure of commonly used balance, is suitable to declare the level of a solvency of a concrete enterprise, however it is impossible to define the degree of "environmental cleanness" of production. The declaration "Consideration of environmental questions at the audit of the financial reporting", developed by the Committee on International Audit Practice states, that urgency of consideration of environmental questions is conditioned to those, that at some circumstances they can entail the risk of substantial distortions (including the incongruous reflection) of the financial reporting (IAS, 2000). In case enterprise use technology or material, which are harmful for the environment it will be useful to take into account risks of environmental tax imposition and necessity of out-of-day equipment replacement.

The traditional accounting from many points of view is not suitable for the complete reflection of enterprise's environmental impacts and environmental management and control implementation. Its main shortcoming lies in the accounting methodology, which still is strongly oriented on the management of costs and incomes, focuses its attention on production processes in a narrow sense, on productivity, process and production.

Secondly, lacks of managerial accounting from an environment point of view induce from insufficient information of market prices. Non-adequate character of market prices drives enterprise to sub-optimal decision from long-term perspective. These lacks arise because of "market blindness", market failures, asymmetric and unclear environmental information, and also complications of valuing the environment.

Quoting Millennium Assessment, we can say that in most countries of the world the marketed values of forest ecosystems associated with commonly measured economic values are less than one third of the total economic values, including non-marketed values (Table 1).

Insufficient reflection of forest ecosystems in financial measures both on enterprises and on national accounts levels indeed provides a background for mismanagement, destruction of ecosystem and harm human well-being.

Table 1. Values associated with forests ecosystems (Millennium Ecosystem Assessment, 2005)

Marketed values	Non-marketed values
• Timber	• Carbon sequestration,
• Fuel wood production	• Watershed protection
• Grazing	• Non-timber forest products
	• Recreation

3. Environmental Accounting as instrument for enterprises' behavior adjustment

Unlike the financial reporting, which purpose, targets and principles are clearly regulated by the proper international standards (Commission Recommendation, 2001), nowadays-common standards of the environmental accounting are not well identified. Discussion about standardization of the environmentally oriented accounting has been taking place among experts. At the same time, work at development of relevant models of account goes ahead, in particular, due to efforts made by Federation of European Experts (FEE). Also guides for identification, measurement and inclusion of environmental costs into annual reports of companies are developed for Europe (Gray, 1990).

In our opinion, optional character of recommended forms and methods used in environmental accounting, as well as voluntariness of its procedure makes less tangible benefits but more labor and time consuming from the enterprises point of view. From other side, absence of any requirements results in volumes of positive information about enterprise's nature protection activity and zero attentions to negative environmental impacts.

The EU countries' experience provides us with a good example of scientific substantiation and robust recommendations in regard to environmental accounting system shaping.

Taking into account that environmental accounting still has been forming, there is no single, common approach to the scope definition. This term is used both at the level of statistical accounting and of bookkeeping. In particular, Environmental Protection Agency proposes such approach, presented in Table 2.

Table 2. Modified system of environmental accounting (EPA, 1995, p. 166)

Type of accounting	Object of calculation	Address	Measure
National income accounting	Nation	External	Quantitative Monetary
Financial accounting	Company	External	Monetary
Managerial accounting	Company, department, channel of service, production line or system	Internal	Quantitative Monetary

As one can see from the Table 1, at an enterprise level the environmental accounting is considered in the context of methods of managerial and financial accounting with the aim of external use, and also for analysis of inputs and outputs of real activity.

Further development of conceptual principles of environmental accounting requires the inclusion of qualitative indicators. ISAR and Financial Accounting Standards Board (FASB) offered such indicators for environmental accounting: importance, objectivity, timeliness, accuracy, validity.

Enterprises, which aspire to proactive management, run their business in environmentally responsible way and design relevant comprehensive environmental accounting system (Maksymiv and Podobyedova, 2001). This system should, from one side, provide relevant information about environmental impacts for external bodies (function of documenting); from other side, this system should support decision-making in strategic, tactical and operation planning (function of planning). Finally the system should be confirmed ex-post (function of control).

Therefore the traditional accounting system should be extended to reflect not only financial results of the enterprises activity, but environmental impacts of this activity too. Negative externalities, which feature a particular enterprise activity, should be appraised and declared.

Hence, initially oriented for the financial indexes accounting system should be complemented by eco-balances, material flow analysis, and other environmentally oriented instruments, that will give possibility to make clear the environmental impacts of an enterprise activity.

Such extension of traditional accounting system induces making decisions not only from narrowly financial and often short-term perspective (in interests of shareholders), but also taking into account the long-term use of enterprise capacity and risk avoiding for benefits of all stakeholders. Raw material scarcity and limitations of carrying capacity have increasing influence on both strategic factors. In other words we talk about new quality of strategic planning and control with the purpose of gradual orientation of enterprise on the course of "sustainable development", that ensure eco-efficiency and eco-justice.

There are three components of environmental accounting (Maksymiv and Podobyedova, 2001):

a) *collection and preparation environmentally relevant data by such means:*
   - differentiation and extension of traditional bookkeeping system (for instance, structuring accounting of different types of expenses and places of their origin, extended accounting of investments, analysis of financial results, calculation of external expenses specific for a particular enterprise);
   - extension of financial accounting through material balances design and calculation, by means of an enterprise, process or product eco-balance;
   - development of environmental indicators system for planning and controlling of enterprise eco-efficiency;

b) *system of eco-controlling* with the permanent planning, management, control within the framework of general controlling (in close relations with the strategic planning and control);

c) *eco-audit* as internal and external revision with purpose of supervision of functional capacity and effectiveness of environmental management system (according to ISO 14001).

Accounting and preparation of data about the environment create basis of eco-controlling, supports environmentally and socially responsible management of an enterprise. Simultaneously the background for certification of enterprise environmental management system according to ISO 14001 is created. Eventually scope, intensity and purpose of environmentally oriented accounting is shaped due to enterprise environmental policy.

Main instruments of environmental accounting:

1. Differentiation and extension of managerial accounting

On the first stage of costs and revenues accounting it is possible to determine primary environmental costs related to nature protection. It is easy to find relevant primary costs for different types and places of origin (for example, relevant equipment depreciation, payment for wastes utilization, effluent discharge, cost of environmental accounting reporting, environmental researches, monitoring, payment of proper personnel).

These costs are known as abatement cost of environment protection, often they arise at the end of pipe and part of them could be voluntarily. Nowadays, statistical registers reflect mainly these primary environmental costs, which are expressly definite in costs calculation. However environmental costs arise not only on the "end of pipe", in form of easily determined filters depreciation, or on the "begin of pipe" in form of environmental investigation costs. They are hidden as secondary environmental costs behind the value creation process both as direct and overhead expenses. Additional expenses for cleaner or certified raw materials are good example of such costs.

Hence, it is suggested to identify environmental costs of inputs, outputs and semi-finished products by means of material flow analysis.

Thus we extend a notion of enterprise environmental costs and consider them as *internalized environmental costs, which arise due to voluntarily, or compulsory measures aimed to avoid, diminish or mitigate environmental impacts and also due to losses of productivity and irreversible losses of energy, materials and raw materials.*

If an enterprise fulfills an environmental policy and takes measures aimed to reduce environmental impacts and implements environmental accounting, then one can expect, that natural capital losses will decrease and greater part of all costs (from wider economic instead of narrow financial point of view) will remain on the previous level (Fig. 1). Hence, we create more value with less cost that corresponds with aims of environmental economics.

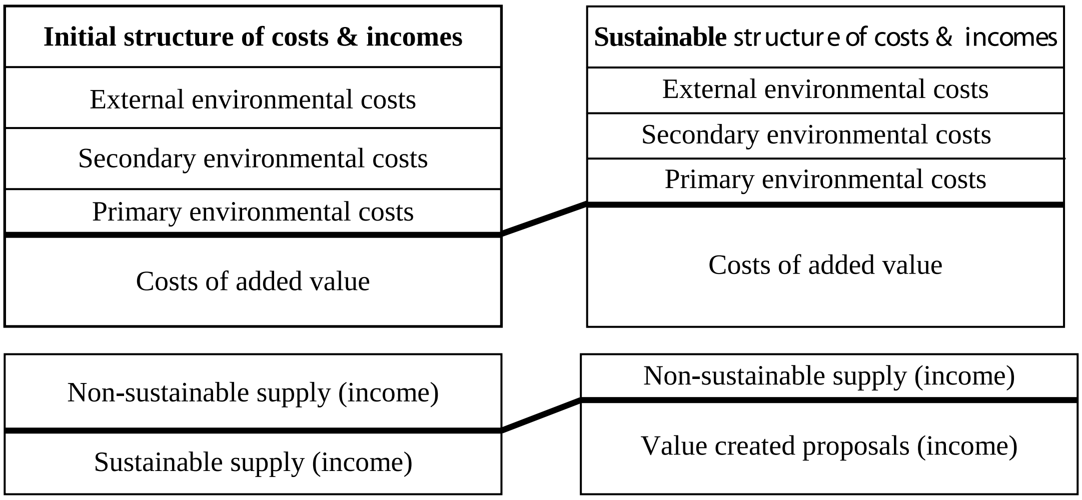

Fig. **1**. Development of sustainable oriented costs and incomes (Stahlman, p.169).

By means of such differentiation and extension of financial accounting it is possible to obtain an idea about key points that illustrate environmental profile of an enterprise's activity. It all takes place within a framework of monetary evaluation and must be complemented by the analysis of the real commodity flows. It will give a possibility to apprise quantitative indicators which are used in costs and income accounting.

2. Financial accounting extending

Reasonable background for a sound analysis of costs and real economic evaluation of environmental impacts seem to be eco-balances. They enable us to explore both objects (for example, tools, package materials, machinery and equipment) and processes (for example, transporting) or various organizational units (like enterprises, production, products) in relation to their impacts on the environment, including possible impacts on human health.

Application of eco-balances enables to extend boundaries of balance (research horizon: balance scope, timing), and also limits of a system in question (research depth: choice of environmental impacts, environmental criteria of evaluation).

Our proposals are in-line with instruments of environmental accounting which is one of four branches of forestry accounting, proposed by Jöbstl and Hogg (1998). Increasing interest of society to environmental and social issues will support strengthening and extending all these branches of forestry accounting.

4. Conclusions

Implementation of enterprises environmental accounting requires a new type of experts, which are able to make decisions taking into account economic efficiency, social justice and environment integrity.

Summarizing above-stated, we make such conclusion:

1. Environmental challenges, which are inalienable constituent of modern economic models development, require forming environmentally conscious activity of enterprises.
2. A bookkeeping as a base of an enterprise's information system must provide relevant data to enterprise managers to ensure environmental risk avoiding in long-term perspective.
3. Enterprises, which decide to accomplish their activity, following principles of offensive environmental business style, need more precise information about impacts caused by their activity, processes and products on the environment. These needs predetermine the necessity of differentiation, more precisely extension of both financial and managerial accounting.
4. Extension of forestry accounting by the most substantial environmental aspects will give possibility to external users to obtain more complete information about outcomes of enterprise activity, representing not only financial results but also level of environmental quality of production.
5. Development of standards (requirements) of environmental accounting in addition to financial reporting of enterprises, which take part in the system of environmental management, will ensure that their accounts are objective and complete from the environment point of view.
6. Differentiation of managerial accounting with a special stress on environmental costs in places of their origin, and for all bearers and types will make these costs transparent and, thanks to it, guided, that, in their turn will promote search of roots of backlogs, ways and instruments of their environmental impact reducing and lightening.
7. Application of recent tools of environmental accounting, such as eco-balances, life cycle analysis, environmental indicators will improve efficiency of enterprises management owing to adjusting of eco-controlling and eco-audit systems.
8. Development of environmental accounting system needs well-educated and trained accountants, which have a good grasp of theory of sustainable development and are able to realize decision-making according to imperatives of sustainable development.

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FAIR VALUE ACCOUNTING OF BIOLOGICAL ASSETS REGARDING TO IAS 41 AND EMISSION REDUCTION REVENUES OBTAINED BY SILVICULTURAL ASSETS: THE CASE OF PRECIOUS WOODS GROUP

Klaus Wallner [a]

Abstract

This case study assesses the financial statements of the Precious Woods Group to focus on two new types of revenue streams in forestry business: fair value gains and revenues from emission reduction activities. The Precious Woods Group - one of its core activities is the reforestation of degraded land in Central America - meets the requirements for such a case study by applying the fair value method to assess its forests and by selling CFI's (Carbon Financial Instruments) generated by its forests. With reference to the fair value accounting of biological assets (IAS 41 - Agriculture) and the revenue of emission reduction activities generated by biological assets the financial statements from 2003 till 2006 were evaluated. The study tries to highlight the importance of these two types of revenues for forestry business in the forthcoming years.

***Keywords**: Forestry accounting, international accounting standards, emissions trade, carbon credits*

1. Introduction

Looking at the recent discussion on climate change, which was significantly triggered by the IPCC-Report in February 2007, afforestation and reforestation projects are gaining public awareness. An instrument to get a better grip on climate change is the instrument of emission trading. This market developed well in the recent years. But beside the enthusiasm the bitter pill for forest projects within CDM[1] cycle is, that they are so called sinks that generate only temporary credits. The share of forest projects in comparison to renewable energy projects within the CDM is currently growing very slowly. There is only one project[2] registered by the Executive Board of the UNFCCC[3]. Within the European Union Emissions Trading System (EU-ETS) the case is even worse, because emission reductions from sinks can't be traded.

The European Emissions Trading Scheme (EU-ETS) is currently the biggest market for CER's[4] generated by projects; therefore the exclusion constrained the potential of forest projects significantly (Ruddell, 2006). But there is an indication that in a Post-Kyoto Regime credits from forestry would be included and the market will gain momentum. The catalyst role will play the merger of the different country-related certificate markets. The crucial point in the debate is that certificates generated by forestry projects in other yet established voluntary markets are already allowed. The Chicago Climate Exchange (CCX) is currently the most im-

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[1] CDM = Clean Development Mechanism is one of the project based mechanisms fixed in the Kyoto protocol (Art. 12 KP).

[2] Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin. Available at: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1154534875.41/view.html.

[3] UNFCCC = United Nations Framework Convention on Climate Change.

[4] CER = Certified Emissions Reductions; A good overview to all types of certificates available at: http://www.eurocarbonltd.com/carbon_trading.htm.

portant exchange platform, where emission reduction credits from increase in carbon stocks - converted in CFI's - could be traded (Ruddell, 2006). Thus for forest management companies emission certificates will become an attractive option to improve the return of its biological assets.

But what is the link between carbon financing and IAS 41? Both are certain types of new revenue streams for enterprises active in the forestry sector. In 2000 the International Accounting Standards Board (IASB) published a new standard regarding agriculture (IAS 41). The scope of IAS 41 covers different types of agricultural activity. In the case of forestry this means the biological transformation of silvicultural plants into logs for sale (IASB, 2003). The accounting standard Agriculture of the IASB represents the introduction of the fair value approach to forestry accounting on an international level (Herbohn and Herbohn, 2006). At least in comparison to German Commercial Law (HGB) and other legislations of European countries like Austria, Finland and France, the systematic change is fundamental (Jöbstl and Hogg, 2005).

One focusing point for example is the realisation principle (§ 252 Abs. 1 S. 4 HGB), which is one of the pillars of the German Commercial Law. This principle states that only earnings, which were realised till the balancing sheet day, should find entrance to the profit and loss statement (Thommen and Achleitner, 2006). Focusing on forestry this means only when the harvested timber is sold, the gain of a grown forest plantation is realised and accrued within the balance sheet. At this point the accumulated undisclosed reserves of the forest asset were lifted. This describes the fundamental problem that the income of forest plantations enters into account not until the sale. Silvicultural products generally have lifecycles of far more than one year, which is very long compared to the business cycle of other companies.

Depending of the stage (growth, harvest) the disclosure of the biological asset and generated agricultural produce is different. During the period of growth IAS 41 is applicable till the point of harvesting. The stored agricultural produce (e.g. logs) after harvest has to be shown in the position inventories were IAS 2 is relevant.

The present case study tries to highlight the effect of IAS 41 and emission trade on profits by analysing the annual statements of the Precious Woods GROUP, which is listed at the SWX Swiss Exchange. The company is an optimal subject for the case study because since 2000 the fair value approach is applied to its biological assets as required by IAS 41. Furthermore Precious Woods have sold CFI's from its forest plantations in Central America in 2006. So at least for this year both effects are reflected in the financial statement.

The reminder of the paper is structured as follows: After the introduction in chapter one, the second part is characterized by an overview of the Precious Woods Group, focusing on important milestones in the history of the group. The third paragraph is evaluating the data source used for the financial analysis. In the fourth chapter the key issues of the accounting standard 41 are summarized and it is shown how Precious Woods realised the necessary premises. A brief information about the earned CFI's is given in part five and the following paragraph is dedicated to the analysis of the extracted data. The last section gives a short conclusion.

2. The Precious Woods Group

The Precious Woods Group - with its headquarters at the British Virgin Islands and its first operative entity in Costa Rica - was founded in 1990 (Precious Woods, 2007). The focus was on forest plantation especially Teak, Pochote and other indigenous species e.g. Caoba, Ron Ron, Cedro Macho. In 1994 the enterprise expanded its plantation activities in Central America by sustainable forest management in Brazil. The Brazil project was operational in

October 1996. Since 2000 the company is applying the International Accounting Standards (IAS/IFRS) for the preparation of its annual financial statement. This includes the early adoption of IAS 41 (Agriculture) to its biological assets (Precious Woods Holding, 2001). In 2001 the Brazilian activities were enlarged by a joint venture with A. van den Berg. Also in 2001 the principal office registered at the British Virgin Island moved to Zug (Switzerland).

In March 2002 shares of Precious Woods were traded the first time at the Swiss Stock Exchange. In 2003 a company in Nicaragua was installed to expand the activities in Central America (see Fig. 1). Another milestone was reached in 2006 by selling its first ever emission rights obtained by the reforestation project in Costa Rica. Furthermore Precious Woods acquired the Dutch company A. van den Berg B.V. which now operates as Precious Woods Europe BV within the group. Besides its key activities in Latin America, in 2007 the Precious Woods Group acquired a minority stake in a forest company (Nordsudtimber Group) based in the Democratic Republic of Congo and a majority stake in two enterprises (CEB and TGI) located in Gabon. The company structure without the African acquisitions is drafted in Fig. 1. All activities from Precious Woods in South and Central America are certified by the Forest Stewardship Council (FSC).

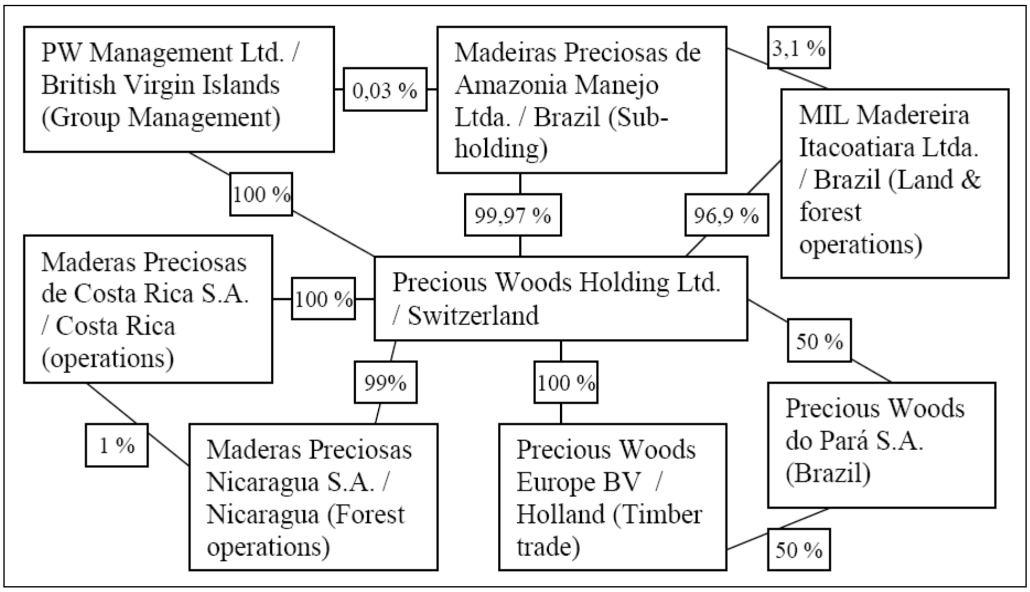

Fig. **1**. Structure of the precious Wood Group. (*Source*: Annual Financial Report Precious Woods 2006).

3. The data basis

Analyzing the financial statements over several years a consistent data basis is necessary. At the company homepage[5] the financial statements from 2000 till 2006 are available. This period was first of all considered as data basis for the case study but during this period the structure of the balance sheet and the statement of income varied significantly. In 2004 a restated financial statement (including the year 2003) was unavoidable because of fundamental accounting errors.

The first error was that Precious Woods has – including the financial statement 2003 – incorrectly applied IAS 12 (Income taxes). This accounting standard especially focuses on

[5] Available at: http://www.preciouswoods.com.

deferred tax on the assets and liabilities side (Pellens, 2004). Secondly the company adopted IAS 38 - concerning intangible assets - incorrect. As a consequence the entry "intangible assets" was deleted from the balance sheet. The incorrect applied IAS 12 and IAS 38 had both effect on the tax payments and liabilities, which were to low. For these reasons the balance sheet for 2003 was restated and the errors were recognized retrospectively, that affected the retained earnings by $ -6,827,933 USD (Precious Woods, 2005). In the overall effect the balance sheet total of the year 2003 shortened about $ -3,171,403 USD and the net profit diminished by $ -732,197 USD.

For getting a reliable data set, the concerning balance sheet entries in the financial statements of 2000, 2001 and 2002 had to be adopted. using the original data without a correction, the determined net income of these years would be diluted and not comparable to the following year. The negative effect on the analysis would have been biased ratios. The problem is that the data provided in the financial statement 2004 was not sufficient for splitting up and clear the monetary effect caused by the application errors to different balance sheet entries. More internal information would be necessary for a correct adoption of the prior balance sheet entries to the level beyond the restatement, but the required data is not publicly available. For this reason the affected years (2000 - 2002) couldn't be included in the analysis without diluting the result.

The financial assessment refers to the activities in Central America (Costa Rica and Nicaragua) because only for these plantations the fair-value approach is used ditto emission reduction credits are only obtained by these plantations. The used data for the analysis cover the historical costs for land, planting and maintenance. The composition of the increase in biological assets for the corresponding years is contemplated as well as the costs incurred during the year for the concerning period. Furthermore, information about dividend payment, the net income before taxes and the total equity is used. After describing the problem of generating a valid data set, the next section is focusing on the requirements for applying IAS 41.

4. The application of IAS 41 by Precious Woods

Since 2000 the Precious Woods Group is applying the accounting standard IAS 41, which regulates accounting treatment, disclosure and the preparation of the financial statement concerning agricultural activity (IASB, 2003). Influenced by the true and fair view principle, which is fundamental for the International Accounting Standards, the annual growth of the biological assets (here forest plantations) have to be included to the profit and loss statement as income in the regarding year (Pellens, 2004). Unlike the historical cost accounting model that does not accrue the income by growth during the period from planting to harvest because the growth gain is not yet realised in cash.

One premise for an application of IAS 41 is that the biological assets are related to agricultural activity during the period till harvest (IAS 41.1). IAS 41.6 mentions forestry as agricultural activity covered by the standard. The three characteristics for all documented activities are the capability of the asset to biological transformation ("growth" IAS 41.7 a (i)), that the change of the asset is managed (by Precious Woods) and that the transformation of the asset is measurable (e.g. diameter). The upcoming question is how Precious Woods measures changes in the fair value of its plantations. IAS 41.10 c states, that only when the fair value could be measured reliably, the enterprise is allowed to recognise its forests as biological assets. Further conditions are that the enterprise controls the asset (e.g. legal ownership as stated in IAS 41.10 a) and that the future benefits will flow to the enterprise (IAS 41.10 b). But the crucial point is the reliable measurement of the fair value of the biological asset. That's e.g.

possible when a market price exists for the current state of the biological asset (IAS 41.17). For timber logs a market price is available but this price is the fair value at the time of harvest and could not be applied to plantations during the entire period of growth.

Considering these circumstances the standard allows the use of the present value of expected net cash flows from the biological asset (IAS 41.20). For discounting a market based rate before taxes has to be applied. Calculating the present value, the enterprise is not allowed to include financial expenses related to the asset as well as taxation and reforestation costs for a new plantation after harvesting the current one (IAS 41.22). The determination of the fair value is facilitated by the possibility of grouping the biological assets according to significant characteristics (IAS 41.15). At this point it is important to mention that the land related to silvicultural activity is not within this scope (IAS 41.2 a). In the standard a second proceeding for biological assets attached to land - like plantation forest - is offered. The approach is the following: If there exists an active market for combined assets (in our case biological assets, raw land and land improvements) as a whole the fair value of the biological asset could be determined by deducting the market price for raw land and land improvements from market value of the total package (IAS 41.25). This option was not used by Precious Woods probably because of the fact that such type of active markets doesn't exist in Central America.

Precious Woods complied with the requirement of reliable measurement by using option 1 and grouped its plantations of Teak and Pochote in five different growth classes separated by country: marginal, low, medium, high and excellent (Only native species are not split up in five groups because of its marginal proportion) [Precious Woods Holding (2001)]. Using representatively distributed sample plots, the growth of each plantation is measured every year and allocated to one of the growth classes. Connected to this classification are an estimation of the volume and the time of harvest. With the expected volume and the remaining period until harvest the discounted cash flows for each category are determined considering the future cash inflow obtained by the investment (sales of logs) and the cash outflow needed to conserve the biological asset during the remaining period. For the main types of trees (Teak, Pochote and native species) the present value is calculated by deducting the point of sale costs from the different prices and then discounting the cash flows with ratios which vary within the five categories and the countries (Table 1). The highest discount rate for the excellent growth class in Nicaragua is 16.60 % and the lowest 8.10 for the marginal growth class in Costa Rica.

Table 1. Growth classes of Teak and their discount rate in Central America 2006, %

Growth class	Excellent	High	Average	Low	Marginal
IRR / Costa Rica	14.9	12.7	11.3	10.2	8.1
IRR / Nicaragua	16.6	14.1	12.0	11.3	9.1

Source: Annual Financial Report Precious Woods Group 2006.

By growing well, a sample plot could be upgraded to a higher class and vice versa be downgraded to a lower one. All estimations for the calculation of the cash flows for each category were based on the experience of Precious Woods (e.g. personnel costs, fuel costs) and conservative assumptions concerning future market prices. Looking at the total lifecycle of a plantation it is obvious that at the beginning the fair value of the plantation is very close to the standard costs of preparing and maintaining a plantation but in the last phase of the plantation cycle - shortly before harvest - the fair value is mainly determined by the discounted cash inflows that will be generated by selling the logs to a certain price (less estimated point-of-sale

costs). For the fair value calculation the market price is relevant, not the price who is e.g. contracted with the future buyer (IAS 41.16).
The range of the fair value per hectare of the Teak plantation (Table 2) was over the last four years constant, only for the Pochote plantation the fair value per hectare was fluctuating due to the lack of sufficient market data and comparable information for modeling the growth. For 2006 the fair value of Teak varies between $1,800 USD/h and $ 14,100 USD/h and for Pochote between $ 1,600 USD and $ 8,000 USD. After the examination of the procedural method of the Precious Woods Group regarding the disclosure of biological assets in concordance with IAS 41 in the following part brief information about the Carbon Financial Instruments is given.

Table 2. Range of fair value of plantations in USD per ha in Central America

	Teak Minimum	Teak Maximum	Pochote Minimum	Pochote Maximum
1 1/2 - years	1800	2100	1600	1780
5-years	4200	6100	2900	4180
10-years	7700	14100	4200	8000

Source: Annual Financial Report Precious Woods Group 2006.

5. Carbon credits and forestry

Since the start of the Kyoto initiative sink projects had been treaded disadvantageous. Currently offsets earned from LULUCF (Land Use, Land Use Change, and Forestry) aren't allowed within the European Emissions Trading Scheme (EU-ETS) which started in 2005 (Ruddell, 2006). Therefore an alternative is the Chicago Climate Exchange (CCX) that offers credits for sequestered forest carbon. An important characteristic is that the market for Carbon Financial Instruments (CFI) is a voluntary market. The mentioned CFI's are the type of carbon credit issued by the CCX displaying by a ratio of 1:100 the sequestrated amount of CO_2. The necessary demand in that market is generated by companies and other entities looking for possibilities to offset their emissions.

The 2,322 CFI's issued by the CCX were created by the afforestation activities of Precious Woods in Costa Rica (Precious Woods, 2007). Premise for the issue of the CFI's was that the offset of 232,200 t CO_2 by the growth of trees was verified by an independent verifier and registered by the CCX. The CFI's from Precious Woods were the first ever generated certificates by a forestry project. The Worldbank bought the CFI's from Precious Woods to offset part of its CO_2-Emissions. In the next paragraph a financial analysis of the key figures is provided.

6. Financial analysis

Starting the financial analysis it is worth to have a look at the historical costs of planting and the land (Table 3). The total costs over the observed period are constantly increasing due to the fact that the Precious Woods Group acquired further land and expanded its afforestation activities in Central America. The total costs rose from 2003 to 2006 by $ 7,120,099 USD which equals 32.62 % referring to 2003 as basis.

Table 3. Historical costs of planting and land in Central America (USD)

	2003	2004	2005	2006
Planting	15,505,381	17,108,798	18,803,143	20,773,009
Land	6,323,775	6,867,709	7,007,724	8,176,246
Total costs	21,829,156	23,976,507	25,810,867	28,949,255

Source: Annual Financial Reports Precious Woods Group 2004 - 2006 / Own calculations

The next step is to examine more closely the different parts regarding an increase of the biological asset. It is possible to distinguish between elements that have a positive effect on the fair value or a negative one. But there are also a few elements that could bear positive as well as negative effects. The "growth of previously existing plantations" and "new plantations in the reporting period" belongs to the first category. The second type consists of "fair value of biological assets harvested" as well as "write-off of poorly growing plots". The mixed category contains "change of valuation assumptions" and "correction to areas planted with GPS measures" which had been negative in the reported period (Table 4).

Table 4. Increase of biological assets in Central America (USD)

	2003	2004	2005	2006
Growth of previously existing plantations	4,247,687	5,125,081	6,081,253	6,151,579
New plantations in reporting period	252,985	486,715	591.006	484,123
Change of valuation assumptions	-227,112	-	-	-638,788
Fair value biological assets harvested	-	-	-133,623	-599,410
Correction to areas planted with GPS measures	-	-79,315	-1,234,254	-
Write-off of poorly growing plots	-268,439	-156,725	-	-
Increase in biological assets	4,005,121	5,375,756	5,304,382	5,397,504
Accumulated increase in biological assets	13,376,897	18,752,653	24,057,035	29,454,539

Source: Annual Financial Reports Precious Woods Group 2004-2006 / Own calculations

The value "growth" in the first line is constantly increasing due to the fact that every year the plantations were expanded. Another input variable is reflected by upgrading a sample lot. The change in valuation assumptions 2006 is owed to an adjustment of the market price for Pochote, in 2003 the company revised a few standard cost profiles for the different categories. The measurement with GPS (Global Positioning System) impacted the biological increase in 2005 significantly ($ - 1,234,254 USD) because the whole area was remeasured. In 2003 the "accumulated increase in biological assets" includes $ 9,371,776 USD for the augment during the Period 2000 - 2002[6]. The total impact during the contemplated four years period amounts to $ 20,082,763 USD. For getting the net fair value gain, the costs occurred during the regarding years have to be considered.

Looking on the personnel costs as one of the input factors the attention lays on the significant increase of 133% from 2003 to 2004 (Table 5). Also interesting is the pledge of "other

6 The inclusion was necessary to calculate the balance sheet value for the following periods correctly.

general costs" in the year 2005. Perhaps the first effect could be justified by the reorganisation of the cost accounting and by the doubling of the Nicaraguan staff. The overall development of the total costs is characterized by a constant rise.

Table 5. Costs incurred during the year in Central America (USD)

	2003	2004	2005	2006
Personnel costs incurred during the year	350,417	817,136	1,186,661	1,093,470
Depreciation expense	89,446	97,199	120,267	149,490
Other general costs incurred during the year	898,353	689,084	387,416	726,905
Total costs incurred during the year	1,338,216	1,603,417	1,694,345	1,969,866
Accumulated costs	1,338,216	2,941,633	4,635,978	6,605,844

Source: Annual Financial Reports Precious Woods Group 2004 - 2006 / Own calculations.

For calculating the balance sheet value of the biological assets the costs of the planting and the "increase in biological assets" have to be summed up and from the result the "total cost incurred during the year" were deducted (Table 6). Therefore the difference between the historical costs and the balance sheet value could be reduced to the accumulated net gain originated by the fair value assessment. The 2006 difference is the result of reducing the accumulated fair value in 2006 by the accumulated costs of the same year. In the four years period the overall contribution of the fair value approach to the company profit amounted to $ 22,848,695.

Table 6. Difference between fair value and historical costs Central America (USD)

	2003	2004	2005	2006
Balance sheet value biological asset	27,544,062	32,919,818	38,224,201	43,621,704
Balance sheet value land	6,323,775	6,867,709	7.007,724	8,176,246
Fair value & land	33,867,837	39,787,527	45,231,925	51,797,950
Total historical costs	21,829,156	23,976,507	25,810,867	28,949,255
Difference historical costs	12,038,681	15,811,020	19,421,058	22,848,695

Source: Annual Financial Reports Precious Woods Group 2004 - 2006 / Own calculations.

The company's net income was not only affected by the net gain from fair value; also the gain from selling the CFI's should be considered as a new revenue[7] stream for Precious Woods Group (Table 7). In 2006 the company obtained additional cash inflow in the amount of $ 885,537 by the sale of emission reduction certificates from its afforestation activity in Costa Rica. Therefore the total gains from both revenue components numbered $ 4,313,175 in 2006.

In relation to the net income before taxes the positive effect is obvious: more than 80 % were contributed to the company's earnings by the new revenue streams. In 2003 the proportion was also nearly 80 %, in 2004 almost the whole net income tributes to the fair value gain and in 2005 the additional earnings avoided a loss beyond ten million dollar. The negative result in 2005 was encumbered by the Brazilian activity because of a disadvantageous exchange rate, a high fuel price and high extraordinary write-offs (Precious Woods, 2006).

[7] Contrary to the fair value gain which has to be neutralized in the cash flow calculation, the earning related to the sale of CFI's are fully included in the cash flow statement of Precious Woods.

Table 7. Net income with and without gain from fair value and CFI's (USD)

	2003	2004	2005	2006
Net gain change in fair value	2,666,905	3,772,339	3,610,037	3,427,638
Gain from selling emissions reductions CFI's	-	-	-	885,537
Total gains from fair value and CFI's	2,666,905	3,772,339	3,610,037	4,313,175
Accumulated gains	2,666,905	6,439,244	10,049,281	14,362,456
Net income before taxes	3,348,829	3,919,817	-8,947,601	5,345,404
Net income before taxes without additional-gain	681,924	147,478	-12,557,638	1,032,229
Percentage of net profit	79.64%	96.24%	negative	80.69%

Source: Annual Financial Reports Precious Woods Group 2004 - 2006 / Own calculations

Calculating the ratio ROE (Return on Equity) the result is not surprising. The overall return on equity reaches 6.01% (2003) and with 5.61% a little bit less in 2004 (Table 8).

Table 8. Return on Equity I

	2003	2004	2005	2006
Equity in USD	55,743,881	69,925,588	144,691,880	158,249,328
Return on Equity	6.01%	5.61%	-6.18%	3.38%
Return on Equity without additional gains	1.22%	0.21%	-8.68%	0.65%
Return on Equity (only additional gains)	4.78%	5.39%	2.49%	2.73%

Source: Annual Financial Reports Precious Woods Group 2004 - 2006 / Own calculations

Without the revenue from the fair value gain the results would have been in 2003 only 1.22 and even below one percent in 2004. The equity rose in 2005 significantly due to an increase in capital stock; therefore the ROE ratio has to drop notably. Because of the loss situation in 2005 the effect is only visible concerning the additional gains, counting barely 2.5 %. In 2006 the net income stabilized at $ 5,345,404 USD before tax but the ROE amounts only 3.38%, influenced by a doubled capital stock in comparison to 2004. Without the additional gains as a result of the application of IAS 41 and the carbon trade the return on equity would have been only 0.65 %. Concluding the financial analysis it is worthwhile to have a look at the dividends. Despite higher revenues the Precious Woods Group didn't distribute dividends and in this case that's a viable strategy for the company considering the revenue structure. If they had distributed in 2003, 2004 and 2006 dividends it would have been very probable that the dividend was mainly achieved by the fair value assessment. The effect of such a dividend would have been the distribution of unrealized earnings.

7. Conclusions

The application of IAS 41 and the possibility to participate in international emission trading is for the forestry sector linked due to similar requirements. That means the transaction costs (implementing reliable measurement/monitoring of growth, etc.) for participating in emission trade when a company already applies IAS 41 to its biological assets especially plantations are quite low. Applying IAS 41 creates the basis for the necessary validation, verification, certification and monitoring procedures but nevertheless further premises depending on the regulations of the registering institution have to be completed.

Taking into consideration the quality, both revenue streams have to be evaluated differently. The earnings from emission trade are realised gains and are therefore elevating the cash flow of the company. Using the revenues from CFI's for financing new investments (so called carbon financing) or for dividend distribution constitutes no difficulty. The income generated by a change in fair value is more problematic in this context. Regarding the principle of a true and fair view, the increase in biological assets by a change in fair value should be included in the balance sheet value as well as to the annual profit. This means the revenues generated by the increase of biological assets are treated like realised gains.

Thus the fair value disclosure is ambivalent and bears certain risks; e.g. when the company uses the fair value gain for financing, the company runs the risk of illiquidity. Moreover, a sophisticated risk management is necessary to cover the risk of complete write-offs caused by calamities (e.g. windstorm, fire, insects. etc.), because by using IAS 41 a company is much more affected than by using historical cost accounting (lower balance sheet values).

The main objective of the case study was to illuminate the growing importance of these relatively new revenue streams for forestry enterprises in the forthcoming years. Especially with the vision of a growing carbon offset market and the possibility for forest companies to participate fully - this includes not only afforestation and reforestation but sustainable forest management and avoided deforestation - in this market by a more open Post-2012-Regime this type of revenue will gain importance. For realising especially the opportunities' related with the carbon market for sink projects, the companies active in the forestry business have to start preparations and by applying IAS 41 to its biological assets a good stake of the effort is already done.

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VALUE CHAIN ANALYSIS: A TOOL FOR ANALYZING OPTIONS IN FOREST PRODUCTS INVESTMENT FOR RURAL DEVELOPMENT IN A TRANSITION ECONOMY

Yurij Bihun[a]

Abstract

Value Chain Analysis (VCA) is a relatively new tool for determining the viability of investing in sustainable forest management (SFM) and value-added forest product manufacturing for rural development. The VCA model requires financial accounting and decision-making at each link of the value chain to determine the feasibility of investment. VCA has been used in North America and developing countries but its applicability to Ukraine's transition economy has not been studied.

The Ukrainian forest products industry was part of the large command economy system that functioned, albeit inefficiently, as part of the Soviet model. Many manufacturing and processing facilities become insolvent and were abandoned in the transition to a market-based economy. Enabling communities to make a definitive, transformational change to another economic system involves creating *multiple streams of income* and determining the financial viability of each of the dense linkages to commercial value chains. To enable this to happen, options include a study of the financial credits associated with business strategies including marketing, product development and quality control. Improving efficiency, adding service components to the product, improving transportation and communication logistics, and reducing risks are all strategies to improve linkages with the value chain downstream. Examples among processing facilities that have made this transition successfully can identify other categories of options.

The author presents the VCA process and evaluates its potential as a practical tool in the forest sector. Case studies in the northeastern United States and South America are used to illustrate the possibilities and limitations of this model.

***Keywords**: Value Chain Analysis (VCA), value-added, multiple streams of income, forest products, sustainable forestry*

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Свідоцтво Держреєстрації серія ДК № 1258 від 06.03.2003 р.

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ISBN 978-966-433-039-5