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Managerial Economics and Accounting in an Evolving Paradigm of Forest Management

Proceedings

Second Edition

by Hans A Jöbstl and Christina Roder

IUFRO
4.05.00 Managerial Economics and Accounting
4.05.01 Managerial, Social and Environmental Accounting
4.05.02 Managerial Economics

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MANAGERIAL ECONOMICS AND ACCOUNTING PERSPECTIVES OF EVOLVING PARADIGM OF FOREST MANAGEMENT

Shashi Kant[1]

ABSTRACT

This chapter provides an overview of the contents of this book. The book is divided in four sections. First section is on Managerial Economics Perspectives, and it includes four papers on rational actions, multiple-objective and multiple-stakeholder decision making, cluster analysis, and financial compensation for contract-based forest management regimes. Second section is on Managerial Accounting perspectives, and it also includes four papers on national and regional accounting, enterprise accounting, and green accounting. Third section is on Economics of Non-timber Forest Products, and it includes three papers on the incorporation of non-timber objectives in forest management planning, valuation of forest services, and impact of the inclusion of carbon value on forest rotation. Final section is on organizational perceptions and learning, and it includes one paper on perceptions and one on learning.

Keywords: forest accounting, multiple objectives, non-timber forest products, organizational learning, rational action, stakeholders, sustainable forest management, valuation

1. INTRODUCTION

The global society is passing through an evolutionary stage with respect to forest management, and social, economic, and ecological factors are expected to make long-lasting contributions to forest management. The accelerated economic growth in developing world with continuing growth in the developed world, globalization, and continuous population growth in developing countries are increasing human pressure on forests for wood-based products such as fuelwood, lumber, pulp and paper, furniture, and wood composites. At the same time, change in societal values of global community is increasing pressure on forests for non-timber goods and services, such as recreation, biodiversity, wildlife habitat, carbon sequestration,

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aesthetic, and Aboriginal values. As a result the emphasis in forest management objectives is shifting from an often exclusive and singular commercial timber production to a broader and multipurpose management approach. This dynamics of forest management poses numerous challenges to the discipline and professionals associated with managerial economics and accounting related to forest resources.

These challenges are not specific to the present because most of these are expected to continue and some new ones will probably emerge in future. However, their magnitude and, sometimes, their direction could hardly be predicted. With multipurpose approach, risks and uncertainties associated with natural and social processes will pose new challenges. Generally, science aims at diminishing these risks and uncertainties and making the future more predictable. However, in the light of recent changes in forest management paradigm, rigorous efforts have to be made to progress in that direction. Normally, risks and uncertainties are a source of threats but they can probably also give rise to opportunities. Hence, the focus should be on reducing the number and impacts of threats and create new opportunities.

At present, forestry is not organised for such a moving context. It has mainly been constituted in a well defined framework, oriented toward a precise goal to be reached in a fixed time. Yet, certain flexibility has been progressively introduced but it should probably be reinforced. Thus, efforts have to be made in order to elaborate decision making procedures for forest management adapted to evolving world.

In view of these evolving features of forest management paradigm, *IUFRO Group 4.05.00, Managerial Economics and Accounting (with its two units 4.05.01: Managerial, Social, and Environmental Accounting and 4.05.02: Managerial Economics)* organised an international symposium on this topic. The main objective of the symposium was to explore and examine some of the managerial economics and accounting questions related to the evolving paradigm of forest management. In this book, thirteen papers, presented during the symposium, are included, and all these papers discuss some important aspects of evolving paradigm. The papers, as per their focus, are divided in four themes: (i) Managerial Economics Perspectives; (ii) Managerial Accounting Perspectives; (iii) Economics of Non-timber Forest Products; and (iv) Organizational Perceptions and Learning. Next, an overview of the papers related to each theme is provided.

2. MANAGERIAL ECONOMICS PERSPECTIVES

Economic rationality is a critical aspect of forest management decision making. In the first chapter of this section, *Vehkamäki* examines a rational action in the context of three theoretical approaches to forestry - soil-rent, resource-management and institutional forestry. The author argues that a rational action in forestry is a social convention with features from all theoretical approaches, and it is a function of the present state of knowledge and ethically a reflection of prevailing value considerations. Hence, he examines a rational action from the knowledge and ethical point of view. From the knowledge point of view, a rational action is examined using the framework of complexity and length of prediction period. The author argues that due to the long prediction periods, the authorization and legitimization of knowledge is a crucial and necessary point of the rationality in forestry. From the ethical point of view, a rational action is examined using discounting and sustainability requirements. The author argues that discounting is justified on the assumption of continuous economic growth, but in the long term, it causes positive real-economic feedback relations and irreversible discontinuity points in forestry. Hence, in the long term, the discounting procedures are compatible with the requirement of sustainability only if other resources and technological improvement can be substituted infinitely for the utilization of forest resources.

Multiple, specifically ecological, economic, and social, objectives management is one of the main features of evolving paradigm. In the second chapter of this section, *Zadnik Stirn* presents a decision model for multiple decision makers with conflicting interests and applies it to a forest in Slovenia. In the decision model, the feasible forest management alternatives are evaluated from a single decision maker's (owner/expert) perspective. The utility function is used as an objective function and the public participation in decision making is expressed through group decision making under multiple criteria. A concept of a fuzzy domination relation is used to solve the problem. The analytic hierarchy process is used to manage the conflicts and to develop a compromise decision.

The concept of cluster analysis may be useful in integrating multiple objectives of evolving forest management paradigm. *Mrosek et al.* in the third chapter of this section, demonstrate the use of cluster analysis to integrate the different components of evolving paradigm of forest management. The authors argue that cluster analysis focuses on the availability of forest resources, the efficiency of the wood supply chain and key socio-economic aspects of various forest industries. It can be applied across various spatial scales, although the framework conditions, design and outcomes of a cluster approach vary from international and national to regional and local levels. The authors identify various features of cluster analysis. First, a cluster management system in forestry produces highly relevant information for strategic decision-making in policy and management, with benefits for industry productivity and innovation. Second, forestry cluster analysis typically includes specific cluster structures, key socioeconomic parameters, competitiveness, development potentials, future development scenarios and cluster management recommendations. Third, multidisciplinary and participatory in nature, the cluster concept improves communication and cooperation among cluster stakeholders. Fourth, it also enhances corporate self-image, public relations efforts, self-organization in forest and wood-based industry branches, and mobilization of political support. Finally, the cluster concept contributes to the overall sustainable development of distinct geographical regions by increasing the competitiveness of forest industries and companies within forestry clusters. The authors present four cases from the forest and wood-based industries in Germany to illustrate how the cluster concept can inform socio-economic perspectives on the evolving paradigm of SFM at various spatial scales: national (Germany), state (State of North-Rhine/Westphalia), regional (Steinfurt County) and local (City of Arnsberg).

In the last chapter of this section, *Möhring and Rüping* present economic concepts related to the calculation of financial compensation for contract-based forest management regimes. The authors present a methodology to calculate annual timber production values for different tree species, age classes, yield classes, and management schemes, use the method to calculate values, and demonstrate their use to evaluate typical changes of forest management like the renunciation of forest production, a change of tree species, the premature harvest and the preservation of mature stands. The authors argue that this method is an important tool for contract-based forest management under European forest conditions.

3. MANAGERIAL ACCOUNTING PERSPECTIVES

Accounting is a multifaceted and important issue for the forest sector, and its role as a management tool has become critical in the context of evolving paradigm which requires monetary as well as physical accounting of timber and non-timber assets of forest resources. New external and internal demands, in the context of evolving paradigm, as well as the developments in information technology and controlling have advanced the role of accounting in forest management decisions. In the first chapter of this section, *Sekot* highlights challenges faced in the representation of forestry as a sector in the national economy, and discusses the concepts and recommendations developed on behalf of the European Union which constitute almost a compulsory framework for sector-specific accounting. The author also presents Austrian experience and results obtained through practical application as well as by means of pilot studies that cover the whole range of forest-specific accounts. The author concludes with the various problems in terms of data deficiencies and methodical challenges to be overcome.

On the similar lines, as discussed by *Sekot*, in the second chapter, *Goio and Gios* argue that in view of the profound changes in the socio-economic scenario, the decreased importance of timber production and the increased role of other forest functions must clearly be incorporated in national accounting systems. The authors highlight the main limitations of the current System of National Account (SNA) with respect to forest assets, and discuss a way of integrating information from the SNA with the information from “green accounting” and “total economic value”. The use of this integrative methodology is demonstrated by applying it to the area of the southern Alps.

An appropriate accounting of forest assets in the accounting of forest enterprises is as critical as the accounting of forest assets in national or regional accounts. In the third chapter, *Hogg and Jöbstl* analyze and compare the key differences in forestry accounting and the main influences on forestry accounting systems of seven regions – Central Europe, British Isles, Nordic region, North America, Latin America, South-east Asia and Oceania. The authors conclude that the coming years will bring increased attention to forestry accounting as internationalization and harmonization continue, and the main challenge is in transferring research to practice and in developing new methods and solutions. The authors identify the three key areas of research: the recognition of forest assets and their value changes in financial and cost accounting, integration of performance measures for non-market benefits, and the extension and improvement of sustainability reporting.

In the last chapter of this section, *Campos-Palacín et al.,* present green accounting of Hicksian income from Spanish cork oak forests. The authors first discuss various limitations of the national Economic Accounts for Forestry (EAF), such as, inclusion of final output only and non-inclusion of intermediate outputs (hunting and grazing rents), and non-inclusion of environmental outputs whether they relate to public visitors’ consumption of environmental services or landowners’ private environmental use (amenities self-consumption). Next, the authors explain and apply an Agroforestry Accounting System (AAS) that overcomes these limitations and allows for homogeneous aggregation of commercial and environmental values (using exchange values). The authors apply the AAS to two multiple-use Mediterranean forests: the Alcornocales (Cádiz-Málaga) and the Monfragüe (Cáceres) cork oak forests, and demonstrate that on-site private environmental income is larger in the Alcornocales forest, while public environmental income is higher in the Monfragüe forest. Production intensity, as measured by total cost, is higher in the Alcornocales forest, owing to the significantly higher cost of the mountain cork oak silviculture. The EAF measures 61% and 72% of AAS social net value added in the Alcornocales and Monfragüe cork oak forests, respectively.

4. ECONOMICS OF NON-TIMBER FOREST PRODUCTS

Emerging social preferences for non-timber forest products and services and their inclusion in forest management decisions are key features of the evolving paradigm of forest management. Hence, this aspect requires a special attention of forest researchers and managers. In the first chapter of this section, *Hodges et al.,* highlight the importance of multiple uses of forests in the region of the Cumberland Plateau, USA. The Plateau has been identified as a region that contains one of the highest concentrations of biodiversity and endangered species on the North American continent. Additionally, the region has supported a significant forest products industry that has expanded in recent years and coal mining pressure is increasing on the Plateau with rising energy costs. Moreover, the region attracts recreationists for a wide range of activities, including kayaking, rock climbing, backpacking, and caving. The authors argue that as a result of the increased pressure for all uses, several efforts have been initiated to address the effects of the competing demands on the forests of the Plateau. The authors provide a description of the ecological, economic, and social history of the region and reviews prior research related to the conflict in management objectives. The authors also report recent efforts to address the conflicting demands being placed on the land base of the Plateau.

In the second chapter, *Šišák* argues that monetary valuation of socio-economic importance of forest services for the society is a considerably difficult and theoretically and practically complex issue. He presents the system of valuation of socio-economic importance of forest services for the society of the Czech Republic (CR). In this method of valuation, forest services are differentiated by their socio-economic essence in the society, by purpose of their employment and input data availability. Valuation of market services is based on the mean year income from timber sale, hunting and game management on incomes from the respective activities, hydrological services by costs of prevention, soil protection services by costs of compensation, CO_2 sequestration by shadow prices of trade with CO_2. Pricing of health-hygienic and cultural-scientific forest services of a non-market essence is performed by expert approach using comparative method, i.e. comparing their socio-economic importance to the socio-economic importance of market services as for example timber production. The valuation method is applied to the area of forests administered by the Forest Plant Zidlochovice belonging to the state enterprise. The author argues that results of valuation are important for decision making in forest management in the area and will also be used in calculations of socio-economic effectiveness of multipurpose forest management by the managerial staff of the Forest Plant Zidlochovice and by managerial staff of the state enterprise.

In the last chapter of this section, *Mingarelli et al.,* examine the effects of incorporating the value of carbon on optimal rotation of popular plantation in Italy. The authors use “incremental” approach and the “discounted costs and revenues” approach for determining optimal rotation. The authors also consider alternative discount rates and alternative timber yields revenues. The authors conclude that the comparison between financial benefits derived by the poplar growth and the incorporation of value of carbon (provisions of the Kyoto Protocol) leads to new scenarios with implications of strategic meaning for the cultivated forestry sector.

5. ORGANIZATIONAL PERCEPTIONS AND LEARNING

One of the most critical requirements for the successful transformation of forest management from the existing paradigm to evolving forest management paradigm is required transformation in forest management organizations. This is the most neglected subject in forest management literature. Two papers included in this section discuss two important aspects of forestry organizations in the context of evolving forest management paradigm.

First paper, by *Hartebrodt et al.,* presents forest enterprises' perceptions about multidimensional reporting-systems. In order to gain insight in the potentials of multidimensional reporting and reasons that prevented a more intensive use of these reports in the forest sector, the authors conducted a survey amongst 400 (private and public) forest enterprises in Germany, Switzerland and Austria, and in this chapter they present an overview of the results of the survey with respect to the present use of different types of reports, the appraisal of the core-objectives and the basic structures of multidimensional reporting (MR) systems. The authors find that generally forest enterprises perceived limited benefits of the MR; there was a clear positive correlation between size of the enterprise and benefits perceived; there were clear distinctions between the different types of enterprises with regard to the core target groups and the present use of various reporting schemes; there was a relevant difference concerning the appraisal of principles of multidimensional reporting between private and public forest enterprises; the perception of different dimensions and contents of the Global Reporting Initiative scheme varied notably; and there is still a trend towards 'greenwash-reporting' especially within the group of private forest enterprises. The authors argue that multidimensional systems require resources and professionals; therefore they would remain a voluntary instrument, and the larger private forest enterprises are ambivalent towards MR, mainly due to the increasing stakeholder integration in these approaches. In addition, MR can be a suitable approach for larger public forest enterprises which play a substantial role in the countries involved in the survey.

In the second paper, *Uerpmann* presents a systematic theoretical discussion of organizational learning processes in the forest administration of Baden-Württemberg, Germany. First, the author presents a conceptual discussion of organizational learning process. The author argues that organizational learning could be an answer to the increasing complexity and rapidly changing conditions faced by forestry organizations, but organizational learning is a very complex process. For example, one can assume that in state forest administration, the information is selected through communication in a dynamic process in which the employees refer to organizational rules and consider relevant facts in their environment. It is difficult to describe such processes only with terms like 'instrumental rationality', 'profitability' or 'power' that the business administration theory traditionally operates with. On the other hand a large organization like a state forest administration cannot follow the changes in the environment seamlessly, but always has to consider aspects of organizational adaptation. Therefore it is all the more alarming, if the mechanisms of self-adaptation remain unexplained, or if causalities are assumed that do not facilitate the description of the organizational learning process in a manner that would allow the derivation of actions for a management of knowledge that is oriented towards influencing this adaptation. Second, the author discusses a system theoretical model that enables a functional depiction of 'organizational cognition'. For this purpose, the state forest administration is modelled as system that selects information from its environment by means of communicating via structural couplings of their employees. Information is not understood as being available ontologically, but rather as differences that have to be selected via observations (determined by organization-specific rules and values), in order to then be combined into organizational knowledge via communication. The author argues that based on empirical observations of several elements from learning processes in the state forest administration of Baden-Württemberg, this model enables a deductive-nomologic manner of attaining statements that can describe key factors that should be considered with regard to knowledge management. The author focuses on the key factor of organizational renewal by adopting a "logic of the business", which allows to generate multiple communicational cross links that are necessary to cope with varying problems that need different solutions every time. In summary, the author explicitly deals with the learning of organizations as well as the management of these organizations as information processing, structurally determined systems, and not with the learning of employees and the management of individual learning processes of employees.

6. CONCLUSION

The thirteen papers in this volume include a considerable diversity of arguments and approaches related to managerial economics and accounting in the context of evolving paradigm of forest management. In fact, some of these papers go beyond traditional boundaries of managerial economics and accounting, specifically two papers in the last section of the volume. As I mentioned earlier, organizational aspects are as critical as economic and accounting aspects for the success of evolving paradigm of forest management. Hence, this volume is a good starting point, but lot has to be done in future.

Refereed Papers

Section I: Managerial Economics Perspectives

RATIONAL ACTION IN FORESTRY

Seppo Vehkamäki[1]

ABSTRACT

Rational action in three theoretical approaches to forestry, soil-rent, resource-management and institutional forestry, is examined from the knowledge and ethical point of view. Rational action is defined as such an action whose predicted realisations fulfil the rationality criteria set to the forestry in each of the approaches.

From the knowledge point of view, the approaches are considered in the framework of complexity and length of prediction period. In this framework, knowledge denotes predictability of forest dynamics and market behaviour of forest resources. Theoretically, forest growth functions are demonstrated to be sensitive (chaotic) to initial conditions. Stumpage prices are shown empirically to have been sensitive to political conflicts that are unpredictable in the long term. Because of the long prediction periods, the authorization and legitimisation of knowledge is a crucial and necessary point of the rationality in forestry. From the ethical point of view, discounting and sustainability requirements are examined. Discounting is justified on the assumption of continuous economic growth, but in the long term, it causes positive real-economic feedback relations and irreversible discontinuity points in forestry. In the long term, the discounting procedures are compatible with the requirement of sustainability only if other resources and technological improvement can be substituted infinitely for the utilisation of forest resources.

The knowledge basis of the rational action in forestry, including the rules for sustainability and discounting, is justified as good forest practice through social, political and scientific conventions. Rational action in forestry is a social convention with features from all theoretical approaches, and it is a function of the present state of knowledge and ethically a reflection of prevailing value considerations.

Keywords: Forestry; Rationality; Predictability; Sustainability; Discounting; Soil rent forestry, Resource management forestry, Institutional forestry

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1. INTRODUCTION

Rationality is a normative concept based on social conventions. An action is rational if it ought to be taken in a given frame of reference to achieve certain goals or to comply with the rules or norms set to the action. Rationality relates to knowledge: an action is rational if it is consistent with what is known about its consequences. A rational action can be defined in the form of a syllogism as follows:

- *Rationality criteria or morals*: goals in value terms, behavioural rules, social norms, standards of behaviour, principles of right and wrong, etc.
- *Knowledge premises*: available information and data, theoretical models, numerical models with their initial values, ability to predict, etc.
- *Rational action*: a rational action is one whose predicted consequences within the limits of available knowledge fulfil the rationality criteria set.

To consider rationality criteria or morals the primary question deals with the principles their choice should follow. There is no external standpoint, by which the actor-related systems of goals and other rationality criteria are evaluated morally, except by their consistency. The reasons for justifying an action as rational are subjective. On the other hand, a rational or moral action can be defined on intersubjective principles so that, what is a rational reason for one actor is or is intended to be a rational reason for every actor, or for most of them, and therefore the rationality criteria justifying the action can be analysed objectively. For example, the criteria oblige, permit or forbid an action, and they express what has value in society (cf. Mackie, 1990).

Forestry is an activity in which the actors produce goods and services by allocating forest resources and management effort in time and place to realize their subjective criteria and the goals and norms set by society. Assessment of the rationality of actions is dependent on the prevailing criteria and on what is assumed to be known of the consequences of the actions. There are different theoretical approaches to characterizing rational action in forestry with different ways taking rationality principles into account and with various suppositions for knowledge.

2. OBJECTIVE OF THE STUDY

Definition of the starting point

Three theoretical approaches to forestry, i.e. *soil-rent*, *resource-management* and *institutional* forestry, are defined as ideal types for purposes of the study. The approaches are presented using their analytical features at the forest estate level. The definitions of the approaches are the objects of investigation in the study. By way of illustration, Finland is used as an empirical reference. Analytically in research, rational action is defined generally as a solution to a hypothetical planning problem, and the rationality criteria are derived from the analytical solutions. In practice, the rationality of forestry actions is assessed in a more complex framework of knowledge and moral criteria than exists in the theoretical context of this study.

The rationality criteria and morals for forestry are usually expressed in terms of *efficiency* and *sustainability*. Productive efficiency relates harvest output to management effort at the level of a forest estate by minimizing cost per given output or by maximizing output per given effort. Allocative efficiency relates the harvest output of goods and services to consumer preferences at the level of the current income of consumers. Sustainability conditions of goods and services refer to allocation of resources over time and place. Originally, sustainability of forestry concerned only timber resources, but recently, sustainability of forestry includes all entities of forest resources. Sustainability is a complicated concept (e.g. Vehkamäki 2005). For this study, sustainability has two dimensions: intragenerational *versus* intergenerational sustainability and single-resource *versus* multiresource sustainability.

Main objective

Conclusions on the rationality underlying the forestry approaches are drawn by analysing them in the frame of reference of the syllogism presented for rational action. *Rationality criteria or morals* are investigated by analysing goal setting and the norms of the approaches. The goals and norms are analysed as moral concepts in a theoretical frame of reference of

- deontological criteria, expressed in this study through the duty-related concepts of obligations, permissions and prohibitions
- teleological criteria, expressed in this study through goal-related value terms.

Characteristically, for the deontologist duty comes before value; for teleologists the only duty is to produce value and sometimes to distribute it in certain ways. The same action can be viewed morally in many ways. In practice, it is not possible to distinguish the deontological and teleological viewpoints sharply, because an action always aims at some end; however, actions always have a moral value, whatever their consequences. In the present study, the value is expressed in market economic terms, although this could also be done using other value indicators, e.g. ecological indicators. In forestry the time distribution of value, in the form of discounting and bequest stocks, is an important issue. In practical morality, the decisive factor is what is intended. But actions may be also unintentional, and intentional actions often lead to unintentional consequences. The intention of an action and its respective consequences can be viewed as a knowledge problem.

To characterize *knowledge premises* of the approaches, the feasibility of *predicting consequences of forestry actions* are investigated. Two essential characteristics of predictability are the complexity and length of the time horizon. For this purpose, the characteristics of forest stand dynamics and the market dynamics of forest resources are analysed. The focal point is the basic epistemological question: what is known and what can be known of these dynamic phenomena and how can it be done?; i.e. how can information and knowledge needed in the approaches be acquired and how is an action justified intellectually from the knowledge point of view in case its consequences are truly uncertain?

3. DEFINITIONS OF THE THEORETICAL APPROACHES TO FORESTRY

3.1 Soil-rent forestry

The soil-rent approach postulates that the objective of the economically efficient forestry agent is to maximize the value of her/his forest estate by maximizing separately the value of every stand, using her/his choice of the rotation periods and management effort (silvicultural intensity), given growth function, stumpage prices and discount rate. This approach is known as the Faustmannian procedure or formula (Faustmann, 1849). The approach and relating literature are presented, e.g. by Chang (1998) and Hyytiäinen (2003).

Characteristically, the soil-rent approach for a forest estate can be presented as

$$VFE = \sum_{n=1}^{n=N} \max_{A_{nps} \in \tilde{A}_{nps}, A_{nss} \in \tilde{A}_{nss}, M_n \in \tilde{M}_n} SV\left(A_{nps}, A_{nss}, c(M_n)\right) \qquad (3.1.1),$$

in which, after rearranging the terms, becomes

$$SV(A_{nps}, A_{nss}, c(M_n)) = (1+\rho)^{-(A_{nps}-A)} \cdot \left\{ \begin{array}{l} \left[p \cdot v\left(A_{nps}, \bar{c}(\overline{M}_n)\right) - c(M_n)\right] + \\ \left((1+\rho)^{A_{ss}} - 1\right)^{-1} \cdot \left(p \cdot v(A_{nss}, c(M_n)) - c(M_n)\right) \end{array} \right\} - \rho^{-1} \cdot a \qquad (3.1.2)$$

in which

VFE	=	Value of the forest estate
$SV(\bullet)$	=	Soil-rent value as net present value of the site
n	=	Individual site, $n = 1 - N$
ρ	=	Discount rate, opportunity cost of capital
$v(A_{nps})$	=	Growing stock of the present stand as a function of the rotation period, with a maximum at $\left[A_{ps}^{\circ}\right]$
$v(A_{nss}, c)$	=	Growing stock of the subsequent stands as a function of the rotation period and management cost, with a maximum at $\left[A_{ss}^{\circ}, c^{\circ}\right]$
A_{nps}	=	Rotation period of the present stand

$\tilde{A}_{nps}$	=	Set of available rotation periods for the present stand
A_{nss}	=	Rotation period of the subsequent stands
$\tilde{A}_{nss}$	=	Set of available rotation periods for the subsequent stands
A_n	=	Age of the present stand
p	=	Stumpage price prediction
$\overline{M}_n$	=	Sunken management effort of the present stands
M_n	=	Management effort of the subsequent stands
$\tilde{M}_n$	=	Set of available management efforts for the subsequent stands
$c(\bullet)$	=	Cost function
a	=	Annual cost estimate (administration etc.) imputed to the site
t	=	Time in years

Thinning and management efforts other than regeneration are not explicitly taken into consideration in (3.1.1)

The resource dynamics of the soil-rent approach is presented as a single-cohort and single-site stand, the growing stock of which is a function of age and management effort. The site is assumed to be under some forest management regime, from the present to eternity. The key concept is an isolated, economically separable stand, which is the precondition for the additivity condition over stands in (3.1.1). Analytically, it is essential that the formula leads to convergent sequences having a finite limiting value as a result of summation evaluated from 0 to ∞. It is assumed that the economy of the stand is connected with the economies of other stands and with the economic environment through market prices of timber and through the interest rate to be applied in discounting when the optimum net present value of the infinite sequence of rotations is determined. The rotations and intensity of forestry realizing the optimum requirements of (3.1.1)

$$\left[A^*_{nps}, A^*_{nss}, c^*(\bullet)\right] \qquad (3.1.3)$$

define the rational action in the soil-rent approach.

The first term in the braces of (3.1.2) represents the net present value of the prevailing rotation and the latter term the net present values of the subsequent rotations up to infinity. In the case in which bare land is the initial state, the first term disappears and the optimum net present value is referred to as the site value.

3.2 Resource-management forestry

Resource-management forestry can be presented as a two-point boundary-value control problem for a forest estate, e.g. Kilkki et al. (1986), and Kowero and Dykstra (1986) as a multidimensional forest resource problem and Vehkamäki (1996) as an aggregate forest resource problem, which is actually a less complex timber production problem. The approach can be presented as follows: the forestry estate maximizes an economic (value) criterion function

$$EVC = \max_{M_t \in \tilde{M}(X_t)} F\big(Y(M_t), C(M_t), \rho\big) \qquad (3.2.1)$$

subject to forest resource dynamics

$$\Delta V_t = g(V_t, M_t, t) - h(M_t) \qquad (3.2.2)$$

and to boundary conditions for forest resources

$$V_0 = \overline{V}_0 \qquad (3.2.3)$$

$$V_{t_f} \in \tilde{V}\big(X_t, t_f(X_t)\big) \qquad (3.2.4)$$

in which

ECV	=	Economic value criterion of forest management
$max\, F(\bullet)$	=	Function for the economic rationality
M_t	=	Management effort vector
$\tilde{M}(\bullet)$	=	Set of permissible management efforts
$Y(\bullet)$	=	Income function
$C(\bullet)$	=	Cost function
ρ	=	Discount rate
V_t	=	Forest resource vector
$\tilde{V}(\bullet)$	=	Permissible set of terminal forest resources
ΔV_t	=	Time difference of forest resources
$g(\bullet)$	=	Biological growth function
$h(\bullet)$	=	Harvest function
t	=	Time
$t_f(\bullet)$	=	Terminal time
$\overline{V}_0$	=	Initial values of forest resources
X_t	=	Political, social, familial and other factors determining the allowable set of terminal forest resources

The approach is based on vector-valued resource dynamics with interactions between species, cohorts and sites. The criterion function is assumed to be nonlinear, in which the economies of scale in harvesting of forest resources, i.e. the interaction of forest resources and management and harvesting capacity, is the reason for nonlinear dependencies (e.g. Vehkamäki, 1997). The time horizon is finite; its length is dependent on the political, social and other factors that are characteristic of every forestry estate. Likewise, the terminal condition is dependent on the forest management agent. It can be interpreted as bequest stocks and as a precaution against inadequate predictability of forest dynamics, economic development etc. The terminal conditions of stocks, constraints on management efforts etc. can be interpreted in terms of sustainability, i.e. in terms of deontological morality.

The relationships between duty-related constraints and the goal-related value criterion can be analysed by means of the solution for (3.2.1.-3.2.4.). Assuming that the first-order maximum conditions of the system (3.2.1-3.2.4) exist, the optimum management can be expressed as Kuhn-Tucker conditions

$$\frac{\partial F(\bullet)}{\partial m_{jt}} + \sum_{n=1}^{n=N} \lambda_{jnt} \cdot \frac{\left(\tilde{v}_n(\bullet) - v_{n t_f}\left(m_{jnt}\right)\right)}{\partial m_{jt}} + \mu_{jt} \cdot \left(\tilde{m}_{jt}(\bullet) - m_{jt}\right) \leq 0$$

$$m_{jt} \geq 0 \qquad (3.2.5)$$

$$\left[\frac{\partial F(\bullet)}{\partial m_{jt}} + \sum_{n=1}^{n=N} \lambda_{jnt} \cdot \frac{\left(\tilde{v}_n(\bullet) - v_{n t_f}\left(m_{jnt}\right)\right)}{\partial m_{jit}} + \mu_{jt} \cdot \left(\tilde{m}_{jt}(\bullet) - m_{jt}\right) \cdot m_{jt}\right] \cdot m_{jt} = 0$$

$$\tilde{v}_n(\bullet) - v_{n t_f}\left(m_{mnt}\right) \geq 0$$

$$\lambda_{mnt} \geq 0 \qquad (3.2.6)$$

$$\lambda_{mnt} \cdot \left[\tilde{v}_n(\bullet) - v_{n t_f}\left(m_{mnt}\right)\right] = 0$$

$$\tilde{m}_{mt}(\bullet) - m_{mt} \geq 0$$

$$\mu_{mt} \geq 0 \qquad (3.2.7)$$

$$\mu_{mt} \cdot \left[\tilde{m}_{mt}(\bullet) - m_{mt}\right] = 0$$

$$j = 1 - J$$

$$n = 1 - N \qquad (3.2.8)$$

$$t = 1 - t_f$$

in which

$\frac{\partial F(\bullet)}{\partial m_{jt}}$	=	Marginal economic value criterion effect of management effort j at the moment of time t
λ_{jnt}	=	Sustainability (shadow price) of management effort j through the terminal forest resource constraint n at the moment of time t
μ_{jt}	=	Desirability (shadow price) of management effort j at the moment of time t

The last two terms reveal the trade-offs between the economic value criterion and the duty-related constraints. The actual behaviour occurs at the initial point in time, $t = 0$. At the moments of time $t > 0$ the behaviour is composed of intentions which will or will not be realized. This suggests that the rational management behaviour is a function of the known or evident initial values of the state variables and of future intentions based on the present state of knowledge (Vehkamäki, 1996), and that in practical applications updating is an essential part of thinking.

The complexity of forest dynamics and criterion functions has led to heuristic resource-management approaches and procedures (Siitonen et al., 1999) to simplify the problem and to make the analysis feasible. Arguments for heuristic management rules are justified analytically, or by legislation, common sense etc., through various social, political and scientific institutions.

3.3 Institutional forestry

Institutional forestry is considered as a social institution that deals with allocation of forest resources in interaction with other social institutions: land tenure, markets of goods and services, institutions preserving diversity of the forest environment, politics etc. and the forest environment in itself. Individual management behaviour is controlled by formal and informal social norms; i.e. shared expectations of behaviour that is considered desirable and appropriate in society. The actual forest management must satisfy a set of criteria of *good forest practice* that come into being from the interactions of different social institutions (cf. Rio Declaration and Statement of Forest Principles by UNCED, 1995; ISCI, 1996; Forest Act, 1996).

Formally, the approach can be presented as follows: the forestry agent satisfies a criterion vector set for her/his forestry

$$GFP_t = \underset{M_t \in \tilde{M}_t \left[R\left(V_t, \tilde{V}_{t+1}\right)\right]}{sat} CF\left(V_t, h\left(M_t\right), Y\left(M_t\right), C\left(M_t\right)\right) \tag{3.3.1}$$

subject to forest resource dynamics

$$\Delta V_t = g\left(V_t, M_t, t\right) - h\left(M_t\right) \tag{3.3.2}$$

and to boundary conditions of forest resources

$$V_0 = \overline{V}_0 \tag{3.3.3}$$

$$V_1 \geq \tilde{V}_1 \tag{3.3.4}$$

in which

sat	=	Operator for satisfying procedure
GFP	=	Criterion vector of good forestry practice, rationality criteria or morals of forest management
$CF(\bullet)$	=	Criterion function
$R(\bullet)$	=	Set of behavioural rules

The criteria are interdependent: economic criteria are interconnected with biodiversity and other criteria. The criteria are duty- and value-related management rules whose realizations have been institutionalized to be a part of good forestry practice. It should be noted that realization of some rotation criteria (soil-rent requirement) or some resource management criteria can belong to the criterion vector of good forestry practice. An example of institutionalized behavioural rules is the classification of forests as development classes in Finland (c.f. The Finnish Forest

Research Institute, different years). The classes are defined using duty-related concepts that determine what actions are permissible or obligatory actions to be taken in forest stands.

4. ANALYSIS OF THEORETICAL APPROACHES

4.1 Rationality criteria

4.1.1 Duty- versus goal-related rules

Ethically, actions differ from each other in how duty- and goal-related rules are taken into consideration. These aspects are not exclusive, not even in the extreme cases. In the following the forestry approaches are summarized according to how they emphasize these aspects.

The *soil-rent approach* is based on three factors: forest dynamics based on the age of the stand, discount rate or rate of return of the alternative investments and price estimates. The approach is based on goal-related morality; it can be said that maximum soil rent is emphasized as the only obligation. Unlike the other two approaches, the time preference in the soil-rent approach is a straightforward phenomenon; it is the opportunity cost being derived from the capital market. In the present study, the approach is based on perfect knowledge and on an absolute value: i.e. maximum soil rent.

In the *resource-management approach,* duty-related morality is taken into consideration using constraints set on the management activities and terminal stocks and goal-related morality through the maximization process. The constraints are functions of economic, social and ecological argumentation. This approach is based on subjective and relativistic values allowing thinking in terms of trade-offs, or shadow prices, between different duty-related indicators, and between duty- and goal-related consequences. The core of the approach is to relate different entities of forestry to each others through a system of a goal and a set of constraints.

The *institutional approach* links together the teleological and deontological aspects of morality in forestry. This linkage comes about through different social institutions and agents. In fact goal-related behaviour, e.g. a good financial result, can be a duty-related indicator in good forest practice: duty-relatedness and goal-relatedness overlap.

4.1.2 Discounting and sustainability

Stereotypically, the term of discounting is used here instead of the more general expression of time preference. The economic rationale of the discounting rate is the opportunity cost of capital. The compatibility of economic efficiency in terms of discounting and sustainability of forest resources is examined in three cases that are typical of the three approaches to forestry: straight discounting, restricted discounting and complex discounting.

Straight discounting

It is assumed that the discounting rate is determined through the capital market. That is the reason why the basic assumptions and properties of the straight discounting are presented in a macroeconomic context. The following assumptions are made:

- The positive opportunity cost of capital is generated by an ever-increasing perfect capital market

  $$\rho > 0 \qquad (4.1.1)$$

- Real aggregate production Q_t grows at the same rate as the capital market

  $$Q_t = Q_0 \cdot (1+\rho)^t \qquad (4.1.2)$$

- Harvesting of forest resource h_t is related to aggregate production at the moment of time *t*

  $$h_t = \alpha_t(t) \cdot Q_t \qquad (4.1.3)$$

- A normal (sustainable) forest at the aggregate level has A^* age-classes and an equilibrium management effort c^* and a forestry equilibrium prevailing at the moment of time *t*

  $$h_t = v(A^*, c^*)_{A^*} \qquad (4.1.4)$$

- A constant price structure is assumed to satisfy the requirement of the infinite geometric sequence of (4.1.2), i.e. the change in aggregate production has no effect on the prices of forest resources.

Then the following equation is true

$$\alpha_t(t) = \frac{v(A^*, c^*)_{A^*}}{Q_0} \cdot (1+\rho)^{-t} \qquad (4.1.5)$$

From (4.1.5) it is seen that the dependence of aggregate production on the forest resource must decline at the rate of discounting if the normal forest structure is assumed to be maintained in a growing economy, that is to say

$$if\,(t \to \infty) \Rightarrow \alpha_t(t) \to 0 \qquad (4.1.6)$$

On the other hand,

$$if\,(not(\alpha_t(t) \to 0) \wedge t \to \infty) \Rightarrow v(\bullet) \to 0 \qquad (4.1.7)$$

the forest resource is exhausted.

Based on (4.1.6) and (4.1.7) the *soil-rent approach* describes an economically efficient situation only if the dependence of the economy on its own forest resources asymptotically approaches zero (cf. Iwai, 2002). This argumentation can be extended to cover all input resources (cf. Daly and Townsend, 1997, pp. 267-273). It is evident that a positive discount (economic growth) rate and the technological dependence on natural resources lead to shortage and conflict situations and furthermore to adjustment reactions.

Restricted discounting

A precondition of maintaining normal forest structure is a non-positive discount rate that leads to a non-convergent sequence or rules to regulate the use of forest resources. If a non-positive discount rate or regulation rules are assumed, a resource-management or institutional approach is used to describe forestry behaviour. Sustainability of forest resources other than the explicit resource under consideration must be taken into consideration indirectly by assuming constraints on the rotation periods and regeneration cost. In the *resource-management approach* the time preference inside the time horizon, indicating the intragenerational time preference, is represented using a discount rate; whereas the intergenerational time preference is represented using the bequest stocks, i.e. the terminal conditions of the stocks. The resultant time preference is a function of the discount rate, length of the time horizon and the terminal condition. In cases where the terminal condition is not binding, the discount rate is the only variable determining the time preference and then the conclusions drawn in the soil-rent case can also be assumed to be applicable to the resource-management case.

Complex discounting

The time preference and bequest formation can be interpreted to be action-level behavioural rules in *institutional approaches* to forestry. They are built-in social norms regulating actions that are concerned with forest resources. The time preference of a forestry agent is an outcome of the interaction of various social institutions, including capital market, and individual needs and concerns. The soil-rent and resource-management approaches contribute to interpretation of time preference in institutional forestry by focusing explicitly on interest rates.

4.2 Knowledge premises

4.2.1 Complexity and length of the time horizon

The complexity and length of the time horizon are connected with the requirement of predictability and numerical computability as well as morality aspects of the approach.

The number of ecological, biological, economic, political, social and other entities indicates the level of complexity of the approach. Every approach is a model of reality that is attained by choice of relevant phenomena from the viewpoint of the purpose of the approach. Through the process of conceptualization and idealization, these phenomena are taken as entities into the model.

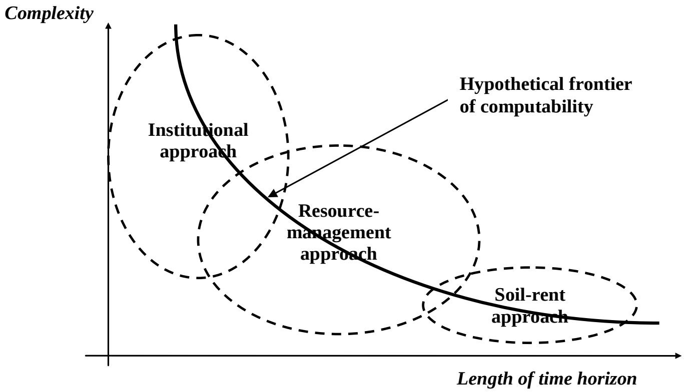

Figure 1: Illustration of the approaches to forestry in the coordinate system of the complexity and the length of the time horizon

In Figure 1 the approaches are classified and illustrated graphically in the coordinate system of the complexity and length of the time horizon. The more complicated the approach the shorter is its length of the time horizon, and vice versa. The downward-curved line is interpreted as a hypothetical frontier of the computability of the approaches.

4.2.2 Predictability of stand dynamics

In the following the knowledge requirements are illustrated by two cases. First, the epistemological problems of stand dynamics are examined. Most stands contain more than one species and they are seldom even-aged, even when a single species has been planted or seeded. Strong competition occurs between species and cohorts, especially during the initial phase of the stands; likewise the initial phase is very sensitive to external shocks.

The dynamics of mixed-species stands can be formalized as a multidimensional and nonlinear difference equation system. Very little empirical quantitative knowledge is available on multidimensional stand dynamics (Oliver and Larson, 1990, p. 347). Theoretically, such nonlinear systems can be thought of having discontinuity (chaotic) points (cf. Mullin, 1993). Using management interventions the development of stands can be directed toward some management ideal: appropriate species composition, appropriate density etc. Without management actions natural selection directs stand dynamics to some attracting stand having a steady state, periodicity or chaotic features. More can be concluded from stands in which a single species predominates after a turbulent natural initial phase or after management interventions. Quantitative descriptions, yield and growth functions are not normally characterized by the chaotic dynamics occurring during the initial phases of the stands, only by well-ordered stand dynamics whose initial state is a result of natural competition between species and cohorts or management actions (c.f. Vuokila and Väliaho, 1980).

Mathematical demonstration of the initial resource sensitivity

The sensitivity of the stand development to its initial state is demonstrated by assuming

- a logistic function for one-resource stand dynamics in terms of the site capacity (Holton and May 1993, 102)

$$f(v_t, g) = v_{t+1} = v_t \cdot [1 + g \cdot (1 - v_t)] \qquad (4.2.1)$$

- the initial stock as a function of management action and natural shock

$$\bar{v}(m_{\bar{t}}, s_{\bar{t}}) = v_{\bar{t}}(m_{\bar{t}}) \pm \varepsilon(m_{\bar{t}}, s_{\bar{t}}) \qquad (4.2.2)$$

- the coefficient of stand dynamics as a function of management action and natural shock

$$\bar{g}(m_{\bar{t}}, s_{\bar{t}}) = g(m_{\bar{t}}) \pm \eta(m_{\bar{t}}, s_{\bar{t}}) \qquad (4.2.3)$$

in which

$f(\bullet)$	=	Logistic resource-dependent function of stand dynamics
v	=	Resource stock of the stand expressed in terms of the site capacity, $0 \le \boldsymbol{v_t} \le 1$
$\bar{v}(\bullet)$	=	Deviated resource stock
$\varepsilon(\bullet)$	=	Deviation function of the resource stock
m	=	Management action
s	=	Natural shock
g	=	Coefficient of stand dynamics
$\bar{g}(\bullet)$	=	Deviated coefficient of stand dynamics
$\eta(\bullet)$	=	Deviation function of coefficient of stand dynamics
t	=	Time
$\bar{t}$	=	Initial time

Assuming that (4.2.1) can be developed in a Taylor series, the actual stand dynamics is depicted as

$$f(v_{\bar{t}}, \varepsilon(\bullet), g_{\bar{t}}, \eta(\bullet)) = f(v_{\bar{t}}) + f_v \cdot \varepsilon(\bullet) + f_g \cdot \eta(\bullet) + O\left(\varepsilon(\bullet)^2, \eta(\bullet)^2, \varepsilon_{\bar{t}} \cdot \eta_{\bar{t}}\right) \qquad (4.2.4)$$

If the partial derivatives of (4.2.4) are positive the stand dynamics is sensitive to the initial values; if they are zero the sensitivity is indeterminate and if negative the stand dynamics is not sensitive to the initial values (c.f. Mullin, 1993, pp. 120-121).

The *ceteris paribus* conditions of sensitivity with respect to the initial resource stock are

$$
\begin{aligned}
&if\left(v_{\bar{t}} < \frac{1+g}{2\cdot g}\right) \Rightarrow f_v > 0 \Rightarrow sensitive \\
&if\left(v_{\bar{t}} = \frac{1+g}{2\cdot g}\right) \Rightarrow f_v = 0 \Rightarrow indeterminate \qquad (4.2.5) \\
&if\left(v_{\bar{t}} > \frac{1+g}{2\cdot g}\right) \Rightarrow f_v < 0 \Rightarrow \text{not sensitive}
\end{aligned}
$$

The *ceteris paribus* conditions of the sensitivity with respect to the initial state of the coefficient of forest dynamics are

$$
\begin{aligned}
&if\ (0 < v_t < 1) \Rightarrow f_g > 0 \ \Rightarrow\ sensitive \\
&if\ (v_t = 1) \quad \Rightarrow f_g = 0 \ \Rightarrow\ indeterminate \qquad (4.2.6)
\end{aligned}
$$

Because the resource stock has been defined in terms of the site capacity, i.e. $0 \le v_t \le 1$ the general conclusion is that the stand dynamics is always sensitive to the initial values, implying that the predictability of stand dynamics is weak, especially during the early phases of stands.

4.2.3 Predictability of stumpage price

Consideration of the predictability of stumpage prices is based on the accounting data of the Finnish State Forests from the period 1935-1996 (Vehkamäki, 2000), on the exchange rate data (Statistics Finland, different years) and historical information on political conflicts (Grant, 1992). The stumpage prices are aggregate figures from the southern districts of the Finnish State Forests; they are deflated using the wholesale price index (Statistics Finland). The stumpage price is defined as a residual income of harvesting activities, i.e. the proportion of forest ownership and management out of the income distribution of harvesting.

The following stumpage price equation for coniferous logs was estimated using ordinary least squares (Eviews) for the observation period 1935-1996 (cf. Figure 2).

$$p_t(p_{t-1}, er_{t-1}, ds_t, \varepsilon_t) = p_{t-1}^{0.66} \cdot er_{t-1}^{0.14} \cdot exp(1.60 + 0.50 \cdot ds_t + \varepsilon_t) \qquad (4.2.7)$$

in which

p_t	Stumpage price of coniferous logs, FIM·m^{-3} Mean = 191; median = 201; maximum = 398; minimum = 66
$ds_t = 1$	Stumpage price shocks induced by a political conflict 1938 World War II; 1951 Korean War; 1952 Korean War; 1975 Energy (OPEC) Crisis; 1991 Gulf War
$ds_t = 0$	Other years
er_t	Exchange rate, FIM·USD^{-1} Mean = 3.1; median = 3.2; maximum 6.5, minimum = 0.5
t	Years, 1935 –1996
ε_t	Residual term

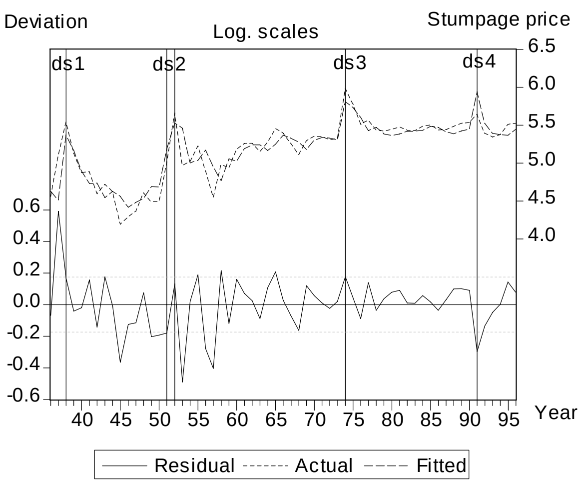

Figure 2: Graphs of the estimation result for the stumpage price 1935 – 1996. The vertical bars indicate demand shocks.

The results show that the demand shocks induced by political conflicts and the exchange rate determined economically and politically are crucial factors in determining the dynamics of the stumpage price of coniferous logs. The predictability of the stumpage prices is in this case highly dependent on the predictability of those unique political events that positively affect stumpage prices at the aggregate level. Evidently, it is not possible to predict their occurrence, and demand shocks can often precede the acute escalation of the conflict situation (e.g. World War II). Furthermore, at the stand and forest estate levels, it is more difficult to predict stumpage prices than at the more aggregate level, because harvesting of different stands is dependent on a whole that is determined by various production factors of the harvesting and market situation (Vehkamäki, 1997). Generally, increasing aggregation improves predictability (e.g. Mullin, 1993, p.165).

The difference equation of the stumpage price derived from equation (4.2.7) is convergent, because the coefficient of the lagged stumpage price is < 1. The stumpage price process converges to a stationary solution, i.e. an attractor (Parker and Stacey, 1994, pp. 42-45). The stationary price can be expressed as a function of the exogenous variables

$$p_e(er_{t-1}, ds_t, \varepsilon_t) = er_{t-1}^{1.47} \cdot exp(4.71 + 0.41 \cdot ds_t + 2.94 \cdot \varepsilon_t) \qquad (4.2.8)$$

in which the exogenous arguments can be characterized as follows:

- The exchange rate has been an administratively determined variable during the main part of the observation period. The change in exchange rate has occurred at economic and political discontinuity points. Since the year 2002 Finland has been a member of the European monetary union, and this variable has ceased to be a valid definition for the exchange rate.
- Whether a price change can be classified as a result of a demand shock or as random variation effect cannot be explained until afterwards. The change must be related to the overall time path of the stumpage price model.
- The error term is a normally distributed stochastic variable.

Although the stumpage price is a convergent system, its attractors are unpredictable.

4.3 Conclusions on the premises of rational action in forestry

Rationality criteria

The soil-rent approach emphasizes the value-related goal. The other approaches are more duty-oriented and include not only value goals but also social obligations. The resource-management and institutional approaches emphasize the socially determined character of forestry actions being based on knowledge at any given time. Changes in forestry behaviour can be interpreted to occur through the authorization and legitimization of new knowledge and information. The short, myopic, time horizons emphasize the variability of knowledge and information (Arrow 1964; Olson and Bailey, 1981). The terminal-stock constraints of forestry resources can be interpreted in two ways: as bequests to the next generation and as guards against imperfect knowledge and information.

Egoism and altruism in the forestry approaches can be considered as interactions of discounting and stock constraints. The stock constraints can be seen in close context with intergenerational altruism, because they can be considered as a bequest. The character of forest resources as a collective asset of the present and future environment has led to the requirement for a political consensus on their utilization. There are formal and informal processes used as interactions of different social institutions to reach this consensus. These processes and their influence on the forestry actions can be considered and examined as morals by agreement (cf. Gauthier, 1986), as explicit or implicit social contracts (cf. Mackie, 1990) or as communicative actions (cf. Habermas, 1981).

Discounting in terms of the opportunity cost of capital implies the presence of economic growth at the aggregate level. In growing economies a condition for the long-term sustainable utilization of forest resources presupposes that technical progress, and non-renewable resources and imported forest resources, can be substituted for domestic forest resources. This shows that the stage of technological development of the economy is an important determinant of the sustainability of forest resources in a world pursuing continuous economic growth.

Knowledge premises

Knowledge of forestry can be thought of as models of reality. There are numerous reasons for the poor predictability of these models (cf. Root, 1993; Parker and Stacey, 1994; Coveney and Highfield, 1995, Ekeland, 2004):

- Forestry knowledge deals with such complex phenomena that it is impossible to specify the initial conditions of processes to enable accurate prediction. The complexity implies the presence of numerous nonlinear feedback relationships. In many economic paradigms the rational action is assumed to be driven by positive feedback, such as in self-reinforcing economic growth. However, in such cases the realism of the frame of reference within which the action occurs can be questioned (e.g. Parker and Stacey, 1994, p.26).
- It is difficult to make reliable and accurate observations on ecological, economic, political and other processes, due to their complexity. Models based on imperfect data are also imperfect. Furthermore, it is impossible to conduct controlled experiments without affecting the behaviour of the human or ecological subjects.
- There is a relationship between the morality and the rationality criteria in society and requirements of knowledge and information. Knowledge is acquired to realize the predominant morality and rationality. Changing morality and rationality changes the knowledge requirements and *vice versa*.
- All relevant forestry phenomena are multidimensional and subject to non-linear feedback dynamics. These qualities lead to chaotic turning points and to the long-term unpredictability of the phenomena.
- Ultimately, how are actions justified if it is not possible to predict their consequences scientifically or intellectually? Normally, there are many social institutions including scientific institutions that justify the arguments for forestry actions.

The fundamental qualitative property of the information and knowledge to be used for rational action in forestry is its legitimacy or authoritative status (Lindblom and Cohen, 1979; Vehkamäki and Heinonen, 1998). The legitimization of knowledge or beliefs to usable knowledge occurs through different social institutions

- scientific institutions
- formal political institutions
- informal social institutions

Scientific legitimacy implies that information and knowledge are accepted by scientific communities for their data recording, degree of testing and theory verification. Due to the costs and lags within the acquisition of scientifically legitimized forestry knowledge, the continuous interaction between scientific justification and formal and informal legitimacy of knowledge is a crucial point, especially because the political, social, economic and ecological conditions of forestry are continuously changing.

Theoretical and empirical models are always partial and idealized descriptions of reality. Desirable properties of models include analyticity, predictability, solvability, computability, simplicity and objectivity. The pursuit of these properties can lead to bias in relation to reality. The models and the predictions based on them do not represent absolute truths. The knowledge and information present in forestry models and for rational actions in forestry are fallible, and whenever some piece of knowledge is found to be false it ought to be replaced by some other piece of legitimate knowledge. In complex cases the main advantage of these models is that they are educational and can make things understandable. The behaviour of a system may be reasonably predictable in the short term, but it is hardly possible to anticipate the long-term outcomes of the actions. For example, it is difficult or impossible to predict technological changes or demand shocks and their impacts[2], but *a posteriori* it is possible to understand and explain their impacts through the use of relevant models.

[2] There are many anecdotes in the Nordic Countries describing the impossibility of predicting the final use of forest cultivation. The oldest well-documented case concerns larch cultivation in Raivola in the Karelian Isthmus (e.g. Ilvessalo, 1923; Redko ja Mälkönen, 2001). The stands were established for the shipyards of the Russian Navy in Kronstadt on an initiative of the Czar Peter the Great between 1738 and 1821. The larch stands are in a region that was annexed to the Russian Empire from Sweden (and Finland) as an outcome of the Great Nordic War of 1713-1721. They have never been used for shipbuilding; some stems are felled only for other uses. They have become a nature monument and a study object with very high mean volumes. In the 19th century iron and steel revolutionized shipbuilding and the use of wood in the Nordic Countries. The stands have belonged alternately to the territory of the Russian Empire, Finland, the Soviet Union and the Russian Federation after political upheavals and outcomes of wars at any given time. In the 1880s the Russian authorities were willing to sell the stands to the Finnish State, but they rejected the bid made by the Finnish State Forests. At the moment it is included in the UNESCO:s worlds inheritance list, but its destiny seems to be to perish. In Sweden, oak cultivations were established on the island of Visingsö in Lake Vättern after the Napoleonic wars in the 1830's (Kardell, 1997). They were intended for military use, mainly for the navy and artillery. The cultivations became mature in the 1970's. Technological changes did the cultivations useless for their original purpose, but they make up an antiquarian cultural object and a tourist attraction (Emanuelsson, 2003).

5. CONCLUDING REMARKS

To act rationally is to fulfil the rationality criteria or morals set to the action. The effects of actions are manifested not only at present, but also in the distant future. The distinctive feature of rationality is that the consequences of actions can be predicted and accepted. In a complex economic and ecological environment the epistemological justification of actions in forestry is an everlasting process. It is possible to make reliable short-term predictions for many economic and ecological processes but in the long term most of the phenomena in forestry have chaotic features. Due to the very long time horizons in forestry much of the knowledge necessary to carry out a rational action is insufficient and must be substituted for weakly justified beliefs based on available *ad hoc* information. Over time these beliefs may prove to be incorrect, or the changing morality and rationality may prove them useless.

Sustainability is one of the most important moral criteria of forestry. It deals with the temporal distributions of the effects of forestry actions, imparting great moral importance to the time preference and time distribution of actions and forest resources. Generally, it is assumed that long-term economic growth justifies discounting in forestry. It is in harmony with sustainability only in those cases in which economic utilization of other resources and technological improvement of production processes can be substituted for forest resources. It is evident that long-term continuous economic growth causes scarcity of natural resources and that the competition for these resources leads to technological change and/or conflicts that also affect prices and the use of forest resources. To predict these turning points is the ultimate target of intellectual efforts but it is difficult in the short term and hardly possible in the long term. In the best cases, these efforts are educative and give good hints for creating new solutions.

The three theoretical approaches to forestry discussed in this study: *soil-rent*, *resource-management* and *institutional* forestry are in fact theoretical entities and mental institutions of forestry. They include commonly recognized symbols in forestry. In many cases, they are based on ideal and absolute concepts, such as even-age stand structure, optimum rotation, optimum forest management plan, biodiversity etc., the existence of which cannot be verified unambiguously. In forestry, the issue is often, if not always, a hypothetical planning situation in which the concepts of the approaches serve as mental tools to assess the rationality of actions in terms of the criteria of good forest practice based on social conventions of any given time and place.

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IMPROVING FOREST MANAGEMENT DECISION MAKING CONSIDERING MULTIPLE STAKEHOLDERS

Lidija Zadnik Stirn[1]

ABSTRACT

Forest management process, which calls for an equilibrium of economic, ecological and social objectives, is based on sustainable multiple uses of forests and multiple decision makers with conflicting interests. As such, forest management has activated researchers to develop and adopt several decision support models aimed at evaluating and ranking the decision alternatives in forest management from both, owners/experts and public aspects.

In the presented decision model, the feasible forest management alternatives are evaluated from a single decision maker (owner/expert) point of view, which is manifested above all in economic outputs. The utility function is used as an objective function in numerical optimization. Further, the public participation in decision making is expressed through group decision making under multiple criteria associated with risks and uncertainties. A concept of a fuzzy domination relation is used. Finally, knowing the effects of decisions on both, owners/experts and public/residents sides, and finding out that their evaluations are in disagreement, the analytic hierarchy process is used to manage the conflicted results, to produce judgment, and to develop a compromise decision.

A case of a forest in Slovenia is used to illustrate the presented decision model.

Keywords: forest management, decision support model, utility function, fuzzy domination relation, analytic hierarchy process, case study forest in Slovenia

1. INTRODUCTION

Recently, in the forest management process it has become indispensable to create an equilibrium of economic, ecological and social objectives based on sustainable and multiple uses of forests (Pukkala, 2002). This process calls for the interference of multiple stakeholders with conflicting interests. On one hand, the land owners and experts are faced with the forest use decisions which maximize the profit, refer to ecological and social objectives, and respect the public's acceptance of decisions; while on the other hand, the public, who benefits from the amenity value of the forests, specifically derives its own scenario of decisions (Zadnik Stirn,

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2006). As such, a multi-objective forest management process which also includes multiple stakeholders is a problem of satisfactory attainment of multiple but conflicting objectives which has activated researchers to develop and adopt several decision support models (systems, methods) specifically aimed at evaluating and ranking the decision alternatives in forest management situations from both, owners/experts and public aspects (Belton and Stewart, 2002; Nutt, 2001; Taha, 1997).

In the presented decision support model, first the feasible forest management alternatives are introduced. How the feasible forest management alternatives can be generated is described in detail in Zadnik Stirn (2003). The developed alternatives are first evaluated from a single decision maker (owner/expert) point of view, which is manifested above all in economic outputs. The economic approach to measuring the forest benefits (a forest stand simultaneously produces several types of outputs) resulting from the selected decision is utility theory (Winston, 1994). This approach resembles the economic approach in that all outputs are converted into a single unit, which is called utility. The original units of multiple outputs are first converted into sub-utilities, ranging from zero to one, and the sub-utilities from different outputs are then converted into a single total utility. The approach is not distinctly different from numerical optimization such as linear programming, goal programming or various heuristics, because the utility function can be used as an objective function in numerical optimization. The utility function has to be developed separately for every management decision. It is situation- and decision-maker-specific and tells how different forest management decisions can be traded off.

Further, the public participation in forest management decision making is expressed through group decision making under multiple criteria associated with risks and uncertainties (Hwang and Lin, 1987; Zimmermann, 1987). A concept of a fuzzy domination relation is used (Kaufmann, 1975). This method produces a complete ordering of decisions for the public goals of forest management.

Finally, knowing the effects of decisions on both, owners/experts and public/residents sides, and finding out that their evaluations are in disagreement, the analytic hierarchy process is used to manage the conflicted results, produce judgment, and develop a compromise decision (Saaty, 1994).

A case study involving a forest area in Slovenia is used to illustrate the properties of the presented methodology (Zadnik Stirn, 2004).

2. METHODS AND DECISION SUPPORT MODEL

The main objective of this paper is to present a mechanism – a decision support model that links the values and objectives of various stakeholders with the existing scientific foundation to develop effective policy to meet the required goals. The term stakeholder here encompasses a broader set of individuals who benefit or lose from the forest under consideration. In the developed decision support model the forest is influenced by invoking the investment and management decisions. These decisions are first identified on the basis of spatial development entities in the area under consideration, economic and institutional indicators, agreements or conflicting views among stakeholders, politicians, experts, state and regional decision makers, and matching the characteristics referring to location, physical size, level of operation, land use, economic and engineering feasibility (Zadnik Stirn, 2003).

Then, the decisions are evaluated from a single decision maker's (owner's, expert's) point of view. In this case, for each decision i, there are K objectives given through the multidimensional objective function, viewed as a separable and additive decomposition of the linear utility function, expressed as the decision maker's multi-attribute utility function $v(a_{1,i},...,a_{k,i},...,a_{K,i})$ (Winston, 1994), and verified by attributes $a_{k,i}$:

$$v(a_{1,i},\ldots,a_{k,i},\ldots,a_{K,i}) = \sum_{k=1}^{K} w_k v_k(a_{k,i}) \qquad (1)$$

where the weight w_k presents the relative importance of objective k The weights w_k are calculated based on the pairwise comparisons of the attributes following the AHP (Analytic Hierarchy Process) procedure. The pairwise comparison data are gathered in comparison matrix A which is a square, positive and reciprocal matrix. The weights w_k are calculated with multiple squaring of matrix A to the satisfactory exponent, i.e., A, A^2, $(A^2)^2$, etc. Then, the lines are summed up and normalized. They are normalized and scaled between 0 and 1 and $\sum w_k = 1$. If the attribute $a_{k,i}$ is assumed to be a numerical variable (known with certainty), and the decision maker is risk neutral, the utility function $v_k(a_{k,i})$ for a single attribute is linear:

$$v_k(a_{k,i}) = (a_{k,i} - a_{i,worst})/(a_{i,best} - a_{i,worst}) \qquad (2)$$

where $v_k(a_{k,i} = a_{i,worst}) = 0$ and $v_k(a_{i,best} = a_{k.i}) = 1.$

Further, the public's participation in decision making is introduced into the model. The procedure to be followed for the evaluation of the decisions by public/residents is presented in a hierarchical structure. The hierarchy is organized around the concept of objectives and attributes, within a two level hierarchy (Figure 1). The first level can be viewed as the objective level. The objectives are presented by attributes which are found at the second level. The attributes define the cumulative effects of objectives, hence their impacts to the objectives must be aggregated. In this paper, the linear combination 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 attributes. In the aggregation process, we also consider the fact that some attributes must be viewed as relatively more significant as the others.

Therefore, aggregating the effects of all attributes takes into account their relative importance.

The cumulative impacts of attributes x on objective k, assigned as c_k (Figure 1), are calculated as a sum over all products of attribute's membership value u_x, and its relative importance (weight) w_x:

$$c_k = \sum_x w_x u_x \tag{3}$$

The weights w_x are calculated based on the pairwise comparisons of the attributes following the AHP procedure. They are normalized and scaled between 0 and 1 and $\sum w_x = 1$. The values u_x are assessed as the values of membership functions assigned to the attributes, and reflect the extent or impact of the attribute on the objective. This may be difficult or impossible to evaluate. Thus, it can only be judged in terms of the degree to which it leads to composite utility value of the objective. In the paper, we use a linear membership function, but other more complex forms of membership functions may also be used (Zimmermann, 1987):

$$u(x) = \left\{ \begin{array}{cc} 0 & \text{for } x < \alpha \\ 1 - \dfrac{\beta - x}{\beta - \alpha} & \text{for } \alpha \le x \le \beta \\ 1 & \text{for } x > \beta \end{array} \right\} \tag{4}$$

where x is the value of the attribute obtained from the survey, α and β are parameters representing limit values of the attribute (Figure 2, Table 2). The values c_k are also between 0 and 1 (Figure 1). The value close to 1 implies that the objective is favorable to the composite utility value of the decision, while its low value implies that the objective contributes poorly to the composite utility value of the decision.

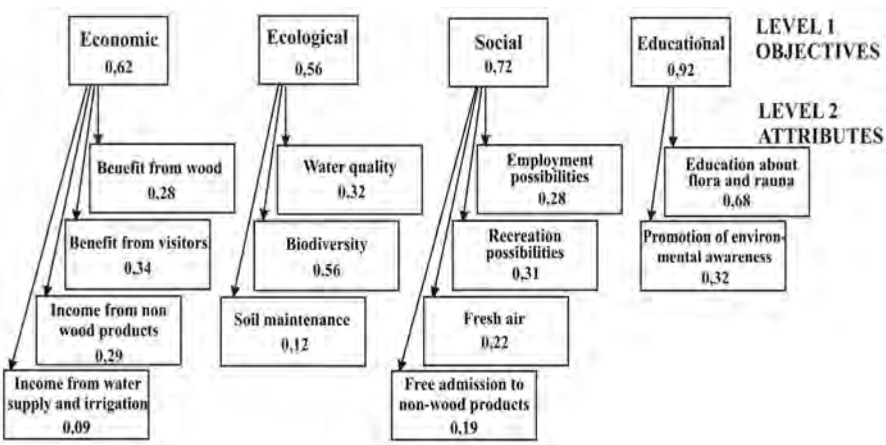

Figure 1: Objectives' and attributes' hierarchy for composite utility value for decision d_1

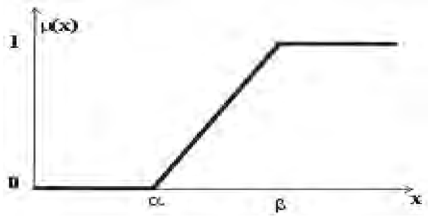

Figure 2: Membership function of fuzzy attributes

The values of objectives (decision factors) $c_1,\ldots,c_n$ identified using formula 3, Figure 1, determine the rows and columns, respectively, of a matrix $X=(x_{ik})$. The entry x_{ik} measures the favorability (the level or value) of a decision factor c_k for a given decision d_i (Figure 1). Since x_{ik} source from qualitative data (surveys) they are transformed to a scale from 0 to 1. Thus, a matrix $Y=(y_{ik})$ is obtained, which is simply a normalized version of X, where the entries in each column are normalized with respect to the largest entry in the column, i.e.,

		c_1	….	c_k	…..	c_n
	d_1			..		
	…			..		
X:	d_i	..	..	x_{ik}		
	…					
	d_m					

$$y_{ik} = \frac{x_{ik}}{\max_i x_{ik}}, k = 1,\ldots,n \tag{5}$$

The identification of the dominant decision is based on the concept of fuzzy dominance relation as described by Kaufmann (1975). It identifies the dominance relationships between pairs of decisions based on the matrix Y. For a pair of decisions d_i and d_j, $D_k(i,j)$ is defined:

$$D_k(i,j) = \begin{cases} 1, \text{if } y_{ik} - y_{jk} > 0 \\ 0, \text{if } y_{ik} - y_{jk} < 0 \\ 0.5, \text{if } y_{ik} - y_{jk} = 0 \end{cases} \text{ for k=1,2,…,n} \tag{6}$$

Then matrix $R'=(r_{ij})$ is defined, where $r_{ij} = \begin{cases} \sum_{k=1}^{n} D_k(i,j), \text{if } i \neq j \\ 0, \text{if } i = j \end{cases}$ for i,j=1,2,…,n

(7)

Finally, we calculate s_i and b_j, where s_i and b_j denote the i-th row sum and the j-th column sum, respectively, of the matrix R'. The row sum, s_i, is a measure of the degree to which the decision d_i dominates the other decisions, while b_j measures the degree to which the decision d_j is dominated by the remaining decisions.

Finally, knowing the effects (normalized values) of each decision on both, owners/ experts, assigned as $v_{utility}$, and public/residents sides, assigned as v_{ph}, the analyst determines the best compromise decision as a weighted sum of both values for each decision, i.e., the overall result (v_{or}):

$$v_{or} = w_1 v_{utilitynormal.} + w_2 v_{phnormal.} \qquad (8)$$

The weights w_1 and w_2 are determined by AHP method (Winston, 1994), so that the distinctive experts are asked to reveal the pairwise comparison on the 1 to 9 Saaty's scale comparing the importance of experts/owners and public/residents for the decision making regarding the investment and management of the forest under consideration.

3. CASE STUDY – MANAGEMENT OF THE FOREST PANOVEC

The presented decision support model is illustrated with the management problem of the forest Panovec which is for the sake of simplicity and with the aim to serve only for illustration presented and treated in a restricted way.

The Panovec state forest in the immediate vicinity of Nova Gorica (the biggest city in the area with 36.400 inhabitants) covers a total area of 384 ha (forest, meadows, trails) of which 364 ha are forests. Section 3 covers an area of 19 ha and is a forest reserve (it is not managed; it is under full protection). Panovec is state owned. In 1981, the Society of Forestry Engineers and Technicians of Posočje and the Forest enterprise SGG Tolmin opened Panovec to the general public with project "Forest learning trail" (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 forest in a different way. The trail is also used for recreation (walking, running,.etc.). The forest-learning trail is under renovation, some new recreational and educational areas will be created, a new guide to the forest learning trail and a handy leaflet will be issued with the aim of inviting more visitors. In addition, an evaluation of the space will be undertaken in terms of defining limits on recreational and other activities. Landscape and ecological characteristics, conservation and biodiversity, variety of the species, forest communities, stands, ownership, Panovec as a part of an agricultural landscape, forest management plan of Panovec and the use of Panovec space today are described in detail in Papež (2001). Four forest management alternatives were determined by experts as described in Zadnik Stirn (2003). The first alternative, assigned as d_1, is economically oriented, the second, assigned as d_2, is ecologically oriented where biodiversity is stressed, the third one, assigned as d_3, is educationally oriented, while the fourth one, assigned as d_4, is nature protection oriented where fire protection, fresh air, water and soil protection are very important.

In the example the owners/experts objectives of the forest Panovec management were considered by utility functions. If we assume that for a certain objective (economic, ecological, social, educational) of the forest Panovec there exist attributes (Figure 1), benefits from wood, assigned as a_1, benefits from visitors, assigned as a_2, etc., and promotion of the environmental awareness, assigned as a_{13}, the utility function $v_k(a_{ki})$, (k=1,2, …., 13), for the decisions d_i, (i=1,2,3,4) is calculated according to equations (1) and (2), (Table 1). The weights in (1) are calculated by AHP procedure and are also given in Figure 1 and Table 1. Here is shown only the calculation of the relative weights for three attributes of the ecological objective. The estimates from their pairwise comparisons are given in matrix A, where water quality is assigned as Q, biodiversity as P and soil maintenance as H:

$$A = \begin{matrix} & Q & P & H \\ Q & 1 & 1/2 & 3 \\ P & 2 & 1 & 4 \\ H & 1/3 & 1/4 & 1 \end{matrix} . \rightarrow \quad A^2, \quad (A^2)^2, \quad ...... \quad \rightarrow \begin{bmatrix} w_1 = 0.32 \\ w_2 = 0.56 \\ w_3 = 0.12 \end{bmatrix}$$

In Table 1 the normalized values are given as well. The revealed utility values ($v_{utilitynormal.}$) show that the decision d_3 is the most important, while decision d_1 is in the second place for the decision maker (owner/expert) who used utility function to assess the decisions, respectively, i.e., $d_3 > d_1 > d_2 > d_4$.

Table 1: Utility functions for 13 attributes and four decisions according to equation (2)

Atribute	d_1	d_2	d_3	d_4	$a_{i,worst}$	$a_{i,best}$	$v_k(a_{k,i})$	weight
a_1	450	50	200	20	20	450	$(a_1 -20)/430$	0.28
a_2	50	20	30	10	10	50	$(a_2 -10)/40$	0.34
a_3	20	5	10	3	3	20	$(a_3 -3)/17$	0.29
a_4	10	10	5	30	5	30	$(a_4 -5)/25$	0.09
a_5	2	1	3	10	1	10	$(a_5 -1)/9$	0.32
a_6	1	5	4	3	1	5	$(a_6 -1)/4$	0.56
a_7	5	4	1	3	1	5	$(a_7 -1)/4$	0.12
a_8	10	1	0	0	0	10	$(a_8 -0)/10$	0.28
a_9	15	0	5	0	0	15	$(a_9 -0)/15$	0.31
a_{10}	0	5	2	0	0	5	$(a_{10} -0)/4$	0.22
a_{11}	0	0	5	0	0	5	$(a_{11} -0)/5$	0.19
a_{12}	5	0	20	0	0	20	$(a_{12} -0)/20$	0.68
a_{13}	0	2	25	0	0	25	$(a_{13} -0)/25$	0.32
$v_{utility}$	1.844	1.081	2.279	0.750				
$v_{utilitynormal.}$	0.309	0.182	0.383	0.126				

In the second phase the public (residents, visitors) assesses the decisions. Their assessment is also arranged in a hierarchical structure (Figure 1). The cumulative impacts of attributes x on objective k (economic, ecological, social and educational), assigned as c_k, are calculated using Table 2 and formulas (3) and (4). Table 2 shows only the values for decision d_1, while the data of the attributes and objectives for the other three decisions are obtained in a similar way. Given the data in Table 2 ($u(x)/d_1$ and w_x), and using formula (3), the impacts of attributes on the objectives are calculated: $c_1 = 0.62$, $c_2 = 0.56$, $c_3 = 0.72$ and $c_4 = 0.92$. The data for all four decisions are gathered in matrix X. Regarding (5), the matrix Y is calculated. From matrix Y we obtain using (6) matrices $D_k(i,j)$ and finally using (7) the matrix R'.

Table 2: Summary statistics of attributes obtained from 48 respondents regarding d_1

Attribute \ Decision	d_1	α	β	$\mu(x)/d_1$	w_x
Benefit from wood	2.67	1.82	4.50	0.32	0.28
Benefit from visitors	3.69	1.60	4.30	0.77	0.34
Income from non-wood products	3.54	1.22	4.20	0.78	0.29
Income from water supply and irrigation	2.42	1.08	3.80	0.49	0.09
Water quality	4.50	2.30	4.60	0.96	0.32
Biodiversity	3.27	2.45	4.80	0.35	0.56
Soil maintenance	2.77	1.82	3.95	0.45	0.12
Employment possibilities	3.13	1.90	4.05	0.57	0.28
Recreation possibilities	4.50	2.10	4.90	0.88	0.31
Fresh air	3.69	2.10	4.65	0.62	0.22
Free admission to non-wood products	3.40	1.80	4.10	0.82	0.19
Education about flora and fauna	4.15	2.15	4.25	0.95	0.68
Promotion of environmental awareness	3.83	2.10	4.15	0.84	0.32

X:

	c_1	c_2	c_3	c_4
d_1	0.62	0.56	0.72	0.92
d_2	0.73	0.62	0.56	0.72
d_3	0.60	0.72	0.68	0.69
d_4	0.74	0.67	0.66	0.71

Y:

	c_1	c_2	c_3	c_4
d_1	0.84	0.77	1	1
d_2	0.99	0.86	0.77	0.78
d_3	0.81	1	0.94	0.75
d_4	1	0.93	0.92	0.77

According to the column s_i in matrix R' we can conclude that for public the decision d_4 is ranked as the most important, while d_1 is ranked in the second place, respectively, i.e., $d_4 > d_1 > d_3 = d_2$.

The normalized results obtained from the owners/experts and from public are gathered in Table 3. The equal weights given by special experts, according to the importance of the regional NGO's for Panovec, are used in (8) for calculating an overall rank of decisions.

$D_1(i,j)$:

	d_1	d_2	d_3	d_4
d_1	0.5	0	1	0
d_2	1	0.5	1	0
d_3	0	0	0.5	0
d_4	1	1	1	0.5

$D_2(i,j)$:

	d_1	d_2	d_3	d_4
d_1	0.5	0	0	0
d_2	1	0.5	0	0
d_3	1	1	0.5	1
d_4	1	1	0	0.5

$D_3(i,j)$:

	d_1	d_2	d_3	d_4
d_1	0.5	1	1	1
d_2	0	0.5	0	0
d_3	0	1	0.5	1
d_4	0	1	0	0.5

$D_4(i,j)$:

	d_1	d_2	d_3	d_4
d_1	0.5	1	1	1
d_2	0	0.5	1	1
d_3	0	0	0.5	0
d_4	0	1	1	0.5

R':

	d_1	d_2	d_3	d_4	s_i
d_1	0	2	3	2	7
d_2	2	0	2	1	5
d_3	1	2	0	2	5
d_4	2	4	2	0	8
b_j	5	8	7	5	

The overall results v_{or} show that the decision d_1 is the most important, d_3 is in the second place, while d_2 and d_4 are the least important to the owners/experts and public/residents who evaluated the forest management decisions of forest Panovec according to their preferences.

4. CONCLUSION

Ecology, environmental planning, politics, economics and social questions are some of the issues involved in forest management planning. Thus, the solution to the multiple-use forest management problem involves the integration and coordination of multiple decision makers and can not be obtained by the sole use of any one operations research method. The combination of multi-objective techniques, captured in a decision support model, that can also accommodate interactions with the stakeholders was presented. It may provide credible solutions and facilitate the acceptance and implementation of the forest management decisions. Further, the decision makers must generate forest land management decisions and make them known to the public.

The public can then make choices and define their own best land management scenario. Thus, the end users of the presented decision support system might be forest institutions or enterprises in charge of public woodland management, rural development institutions, private owners of woodlands, and mixed farms using their land for both forestry and agriculture.

During the implementation of the decision support system, the preferences of the decision makers, and/or public may change, or new ideas of experts may be produced. In order to control such changes, the system must be constantly monitored to ensure that the chosen parameters are still relevant. As soon as they change, the feedback in the decision support model should be witnessed.

Table 3: An overall evaluation of decisions

Value/Decision	d_1	d_2	d_3	d_4	weight
$v_{utilitynormal.}$	0.309	0.182	0.383	0.126	0.5
$v_{phnormal.}$	0.28	0.20	0.20	0.32	0.5
v_{or}	0.2945	0.191	0.2915	0.223	

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CLUSTER ANALYSIS AND MANAGEMENT IN FORESTRY: PROVIDING RELEVANT SOCIO-ECONOMIC INFORMATION AND SUPPORTING SUSTAINABLE FOREST MANAGEMENT AT VARIOUS SPATIAL SCALES

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ABSTRACT

The definition and concept of sustainable forest management (SFM) continues to evolve with changing values and corresponding societal goals. The trend towards revising SFM priorities in response to changing public needs has accelerated in recent decades with continued economic development in industrialized countries, and unrelenting population growth in developing countries. At the same time, the growing demand for both wood products and non-timber forest products (NTFPs) and services (e.g., tourism) is placing increased pressure on forest resources and further challenges for SFM.

Existing forest management systems are hard pressed to provide an optimal balance of multiple products and services while remaining adaptable to changing management objectives. Traditional forestry research approaches can be ineffective for integrating the wide range of SFM concerns, and are difficult to incorporate into dynamic scenario assessments of the risks, opportunities and challenges for strategic planning in multi-purpose forest management.

The cluster concept to forestry offers a more suitable approach for analyzing, assessing and monitoring relevant aspects of SFM. Integrating all branches of forest, wood-based and other (i.e., NTFPs and services related) industries, this technique produces a more holistic view of forest resources and their sustainable use. Cluster analysis focuses on the availability of forest resources, the efficiency of the wood supply chain and key socio-economic aspects of various industry branches. It can be applied across various spatial scales, although the framework conditions, design and outcomes of a cluster approach vary from international and national (focus on political aspects) to regional and local levels (focus on management aspects). Implementing a cluster management system in forestry produces highly relevant information for strategic decision-making in policy and management, with benefits

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for industry productivity and innovation. Forestry cluster analysis typically includes specific cluster structures, key socioeconomic parameters, competitiveness, development potentials, future development scenarios and cluster management recommendations. Multidisciplinary and participatory in nature, the cluster concept improves communication and cooperation among cluster stakeholders. It also enhances corporate self-image, public relations efforts, self-organization in forest and wood-based industry branches, and mobilization of political support. Finally, the cluster concept contributes to the overall sustainable development of distinct geographical regions by increasing the competitiveness of industry branches and companies within forestry clusters.

This paper presents four cases from the forest and wood-based industries in Germany to illustrate how the cluster concept can inform socio-economic perspectives on the evolving paradigm of SFM at various spatial scales: national (Germany), state (State of North-Rhine/Westphalia), regional (Steinfurt County) and local (City of Arnsberg). Selected key results (including cluster structures and key socio-economic parameters) are highlighted to demonstrate the suitability of the concept for application to forest and wood-based industries.

Keywords: forest and wood-based industry clusters, cluster concept, cluster analysis, cluster management, socio-economic analysis, case studies, Germany

1. INTRODUCTION

Worldwide, the forest industry faces significant challenges from economic and policy developments, such as the growing demand for forest-based products and services, increasingly competitive markets, and progressively more complex standards and constraints for forest management (Food and Agriculture Organization of the United Nations, 2005 & 2006; Ministerial Conference on the Protection of Forests in Europe & United Nations Economic Commission for Europe, 2003).

The definition and concept of sustainable forest management (SFM) continues to evolve in the context of changing values and corresponding societal goals (Wiersum, 1995). At the same time, there is an evident and growing gap between current industrial capacity and market conditions, and societal and political demands for international SFM standards. In some cases, the legislated (regulatory) and certification (voluntary) standards for SFM - designed to address multiple and often competing objectives - do not qualify as either operational or market-oriented. As an example, forest operations in Germany (specifically private forest companies and woodlot owners) now face significant economic challenges (Brabänder et al., 2001; Die Bundesregierung, 2004; Hoelzel, 2004). From a management perspective, both the continued economic development in industrialized countries and population growth in developing countries are driving an accelerated trend towards constant revision of SFM priorities in response to changing public needs (Wiersum, 1995).

At the same time, a growing demand for wood products and non-timber forest products (NTFPs) and services (e.g., tourism) is increasing pressure on forest resources with consequent challenges for SFM. In Germany, different branches of the wood-based industry must now compete with each other for domestic timber resources. Sustainable wood supply is becoming a strategic concern, particularly as new industries such as commercial wood-based energy use emerge on the timber market (Mantau, 2006). Germany's forest owners face substantial economic pressure (Brabänder et al., 2001; Die Bundesregierung, 2004; Hoelzel, 2004), and must also contend with constantly growing societal demands for forest services such as recreation and forest-based sport activities, particularly in highly populated urban and suburban regions (Mantau, 2001). Although this demand could theoretically offer a new source of income for forest owners, under existing legislative and political conditions it poses yet another challenge to forest management.

For the most part forestry remains a relatively conservative industry, which means adapting to the evolving paradigm of SFM will be a challenging, long-term process. Existing forest management systems often have limited capacity to provide an optimal balance of multiple products and services while remaining adaptable to evolving management objectives. Time and again, the German forest industry has failed to identify or respond to new market or policy trends. This has resulted in delays and subsequent disadvantages for adapting to such demands (e.g., transitioning from support for individual industry branches of companies to regional management of wood-based chains of custody, and marketing forest services such as recreation or conservation values).

In the context of SFM, these strategic decision-making limitations are compounded by traditional forestry research approaches, which can be similarly ineffective for integrating the wide range of SFM concerns. Such research approaches remain inadequate for a multi-purpose forest management environment that requires dynamic assessment of future development scenarios that effectively considers the risks, opportunities and consequent challenges for strategic planning. Application of the cluster concept to forestry provides a more suitable and contemporary approach for analyzing, assessing and monitoring all relevant aspects of SFM. Porter's (1998) cluster concept - which has been widely applied to other international industries - has enjoyed relatively restricted implementation and utilization in the forestry context.

Within Europe, the existing forestry cluster initiatives typically focus on regional economics, cooperative networks and centers of innovation (Hanzl & Urban, 2000; Hazley, 2000; Kalela, 2002; Viitamo & Bilas, 2002; Bundesamt für Statistik & Bundesamt für Umwelt, Wald und Landschaft, 2004; United Nations Economic Commission for Europe & Food and Agriculture Organization, 2005). Early examples of the application of the cluster concept to forestry originated in Austria (Technologie- und Marketinggesellschaft m.b.H, 2005), Finland (Ministry of Agriculture and Forestry Finland, 2001) and Sweden (Anon., 2001).

We used the EU definition to identify several suitable German case studies for the application of the forest and wood-based industry cluster concept (Commission of the European Union, 1999; Bundesrat, 2001). This paper presents four cases illustrating how the cluster concept can inform socio-economic perspectives on the evolving paradigm of SFM across a range of spatial scales: national (Germany), state (State of North-Rhine/Westphalia), regional (Steinfurt County) and local (City of Arnsberg). Selected key results (e.g., cluster structures and key socio-economic parameters) are also highlighted to demonstrate the suitability of the cluster concept for the forest industry. For the purposes of this paper, the term "forestry cluster" includes all branches of forest and wood-based industries, as well as other industries related to NTFPs and services.

1.1 Research activities

In 2004, the University of Münster initiated a long-term research project to conduct a cluster analysis of the German forest and wood-based industry in cooperation with the German Main Association of the Wood and Plastic Processing Industries and related Industry Branches. The main objectives of the initial phase of this study (2004-2005) were to develop a suitable cluster definition and corresponding analysis methods, assess the socio-economic importance of the cluster, and develop recommendations for a cluster management.

The large scale cluster analysis for the State of North-Rhine/Westphalia, conducted over 2001 to 2003, represents the first forestry cluster analysis to be undertaken within Germany. The adaptation of the EU forestry cluster definition for German conditions, and further methodological development in this context, represent another unique research effort. This improved methodology was used to assess and analyze the full range of cluster variables (including needs for cluster management), leading to a new and highly innovative perspective on German forestry as a whole. The North-Rhine/Westphalia forestry cluster phase of the research was carried out by a consortium of universities (University of Paderborn (lead partner), University of Freiburg, University of Applied Sciences of Lippe and Höxter), the

German Main Association of the Wood and Plastic Processing Industries and related Industry Branches, and Jaakko Pöyry Management Consulting Europe GmbH.

The University of Münster conducted the regional cluster analysis for forest and wood-based industries in the County of Steinfurt, and the local cluster analysis for the City of Arnsberg over 2004-2005. In both research projects, the cluster definitions for forestry developed by the EU and within the North-Rhine/Westphalia case study were further modified and extended. Prior to this research, there were no existing German studies that included NTFPs and services (e.g., tourism) and traditional wood-based products, in the context of the forestry cluster concept. These case studies also further developed the cluster analysis methods to better address specific operational concerns in the regional and local forestry context.

2. METHODOLOGY

The cluster concept in forestry presented in this paper is based generally upon the cluster theory initially formulated by Porter (1998). An extensive scientific body of knowledge exists around the application of the cluster concept in various industries and countries (see Armstrong & Taylor, 2000; Brenner, 2004; Maier & Tödtling, 2002; Scherer & Bieger, 2003; Schiele, 2003; Sölvell et al., 2003). Although development, testing and implementation of the cluster concept remains limited in the field of forestry, scientific applications in other industries are clearly relevant and were consequently considered when adapting this approach for the German forest industry.

In this study, the specific basis for the cluster concept was the EU definition of the forest and wood-based industry cluster developed by the European Commission (Commission of the European Union, 1999; Bundesrat, 2001). The concept of the forest and wood-based industry cluster has recently undergone further development in Germany, and several suitable case studies for testing and application of the concept have become available. (The modified and extended definition of the forestry cluster is presented in some detail in Section 3.1 of this paper: “A concept of the forest and wood-based industries cluster”.)

Cluster analysis methods were used to apply the cluster concept to the four German case studies representing national, State, regional and local scales of industrial activity (Mrosek & Schulte, 2004; Mrosek et al., 2005c). The cluster analyses employed a multi-disciplinary and participatory research approach to analysis, including fundamental aspects of the forestry cluster such as forest resources (primarily wood products, although NTFPs and services were included in some case studies), wood supply chains (Bergen et al., 2002; Schmithüsen et. al., 2003) and relevant stakeholders (Krott, 2001). Key socio-economic aspects of the cluster and its various industry branches (e.g., number of companies and employees, annual sales) were also analyzed. Finally, both SWOT (strengths, weaknesses, opportunities, threats) and trend analyses were conducted (Fleisher & Bensoussan, 2003) in conjunction with evaluation of future development scenarios (Fink et al., 2002) to develop recommendations for cluster management.

Data collection methods and primary data sources varied among the four case studies. In general, all studies were based on specific business surveys, expert interviews, general statistics from government institutions and industry associations, and academic literature review. For the national and the State level case studies, government and industry databases formed the most important data sources. The regional and local level case studies relied upon expert interviews and stakeholder workshops as crucial sources of information.

2.1 Case study areas

The four case studies analyzed in this paper illustrate the application of the cluster concept in forestry at various spatial scales: national (Germany), State (State of North-Rhine/Westphalia), regional (Steinfurt County) and local (City of Arnsberg). See Figure 1 (shaded areas) and Table 1 for a brief overview of the four case studies discussed in this paper.

While the four case study areas are not directly linked, the examples presented within this paper show how the framework conditions, design and outcomes of a cluster approach vary across the national and State (which focus on political aspects) and the regional and local levels (which focus on management aspects).

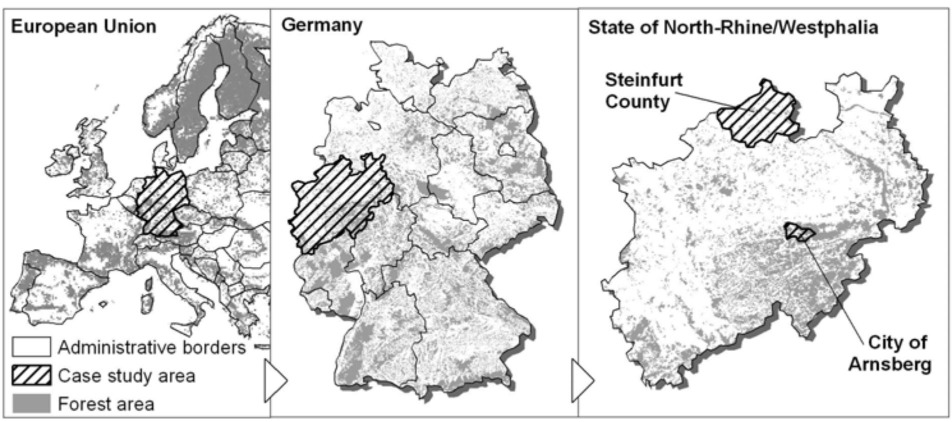

Figure 1: Map of case study areas (Data sources: ESRI Geoinformatik GmbH, 2004; Deutsches Zentrum für Luft- und Raumfahrt & Deutsches Fernerkundungsdatenzentrum, 2004).

Table 1: Selected background information on the case study areas
(data sources: Statistisches Bundesamt Deutschland, 2006; Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen, 2006; Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft, 2005; Landesforstverwaltung Nordrhein-Westfalen, 1999; Ministerium für Umwelt, Naturschutz, Landwirtschaft und Verbraucherschutz Nordrhein-Westfalen, 2002; Landesbetrieb Wald und Holz NRW – Forstamt Steinfurt, 2005; Landesbetrieb Wald und Holz NRW - Forstamt Arnsberg, 2005)

	Federal Republic of Germany	State of North-Rhine/ Westphalia	Steinfurt County	City of Arnsberg
Land area (km²)	357,027	34,082	1,792	193
Population (thousands)	82,464	18,070	433	77
Gross Domestic Product (billion €)	2,177.0	481.4	-	-
Forest area (km²)	110,758	8,876	249.0	119.9
Forest area (%)	31.0	26	14.0	62.0
Coniferous forest (%)	57.6	47.2	38.2	64.0
Deciduous forest (%)	40.1	50.6	61.8	36.0
Private forest owners (%)	43.6	67.0	91.0	43.0
State forest owners (%)[i]	19.5	15.3	3.0	19.0
Municipal forest owners (%)	29.6	14.3	2.0	38.0
Federal forest owners (%)	3.7	3.4	4.0	0.0
Timber volume (million m³)[ii]	3,380.6	240.2	6.8	7.0

Annotations:
[i] National figures excluding “Treuhand forest” (East German state owned trust).
[ii] National figures excluding East German States; figures for the City of Arnsberg refer to the State forest district of Arnsberg.

3. RESULTS

3.1 A concept for the German forest and wood-based industries cluster

The cluster concept in forestry provides a suitable approach for analyzing, assessing and monitoring the most relevant aspects of SFM in the context of the German forest industry. The integration of all branches of forestry, wood-based and other industries related to NTFPs and services allows for a holistic view of forest resources and their sustainable use. The wide range of industry branches considered within the German forestry cluster concept is shown in Figure 2.

Rather than viewing and managing industry branches or companies in isolation, the cluster concept focuses on the wood supply chain and value-addition processes. Considering all the branches of forestry, wood-based and other industries related to NTFPs and services in their larger context, demonstrates the socio-economic importance of the entire forestry cluster more effectively. This in turn helps forest and wood-based industries improve their self-image, and suggests that application of the cluster concept can also support corporate public relations efforts and mobilize political support.

In addition to providing relevant information on the forestry cluster structure, linkages and socio-economic importance (e.g., number of companies and employees, annual sales), the cluster analysis produces more specific economic data, including specific information on: resource, market and industry development potentials; resource utilization; processing and marketing limitations; and overall industry development constraints. It also covers market and industry trends, future development scenarios and cluster management recommendations. Cluster analysis can therefore provide highly relevant information for strategic decision-making at both policy and management levels (Mrosek & Schulte, 2004; Mrosek et al., 2005).

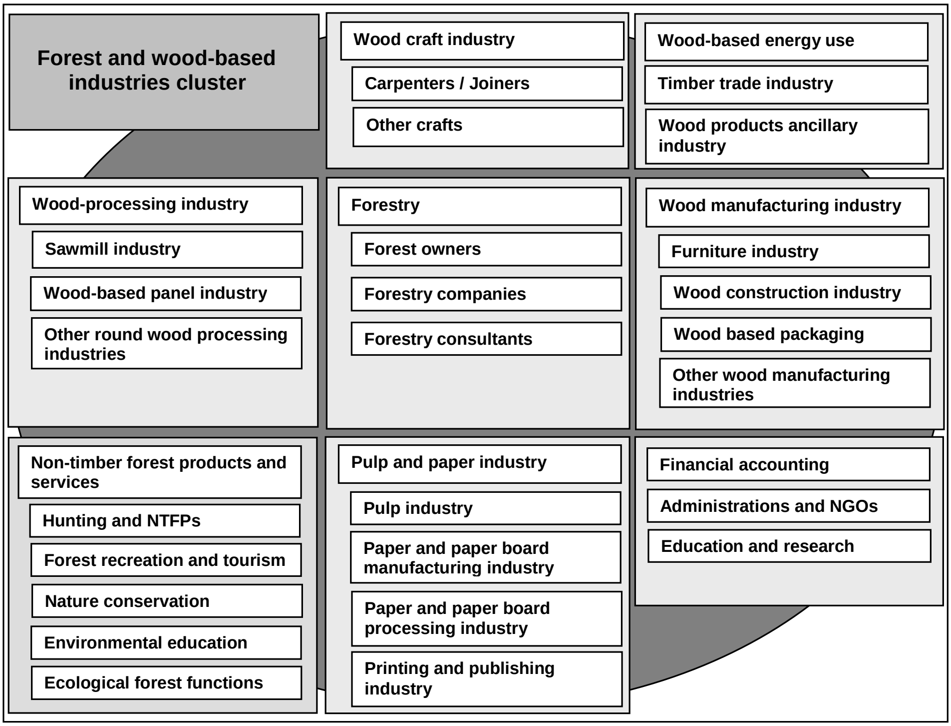

Figure 2: Structure of a forestry cluster covering all potential branches of forestry, wood-based industries and other industries related to NTFPs and services (Mrosek et al., 2005c, modified and extended from Commission of the European Union, 1999; Bundesrat, 2001; Schulte, 2002 & 2003a,b; Mrosek & Schulte, 2004).

By facilitating self-organization in forest and wood-based industry branches, application of the cluster concept in forestry also improves communication and cooperation among various cluster stakeholders. In addition to the usual competition factors, identifying interconnectivity between the different industries in a specific spatial context also makes interdependencies and joined strategic interests more explicit. Exposing such linkages between different businesses and partly shared interests around forest resources also creates opportunities for industry representatives and managers to explore more extensive communication and collaboration. An environment of improved communication and cooperation is also more likely to benefit productivity and innovation (i.e., through joined research and development projects) (Ibid.).

The potential benefits of the cluster concept in forestry are significantly increased when complemented by the implementation of cluster management. A cluster perspective on all industry branches of forestry benefits both participating industries and individual companies, and cluster management significantly contributes to communication, self-organization and cooperation activities. Joined cluster management efforts among different forest industry branches or corresponding regional companies enhances productivity and innovation, simultaneously producing significant synergies in fields such as research and development, production, marketing and public relations (Ibid.).

Finally, the concept contributes to the overall sustainable development of the spatial unit under consideration by increasing the competitiveness of both industry branches and individual companies within the forestry cluster.

3.2 Case studies

National scale case study: Germany

In Germany, the different branches of the forest industry have traditionally been viewed, managed and represented in relative isolation. Linkages between the different industry branches are more frequently characterized as supplier-customer than cooperative relationships. Industries and individual companies have seen little support in their efforts to address evermore challenging SFM requirements and pursue more effective communication and cooperation. One consequence of this tendency to separate the different branches of the German forest industry has been negative effects on awareness (profile) and support for the industry among politicians, media and the general public alike.

Our cluster analysis of Germany's forest and wood-based industry resulted in a more holistic perspective on the wide range of forest resource-based industry branches, companies and stakeholders. This integrated view has allowed decision-makers in German industry and policy arenas to recognize more clearly the interconnectivity and interdependency of their respective industries. Applying the EU cluster definition to the forestry cluster data has also far more effectively demonstrated the actual socio-economic importance of the industry sector.

The basic socio-economic profile of the German forest and wood-based industries cluster is shown in Table 2.

Table 2: Industry branches and selected socio-economic attributes of the forestry cluster in Germany (various data sources and reference years; branches wood-based energetic use and wood products ancillary industry only included exemplarily) (Mrosek et al., 2005b).

Industry Branch	Employment (# employees)	Annual Sales (billion EUR)
Forestry	98,009	2.27
Wood-processing industry	40,978	9.22
Wood manufacturing industry	182,538	27.34
Wood craft industry	452,658	34.20
Pulp and paper industry	139,563	31.65
Printing and publishing industry	329,592	58.52
Timber trade industry	35,500	9.94
Wood products ancillary industry	45,485	7.71
Forestry cluster total	1,324,323	180.85
Cluster, excluding ancillary industry	1,278,838	173.14
Cluster, excluding printing, publishing and ancillary industries	949,246	114.62

In terms of employment, the wood craft industry (~ 452,000 employees) plays an important role in the forest and wood-based industries cluster, followed by the printing and publishing industry (~ 329,000 employees). The printing and publishing industry contributes annual sales of more than 59 billion EUR to the cluster in Germany, followed by the wood craft industry (~ 34 billion EUR), pulp and paper industry (~ 32 billion EUR) and wood manufacturing industry (~ 27 billion EUR).

Figures 3 and 4 illustrate the relative socio-economic importance of the forest and wood-based industries cluster of Germany is shown in comparison to other national industries.

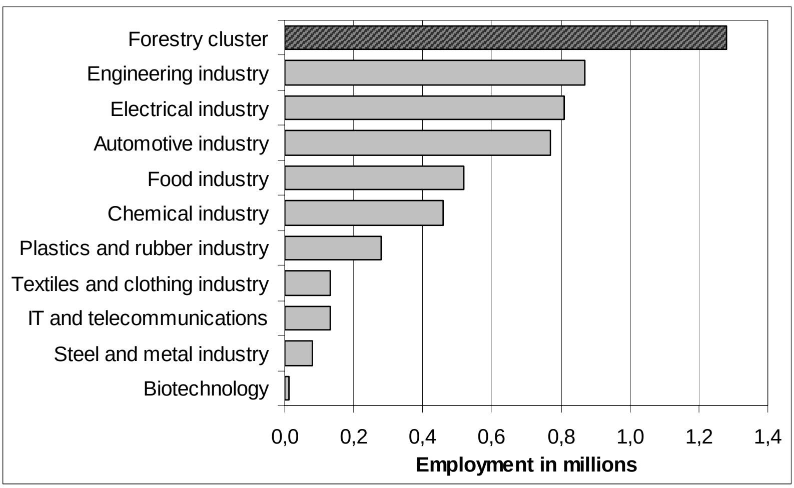

Figure 3: Total employment (number of employees with social insurance registration) within the forestry cluster (multiple industry branches, cluster excluding wood products ancillary industry, reference year 2004 for most data) and other selected industry branches (Mrosek et al., 2005b).

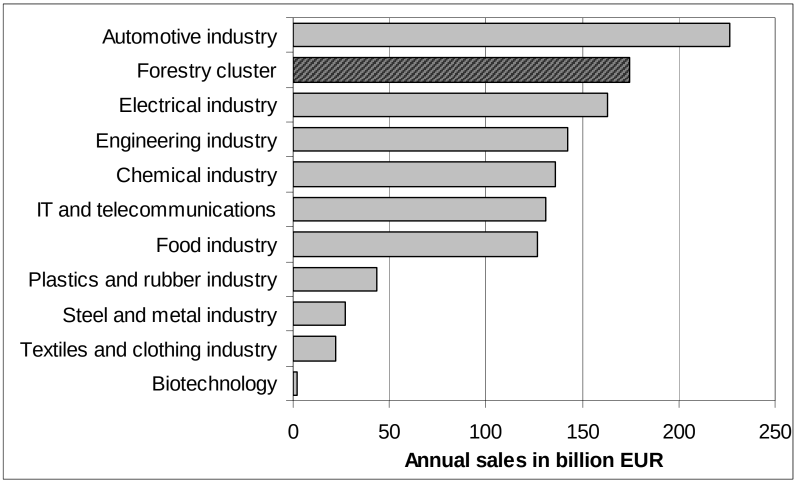

Figure 4: Total annual sales within the forestry cluster (multiple industry branches, reference year 2004 for most data, cluster excluding wood products ancillary industry) and other selected industry branches (Mrosek et al., 2005b).

The cluster analysis database also allowed both forest industry representatives and stakeholders to develop more appropriate and accurate self-images for use in their respective marketing and public relations with clients, politicians, the media and general public. Applying the cluster concept to the forest industry also significantly supported efforts to improve self-organization, mostly at the level of industry associations.

Finally, the new cluster perspective highlighted the need to identify and support all forest resources-related industries in an integrated manner along the wood supply chain and value-addition processes. The recommendations of the cluster analysis (Mrosek & Kies, 2006) focused on the establishment of cluster management at the national level, and the identification and support of regional clusters of the forest and wood-based industry. Specific recommendations for cluster management included:

- Specified objectives for cluster management
- Improved political and legislative framework conditions
- Institutional and financial support of cluster management
- Improved data availability and reliability concerning key cluster characteristics
- Ensured wood-supply for wood-based industries
- Increased technological competitiveness and optimizing logistics
- Strengthened international marketing of wood products
- Increased competitiveness in terms of highly qualified human resources
- Strengthened research and development for increased innovation
- Increased public relations efforts and supporting environmental education

State scale case study: State of North-Rhine/Westphalia

The general situation of the forest and wood-based industry in the State of North-Rhine/Westphalia, and the effects indicated by the regional cluster analysis for forestry, were similar to the findings described for Germany as a whole. Consequently, only selected North-Rhine/Westphalia-specific data and special attributes of the cluster analysis used for this case study are discussed.

This analysis represents the first time that all forest industry branches were considered in an integrated way, based on the EU cluster definition for forestry. The lack of data regarding the socio-economic importance of North-Rhine/Westphalia's forest and wood-based industry and the consequent effects suggested by the cluster analysis were even more dramatic in this state level case study, since no prior cluster analysis had been conducted for German forestry. As a result, the socio-economic profile of the North-Rhine/Westphalia forestry cluster surprised not only politicians, media and the general public, but industry representatives and decision-makers within the forest industry sector as well. Based on the positive outcomes of the North-Rhine/Westphalia forestry cluster analysis, similar studies have since been completed or initiated for several other German States (Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg, 2005; Seegmüller, 2005; Lutze et al., 2006) (although there were none comparable in either scale or detail at time of publication).

The basic socio-economic profile of the forest and wood-based industries cluster of North-Rhine/Westphalia is shown in Table 3.

Within the forestry cluster of North-Rhine/Westphalia, the wood craft industry shows the largest number of employees (~ 73,000), followed by the printing and publishing industry (63,000 employees) and the wood manufacturing industry (~ 59,000

Table 3: Industry branches and selected socio-economic attributes North-Rhine/Westphalia forestry cluster (wood products ancillary industry not explicitly considered) (adapted from Schulte, 2002 & 2003a,b).

Industry Branch	Employment (# employees)	Annual Sales (billion EUR)
Forestry	9,900	0.55
Wood-processing industry	15,700	2.54
Wood manufacturing industry	59,200	9.51
Wood craft industry	72,500	6.62
Pulp and paper industry	37,500	8.05
Printing and publishing industry	63,000	7.47
Wood-based energy use	2,200	0.22
Forestry cluster total	~ 260,000	~ 35
Cluster, excluding printing and publishing industry	~ 197,000	~ 27

employees). The wood manufacturing industry leads in terms of annual sales (~ 10 billion EUR), followed by the pulp and paper industry (~ 8 billion EUR) and the printing and publishing industry (~ 7 billion EUR).

Despite the highly innovative and valuable results of this cluster analysis of North-Rhine/Westphalia's forest resources-related industries (including extensive and detailed recommendations for supporting the State forest industry and increasing its strategic competitiveness), State-wide forestry cluster management does not yet exist. Such initiatives are currently limited to a few regions within the State, although efforts to develop and implement an overall cluster management for forestry in North-Rhine/Westphalia are ongoing.

Regional scale case study: Steinfurt County

The cluster analysis for Steinfurt County represents the first effort to assess and analyze all branches of forest and wood-based industries (including industries related to NTFPs and services) in an integrated manner at a regional level within Germany. Although the general lack of information available regarding the socio-economic importance of the forestry sector and the effects of the cluster analysis results were comparable to the situations described for the larger scales of Germany and North-Rhine/Westphalia, this phase of the study offered a wider and more operational perspective. Consequently, the findings were relevant not only to decision-makers in policy and industry in general, but also more specifically to regional forestry company owners and managers.

The basic socio-economic profile of the forest and wood-processing industries cluster of Steinfurt County is shown in Table 4.

Table 4: Industry branches and selected socio-economic attributes of the Steinfurt County forestry cluster (wood products ancillary industry not explicitly considered) (Mrosek et al., 2005a).

Industry Branch	Employment (# employees)	Annual Sales (million EUR)
Forestry	453	8.6
Wood-processing industry	50	5.4
Wood manufacturing industry	1,291	195.9
Wood craft industry	3,845	316.2
Pulp and paper industry	778	217.0
Printing and publishing industry	1,092	113.3
Wood-based energy use	107	23.1
Timber trade industry	246	72.3
Non-timber forest products and services	22	1.1
Forestry cluster total	7,884	953.0
Cluster, excluding printing and publishing industry	6,792	839.6

In terms of employment and annual sales, the forestry cluster of Steinfurt County is dominated by the wood craft industry (~ 3,800 employees and annual sales of ~ 316 million EUR). Other important industries in this cluster are the wood manufacturing industry (~ 1,300 employees and annual sales of ~ 196 million EUR), the pulp and paper industry (annual sales of 217 million EUR) and the printing and publishing industry (~ 1,100 employees).

In addition to details on the socio-economic profile of the forestry sector, these results provided more operationally relevant information to regional forestry stakeholders, such as data on forest resources, NTFPs and services, the wood supply chain, markets, use conflicts, trends and possible future development scenarios. Most importantly, the study developed extensive recommendations for improving the competitiveness of regional companies and supporting the sustainable development of the entire region through cluster management. Since forestry companies and other stakeholders in Steinfurt County already exhibited high levels of communication and cooperation, recommendations for extended network activities and regional cluster management beyond the scope of individual industry branches were readily accepted. As a result, the institutional framework conditions for successfully establishing and further development of cluster management in forestry look positive for Steinfurt County.

Local scale case study: City of Arnsberg

This cluster analysis for the City of Arnsberg is the first example applying the extended cluster concept at the local level within Germany that integrates all branches of forest and wood-based industries with NTFPs and services-related industries. Although the results of this study share the general characteristics of the national, State and regional level forestry clusters, the operational aspects of the for-

Table 5: Industry branches and selected socio-economic attributes of the City of Arnsberg forestry cluster (wood products ancillary industry and printing and publishing industry not explicitly considered; branch education and research incorporated exclusively) (Mrosek et al., 2006).

Industry Branch	Employment (# employees)	Annual Sales (million EUR)
Forestry	186	8.1
Wood-processing industry	872	196.4
Wood manufacturing industry	174	26.1
Wood craft industry	170	12.4
Pulp and paper industry	940	212.6
Timber trade industry	34	9.5
Non-timber forest products and services	43	2.4
Education and research	57	7.4
Forestry cluster total, excluding printing and publishing industry	2,476	474.9

estry cluster are even more relevant in this case (even when compared to the Steinfurt County project). To avoid repetition from the previous cluster descriptions, we have highlighted only specific characteristics of the local level forestry cluster analysis.

As shown in Table 5, the City of Arnsberg forestry cluster has a highly specific socio-economic profile in which forest and wood-based industries play an unusually important role that would be generally unexpected for other cities of comparable size in Germany.

Within the forestry cluster, the pulp and paper industry (872 employees and annual sales of ~ 196 million EUR) and the wood manufacturing industry (940 employees and annual sales of ~ 213 million EUR) show the most significant socioeconomic importance.

An overall assessment of the competitiveness and development potentials of the City of Arnsberg forestry cluster is shown in Figure 5.

Strengths • Availability of forest resources • Presence of all branches of the forest and wood-based industries cluster • Presence of small and medium sized enterprises in the wood-based industries • Effective cooperation between forestry and wood-processing industry • Competence cluster in forestry • Suitable infrastructure	**Weaknesses** • Inefficient business structure of small privately owned forests and negative legislative and political framework conditions (e.g. protected areas) • Limited cooperation between forestry and many branches of wood-based industries • Gaps in the local chain of production and value-adding • Weak public relations • Limited integration of forest-based tourism and forest conservation
Opportunities • Further optimization of logistics and multiple forest use • Further access of business opportunities (e. g. commercial wood energy, forest-based tourism and education) • Improved communication and cooperation between stakeholders along the chain of production and value-adding • Improved public relations	**Threats** • Negative development concerning economic performance of small forestry companies with increasing loss of wood-based companies • Further decreasing of perception and support of the forestry sector through policy, media and the public • Further reduction of public funding

Figure 5: Analysis of the strength, weaknesses, opportunities and threats of the City of Arnsberg forestry cluster (Mrosek et al., 2006).

Due to the high concentration of the forestry and industries related to NTFPs and services in the City of Arnsberg, local decision-makers in policy and industry were specifically interested in the information provided by the cluster analysis. Consequently, the information on the City of Arnsberg forestry cluster focused on operational aspects, and the specific needs and interests of local company owners and managers, to an even greater extent than the Steinfurt County analysis. Since a network of forestry stakeholders already existed (albeit in basic form) the framework conditions for connecting representatives from all cluster branches to improve communication and cooperation were also positive. Within this particular study, the diversity of forestry stakeholders was at a maximum and a wide range of SFM topics were represented in the data collection and communication processes. This allowed both forestry companies and stakeholders to directly identify the specific benefits of the cluster analysis and possible benefits of cluster management in the future. Efforts to establish cluster management are now ongoing.

4. DISCUSSION

Although a basic conceptual framework and research methodology exists in the field of forestry science, application of the cluster concept in forestry is still relatively new and further research and development is necessary. The most pressing research needs include further development of the cluster definition and improved methods for cluster analysis and management. Standardized procedures for data collection and integration, as well as data quality standards, are needed for cluster analysis, particularly for application at different spatial scales. Further testing and implementation is also required to gather more practical experience for refining the research and analytical methods and confirming initial conclusions.

Further development of the cluster concept in forestry should draw more extensively from existing scientific and practical experiences applying this concept to other industries. Links to other scientific disciplines and research fields (e.g., regional economics and policy, cooperative networks, innovation centers, regional social capital and sustainable development in rural areas) should also be explored to a larger extent.

The significant costs implied - most specifically for analyses conducted at larger scales, such as the national or state level - represent a major limitation for the application of the cluster concept in forestry. In this context, co-financing with industry, private-public partnerships and common public funding of cluster initiatives should be further encouraged to support the research.

The cluster concept can contribute to improved self-organization and self-marketing in a forest industry facing significant problems such as weak economic performance by small forest owners and companies, and limited political support. As shown by the case studies described in this paper, the intent and capacity of the cluster concept varies in relation to the level of application (spatial scale). Although this method has its strongest impact in the field of forest policy and strategic decision-making (at national and state levels), it becomes most effective in operational terms at regional and local levels. SFM is a complex and dynamic goal, in many aspects being characterized by high levels of uncertainty. Nonetheless, a holistic view of all branches of forest and wood-based industries can support companies and stakeholders alike at all levels as they orient themselves towards SFM.

5. CONCLUSIONS

Experiences from the case studies described in this paper, other international examples in forestry, and the related economics literature on the cluster concept in general, suggest that the cluster concept is an appropriate tool for supporting forestry and wood-based industries in various ways across different spatial levels. In the forestry context, the cluster concept clearly supports industries and individual companies alike with strategic orientation towards a more complex and dynamic understanding of SFM. The potential benefits for participating industries and companies include a more accurate and informed self-image, more efficient self-organization, improved framework conditions for communication and cooperation, and a more effective representation of the sector to external target groups. Meaningful application of the cluster concept in conjunction with cluster management requires strong joint efforts and significant resources. However, such an investment is readily justified by the potential of the cluster concept to significantly contribute to increased competitiveness and overall sustainable development of the forestry and wood-based industry sector.

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A CONCEPT FOR THE CALCULATION OF FINANCIAL COMPENSATION FOR CONTRACT-BASED FOREST MANAGEMENT REGIMES

Bernhard Möhring and Ursula Rüping[1]

ABSTRACT

When managing the forests under social convenience, forest enterprises are faced with financial losses. With regard to practical experience in forestry there is a considerable lack of information about the economic consequences.

To estimate these losses related to changed silvicultural treatment, a calculation scheme based on the annuity method was developed and figures were calculated for different tree species and age classes. The annual timber production value determined per ha and year was documented in tables and, as shown by examples, could be used to evaluate typical changes of forest management like the renunciation of forest production, a change of tree species, the premature harvest and the preservation of mature stands.

Standardized annual timber production values for different tree species, yield classes, management schemes etc. can be helpful to estimate the financial compensation of private forest land owners when changing the management strategy. Therefore, the scheme turns out to be an important tool for contract-based forest management under European forest conditions.

Keywords: Contract-based Forest Management, Financial Compensation, Annuity, Annual Timber Production Value

1. INTRODUCTION

There are many environmental reasons such as nature conservation, biodiversity, water protection or recreation, which require a change of the forest management regime in Germany. The main measures are:

- the conversion to native, non-coniferous trees,
- the premature opening and harvesting of productive pure coniferous stands and
- the maintenance of mature broad-leaved trees.

So far mainly institutional regulations were established in order to achieve these goals. However, in Germany there is a strong political intention to encourage contract-based forest management: forest owners get a financial compensation for the

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losses of the changed forest management regime. Such compensations are commonly paid in the German agricultural sector but still absent in forestry.

2. METHODOLOGY AND DATA

2.1 Valuation based on the annuity method

In the following, a valuation concept based on annuities as a yearly success value is developed to estimate the financial losses of the forest land-owner, when he changes his management regime (Möhring et al., 2006). It appears to be advantageous to base the valuation on standardized annual payments, both for the purpose of evaluation and the communication of the results. It is intended that this kind of calculation will develop to a standard tool to appraise compensation for contract-based forest management (Möhring and Rüping, 2006).

By using the so called annuity formula (see Eq. 1) the unsteady cash flow of an investment can be transferred into a constant annual but economically equivalent cash flow.

$$a = \sum_{t=o}^{n} \frac{(R_t - E_t)}{(1+i)^t} \cdot \frac{i \cdot (1+i)^n}{(1+i)^n - 1} \qquad (1)$$

a: annuity (equal annual payments)
t: point in time (years since beginning of the accounting period
n: length of accounting period (years)
R_t: revenues at t
E_t: expenditure at t
i: interest rate

The annuity can be interpreted as a constant series of equal annual payments at a regular interval. The annuity can be seen as a yearly gross margin. The annuity corresponds with the amount of money which can be removed annually as profit contribution during the investment period while maintaining the capital stock. In contrast to the net present value, which represents the total surplus of an investment at the decision time, the annuity specifies an annual average surplus during the investment period.

The ascertained annuity of forest production will be termed as “annual timber production value”. This item expresses that the value is directly connected with the forest-wood production (also the planting, tending and harvesting of trees). Non-timber outputs and other forest amenities originated from a change in forest management regime are not taken into account.

The “annual timber production value” equates to a yearly contribution margin from the silvicultural (biological) production including the cost of capital before deducting the annual fixed costs.

By applying the annuity equation (1) to the entire forest rotation length (u) from stand establishment to final cutting the formula gets the following notation (see Eq. 2):

$$a_u = \left(\frac{A_u}{(1+i)^u} + \sum_{a=1}^{u} \frac{D_a}{(1+i)^a} - c \right) \cdot \frac{i \cdot (1+i)^u}{(1+i)^u - 1} \tag{2}$$

a_u: annual timber production value for a whole rotation length u
u: rotation length
A_u: clear-cut revenue net of harvesting cost in year u
D_a: thinning revenue net of harvesting cost in year a
c: plantation costs

The "annual timber production value" is not only calculable as an average value for a whole rotation period but there are also values ascertainable for shorter periods of time. For a time period of n years, the annual timber production value can be calculated by the following equation (see Eq. 3):

$$a_n = \left(\frac{A_{x+n}}{(1+n)^n} + \sum_{a=x}^{x+n} \frac{D_a}{(1+i)^{a-x}} - A_x \right) \cdot \frac{i \cdot (i+1)^n}{(1+i)^n - 1} \tag{3}$$

a_n: annual timber production value for a time space of n years
n: number of years of the time period
A_x: clear-cut revenue net of harvesting cost in year x
A_{x+n}: clear-cut revenue net of harvesting cost in year x+n

2.2 The data base for the examples

The following calculations are based on a data pool which gives a simplified actual description of good growing conditions in Northern Germany (see Möhring and Rüping, 2006):

- With respect to the general application, standard yield tables for Norway spruce (1. yield class, moderate thinning grade) and European beech (1. yield class, moderate thinning grade) are the basis for modelling the natural production process (Schober, 1975); however the average stand diameter is adjusted by using the Richards-Function to the present silvicultural situations (Wollborn and Böckmann, 1998).
- Timber prices and logging costs are derived from the forest valuation directive of North-Rhine-Westphalia (MURL NRW, 2005) but a special variant for beech has been established which considers the fall in price as a consequence of red heart in old growth.
- Plantation costs are fixed at 2,250 EUR/ha for Norway spruce and 5,000 EUR/ha for European beech. Calculations are done with and without plantation costs because of natural regeneration or financial subsidies provided by the state.
- Silvicultural treatments are assumed to be realized at the age of 10 and 20 years for both tree species with costs of 250 EUR/ha per intervention.

- All other costs are considered as fixed costs and omitted based on the assumption that they occur independently from the management regime.
- The interest rate is fixed at a real marginal rate of 1.5 %. In this context, the problem of choosing a suitable interest rate also has to be solved. This is always a special problem when evaluating forest management regimes. An entire renouncement of interest would imply unlimited capital funds. This is quite unrealistic because there is always a lack of capital and alternatives to use scarce capital can always be found. However, it must be considered that the profitability of capital bound in forest stands in Germany is quite low. If the interest rate has to reflect alternative investments in the forest stock within the forest enterprise, an internal interest rate should be used for the calculations. The analysis of management regimes for beech and spruce in the Solling-Area in Lower Saxony (Northern Germany) has shown real marginal interest rates between 1.5 % and 2.0 % (Möhring, 2001a and 2001b). As the internal rate of return has to represent a feasible investment alternative within the forest enterprise a real interest rate of 1.5 % is used.

All these data are assumed to be constant over time.

3. RESULTS

Based on the data described, the cash flow of managing Norway spruce (see Figure 1) was calculated. At the same time, this figure also shows the development of stumpage values over time.

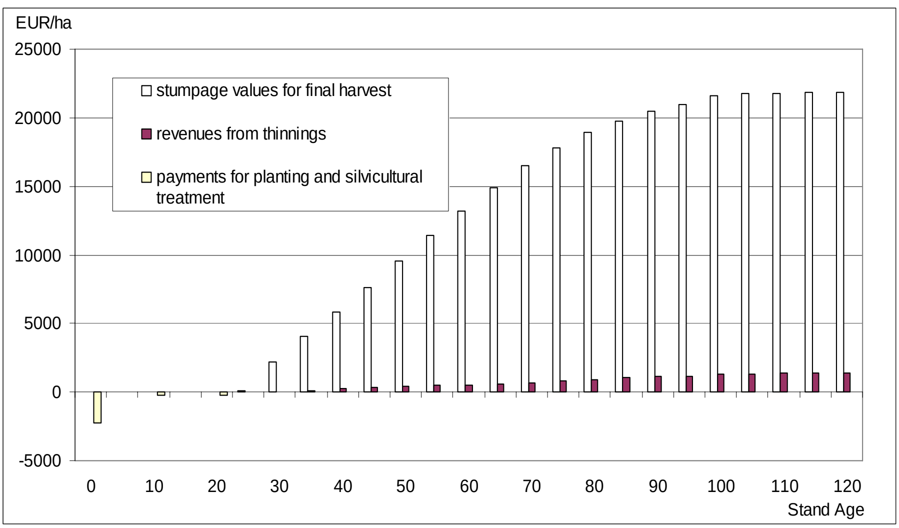

Figure 1: Norway spruce (1st yield class, moderate thinning grade): Payments for stand establishment and silvicultural treatments, revenues from thinnings and stumpage values of standing volume for final harvest.

On the basis of the discontinuous cash flow from plantation to final harvest, the annual timber production value was calculated using the annuity formula (see Eq. 2). This calculation contains all revenues and expenditures from the stand establishment to final harvest. The optimal rotation time is reflected, where the annual timber production value is maximal. For Norway spruce with an 80-year rotation (based on the data described above), the annual timber production value amounts to 110 EUR/ha/year (see Eq. 3 and Table 1).

The Annual Timber Production Value cannot only be used for the entire production cycle from stand establishment to final harvest but it is also possible to calculate the corresponding amount for shorter time periods (see Table 1).

This approach corresponds with the ongoing decision process during the forest production cycle. The forester has to decide whether to divest capital by harvesting the standing volume or to invest capital in the stumpage value by leaving the stand untouched to continue forest production.

Table 1: Norway Spruce (1st yield class, moderate thinning grade): Annual Timber Production Value in EUR/ha for different stand ages and lengths of consideration period.

	to age ... : Annual Timber Production Value in EUR/ha/year (Norway spruce, I. yield class)											
from age ...	10	20	30	40	50	60	70	80	90	100	110	120
0 (with plantation costs)	-267	-154	-53	25	71	96	108	110	108	105	99	94
0 (without plantation costs)	-23	-23	41	100	135	153	160	159	154	148	141	134
10		-23	81	156	192	207	210	204	195	186	175	166
20			202	267	288	289	281	266	249	234	218	205
30				343	342	328	309	286	262	242	222	206
40					340	318	294	265	237	214	192	174
50						293	266	232	200	176	152	133
60							235	193	159	134	108	90
70								145	112	89	63	45
80									74	54	26	10
90										31	-3	-19
100											-43	-50
110												-59

3.1 The appraisal of financial losses when changing the forest management regime

In the following, we show how these annual timber production values can be used to appraise the financial losses of four typical changes in the forest management regime when environmental objectives have to be followed.

3.1.1 Renunciation of forest production

The simplest case is the suspension of reforestation after the final harvest, for example to achieve natural succession on the forest ground (e.g., an area of 1 hectare of forest ground, normally planted with spruce, is not reforested). The alternative striven for is usually a nature oriented regime, whereas the reference is normally a conventional, economic oriented management regime.

Reference - Normal Forest Production: Under the given conditions the forest management regime with Norway spruce would achieve an annual timber production value of 110 EUR/ha/year when considering the optimal rotation length of 80 years (see Table 1).

Alternative - Environmentally Orientated Management: Here, the simplifying assumption is made that the succession neither requires expenditures nor generates any revenues. Thus, the average annual net surplus of the area is 0 EUR/ha/year.

Financial loss: This corresponds to the forgone annual timber production value during the alternative use of the forest ground; in this case 110 EUR/ha/year (see Figure 2).

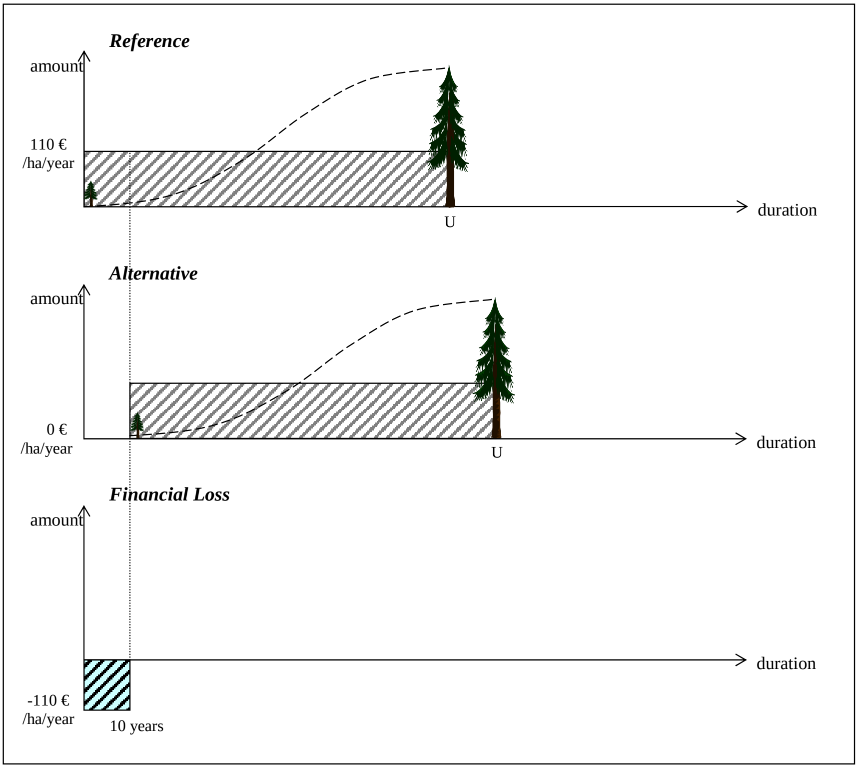

Figure 2: Renunciation of Forest Production

3.1.2 Change of tree species

Often it is of public interest that the forest owner changes tree species. This is normally the change from coniferous trees, which are more productive but not endemic, to near-to-nature but less productive broadleaf trees. This change of tree species influences the forest production until the requested species reaches maturity. Table 2 shows the annual timber production value of European beech. Given price erosion as a consequences of red heart in old growth, the annual timber production value of beech reaches its maximum with 1 EUR/ha/year at the age of 120 but it is negative for almost all alternative rotation periods (see Table 2).

Table 2: European Beech (1st yield class, moderate thinning grade): Annual Timber Production Value in EUR/ha for different stand ages and lengths of consideration period.

	to age …: Annual Timber Production Value in EUR/ha/year (Beech I. yield class)														
from age …	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
0 (with plantation costs)	-566	-315	-225	-181	-139	-109	-83	-61	-39	-22	-9	1	1	-4	-15
0 (without plantation costs)	-23	-23	-17	-13	3	18	33	47	63	75	84	91	89	81	69
10		-23	-13	-9	13	30	48	64	82	96	107	114	110	101	86
20			0	0	29	49	70	88	109	124	135	143	137	125	107
30				0	48	71	96	115	138	154	166	174	165	150	127
40					103	115	138	156	181	196	207	214	201	181	153
50						130	160	180	208	225	236	241	224	198	163
60							195	211	243	258	268	271	247	214	170
70								229	273	286	294	294	261	218	164
80									325	323	324	318	271	216	149
90										320	323	315	252	182	101
100											327	312	221	133	34
110												294	155	47	-71
120													-6	-107	-234
130														-225	-376
140															-552

The calculation of the financial losses when changing from spruce to beech can be realised by three different approaches.

Approach A:

Reference: The forest management regime with Norway spruce would achieve an annual timber production value of 110 EUR/ha/year, considering the optimal rotation length of 80 years (see Table 1).

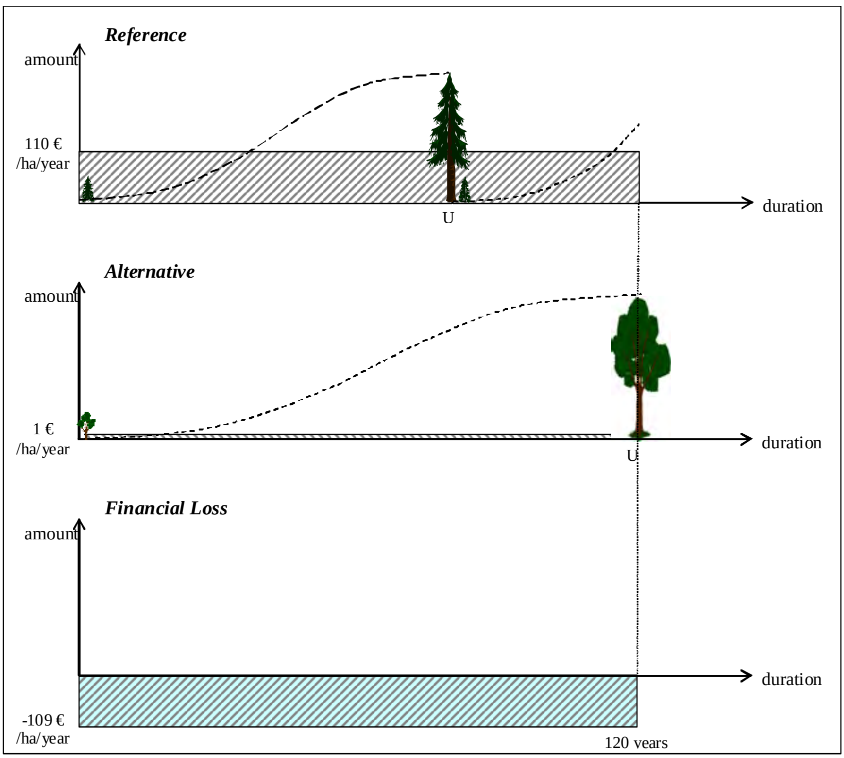

Figure 3: Change of tree species – Approach A

Alternative: Under the given conditions the forest management regime with European beech would gain an annual timber production value of 1 EUR/ha/year, considering the optimal rotation length of 120 years (see Table 2).

Financial loss: The difference between the annual timber production value of the two species amounts to 109 EUR/ha/year during the entire production length of European beech (see Figure 3).

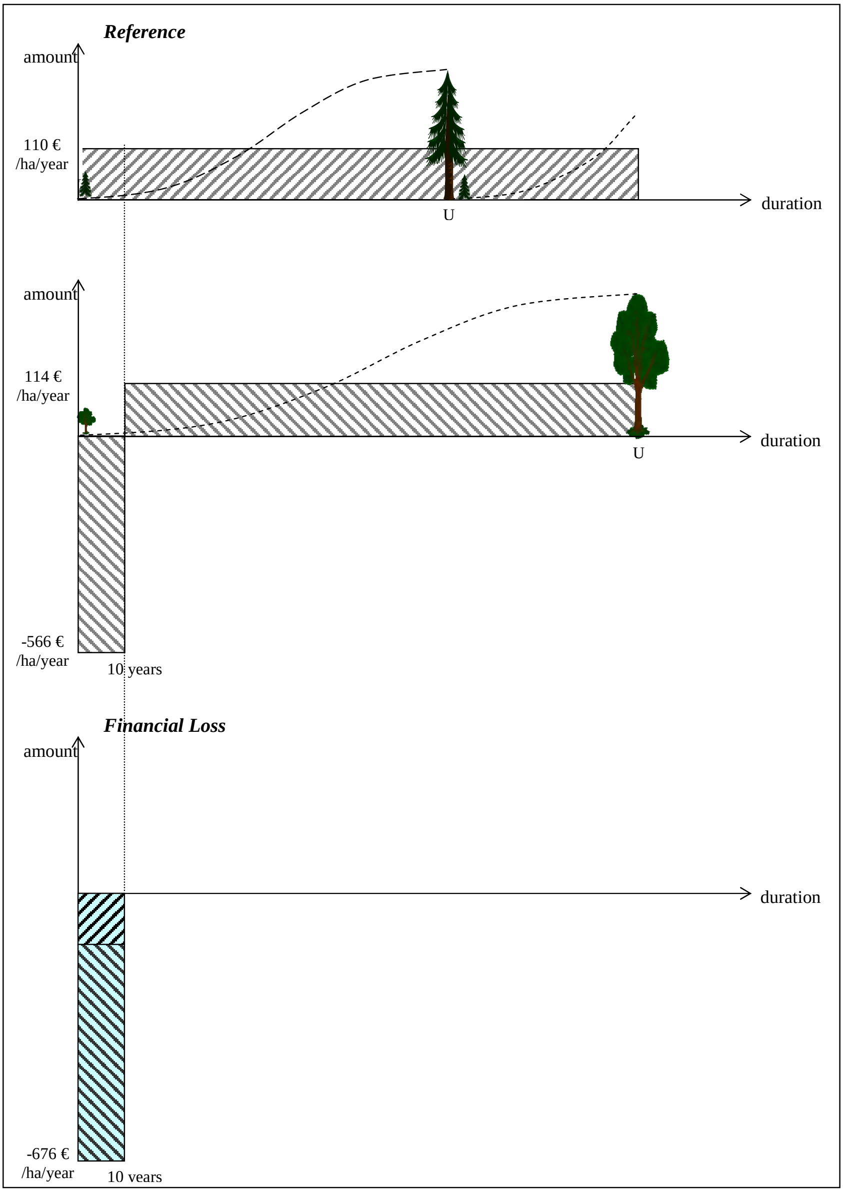

Figure 4: Change of tree species – Approach B

Approach B:

Taking this extremely long time span into account, a different approach (B) seems to be more suitable for practical purposes. This approach is based on the consideration that - despite of the higher average productivity of Norway spruce - it is advantageous to continue with European beech production when an existing beech stand has already reached a certain age. Therefore, we have to determine the age of a European beech stand from which the annual timber production value of beech is equivalent to the average annual timber production value of spruce. Beyond this age, the beech stand does not cause any economic disadvantage anymore. Thus, the losses accumulated up to this age have to be determined. The following example illustrates this approach.

Reference: The annual timber production value of the Norway spruce management regime is 110 EUR/ha/year considering the optimal rotation length of 80 years (see Table 1).

Alternative: Once a European beech stand reaches the age of 10, the average annual timber production value is 114 EUR/ha/year until its optimal rotation length of 120 years, which means that the annual timber production value is almost equivalent to Norway spruce. However, up to this age (the first 10 years), European beech has a negative annual timber production value of -566 EUR/ha/year (see Table 2).

Financial loss: For the first decade, the difference of the annual timber production value between the two species amounts to 676 EUR/ha/year. Once having past this period no more losses arise for the forest owner (see Figure 4).

Approach C:

In the case where plantation costs of beech are refunded to the forest owner in the form of subsidies (approach C), the average annual net surplus rises notably. For the first 10 years of beech production (see Table 2), the negative annual surplus is reduced to -23 EUR/ha, however, the average annual timber production value of 110 EUR/ha for the spruce production is forgone. Therefore, the loss of future earnings equates to 133 EUR/ha for the first 10 years (see Figure 5).

Table 3: Three different approaches (A-C) to calculate the financial losses, when the tree species is changed from Norway Spruce to European Beech.

Approaches	Annual Financial Loss (EUR/ha/year)	Length of period (years)	Interest rate (%)	Present Value of Financial loss (EUR/ha)	Refunding Plantation Costs (EUR/ha)	Financial Loss (EUR/ha)
A	109	120	1.50 %	6049		6049
B	676	10	1.50 %	6234		6234
C	133	10	1.50 %	1227	5000	6227

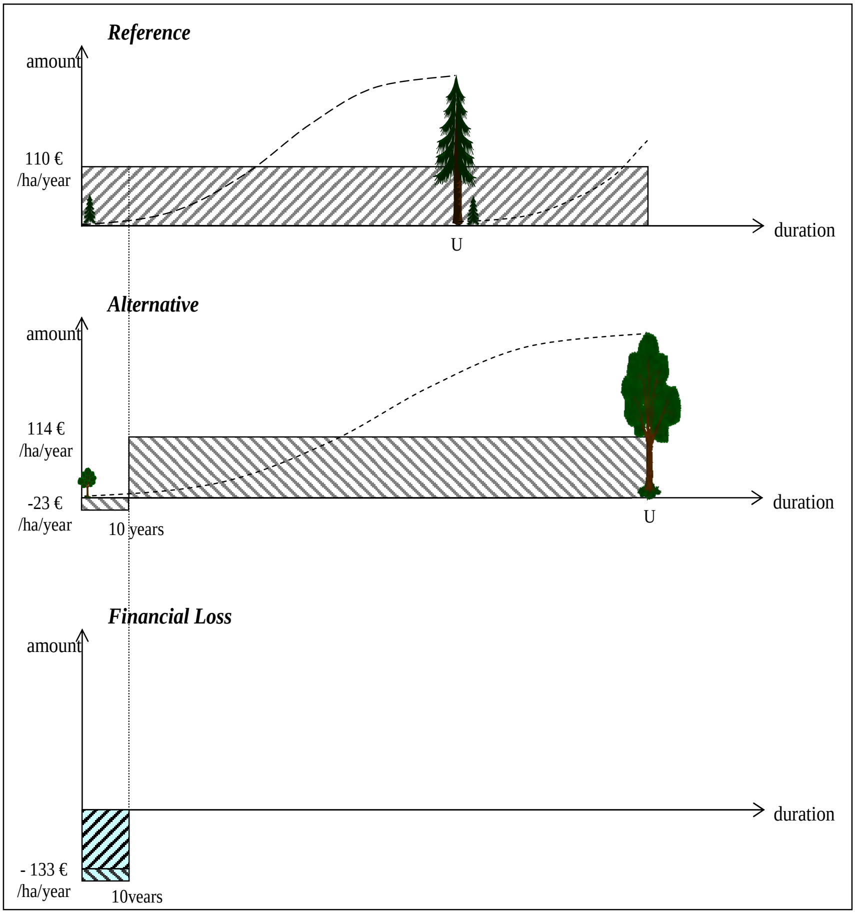

Figure 5: Change of tree species – Approach C

These three different approaches (A, B, C) lead to almost the same net present value (see Table 3). The differences are only caused by truncation and, thus, the three different approaches can be regarded as equivalent from an economic view point. However it is recommended that the approaches B and C should be prioritised in practice due to their shorter timeframe. It is an important result of these examples that even complete refunding of the plantation costs for European beech still leads to financial losses for which the forest owner has to be compensated.

3.1.3 Premature harvest

When forest management strategies are changed, for example in order to develop a habitat, it is often necessary to harvest stands in total or inpart before maturity. Harvesting such a stand results in the loss of future production and earnings which is demonstrated in the following example of a premature 40-year old Norway spruce stand.

Reference: Between the age of 40 and its optimal rotation age of 80, the Norway spruce stand would gain an annual timber production value of 265 EUR/ha/year (see Table 1).

Alternative: If the existing stand is harvested prematurely, the annual timber production value of the alternative land use has to be calculated; often it will be 0 EUR/ha, as it is supposed here.

Financial loss: Without an alternative use for the forest land, the forest owner will lose 265 EUR/ha/year during the future 40 years (see Figure 6).

This calculation assumes that the forest owner receives the undiminished stumpage value of the premature harvested stand. If the stand cannot be utilized to its full value, for example because the harvest occurs out of season, the additional loss has to be compensated as well.

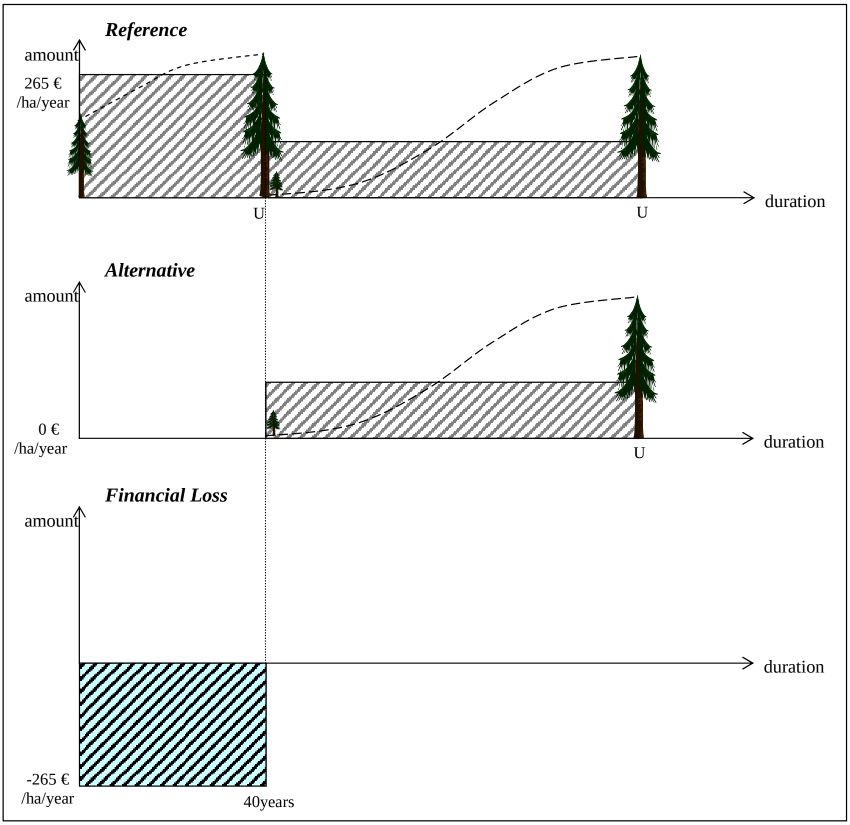

Figure 6: Premature harvest

3.1.4 Preservation of a mature stand

A converse but in terms of valuation similar case is the preservation of mature old broadleaf trees, e.g., because of their importance as habitats. This is explained in the following example of a 120 year old beech stand which should be preserved for three additional decades.

Reference: Having harvested the mature European beech stand, a spruce stand is to be established. The annual timber production value of Norway spruce is 110 EUR/ha/year when considering the optimal rotation length of 80 years under the given conditions (see Table 1).

Alternative: The mature European beech stand remains. The average annual timber production value of a 120 year old beech stand is -234 EUR/ha/year for the next 30 years (see Table 2). This negative amount reflects the assumption of falling prices as a consequence of red heart in old growth.

Financial loss: For the next 30 years, the financial loss is the difference between the annual timber production values of the two land uses and totals 344 EUR/ha/year (see Figure 7).

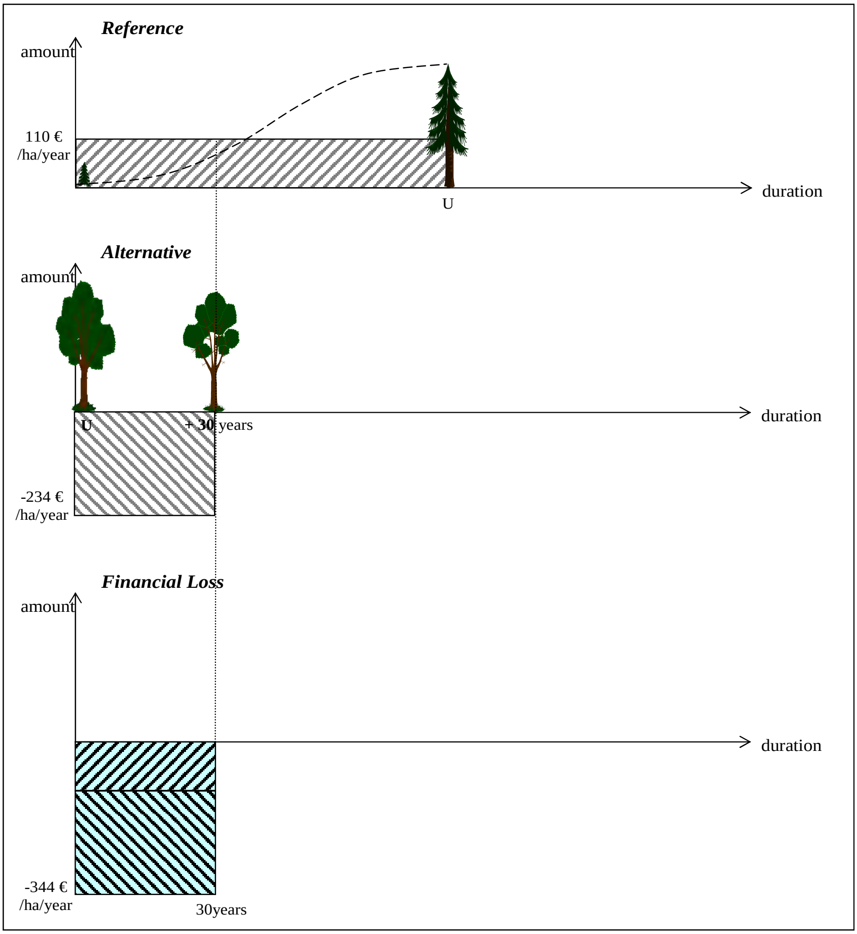

Figure 7: Preservation of mature stand

4. CONCLUSIONS

It was the objective of this paper to present a feasible method for providing a transparent basis for the appraisal of the financial losses when the forest management regime changes.

This approach provides many advantages:

- The annuity method is a consistent procedure that corresponds to the methods of the dynamic investment theory and it is suitable for the calculation of compensation payments for changing forest management regimes.
- The annual timber production value can be easily interpreted as the annual gross margin of the timber production. Also, on the basis of this figure, different rotation periods can easily be compared.
- The calculated annual timber production values can be tabulated for different tree species, yield classes and management regimes etc. Thus, easy application is guaranteed.
- The need for objectifying, which exists for compensatory payments can be achieved by these tabulated and standardised values.
- The conversion of annual payments into present values is possible and can easily be achieved. This is important when a one-time payment is stipulated.
- The tabulated annual figures can easily be compared with other annual compensation payments, for example from the agricultural sector, where the instrument of annual payments has been used for a long time.

It is assumed that the approach described will be very helpful for implementing contract-based forest management and, therefore for promoting near-to-nature forest management regimes. However, some disadvantages remain which deserve further comment:

- The valuation based on annual timber production values and the terminology are not common and as such foresters are unaccustomed to the terms applied.
- Standardised tables might be interpreted as true values and the underlying assumptions and conditions could be ignored. There are many assumptions in the evaluation, e.g., concerning the production model, the prices and costs and the chosen interest rate. All of these have to be proven before applying the data.
- The valuation only covers the objective of economic success as far as it results from timber production. Other objectives and non-timber outputs are not taken into account.

- The calculations presented are based on traditional yield tables for pure stands consisting of one tree species, only. The adaptation to normal risks and the specific development of mixed stands are fields of future research. However, the traditional yield tables can be replaced by modern growth simulators (e.g. BWIN (Nagel, 1999), Silva (Pretsch et al., 2002)) that are able to depict modern management regimes.

All in all this paper deals with the description of a consistent approach to appraise financial losses when changing the forest management regime. Thereby, yearly values of the forest wood production, here termed as annual timber production values, come to the fore.

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Section II: Managerial Accounting Perspectives

FORESTRY IN THE CONTEXT OF NATIONAL ACCOUNTING: EUROPEAN BACKGROUND AND AUSTRIAN EXPERIENCES

Walter Sekot[1]

ABSTRACT

The representation of forestry as a sector of the national economy faces specific challenges. Respective concepts and recommendations have been developed on behalf of the European Union and constitute a more or less compulsory framework for sector specific accounting. The paper provides a concise overview as to these European concepts and recent developments in this field. Austrian experiences and results obtained through practical application as well as by means of pilot studies cover the whole range of forest specific accounts. They are reported in terms of a country specific case study which briefly summarizes the respective research results, thereby highlighting the various problems in terms of data deficiencies and methodical challenges to be overcome.

Keywords: Forest Accounting; Economic accounts for forestry; Natural resource accounting; Forest valuation; Forest timber accounts; Austria

INTRODUCTION

Forestry accounting on the national level consists of several elements, some of which being compulsory, others representing just recommendations. International efforts are directed towards establishing a consistent framework for the comprehensive representation of this industry. The paper is to contribute to this goal by investigating the various concepts and methodologies as well as the interrelationships of the approaches. Austrian case studies provide empirical references for the challenges associated with the practical application of the different concepts. The national synopsis complements internationally coordinated pilot studies devoted to specific fields of related research.

The latest revision of the European System of Integrated Economic Accounts in 1995 (ESA 95) triggered also further developments in the field of forestry statistics:

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The Economic Accounts for Forestry (EAF) were adapted accordingly. The EAF is a satellite account providing additional information and concepts adapted to the particular nature of the forest industry. As the elaboration of the EAF within the European Union is based merely on a gentleman's agreement, the state of implementation varies to a great extent between individual countries. Although the elaboration of the EAF is more and more developing into a routine procedure, some shortcomings have to be acknowledged.

The valuation of the increment as the primary output of forestry is a major issue for fitting the EAF via the so-called bridge tables into the national accounts. In practice, it is hardly possible to comply with the general guidelines for valuation as postulated by the ESA so that alternative approaches have to be considered. Accounting for the growing stock as a natural asset faces similar problems as concerns the physical data as well as monetary valuation. The results are quite sensitive to alternative approaches and assumptions, revaluation usually dominating the change items of the balance.

Originating in the mid 1990's, the European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF) is the second major satellite account devoted to the forest industry. The IEEAF aims at a more comprehensive documentation of forestry, the framework covering not only transactions but also assets and residuals. Additionally, Non-ESA-functions are addressed. These externalities of forestry like forest recreation and carbon sequestration are to be assessed by means of physical descriptors in the first place. As regards the Non-ESA-functions, the close relationship to the so-called Helsinki-criteria for sustainable forestry as defined by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) suggests an integration of respective definitions and approaches.

The integration of the two satellite accounts devoted to forestry under the heading of environmental accounts is an issue recently proposed by Eurostat. Given the differences in scope and background, a respective harmonization is all but straightforward nevertheless should help to establish forest accounting on the national level throughout the European Union.

1. EUROPEAN SCHEMES FOR FOREST ACCOUNTING

1.1 European System of Integrated Economic Accounts (ESA)

ESA is the compulsory framework for national accounting in the European Union (Statistical Office of the European Communities, 1999a). It is based on and closely related to the System of National Accounts (SNA) as proposed for general application by the United Nations. Data pertaining to the forest sector have to be provided to the national accounts in compliance with ESA definitions and respective methodology. Although ESA is a general framework, it also provides a few regulations specific for forestry. The latest revision of ESA in 1995 brought about significant changes, some directly affecting the forest sector and respective statistics. The industry approach, for instance, has been introduced for production statistics and input-output analysis. The industry concept is based on so-called local ‚kind-of-activity units’ (local KAUs). In contrast to the sector classification of the economy, which relies on institutional units, the local KAUs are smaller and more homogeneous parts of institutional units emphasizing a special technico-economic relationship. They are defined by activities according to 4-digit NACE- categories (NACE being an acronym for the nomenclature of economic activities derived from the French expression: ‘Nomenclature générale des Activités économiques dans les Communautés Européennes’), so that even small but diversified companies such as farms, engaged not only in agriculture but also in forestry, have to be split up accordingly. Consequently, also the economic interactions between local KAUs of the same institutional unit have to be recorded as outputs and inputs of the respective sub-industries.

The compulsory distinction between 'forestry‘ (defined as growing timber and tending forests) and 'logging' (harvesting of timber and extraction of wood products) triggered a significant increase of the sector’s output. Nowadays, the increment is to be valued as the output of forestry, independent of any harvests. In non-commercial forests where the growth is not organized, managed and supervised by an institutional unit, the increment occurs in terms of ‚economic formation', whereas in commercial forests the increment is to be treated as ‚changes in stocks of work in progress', which is a special kind of gross capital formation. The logic is, that the production of standing timber provides an output which is not yet sufficiently processed to be in a form which is ready to be marketed. Only when the trees are felled, the process of production is completed and the work in progress is transformed into inventories of finished products ready for sale or other use.

The output of logging adds to the output of forestry and is to be assessed as the roadside value of the timber harvested. The value of the standing timber harvested in the accounting period is to be treated as the respective input provided from within the sector. Consequently, the value of production is increased by the value of the increment, whereas the net increment (value of the increment minus value of standing timber harvested) contributes to the gross value added of the sector. Conceptually, total output in forestry can be measured by the value of sales plus other uses plus changes in inventories including work in progress. The output should be recorded as being produced continuously over the entire period of production and not simply at the moment of time when the process is completed, i.e., when the trees are felled.

ESA postulates the following rules for the valuation of standing timber in terms of work in progress:

- Flows as well as stocks are to be evaluated with reference to market values.
- Where market prices are not available, costs of production or discounted net revenues can be used as surrogates.
- As regards stock entries of work in progress, the price used should be the estimated basic price of the finished product at the pro-rata production costs incurred.
- The basic price corresponds to the amount received by the producer from the buyer per unit of good or service produced (= producer price; not including invoiced VAT) minus any taxes on products payable plus any subsidies on products due on that unit as a consequence of its production or sale.
- Standing timber is to be evaluated according to the future proceeds from selling the timber minus the costs of tending the forest till the harvesting age and the costs of harvesting, all these items to be discounted.
- Instead of applying any general rate for discounting (esp. the social rate of interest), the respective factor should be derived from information on transactions concerning the very asset under investigation (forests).

Another innovation introduced by ESA 1995 is the extension of the national accounts by balances for natural resources. Accounting for the changes in value of natural assets shall allow differentiating GDP into real output on the one hand and output due to depletion of natural resources on the other. However, it has to be kept in mind that the valuation exclusively refers to the income generating potential of these resources, whereas any externalities are not to be accounted for. The balance scheme for forests comprises the following flow items: natural growth, fellings, catastrophic losses, other changes, changes in classification and revaluation.

1.2 Economic Accounts for Forestry (EAF)

The EAF is a satellite account providing additional information and concepts adapted to the particular nature of the forest industry. The main purpose of the EAF is to analyse the production process and primary income generated by it. The forestry part being an extension of the original scheme of agricultural accounting, the Economic Accounts for Agriculture (EAA) and the EAF methodologies are jointly covered by one manual (Statistical Office of the European Communities, 2000a).

Although EAF methodology is based on ESA regulations and was mostly adapted to ESA 1995, the two concepts are still not fully compatible. There do exist minor differences as to the delimitation of agriculture and forestry e.g. as regards the production of Christmas trees in nurseries. The most important difference between

ESA and EAF however, concerns the measurement of output. For practical reasons, it is stated that in cases, where standing timber stocks are relatively regular (i.e. their volume does not fluctuate substantially from one year to the next) timber output is to be recorded only at the time of felling. Due to these differences, the figures on forestry deviate between the two concepts. So-called bridge-tables were introduced in order to document respective gaps.

The EAF contains 4 sections:

- Production account
- Generation of income account
- Entrepreneurial income account
- Elements of the capital account

The production account records the outputs as well as the inputs of the industry. The output of the forestry industry comprises forestry goods, forestry services as well as inseparable non-forestry secondary activities. Production is to be valued at the basic price. Total output minus intermediate consumption gives gross value added. From this, fixed capital consumption is deducted. Final result of the production account is the net value added at basic prices.

The generation of income account considers other taxes as well as other subsidies on production. Net value added modified by these elements gives the factor income, which is further differentiated into the compensation of employees on the one hand and the operating surplus or mixed income on the other. The entrepreneurial income is derived by further considering rents and interest. Finally, gross and net fixed capital formation, changes in stocks as well as capital transfers are documented as part of the capital account.

In contrast to ESA, there is no legal basis which would compel the member states to provide respective data. The elaboration of the EAF is voluntary and respective commitments are of the character of gentleman's agreements. Results of the EAF are available to the public in the Newcronos database. However, EAF data are only partially provided by a number of countries. Regarding 2004, only 6 countries out of EU15 and 1 new member country (Lithuania) sent EAF data to Eurostat as per end of November 2005.

1.3 Integrated Environmental and Economic Accounting for Forests (IEEAF)

The IEEAF is the second major satellite account devoted to the forest industry. It aims at a more comprehensive documentation of the sector (Statistical Office of the European Communities, 2002a). Inspired by the schemes for environmental accounting, the framework covers not only transactions but addresses also assets and residuals. Even the part of the so-called ESA-functions of forests exceeds the scope of the EAF: The scheme comprises balances for forest land and standing timber as well as input-output tables, all of them in physical as well as in monetary terms. Furthermore, forestry based outputs of other industries such as agriculture and tourism are taken into account and a differentiation between market and non-market output is introduced. Additionally, Non-ESA-functions are addressed. These externalities of forestry are to be assessed by means of physical descriptors in the first place, monetary valuation of forest services being not part of the concept so far. The original framework addressed 5 different Non-ESA functions (carbon binding, factors linked to biodiversity, recreational functions, protective functions, health of trees) with a total of 9 tables. The Eurostat Task Force on Forest Accounting refined the original concept in the late 1990's and several countries participated in a series of IEEAF pilot applications (Statistical Office of the European Communities, 1999b, 2000b, 2002b,c).

Unlike the strict rules defined by ESA which have to be obeyed in the context of national accounting, the IEEAF manual merely proposes alternative approaches for the valuation of forests, forest land and standing timber. Due to this vague methodological guideline, a direct compatibility and comparability of the monetary values at the international level must not be expected. In principle, transaction value methods and net present value methods can be distinguished, each group comprising several variants. The following approaches were considered explicitly, the alternatives quoted implying a potential inconsistency in methodology even within a national balance:

Combined valuation of land and standing timber (stock):

- Market value based on transactions in forest real estates
- Valuation based on forestry income

Separate valuation of land (stock):

- Transactions in bare forest land
- Surrogate markets – e.g. marginal agricultural land
- Recommended values

Separate valuation of standing timber (stock):

- Consumption value
- Stumpage value
- Net present value

Fellings (flow):

- Stumpage value

Natural growth (flow):

- Yearly costs of growing timber
- Net present value
- Consumption value or stumpage value

Other changes in volume (flow):

- Net present value
- Consumption value or stumpage value

Eurostat concluded from a series of pilot studies, thereby highlighting the practical problems of forest valuation which prevail also in the national context (Statistical Office of the European Communities, 1999b, p. 16): “The standard approach would be to derive the present value of standing timber from the future receipts. In this case one should make assumptions about the future volume of timber felled, value them by the stumpage prices, deduct the costs of bringing the timber to maturity, and discount the receipts to the present period. This approach necessitates knowing the age structure of the standing timber, as well as the future expenses. One also has to deal with the issue of variation in prices over time and by type of wood products. As a simplification the value of standing timber is calculated by multiplying the present volume with the stumpage price.”

If at all, compliance with ESA-rules may be argued by interpreting transaction values as special kinds of net present values (Statistical Office of the European Communities 2002a, p. 102): “Both, the stumpage value and the consumption value methods may be seen as a simplification of the present value method. The rationale would be that the future increase in the volume of standing timber due to natural growth offsets the need for discounting the future returns. For the consumption value method, this ‚implicit discounting‘ is higher and corresponds to both the future natural growth and the future increase in quality, e.g. due to the fact that higher diameters may receive higher prices per cubic meter.”

So far, the IEEAF table addressing economic accounts for forestry are not fully compatible with EAF standards. A major distinction is, that whereas fewer indicators are considered, a general differentiation between forestry and logging is requested.

Like the EAF, the IEEAF lack any legal basis. Implementing this scheme is therefore voluntary and providing Eurostat with respective data is merely based on a gentleman’s agreement. The IEEAF transmission programme is based on a questionnaire sent out every other year and inquiring data of the years n-4 and n-3 respectively. So far, the response as such as well as the quality and comprehensiveness of the data transmitted has been rather poor. For that reason, Eurostat has not made the results available in Newcronos database yet. The latest round of data collection took place in 2004, requesting data of the years 2000 and 2001. This inquiry was answered by just 5 EU countries and 1 candidate country at that time (Lithuania). The next questionnaire is due in 2006, referring to the years 2002 and 2003.

1.4 Outlook on European forest accounting

Whereas forestry as such has to be incorporated into the national accounts ever since, it may be presumed, that only few countries fully responded to ESA 1995 requirements and really have implemented the valuation of changes in inventories of standing timber yet. International comparisons of sector-specific data may be severely misleading for that reason. It is quite likely that this unbalanced status will last for some time, as forestry is usually of minor concern in the ESA context.

Forests and mineral resources have already been quoted as priorities of natural resource accounting for several years. However, accounting for natural resources as requested by ESA is still lacking a legal basis. Although its compulsory implementation had originally been envisaged for 2005, the concept is far from general application and respective progress is not to be expected for the near future.

Starting from a comparatively low level of commitment, there are some indications for an increasing interest in EAF statistics. For instance, Germany elaborated respective tables for the period from 1991 to 2002 (Dieter et al., 2004). Obviously, some of the new member states have started to investigate the EAF concept and at least consider its implementation. Only recently, Eurostat has shown an increasing interest in statistical data on forestry. At a recent meeting of the Agricultural Statistics Committee it was reported, that data from Economic Accounts of Forestry are asked more frequently, in particular to fulfil the requests related to the elaboration of Sustainable Indicators in the context of Rural Development and Sustainable Management of Forests.

Due to organizational changes and shifting responsibilities at Eurostat, activities related to integrated forest accounting have been sparse since the latest publication of IEEAF pilot studies in 2002. Even the work of the Task Force on Forest Accounting has been discontinued. Nevertheless, there seems to be a rising interest in this topic. In November 2003, the Statistical Programme Committee adopted a European strategy for environmental accounting. Forest timber accounts have been defined as one of the priority modules for harmonized reporting. The 6th Environmental Action Programme considers forests as a key natural resources and an important economic asset. The Programme asks for well-preserved and sustainably managed forests, as a contribution to biodiversity and rural development. The forest timber accounts were derived from the IEEAF, focusing on the wood supply function of forests. The module timber accounts also contributes to the climate change issue, describing CO_2 flows related to forest activities, use of wood as a renewable energy source and changes in land use. However, other functions of forests are omitted. In fact, the IEEAF questionnaire sent out in 2004 addressed the forest timber accounts and hence did not comprise any more the Non-ESA elements: factors linked to biodiversity, recreational functions and protective functions. On this basis, Italy and Estonia elaborated IEEAF pilot studies in 2005. This year, Hungary, Latvia and Greece are working on these timber-focused IEEAF tables on a grant basis.

The integration of the two forestry satellite accounts, namely the EAF and the IEEAF, under the heading of forest timber accounts is an issue recently proposed by Eurostat. This step shall help to avoid incoherence, double work for the member states and for the responsible working groups at Eurostat. However, the integration of the two systems cannot be done simply by inserting the EAF standard data transmission table into the set of standard IEEAF tables. There are methodological (treatment of growing timber etc.), classification (breakdown of the elements of outputs etc.) and also practical (way and form of disseminating data etc.) issues to be solved first. In the last meetings of the Working Groups "Agricultural Accounts and Prices" and "Forestry Statistics", Eurostat's proposal of merging EAF and IEEAF has been generally welcomed. For the time being, the respective views of the member states are being collected. Given the differences in scope and background, a respective harmonization is all but straightforward but should help to establish forest accounting on the national level throughout the European Union.

Even though the integrated concept of forest timber accounts addresses considerably less topics than the original scheme of IEEAF, Eurostat Unit E3 environmental statistics is to be responsible for data collection. It is proposed to give up collecting the annual data every two years and to switch to a regular annual data collection. According to the delayed availability of some kind of data, the new set of IEEAF tables shall be split into two groups on the basis of the reference year. Whereas the standard deadline is t+12 months, supply and use tables are to refer to the year n-3.

As regards the non-timber aspects of forestry, the need for harmonization with other reporting schemes is more and more acknowledged. In general, the close relationship to the so-called Helsinki-criteria for sustainable forestry as defined by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) strongly suggests an integration of respective definitions and approaches. So far, however, the latest IEEAF manual of 2002 just briefly investigates the possibilities of integrating the criteria and indicators of the Helsinki Conference into the IEEAF scheme (Statistical Office of the European Communities, 2002a, p. 95). It seems advisable to strive for a common framework of forestry statistics in order to avoid a multiplicity of closely related concepts as well as any redundancies.

2. FOREST ACCOUNTING IN THE CASE OF AUSTRIA

2.1 Research efforts and pilot studies

Forest statistics and respective developments have been of considerable interest ever since, Austria being one of the most densely forested countries in Europe (e.g. Sekot, 2000, 2004a). The EAF were implemented at an early stage. Austrian representatives contributed to the work of the Eurostat Task Force on Forest Accounting by co-designing and testing the concept of the IEEAF.

In response to the new requirements, especially those triggered by ESA 95, specific projects – European as well as national ones - were launched. A series of pilot studies was elaborated at the University of Natural Resources and Applied Life Sciences, Vienna, investigating the implementation of ESA, EAF and IEEAF respectively:

- Valuation of the increment as output of forestry (Sekot, 1998)
- Natural resource accounting for standing timber (Sekot et al., 1996; Sekot and Nikodem, 1999; Sekot, 1999; Statistical Office of the European Communities, 1999b, 2000b)
- Economic Accounts for Forestry (Sekot, 2004b)
- Integrated environmental and economic accounting for forests – annual set of tables for ESA-functions of forests. Austria 1999 (Sekot and Stefsky, 1999; Statistical Office of the European Communities, 2002b)
- Non-timber functions of forests, monetary values and carbon balances for Austria and Germany (Sekot et al., 1999; Statistical Office of the European Communities, 2002c)

2.2 Current situation of forest accounting

Statistics Austria, the national statistical office of Austria, is responsible for establishing the national accounts. Meanwhile, the obligatory adaptations as requested by ESA 1995 have been implemented. As regards forestry, the bulk of respective data are taken from the EAF, covering the gaps between the requirements of ESA and EAF by means of the so-called bridge tables. The same applies to agriculture, the EAA serving as a basis for representing the sector in the national accounts. Because of the close relationship of the national accounts with both, the EAF as well as the EAA, these satellite accounts are not only well established, but also of a certain practical significance. Due to the different regulations of ESA and EAF as regards the output of forestry (ESA: increment of standing timber as output of forestry and value of harvests as output of logging; EAF: practical rule allows for valuing the timber harvested as the output of forestry), the respective figures vary to a considerable extent. Furthermore, a positive net increment leads to a systematically higher value in ESA also in terms of value added. Hence, there are obvious, though explainable, incoherencies.

Although alternative concepts for establishing natural resource accounts for standing timber were investigated in the course of a research project, this non-obligatory extension of national accounting has not been implemented on a regular basis yet.

Conversely, the EAF have been implemented according to the new guidelines, a consistent time series being available from 1988 onwards. The tables are established and transmitted to Eurostat on a regular basis. Respective data are available at the homepage of Statistics Austria. Commented results have been published repeatedly (Sekot and Mayer, 2004, 2005). Until 2007, the University of Natural Resources and Applied Life Sciences, Vienna will continue to be responsible for the EAF, including a respective breakdown at NUTS II-level (NUTS being an acronym for regional units derived from the French expression: 'Nomenclature des unités territoriales statistiques' and level II referring to the provinces in Austria) and a series of further adjustments.

As regards the IEEAF, however, there was no follow-up to the initial pilot studies so far. Until recently, neither the Ministry of Agriculture and Forestry, Environment and Water Management nor Statistics Austria were aware of the questionnaire sent out in 2004. Even without these deficits as regards the information flow between Eurostat and the Austrian institutions, it is doubtful, whether any additional information not readily available could have been provided. Neither the ministry nor Statistics Austria feels responsible for financing any related activities.

2.3 Problems, solutions and results

2.3.1 Differentiation of forestry and logging in the national accounts

The valuation of the increment as the primary output of forestry and of the timber harvested as intermediate consumption of logging are the main issues for fitting the EAF via bridge tables into the national accounts. Whereas the respective physical data regarding the fellings can be taken directly from the annual record of cuts, the increment of a specific reporting year is not available as such.

Empirical data on the increment are provided by the National Forest Inventory (NFI). Due to the statistical scheme of data collection of the NFI, results become available with a periodicity of some 5 to 10 years. Like all the other flow items derived from the NFI, the figures of the increment can neither be related to a specific year nor to a certain period, as the individual years influence the average results with different weights. Consequently, the data available show a considerable time lag and represent mean values for a period of several years. In practice, the latest data have to be kept constant until new results of the NFI become available. For assessing the increment of the year 2005 for instance, data published in 2004 and representing natural growth of the years 1992 till 2002 have to be used as surrogates. Only in 2011, when the next results of the NFI are to be expected, it will be possible to at least adjoin the average increment derived from the measured natural growth of the years 2000 – 2009 to the reporting period 2005. Even after such a backward correction, some problems prevail as regards the delimitation of commercial forests and respective production:

- Unmanaged forests or non-timber goals
- Shifting economic accessibility of stocks
- Losses and other non-recoverable increment
- Overmaturity as indication of reserve or abandonment

Apart from these problems concerning the physical data base, the issue of valuation is also quite complicated. In practice, it is hardly possible to comply with the general guidelines for valuation as postulated by ESA so that alternative approaches have to be adopted. The following major obstacles hindering the implementation of ESA rules for valuation were identified:

- The effective harvesting age of trees differs in a wide range (e.g. thinning, short rotation) and there is no operational indication for terminated production before harvest or mortality. Hence, the status of production can be assessed only by means of far reaching assumptions.
- Only when assuming the unrealistic conditions of the ‚normal forest‘, there is a direct and sustained connection between the current costs of production and the increment. In practice, increment occurs also without any management.
- Due to the extremely long time horizons of several decades, the assumed future proceeds are highly speculative.
- Interest rates derived from limited time series of past transactions (in terms of number of years and number of cases) are hardly suitable for discounting long term projections.
- Current values of costs and prices are volatile and as such do hardly reflect long term expectations. Hence, also the use of 3- or 5-years averages is but a poor surrogate for expected values.

In view of these problems it was decided to apply a simple approach and to deviate explicitly from the ESA rules. Instead of referring to future prices, the increment is valued at stumpage prices. These are derived from the average roadside prices of 6 different assortments of the reporting year by deducting the average harvesting costs per m^3 of that year. For deriving the intermediate consumption as requested by the ESA scheme, the same stumpage prices per assortment are applied to the standing timber harvested.

As shown in Figure 1, the results are quite volatile, mostly driven by fluctuations of timber prices. The validity of the data derived this way seems rather poor. Nevertheless, these results are of some significance. The value of production and especially the gross value added are major indicators of the economy and trigger various political and economic consequences. The value of the net increment equals the difference between EAF results and the industry's data in the national accounts.

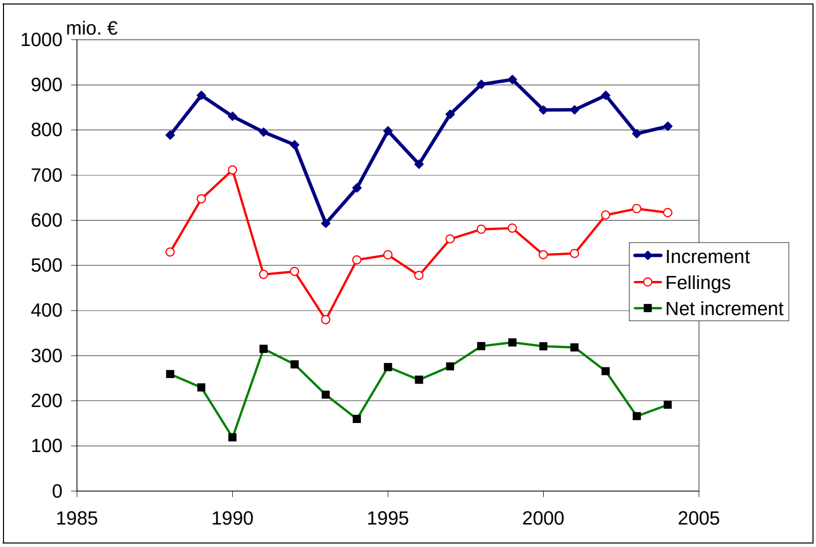

Figure 1: Output of forestry, intermediate consumption of logging and resulting net increment

2.3.2 Natural resource accounts for forests

The possibilities for drawing up natural resource accounting for standing timber have been explored by means of a pilot study and investigated the periods from 1993 to 1997 (Sekot and Nikodem, 1999). Five different approaches for valuing the standing timber within the framework of natural resource accounts were tested. Table 1 provides a concise characterization of the respective methods. All of the variants refer more or less directly to current stumpage prices.

Table 1: Identification of the different approaches

approach	characterization
I	consumption value method; growing stock assorted by age class
II	stumpage value method; growing stock undifferentiated
III	valuation based on age constants
IV	consumption value method; growing stock assorted via grading models applied to the sample trees of the NFI
V	calculation of net present value and deduction of management costs

As natural growth and fellings are two flow elements of the respective balance scheme, accounting for the growing stock as a natural asset has to cope with the same problems concerning the physical data as well as monetary valuation as described above in the context of regular national accounting. Dependent from the availability of physical data from the NFI, most of the elements quoted in the balance scheme suffer from a considerable time lag. Starting from the latest results of the NFI, the yearly figures of stocks have to be calculated by adding or deducting the various flow items. Usually there is no data available on catastrophic losses, most of the damages due to e.g. windthrow or bark beetle being recovered in terms of sanitary fellings. Changes in classification might be captured on the basis of the NFI in intervals of several years only. When new NFI data become available, as was the case in 1997, the calculated figure of the stock has to be adjusted to the empirical measure, the difference entering the balance under the heading of 'other changes' (see Table 2).

Table 2: Forest balance for standing timber for the years 1996 and 1997 according to 5 different approaches of valuation (I to V)

	physical balance in mio. m³ o.b.	monetary balance in mio. €				
1996		**I**	**II**	**III**	**IV**	**V**
Opening stocks	1014.68	20843	22906	28880	21642	29062
Natural growth	+ 30.67	+ 516	+ 516	+ 516	+ 516	+ 516
Fellings	- 23.59	- 400	- 400	- 400	- 400	- 400
Catastrophic losses	.	.	.	.	.	.
Other changes	.	.	.	.	.	.
Changes in classification	.	.	.	.	.	.
Revaluation	-	- 3169	- 3597	- 4302	- 3532	- 7100
Closing stocks	1021.76	17790	19425	24694	18226	22078
1997						
Opening stocks	1021.76	17790	19425	24694	18226	22078
Natural growth	+ 26.78	+ 545	+ 545	+ 545	+ 545	+ 545
Fellings	- 21.27	- 436	- 436	- 436	- 436	- 436
Catastrophic losses	.	.	.	.	.	.
Other changes	- 51.79	- 1054	- 1054	- 1054	- 1054	- 1054
Changes in classification	.	.	.	.	.	.
Revaluation	-	+ 3343	+ 4215	+ 5974	+ 4564	+ 11024
Closing stocks	975.47	20188	22695	29723	21845	32157

As exemplified by Table 2, the monetary results are quite sensitive to alternative approaches and assumptions. Revaluation usually dominates the change items of the balance. It is derived as the difference of value of the opening stock valued at price levels of the previous year and of the reporting year respectively.

Whereas the significance of the yearly results of this kind of natural resource accounting is quite limited due to the low reliability as well as poor accuracy of the various underlying data, respective developments may be of some interest in the long run. Figure 2 shows, that despite of a considerable increase in volume, the stumpage value of the growing stock has declined in real terms during the last 30 years. Even an increase of timber production in physical terms does not suffice for sustaining the economic potential of forestry.

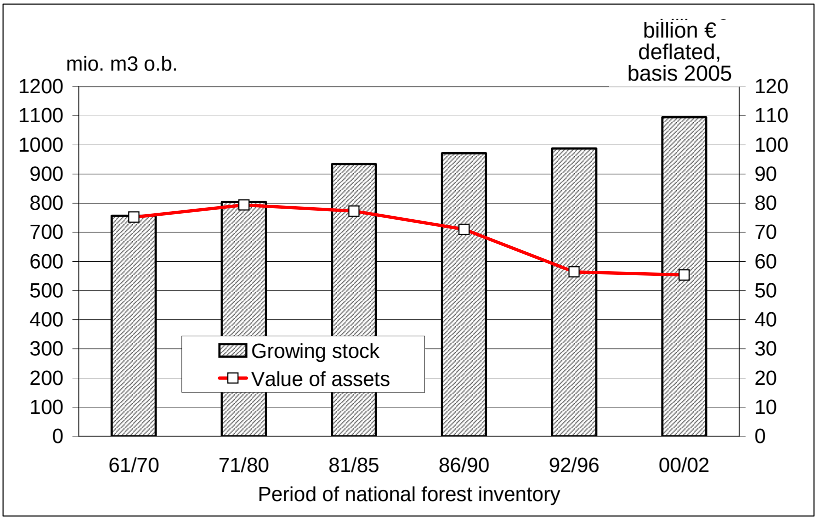

Figure 2: Stocks of standing timber in physical and monetary terms

2.3.3 Economic Accounts for Forestry

Being just a satellite account and therefore not fully integrated into and adjusted to the national accounts, the EAF bear a considerable potential for double counting. For instance, farm forestry could be recorded as inseparable non-agricultural secondary activity quite in line with EAA-regulations. In the Austrian case this would mean, that roughly half of the industry could be captured by the EAA already. Due to the high significance of farm forestry, however, a strict differentiation between agriculture and forestry has been observed ever since.

The conceptual framework for establishing the EAF in Austria follows a multi-stage approach: Wherever possible, aggregated data comprising the entire industry are adopted. Respective statistics are available especially as regards fellings, production of forest plants, plant protection products, real property tax, forestry subsidies and compensation of employees. Complementary data is derived from individual enterprises, which are differentiated into three categories: Small scale forestry with up to 200 ha is represented by the accountancy network of farm forests. The bigger forest enterprises (> 200 ha) are characterized by data from the accountancy network of forest enterprises exceeding 500 ha. Statistical inferences are based either on the volume of fellings or on the area of forest land of the respective category. The national forests are considered as a separate category and provide some data based on their own accounting for EAF purposes. Remaining items are assessed in terms of expert opinion. This is the case as regards intermediate consumption of enterprises rendering forest services and the production of forest plants as well as for overcoming various other data deficits. Following this approach, it is possible to address most of the items listed in the EAF transmission table. Figure 3 shows some of the main results.

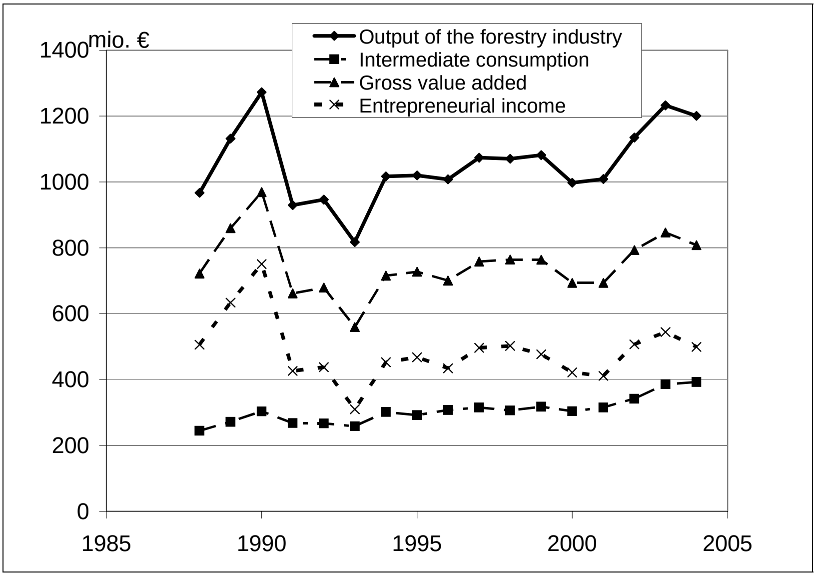

Figure 3: Main results of the EAF for Austria in nominal values

Although the elaboration of the EAF has meanwhile become more or less a routine procedure, some shortcomings still prevail and the methodology is quite crude in some respects. For instance, use data provided by the wood processing industry point to a considerable statistical difference as regards the fellings, the EAF referring to the figures of the annual record of cuts. Furthermore, it could not be clarified yet, to what extent inseparable non-forestry secondary activities are in fact captured or missed by other statistics.

Due to the fact, that the 'practical rule' is applied and forestry output is measured in terms of timber harvested only, high levels of fellings due to calamities tend to trigger an increase of output, gross value added and entrepreneurial income as documented by the EAF. This was the case e.g. in the years 1990 and 2003. Conversely, the national accounts reflect also the associated reduction of net increment. Whereas EAF recorded an increase of gross value added from 2002 to 2003 in the magnitude of 7.2%, there was in fact a decrease of 3.6% according to ESA rules.

Like the EAA, also the EAF are elaborated not only at the national level but also for NUTS II categories and represent the sector in the regional accounts via bridge tables. For deriving the EAF at provincial level a top-down approach is applied: the national results are split up by referring to the shares of ownership categories as well as to the respective fellings. Neither timber prices nor accounting data are differentiated, however. As the national averages are no truly weighted means of provincial data, coherence of the results could not be safeguarded by a bottom-up approach.

2.3.4 Integrated Environmental and Economic Accounting for Forests

Austrian experiences with pilot applications of the IEEAF underpin some of the typical problems associated with the availability of data requested as well as valuation issues. Major problems pertain to the forest specific extensions, sound results requiring costly primary data collection. Hence, in the Austrian case it proved to be all but straightforward to meet the goals of the IEEAF.

In regard to the so-called ESA-functions of forests, the main problems were related to the following issues:

- Yearly balance and evaluation of forest soil and standing timber
- Availability of data on forestry based outputs of other industries
- Differentiation of “market output” and “non-market-output”
- Differentiation of “forestry” and “logging”, the details requested exceeding respective requirements postulated by ESA
- Statistical differences as regards output of timber
- Hitherto unresolved questions in regard to certain definitions and classifications

Apart from carbon binding and health of trees, which are topics well covered by established statistics, there is a severe lack of data as regards the Non-ESA functions. In essence, it is not generally possible to relate directly the data available to forestry (e.g. red list species to be classified as “forest occurring”). The availability of data does hardly match the IEEAF-schedule for reporting. In many respects, basic data are just missing. Especially several flow-items cannot be provided. Hence, full coverage of all items would necessitate a lot of ‘guesstimates’ even on behalf of experts in the respective fields.

Carbon binding:

> About 60 % of the total carbon stock of forest ecosystems in Austria is stored in the forest soil. Net accumulation is about 3.5 mio. t C/year. Assuming a value of 5 €/t CO_2, the yearly output of carbon storage amounts to some 64 mio. €. (Lately, a value of more than 10 €/t seems realistic in the light of carbon trading.) Thus, the value of net accumulation lies in the magnitude of 7 % - 15 % of the ESA-output of forestry.

Factors linked to biodiversity:

Identifying the “forest occurring species” within the categories established by IUCN (International Union for the Conservation of Nature and Natural Resources – the World Conservation Union) would necessitate specific research. Information on protected areas of forests will be available according to MCPFE-classification, which deviates from IEEAF nomenclature, however. Furthermore, it will hardly be possible to assess all of the flow items as defined by the balance approach. Balances in regard to “forest regimes” may be provided at best according to a modified classification.

Recreational functions:

Deriving unambiguous data on “urban recreation areas” proves to be problematic. Based on the micro-census 1998, the number of visits to Austrian forests by Austrian residents of more than 15 years of age can be estimated to some 220 million. Any differentiation as to duration and purpose of visits to forests would have to rely on specific empirical research, however. Already at a threshold level of 5 € per visit, this partial value of forest recreation equals the output of forestry goods.

Protective functions:

There are practically no data available for balancing the area associated with different protective functions. Due to the problems of delimitation of functional units and the overlapping of such units, the prospects for deriving such data are definitely poor.

The newly introduced classification of protective forests in Austria does not comply with the requirements stipulated by the IEEAF tables. Depending from the method of valuation (e.g. production costs, replacement costs, damage costs), monetary values may vary to a great extent.

Health of trees:

The basic question is, whether “health of trees” is a forest service as such or just a feature influencing the provision of non-timber-functions in terms of quantity and/or quality. The physical documentation relies on an internationally standardized system so that the data are readily available. Alas, no additional information is generated by recording these data within the IEEAF framework. A respective monetary value would have to be restricted to a specific existence value, all related use values being captured under the topics of typical forest functions like recreation and protection. Hence there is a great danger of double counting.

Government expenditure:

> The public funds devoted to a specific “forest function” shall indicate the social significance of the respective function. Subsidies, reimbursements, commissioned research, specific additional costs and revenues forgone of public forest enterprises were identified as potential elements to be assessed. On behalf of the Ministry of Agriculture and Forestry, Environment and Water Management it is even hardly possible to provide sound data on forest subsidies. Full coverage of all relevant items cannot be achieved, at least for the time being.

2.4 Outlook on forest accounting in Austria

The current standards fulfil all the requirements for national accounting imposed by ESA 1995. Conversely, any extension of the national accounts in terms of natural resource accounting will have to be triggered by specific legal obligations.

As concerns the EAF, there is a clear commitment on behalf of Statistics Austria. The EAF are regarded as a relevant complement to the EAA and as a prerequisite for deriving sound data on the forest sector for purposes of national accounting. They help to avoid double counting or omissions. From 2008 onwards, Statistics Austria is to take over the routine work of establishing the respective tables.

In contrast to the case of the EAF, Statistics Austria has no interest in extending its activities to IEEAF or to the forest timber accounts. Respective activities would have to be commissioned and financed by other institutions, namely the Ministry of Agriculture and Forestry, Environment and Water Management. The ministry is generally interested in any kind of sector-specific statistics. However, the political interest focuses on the requirements of MCPFE. Consequently, the IEEAF are no issue of any priority and will hardly be financed additionally.

Based on this situation, neither Statistics Austria nor the ministry are very much in favour of Eurostat’s intention to integrate the EAF into IEEAF under the heading of forest timber accounts. As compared to the current situation, where only the EAF are implemented on a regular basis, the integrated scheme would require additional efforts. On the other hand, it would be doubtful, whether and by what institution the elaboration of independent IEEAF-tables would be commissioned at all. Whereas IEEAF definitely belongs to environmental statistics at Eurostat, the department of environment at the Austrian ministry claims too few environmental indicators in the framework of the forest timber accounts to take over responsibility and costs. Ultimately, the integrated concept may therefore elicit a maximum of commitment and data transmitted to Eurostat. At any rate, the new scheme would close the gaps between EAF and the national accounts and offset the need for bridge tables and respective explanations.

3. CONCLUSIONS

For the time being, there are huge gaps between the idealistic concepts of forest accounting on the one hand and current European practice on the other. These gaps exist not only in terms of commitment and implementation but also as regards the basic data available, the methods applied for valuation and ultimately also the quality and significance of the results in those cases where respective accounting is being practiced.

As regards the prospects for natural resource accounting for standing timber, the concept might even be abandoned, the SNA itself suggesting such a decision (SNA 1993, p. 136): 'There may be circumstances in which the uncertainties attached to the estimation of the value of work-in-progress in advance of the harvest are so great that no useful analytic or policy purpose is served by compiling such estimates.'

It is a major task for forest policy to underpin the overall significance of the sector, referring not merely the industry's contribution to GDP, but pointing also to its relevance in terms of social welfare. Developing concepts and methodologies suitable for respective monitoring schemes at the national and international level is a challenge requiring some expertise in forest economics. So far, the European systems for forest accounting have neither been unanimously esteemed nor generally implemented. Even a densely forested country with a huge forest industry, such as Austria, is not ready to implement all respective concepts on a voluntary basis. There are hardly any incentives to provide Eurostat with respective data. Coherence, comparability and hence also the political significance of the results are rather poor at the international level, especially due to the vagueness of the methodology to be applied for valuation.

However, there are indications for an increasing interest in this field. General trends and recent developments in national as well as sector specific accounting enhance a respective awareness. In order to overcome the lack of national support, it has to be pointed out, what interests and purposes can be served by compiling such accounts. The new scheme of integrated forest timber accounts neither meets the requirements of comprehensive environmental accounting in regard to forests nor is it suitable for capturing the overall welfare effects associated with the forest resource and its utilization. At least, it is fully compatible to ESA standards and integrates some sector-specific extensions. Thus, the integrated forest timber accounts may serve as a new starting point for forest accounting in Europe.

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ROLE OF FOREST RESOURCES AND NATIONAL ACCOUNTING: RESPONSES TO NEW NEEDS

Ilaria Goio[1] and Geremia Gios[2]

ABSTRACT

The profound changes taking place in the socio-economic scenario urge us to rethink the role of the forestry sector and the decreased importance of timber production and the increased role of other forest functions must clearly be taken into account. It is no coincidence that this questioning of forestry aims is particularly evident in alpine areas. Over recent years the forestry sector in such areas has been struggling more than elsewhere to achieve economically competitive production. Indeed, in some ways we can say that the very idea of limits represents the essence of mountain life and from this point of view it is interesting to re-examine the role and the functions of alpine forests. Such a re-examination cannot but start by identifying the significant variables in the current context. These variables are, in part, different from those of even the recent past and consequently require us to redefine both aims and the instruments needed to achieve them. To this purpose, proper information is obviously required in order to apply appropriate economic policy tools. This paper seeks to highlight the main limits of the current System of National Account (SNA) and, in relation to forests, to indicate a way of integrating information obtained from standard national accounting methodology in the light of "green accounting" and "total economic value". These methodological indications are in turn exemplified by the results of an application of the proposed integration in an area of the southern Alps.

Keywords: alpine areas, forest accounting, System of National Account, green accounting

1. INTRODUCTION

Everything experienced so far in relation to the issue of sustainable development seem to concur in indicating the expediency of sectorally and territorially balanced, systematic approaches. Such a balance should be dynamic and cannot be achieved so much spontaneously as through the appropriate intervention of economic policy. To be effective these require proper information on the potentiality of every natural asset.

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In effect, from the point of view of sustainability, this is not so much a question of simply optimising a given function, or maximising certain variables within given limits, as of identifying long-lasting development modes and methods able to reabsorb existing imbalances. This is particularly true of the mountains where, even between adjacent areas, the characteristics of economic and territorial homogeneity are minimal. This is due not only to the existence of widely differing resources (soil, manpower, transport facilities and the quality of interconnection with other areas), but also to huge differences in: population densities; the "openness" of groups of people towards external economies; income; natural resources and many others besides. In other words, not only must the environmental, economic and social aspects be considered together, but also the value they assume can vary enormously over time and space.

In this context, an economically and socially sustainable forest management must necessarily be based on ecological sustainability. Preservation and careful forest management can in fact contribute to a sustainability that is broadly speaking able to provide a wide variety of uses, values, goods and services, and therefore extend the range of possible opportunities and options available, to the advantage of society in general. Alternatively, in order to guarantee better standards of living, ecological sustainability is in turn based on economic and social sustainability.

The problem of conservation and utilisation should therefore be treated in a balanced way, and should be so by all those who come into contact with natural resources. On one hand it is necessary to analyse how conservation and utilisation requirements can be harmoniously combined to obtain the maximum possible benefits for present and future generations, and on the other it must be remembered that local decisions concerning the utilisation of timber have repercussions for other regions and countries.

In such a framework we believe it is not possible to preserve without managing, and that efforts to find the most appropriate balance between production and protection, and between utilisation and preservation, dictate the application of suitable economic policy tools: tools that require the availability of sufficient information, not only to determine the grading, but also to guarantee social consensus on the employment of resources in directions that, at first sight, seem orientated towards guaranteeing development.

From this point of view, information deducible from the System of National Account (SNA), which underlies the majority of economic policy measures, assumes a role of primary importance.

2. BRIEF NOTES ON THE SYSTEM OF NATIONAL ACCOUNT

As we know the current System of National Account (SNA) was introduced during and just after the second World War, in the general framework of Keynesian economics. The SNA is "an integrated system that provides information about many aspects of the performance of national economies" (Inter-Secretariat Working Group on National Accounts, 1993) and therefore enables us both to assess the current state of national economies, in terms of their short term functioning and future developments, and to make interesting international comparisons. The system works around a series of interconnected accounts, concerning the different types of economic activities that make up the economy in a given time span.

In spite of the indubitable advantages it offers, the SNA has been object of "much criticism associated with the incapacity of its main indicators (GDP,.........) to offer a correct picture of the «well-being of a nation»" (Hultkrantz, 1992; Scarpa, 1993; Pettenella and Baiguera, 1997; Vincent, 1999; Turner and Tschirhart J., 1999; Haener and Adamowicz, 2000), and the sustainability of its development. This inability is particularly apparent in relation to environmental goods (Scarpa, 1993; Vincent, 1999; Lange, 2004). On this point we should remember that not paying enough attention to the environment means overlooking a dimension that is crucially important to the functioning of the economic system itself, and to maintaining human well-being" (UN *et al.*, 2003).

In particular, SNA does not evaluate three aspects (Scarpa, 1993) that are of great importance in assessing the links between the environment and the economic system:

- non-market goods and services;
- the consumption and depreciation of natural capital;
- the environmental costs of prevention and protection.

Consequently, as far as forests are concerned SNA takes no account of their functions beyond that of production, and so reflects an incomplete picture of the contribution and value of forest heritage.

3. GREEN ACCOUNTING

"To fill the gaps in the System of National Account" (UNEP, 1997) experts make reference to green accounting, also known as environmental accounting or natural resource accounting, a concept that is by no means new in international literature "even though somewhat popular" (El Serafy, 1997). To be more precise, "first attempts in this direction can be traced back to the seventies, to the work of Nordhaus and Tobin in 1972, and to the work of the Norwegian government in 1974"

(Scarpa, 1993). The idea of green accounting is by now recognised at worldwide level to be an indispensable tool, and it has gained citizenship in the most prestigious seats of high politics and great multinational enterprise, though “it is too early to think that the conceptual reference framework is complete” (Buckwell, 2005). The main aim is to achieve a total integration of the environment (Eisner, 1988; Repetto *et al*., 1990; Hartwick, 1990; Bartelmus and van Tongeren, 1994; Hamilton and Ernst, 1996) into reference account frames, in order to correctly define its value and its contribution to economic development and, above all, in order to “turn sustainable development from a mere declaration of intent into a real strategic goal (Vincent, 1999)”. This, because environmental accounting “enables us to find out more and decide better. It serves to teach the economy that what at present seems worthless may, in the medium and long term, be of value. It serves to measure – and not only intuitively feel – both the absolute and the relative weight of the different environmental problems. It serves to take what economists call externalities into account” (Giovanelli, 2000).

“Forest resources are considered «proto-typical» for green accounting, because they have ceased to be commercial «*assets*» and because of the many non-commercial and non-market benefits they produce for society” (Cairns, 2001). This is the reason why, in addition to Eurostat[3] (1999), many experts (Hultkrantz, 1992; Vincent and Hartwick, 1998; Vincent, 1999; Haener and Adamowicz, 2000; Haripriya, 2001, Cairns, 2001; Chopra *et al.*, 2001; Krieger, 2001; Kriström and Skånberg, 2001; Doldan and Chas, 2002; Caparrós *et al.*, 2003; Lange, 2004) have also partly or totally focused on these resources with the intention of “integrating data deducible from national accounting, and therefore concerning the commercial value of timber and non-timber products, with data concerning non-market functions and stock variations” (Battellini *et al*.,1996; Cairns, 2001; Krieger, 2001; Kriström and Skånberg, 2001; Doldan and Chas, 2002).

4. A CASE STUDY: THE FORESTS OF THE AUTONOMOUS PROVINCE OF TRENTO

56% of the Autonomous Province of Trento is covered by forest (an overall total of 345.293 hectares; PAT, 2003). For such an area it is therefore useful to present the results of an enquiry conducted in 2003[4], concerning:

a) the production value of these forests, obtained by applying methodology proper to both national and green accounting;

[3] The Eurostat Task Force on Forest Accounting has elaborated an accounting system for the forestry sector, entitled “Integrated Environmental and Economic Accounting for Forests” (IEEAF). The first version was presented at the “London Group” meeting in Stockholm in May 1996, (Eurostat, 1999).

[4] No differences were registered for the years 2000, 2001 and 2002.

b) the value of non-market functions, particularly the landscape-recreation, protection and carbon fixing functions.

4.1 The production value of forests of Trento

The production value of forests differ according to the evaluation methodology used. In fact, according to:

1. *National accounting*: this is the commercial value of timber products[5] and non timber products (chestnuts and hazelnuts; strawberries, raspberries and bilberries; mushrooms and truffles; game, hunted in the forest)[6]. The values are shown in the Table 1.

Table 1: The value of timber and non timber products

Year	Value of timber Products (€)	Value of non-timber products (€)	Total value (€)
2003	19,142,028	9,618,648	28,760,676

Source: Goio *et al.*, 2005.

2. *Green accounting*: this is given by adding the commercial value of timber products and non timber products and the value of changing stock in timber[7] and game[8]. The values are shown in the Table 2.

Table 2: The value according to green accounting

Year	Timber and non-timber products: harvested (€)	Timber products: changing stock (€)	Game: changing stock (€)	Total value (€)
2003	28,760,676	16,130,733	41,490	44,932,899

Source: Goio *et al.*, 2005.

4.2 Estimating non-market output of forests of Trento

Recognising the multi-functionality of forests means understanding that their value depends on a wide variety of factors and that these factors must be evaluated. We refer in particular to:

5 Obtained multiplying timber actually harvested (m^3) by the corresponding price (stumpage price).

6 Obtained by multiplying quantity by respective market price. According to the ESA (European System of Accounts (1999) in theory this value had to be estimated by national accounting. In practice this doesn't occur.

7 It is necessary to identify the size of the annual increment (separated into industrial roundwood and firewood) not harvested and therefore contributing to increase the timber stock and to multiply this quantity for stumpage price (Hultkrantz, 1992). As some authors (Merlo and Ruol, 1994) suggest we applied a conservative 50% of the average stumpage price.

8 Variations in the quantity of game at the beginning and end of the period must be assessed. A conservative 50% of the value of single heads of game is applied to these quantities in a similar way to that undertaken for the mass of timber.

1. *The landscape-recreational value*. It concerns two different aspects: the forest as such[9] and game (only for hunters)[10]. The values are shown in the Table 3.

Table 3: The landscape-recreational value

Year	Landscape-recreational value of the forest (€)	Hunting value[1] (€)	Total value (€)
2003	12,471,983	4,080,498	16,552,481

[1] Net of the productive value in hunting.

Source: Goio *et al.*, 2005.

2. *The carbon-fixing value*[11]. Forest ecosystems are "the main actors in the earth's carbon balance (Cescatti *at al.*, 2003) and, with the Kyoto Protocol, have assumed an essential role as a tool for the mitigation of climate change (Bolin, 1998; Ciccarese *et al.*, 1998; Cescatti *et al.*, 2003; Rosenbaum *et al.*, 2004; Grassi, 2005), such that like the agricultural ones they have been called «*sinks*». The value is shown in the Table 4.

Table 4: The carbon fixing value

Year	Carbon fixing value (€)
2003	4,362,546

Source: Goio *et al.*, 2005.

3. *The hydro-geological protection value*. We have long been aware of the role of forests, particularly on mountain slopes. There is still no identity of opinions on criteria and methods for evaluating, in monetary terms, the benefit flows deriving from the hydro-geological protection function. For some authors (Pettenella and Baiguera, 1997), the best criteria is the cost of a water system able to guarantee similar degrees of protection to that guaranteed by the forest. For others (Marangon and Gottardo, 2001) it is more appropriate to consider the cost of planting and maintaining a meadow in efficient condition, in place of the

[9] A quantity evaluation model for tourist-recreational pressure on the forest resources in the province of Trento was built up from a sample survey (Scrinzi *et al.,*1995) conducted in the nineties. This information was integrated with the results of a contingent valuation survey, conducted in 2002 in the forests of Trento (Bettiol, 2004; Notaro *et al.*, 2005), which enabled visitor willingness to pay (WTP) to be estimated.

[10] The value can be estimated as equal to hunting value, from which the value of carcasses and trophies already valued in the productive function must be subtracted.

[11] This was calculated by multiplying the quantity (in tonnes) of carbon fixed in the forests (Qc) by the price (conservative value) of a tonne of carbon, estimated at € 19.90 (La Notte and Paletto, 2002). The value Qc is obtained by the following formula:

$$Qc = [Vj+(Vj*0{,}50)+ (Vj*0{,}34)]*0{,}42*0{,}46$$

Where: VJ = overall volume of high forests in cubic metres; 0,50 = multiplication coefficient to allow for epigean biomass; 0,34 = multiplication coefficient to allow for hypogean biomass; 0,42 = conversion factor, from cubic metres to tonnes of dry weight; 0,46 = conversion factor, from tonnes of dry weight to tonnes of carbon.

forest. We use the second approach because the application[12] relies on information which is more easily obtainable. The value is shown in the Table 5.

Table 5: The hydro-geological value

Year	Hydro-geological value (€)
2003	63,080,858

Source: Goio *et al.*, 2005.

5. DESTINATION OF FOREST UTILITY-FLOWS

Therefore, considering the contribution made by forests to overall well-being in a country, not only do the amounts of the values appear very different to those derivable from standard national accounting (128,928,784[13] euro as against 28,760,676), but the evaluation itself of the role and benefits of this resource changes.

In effect, if we consider the total utility flow from a forest we find that, in terms of added value, it comes from the sum of the value of:

- production for the market (X_1), which goes to benefit of forest owners;
- production reserved for future generations (X_2), this too can be considered, to a large extent, as going to the benefit of forest owners and, in the case of common property to local populations, albeit at an unspecified moment in the future;
- production deriving from non-market utility flows (X_3). This final component goes in part to local populations (X_{31}) and in part (variable from case to case) to other populations (X_{32}).

It is evident that different utility flows are partly complementary and partly antagonistic. In effect an increase in X_1, obtained by an increase in the quantity harvested or by a shift from naturalistic type forestry to one based on clear-cutting, produces a reduction in X_2 and X_3. On the other hand, an increase in X_3 may entail a temporary reduction in X_1 related flows.

So, optimum management clearly calls for approach that maximise the sum of ($X_1 + X_2 + X_3$), and economic policy intervention aiming to “compensate” forest owners

[12] The resulting formula for calculating the value of the hydro-geological protection function (B_{id}) for the land incline group over 20° degrees, is the following:

$$B_{id} = (C_a + C_o * r) * CN_m * S$$

Where: C_a = planting cost; C_o = annual mowing cost; r = interest rate: 1%; CN_m = reduction coefficient to account for different degrees of hydro-geological efficiency; S = surface area.

[13] Given by the sum of the production value (according to green accounting) and the value of non-market functions.

and local populations for their “sacrifices” is also indispensable to achieve a socially optimum use of the forest.

6. FINAL CONSIDERATION

It should be remembered that applying the new, highly labour and capital intensive, technologies basic to staying competitive, tends to make it less easy to achieve both production and service goals at the same time. In effect, the growing specialisation that is both condition and consequence of the quest for economy of scale may reduce the multi-functionality of forestry activities and consequently the production of positive externalities.

Another important aspect to bear in mind is that the beneficiaries are changing. In fact, while the supply of goods goes exclusively to the benefit of local populations, the supply of services, in some cases, is of greater benefit to people from elsewhere than to local residents. Loosening the bonds between local populations and common property means that violations and profound transformations are far more likely to occur. In some cases, these cancel or greatly reduce not only the flow of input, but also of positive externalities. The growing cultural distance between beneficiaries and modes of use that enable the flow of positive externalities, should also not be underestimated, in that it leads people to believe that common property is a natural good that without intervention of any kind, naturally, produces benefits.

We therefore believe that access to such property must be guaranteed to all, even though this may produce an increase in congestion phenomena. A propos, it must be stressed that many of the functions guaranteed as positive externalities by a semi-natural management of resources (e.g. alpine forests), are not spontaneously obtainable simply by returning to “the natural state of things”. For example, forests in the Alps that have been treated for centuries following the dictates of naturalistic forestry, would not only be totally different if no longer subject to periodic forms of use, but would also be far less functional to the interests of human society.

Again, it should be pointed out that the return of vast areas to nature cannot but trigger an intensification of productivity in other areas, in order to keep up production. Consequently, in the end, the overall balance in terms of more or less irreversible transformation to the natural can only be negative.

So, excessive specialisation and a “return to the natural” both only seem possible paths in a few limited cases. The alternative path can therefore only be the production of environmental services through management for production. For this to be possible it is necessary that:

a) There is an awareness that following several aims contemporarily means none of them can be achieved to the maximum.

b) in the multifunctional approach that must be pursued if we are to guarantee the achievement of positive externalities alongside the production of goods, we must turn to flexible economies rather than scale economies.

c) We must be able to remunerate forest owners/producers for the services produced, at least where obtaining such services leads to a reduction in the value of market production and/or an increase in production costs.

d) Local populations must not only nominally conserve the management of common property, but they must also have new stimuli to continue such management. These can only derive from an awareness of the advantages that such property brings, not only from a collective point of view, but also to each individual. This means that the time may be ripe to add new rights, e.g. to landscape-recreational benefits, alongside traditional rights such as those to timber, grazing etc.

e) It is fundamental to maintain simple, understandable, management mechanisms and avoid excessive bureaucracy or complex procedures. It would be appropriate to liken common property management to that used by public bodies.

It does not seem possible however to achieve these results in the absence of adequate information. In this regard, a revision of national economic system of accounts appears both indispensable and urgent.

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STATE, DEVELOPMENT AND DETERMINANTS OF FORESTRY BUSINESS ACCOUNTING FROM AN INTERNATIONAL PERSPECTIVE

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ABSTRACT

Accounting is actually not a new but a multifaceted and increasingly important issue for the forest sector. It has been used as a tool assisting management in gaining information and supporting control and decision-making both internally and externally for ages. New external and internal demands as well as the developments in information technology and controlling have advanced the role of accounting in the last 35 years. Internationally there are large differences in accounting methods and intensities depending on the region, size structure or forest ownership. The recognition of the forest asset is the common core weakness of accounting in forest enterprises. Due to the high proportion of small-scale holdings only a small part of forest management units utilise comprehensive accounting to support decision-making and information. By and large, accounting is not yet fully developed and by far not sufficiently utilised to support management.

History shows some interesting trends in focus and research intensity which differ regionally and over time depending on the context. The IUFRO-Group “Managerial, Social and Environmental Accounting”, established in 1995, started its efforts with a study on forestry accounting in Europe and worldwide. Research was carried out with the working hypothesis that differences in business culture and operating environment around the world have a significant impact on forest business accounting and related aspects of business management in forest enterprises. This encompasses historical trends as well as current activities.

This paper analyses – starting from a historic overview on the development of forestry accounting – and compares the key differences in forestry accounting and the main influences on its systems by means of literature and case studies focussing on six regions. The paper concludes that the coming years will bring increased attention to forestry accounting as internationalisation and harmonisation continue. Future challenges lie in increasing the application of research to practice and in developing new methods and solutions. Without doubt, the three key areas of research will include the recognition of forest assets and their value changes in financial and cost accounting, the integration of performance measures for non-market benefits, and the extension and improvement of sustainability reporting.

Keywords: Accounting system; Harmonisation; Accounting standards; Forestry accounting history

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1. INTRODUCTION

Accounting is actually not a new and very prominent topic but a multifaceted and increasingly important issue for the forest sector. Forest business accounting has long been a core element in forest management (e.g. Wessely, 1870). Documents of forestry accounting date back into the middle ages. The last two centuries saw significant efforts of forest economics research invested into systematising and improving this science (e.g. Abetz, 1959; Brabänder, 1961; IUFRO, 1966). The objective of forestry accounting has always been to provide management with relevant, reliable, consistent and comparable information on status and flows in forest enterprises.

More so than ever before in its history, forest business accounting has now emerged from its specialist status. The uniqueness of its business means – the self-generating forest resource – has gained attention also in general financial accounting and bookkeeping. This reflects the trend that more and more forest holdings are listed on public stock exchanges as part of forest industry corporations or standalone investments. The listing and reporting processes require accuracy and transparency in monitoring value and value changes of all assets including standing timber, representing the main asset in forestry. Standardisation and international harmonisation of forest accounting practices have aimed to improve transparency, distribution, comparability and reliability of the financial forest information presented to shareholders. Public stakeholders increasingly hold their state or local government owned forest operations accountable.

Beyond its use for external reporting, forest business accounting fulfils a key role in internal control, operational management and strategic planning for forest enterprises. Smaller and privately owned forest companies utilise accounting practices more focussed on their internal needs. In these smaller entities the external reporting functions are primarily addressed to tax authorities thereby generating a totally different objective for external representation (Urban, 2000).

The international dimension of accounting is becoming increasingly important and is impacting not only the multinationals (e.g. assetisation trend in Europe and North America), but also forest enterprises as accounting harmonisation and internationalisation of the capital markets are progressing.

This paper attempts – starting from a historic overview on the development of forestry accounting and based on different research activities – to analyse the interdependencies of forestry accounting systems with respect to the business environment or the "forest culture" of a country or region. Forestry accounting is defined here as forms of monetary business accounting including social and environmental accounting as opposed to national accounting or non-monetary resource accounting practices (Figure 1). The framework underlying this analysis is the forest enterprise as an economic entity, ignoring the policy or (inter)governmental levels of national economics which are not relevant to the forest companies' business accounting. The working hypothesis is that differences in business culture and operating environment around the world have a significant impact on forest business accounting and related aspects of business management in forest enterprises.

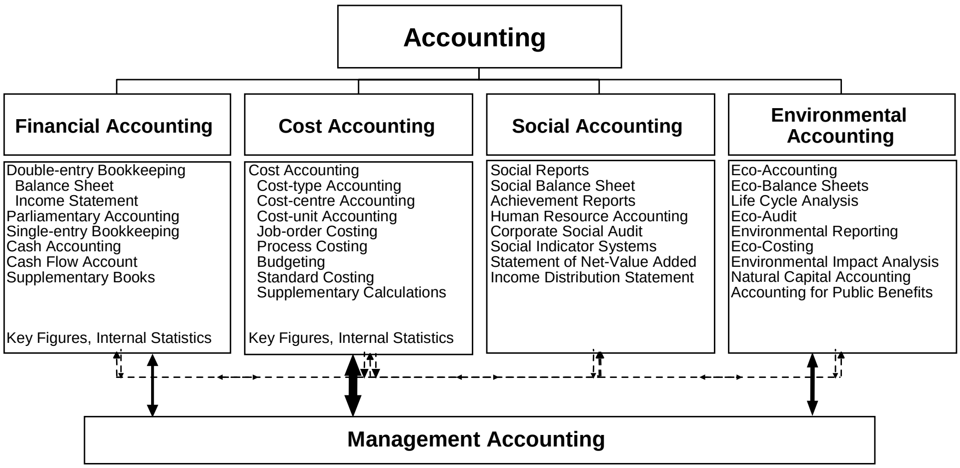

Figure 1: Components of extended management accounting (Jöbstl and Hogg, 1998)

2. HISTORICAL DEVELOPMENT OF FORESTRY ACCOUNTING ACCORDING TO LITERATURE

History shows some interesting trends in focus and research intensity. The significance and developmental tendencies of accounting in certain regions are reflected in the accounting subjects in literature and in international activities.

Figure 2 gives a first impression. It depicts the enormous growth in the number of publications in German since 1800 and the emergence of the most important subjects and keywords in accounting over time.

In earlier forestry compendia, the forest administration duties from the accounting point of view were described as materials accounting and stringent separation between materials accounting and monetary accounting. There was a large number and range of published forms and instructions for accounting procedures, and there were efforts to apply bookkeeping for purposes of control and safeguard against disloyalty and disorder.

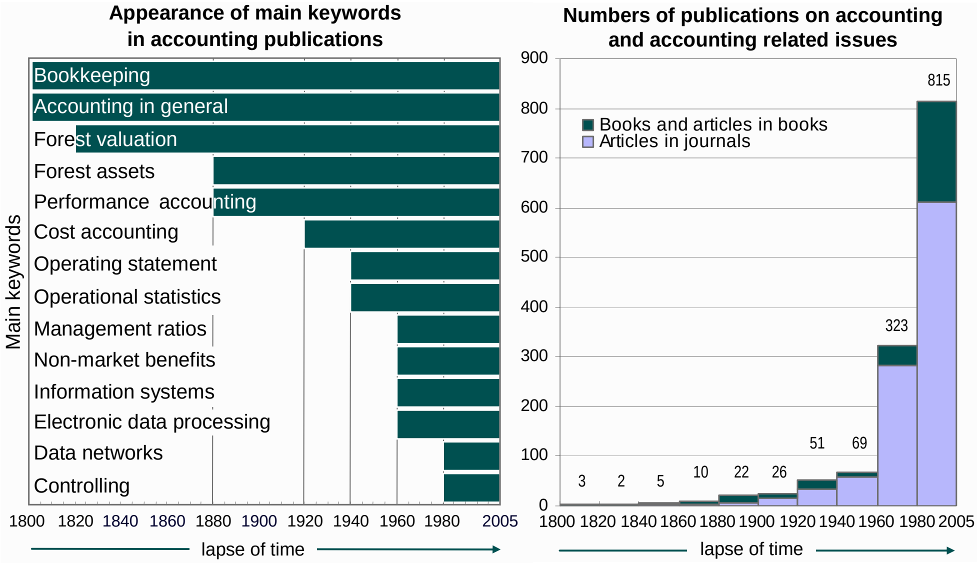

Figure 2: Appearance of main keywords (subjects) in German publications on accounting (left) and numbers of publications on accounting and accounting related subjects in German language media (right) in lapse of time from 1800 to 2005 (Source: Forestry Accounting Literature Database by Soucek, 1998, and Faltejsek, 2001, updated in 2006)

Abetz (1931) considers the separation between materials and monetary accounting spheres in different federal forest administrations (more stringent than in private forest management) an important reason for the late engagement in forestry bookkeeping matters and the relative backlog of forestry accounting in comparison with other business sectors that were just caught up in the second half of the twentieth century. Earlier, a central goal was to find an ideal bookkeeping system. Financial and physical information were typically handled separately. Many historical sources also addressed the difficulties in measuring changes in forest assets by using balance sheets and performance accounting. The second half of the twentieth century put growing pressure on economisation, reduced the economic importance of wood production and increased environmental awareness, leading to greater societal influence on forestry. This led to a variety of new tasks in accounting that had to be solved using innovative approaches and new technical means. International activities were initiated. These developments differ from region to region.

2.1 Main developments of forestry accounting in Central Europe

The development of forestry accounting in Central Europe can be divided into five periods each characterised by specific issues: 1) period until 1870 (stock accounting, cameralistic), 2) period from 1870 to World War I (performance accounting, beginning of double-entry bookkeeping in forestry), 3) period between World Wars I and II (discussion about cameralistic and double-entry bookkeeping, increased application of double-entry bookkeeping, asset valuation), and 4) period from 1938 to 1965 (performance and cost accounting). The fifth period from 1965 till now is characterised by electronic data processing and its applications in forestry accounting (e.g. financial and cost accounting). Forestry performance accounting was often part of the scientific discussion in the 1960's and in the 1990's. Data bases, models, forest asset valuation, performance reports etc. were in the scientific focus. In addition to controlling in forestry accounting, environmental and social aspects started becoming important during the last decade.

2.2 Main developments of forestry accounting outside of Central Europe

Figure 3 illustrates the trends outside Europe. In the plantation forestry areas cost estimation was key and in later days environmental accounting has been up and coming. Plan economies had few real developments and they are now transitioning mainly to the Anglo-American model. Scandinavia developed much in parallel to Central Europe but has shown stronger leanings to the Anglo-American model recently.

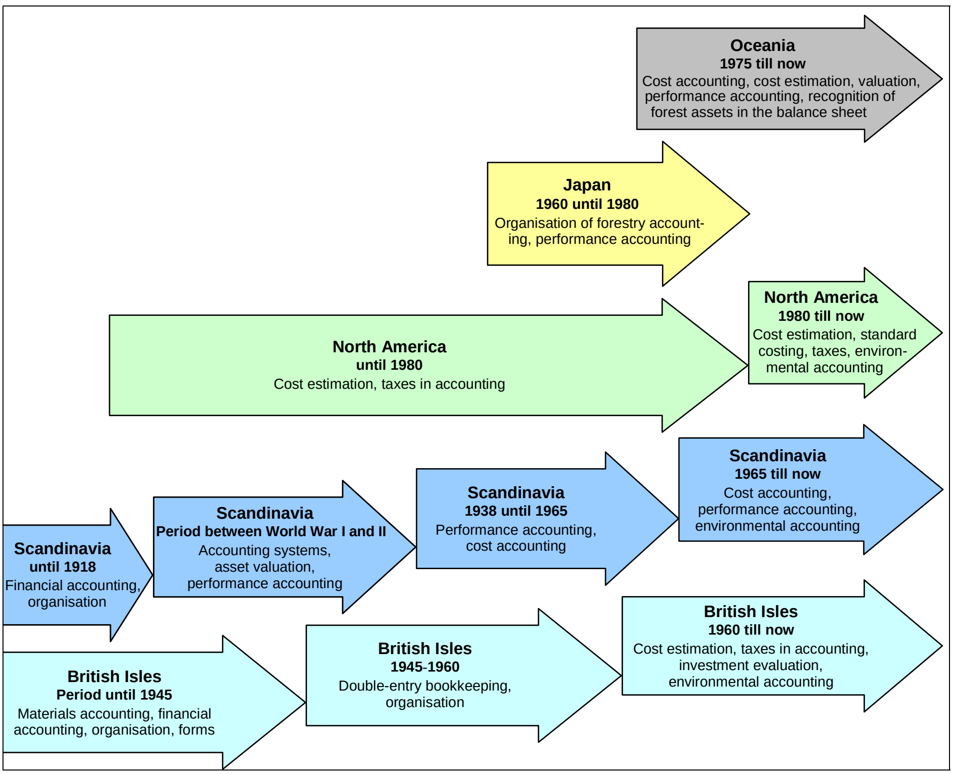

Figure 3: Main steps in the development of forestry accounting outside of Central Europe as reflected by corresponding literature

The concern in North America during the last 35 years has been focused on taxes in accounting along with cost estimation. In most recent years, the focus has shifted to standard costing and environmental accounting.

In Eastern Europe and Russia, accounting was developed according to the requirements of a ‘central planned economy’. Since the upheaval, a comprehensive orientation to western standards has become common.

Japan was mostly engaged with the organisational aspects of forestry accounting and performance reporting. In Australia and New Zealand, research on forestry accounting blossomed during the 1980s, when cost accounting methods were introduced and the foundations of up-to-date guidelines for evaluation of forest assets in financial reporting were developed.

2.3 International activities

The first attempts to internationally harmonise subjects related to forestry accounting were tackled in the mid-1950s by a IUFRO-group. The group was focused primarily on international communication and comparability through terminology, providing important contributions, including systems of accounts, cost types and cost centre accounting, cost estimation and the evaluation of growing stock in combination with performance accounting. It also discussed fundamental problems surrounding evaluation and recommended solutions. After the mid-1980s (keywords: forest damage, privatisation of public forest enterprises, internationalisation, etc.) accounting related subjects were sometimes presented at conferences of the “Forest management planning” group. Later, these subjects were also presented at conferences organised by the group "Site types and management targets", which was founded in 1981, and renamed to "Managerial economics in forestry" in 1990. New tasks and subjects, especially evaluation of non-market benefits, business management and macro-economic aspects of social and environmental accounting and other diverse valuation tasks led to the establishment of an interdisciplinary accounting group in IUFRO in 1995, named “Managerial, social and environmental accounting”. It made relevant contributions to the analysis of the status and further development of accounting. Its main activities consisted of the systematic study of forestry accounting in Central Europe and the rest of the world, along with annual organisation of conferences. Results of the study, based on the 4-area model (Figure 1), were presented in various publications and at the 14 yearly conferences (Hogg and Jöbstl, 1997; Jöbstl and Hogg, 1998; Hogg, 2000), in which a total of 140 presentations with accounting subjects were held.

The themes at the conferences and the titles of the presentations reflect the actual focal points of forestry accounting:

- evaluation of growing stock, forest asset evaluation and performance accounting

- information systems and controlling
- non-market benefits of forests (NMB), corresponding evaluation and incorporation into accounting
- environmental accounting, total economic value
- international regulation in financial reporting, standardisation, harmonisation
- internal management accounting and reporting
- inter-company comparison, accounting data networks
- national accounting

Central career themes and concepts included multiple use, NMB, performance accounting, growing stock/forest asset evaluation, accounting data network, national accounting.

Besides, other IUFRO-groups (i.e.: Small scale forestry) and especially more regional economic circles, for example Scandinavian society of forest economics, German forestry economics colloquium, as well as international organisations (FAO, EUROSTAT, IASB) dealt with supra-regionally relevant themes in forestry accounting.

3. COMPONENTS OF THE BUSINESS ENVIRONMENT IMPACTING THE FOREST ACCOUNTING SYSTEM

Culture is a complex phenomenon understood as a common set of ideas, beliefs and values shared by a group. It affects how a society organises itself, which affects businesses and accounting in a variety of ways (Hofstede, 1984). An analysis of the different underlying dimensions, aspects and components can provide improved understanding of the cultural dimension and its impact on forestry accounting.

Business and management culture in forest enterprises encompasses several relevant components as illustrated in Figure 4, which shape forestry accounting in particular. Management accounting as a tool to support management in its strategic decision-making as well as facilitating the making of choices in everyday operational decisions faced by the management of forest enterprises interacts strongly with different managerial cultures around the globe. Varying levels of importance or substance of the influence factors between countries are therefore the reason for differing accounting systems and practices around the globe (Figure 5). Business culture shapes forestry accounting and vice versa.

Forest traditions and practices including the nature of the resource (i.e. virgin, natural or plantation forests) are a key factor shaping forestry accounting. The idea of sustainable forest management, which is largely based on a constant forest area

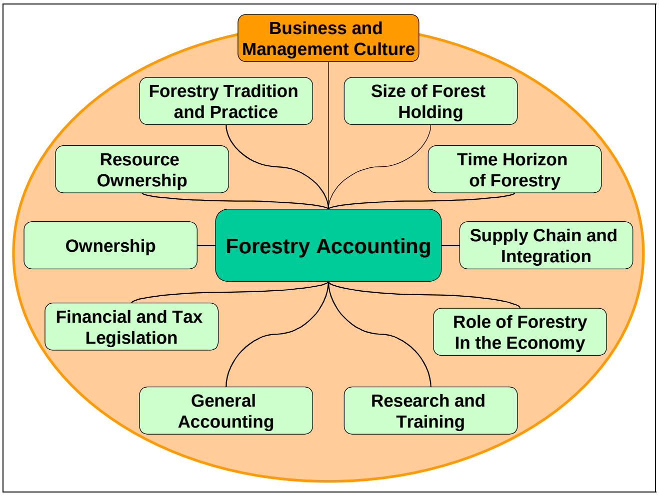

Figure 4: Influence factors from the business environment on forestry accounting

and more or less constant volume of the growing stock, has shaped forestry accounting in most parts of Central and Northern Europe. In North America and the tropical and subtropical areas forest practices have for a long time been tailored to the utilisation of old growth forest and their conversion to secondary forests or non forest lands. Today the emphasis is generally shifting towards plantations and shorter rotation but also to more constant cover 'natural' forests. Together with Oceania the subtropics and tropics have some of the world's most productive plantation areas utilising modern forest management techniques in all their facets.

In forestry, the time horizon is closely interlinked with forest management practices, silviculture regimes and growth area. The duration of the rotation has been a key feature of forestry distinguishing it from other businesses. Annual accounting and reporting has found it difficult to capture the natural growth processes through the length of a rotation, which may well exceed 100 years. Differences in average rotation cycles around the world depend on the timber species, climate and growth area impact the time element relevant to accounting and thereby forestry accounting. Cost recording practices, which are suitable and accurate for 10 or 20-year rotations such as fast growing eucalyptus plantations, are inconceivable in the production of high value oak logs for veneers over a rotation exceeding 200 years.

Resource ownership is another key determinant for forest accounting practices. Third parties manage large tracks of the world's forests as licensees or concessionaires. The perspectives of such concessionaires vary considerably from the resource owner and require a very different treatment in accounting, as the contractual agreement is the asset and not the resource.

Beside resource ownership, the legal ownership form of the forest enterprise is highly significant for the accounting system, as different legal forms require different systems and levels of financial accounting. Requirements differ from country to country, but in general an increasing number of owners increase the onus of financial accounting. Single private owners, such as farmers, large forest corporations and the public sector all have different perspectives. Joint-stock companies wishing to raise capital through public exchanges face additional requirements imposed through the listing criteria of these stock exchanges. They also face scrutiny of institutional and private investors. Different accounting systems and practices frequently go hand in hand with the legal ownership form.

The size (i.e. area, timber volume and turnover) of forest holdings around the world is significant in predetermining the level of accounting system and information. The refinement level of the forestry accounting system is, to a large extent, dependent on the size of the forest enterprise and, therefore also dependent on the cost vs. benefit of accounting information.

The role of forestry in the national economy is relevant in determining the importance of the forest sector and the public attention it receives. The likelihood that specific guidelines and conventions will be developed specifically for dealing with forestry is higher in regions where it plays a larger role in the economy. The level of codification is usually higher in countries where forestry has a high profile.

Financial and tax legislation has a considerable impact on financial accounting. The structure and content of forest accounting information is also important. Depending on the size and legal structure of the forest enterprise, income or corporation tax are frequently key recipients of accounting information and the financial accounts form part of the tax declaration. The dilemma of satisfying the need for objective information (true and fair view) while avoiding a high tax burden is evident. In some cases (e.g. in Central Europe) accounting malpractices have been codified de-facto through tax measures and levels.

In many countries financial accounting has to fulfil external information requirements beyond taxation. With the opening of borders, the development of multinational companies, global trade, and the internationalisation of the financial markets legislation and accounting, standard setting has become the subject of increasing harmonisation efforts to promote the development of free markets and ensure their transparency. The development of International Accounting Standards (IAS, IFRS) by the International Accounting Standards Board (IASB, formerly IASC) and the European Union directives on accounting matters are prominent among these harmonisation efforts. Unlike the EU directives, the IASB aims to take up specific challenges posed by forestry in accounting. The IASB standards intend to address primary forestry-specific issues regarding the treatment of the growing stock in a certain standard, thereby having only indirectly shaped forestry accounting.

Forestry accounting as a specialist branch is largely embedded in the framework of general accounting. Much work has been done in analysing the different schools and approaches in general accounting (e.g. Nobes and Parker, 1995). Jöbstl and Hogg (1998) have analysed the interrelationship between general and forestry accounting in some detail and shown that general accounting is a key determinant for forestry accounting. Most accounting conventions used in forestry accounting in specific countries are determined by general business accounting in the corresponding countries. The treatment of growing stock is the only key feature distinguishing forestry from other businesses covered in general accounting.

In recent years the rapid growth of stock markets has given rise to the Anglo-American approach to general accounting (Figure 5), characterised by professional regulation and standard setting. It also places a strong emphasis on investor information and the key principles of "true and fair" and relevance. This has resulted in a much bolder and quite pragmatic approach to provide relevant investor information. This has also led to the extension of the establishment of comparable values for forests in financial accounts. However, some methodical problems may be pushed aside for the sake of providing a comprehensive and relevant picture of the forest enterprises financial status and performance. The IAS embrace this approach with all its opportunities and shortcomings.

Within forest corporations in all parts of the world, the supply chain and role of forestry within as an either independent or integrated element of the supply chain plays a key role in understanding the role of forests and forestry. Processing industries such as pulp and paper can be the main business driver, making forests to raw material feeds with no own profit responsibility and thereby little incentivisation and

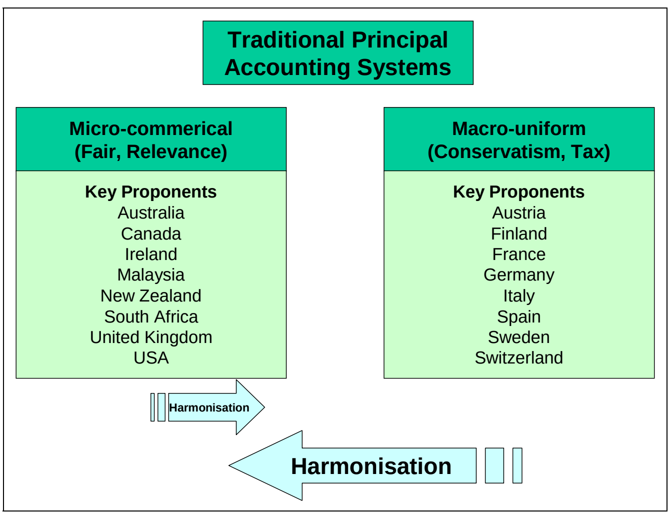

Figure 5: Taxonomy of general accounting systems and the impact of recent harmonisation

accountability. The transfer pricing rules between the different business areas (forest, harvesting, saw milling, pulp, paper, etc.) render any transparency or comparability on a business division or supply chain level useless. In the absence of a sufficient internal management accounting system, controlling of the forest operations is mostly based on non-monetary and market-unrelated performance measures (Jöbstl, 1981a, 2000; Borchers, 1999; Karisch, 2000, 2003).

Related to this issue of forestry outputs, many public forest enterprises are partially abandoning economic accountability of timber production for the less measurable image of the environmental and social benefits of forestry. With rising concern over environmental issues and material balance of the Earth, interest has grown in developing a better understanding of environment-related costs and benefits. Advances in social and environmental accounting have so far been evaluated in a narrative manner. This describes a qualitative character that can be focused on the monetary evaluation of the positive benefits or externalities. Attempts to a comparable consolidation with existing management accounting information have been rare (Merlo and Jöbstl, 1999). Most other attempts in valuing non-market benefits have remained outside the four distinct approaches identified in Bartolomeo et al.'s (2000) taxonomy of environmental accounting: external financial reporting, social accountability reporting, energy and materials accounting and environmental management accounting. In the future, increasing public and market pressures are likely to boost the need for environmental accounting information beyond the mention of tonnes of carbon stored in the growing stock and amenity facilities provided in many corporate environmental reports.

The level of research and education in forestry accounting shapes the everyday accounting practices to a significant extent. Research determines what refined accounting theories and models are and what practical adaptations have been developed. Education is required to transform research into practice. Hogg (2000) showed the substantial differences in the extent and content of forestry accounting education offered to undergraduates at European forestry universities and colleges. Where forestry specific accounting education is insufficient, general accounting will fill the gap at the cost of understanding the forest business and catering for its specific needs. In the case that general accounting is dominant, the interrelationship of forest business management and forestry accounting is limited and the two are more parallel than forming part of an integrated system.

As outlined above, the socio-economic business environment plays a unique role in shaping forestry accounting. For the countries covered in the case studies some of the key features and differences in the business environment shaping forestry accounting are summarised in Table 1 on a general level. The interaction between these factors shapes the business and management culture, which in turn affects forestry accounting as part of this culture. Differences in the European sphere have been analysed in detail by Jöbstl and Hogg (1998) and in the following more emphasis will be put on the most relevant feature – the self-generating forest resource – but in a global context.

4. ESTABLISHMENT OF PERFORMANCE MEASURES FOR FOREST ENTERPRISES

Forest stands are the key asset of the forest enterprise frequently representing over 80% of all assets. The computation of annual results reflecting the performance of the enterprise is one of the key elements of accounting. Meaningful performance measures for forestry cannot be based solely on annual returns (in terms of earnings and investments), but must take the value added in the forest stands into account. The measurement of these value changes has been one of the long-standing problems in forest economics (Lemmel, 1956; Frauendorfer, 1958; Abetz, 1959; Brabänder, 1965; Jöbstl, 1981a; Karisch, 2003) and a simple yet accurate solution has so far proven elusive. The most discussed methods are summarised in Figure 6 including the more recent extension that also captures the non-market externalities of forestry within the performance assessment.

The objective of performance accounting is to measure and control performance including deviations from management plans or the equilibrium status (sustainability as more far-reaching going-concern principle). These deviations have a direct impact on current and future asset value and revenue streams of the forest enterprise. The complexity of these value changes deriving from natural growth, non-

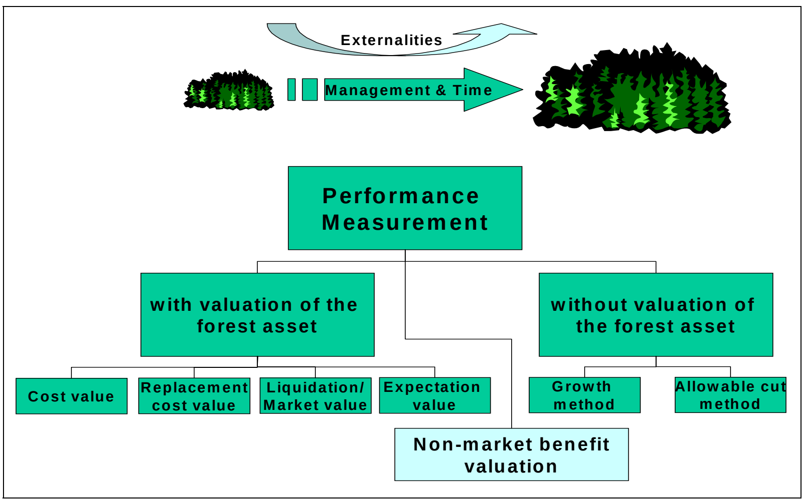

Figure 6: Principle methods for performance evaluation in forestry (extended according to Brabänder, 1965)

linear price/size relationships, quality/grades, market price fluctuations of timber and other factors has so far led forestry practice to shy away from full accountability. Conventions are only slowly being introduced to abate this main shortcoming of forestry accounting. The conventions to include realistic forest values in financial reporting (e.g. Davy, 1987; Roberts et al., 1995; Borchers, 1999; IASC, 1999; Herbohn, 2009) give rise to discussion about the accuracy and value-relevance of inventories (Gierer, 2000), yield models or evaluations and the separation of different influence factors to determine management achievement.

5. CASE STUDIES ILLUSTRATING THE INTERNATIONAL INTERDEPENDENCIES BETWEEN FORESTRY ACCOUNTING AND THE BUSINESS ENVIRONMENT

In the following case studies we aim to select illustrative examples, which are used to describe the impact of the business environment on forestry accounting and the existing interdependencies between forest management and accounting. As they are all routed in their local or regional cultural context they do not purport any evaluation or recommendations.

Classifications have been a key element in understanding differences and ultimately lead to harmonisation (Roberts et al., 1998). A detailed comparison of differences between accounting legislation and practices in European countries has been part of earlier work (Hogg and Jöbstl, 1997). Systematisation of the different approaches to forestry accounting has been attempted by Hogg (2000) using a classification scheme with key criteria relevant to forestry accounting. Key results from the following case studies are summarised in Figure 7 and Table 1.

Central European forest enterprises

Across Central Europe forestry accounting, like general accounting has traditionally been using a two circuit approach differentiating between taxation-oriented financial accounting and management-oriented cost accounting. Tradition in forestry accounting is well rooted in the forest economics of German speaking countries, with many noteworthy scholars dedicating research efforts to this subject (e.g. Abetz, Brabänder, Frauendorfer, Guttenberg, Jöbstl, Lemmel).

Smallholders represent the majority of the forest owners but also a high share of the forest area. By law these smallholdings require only a minimum of accounting information.

For the larger forest enterprises there is a clear distinction between those in private and those in local or national government ownership. The larger private forest enterprises – i.e. those with holdings above 500-1,000 ha – use the two-circuit approach where tax is dominant in external financial accounting. In accordance with principles of (volume) sustainable forest management, conservatism and protection of creditors and tax legislation, the growing stock (i.e. standing trees) is generally not accounted for in the financial accounts.

The growing stock represents an important hidden reserve which, when uncovered through calamities or utilisation above sustainable averages, requires exceptional treatments in taxation (Urban, 2000). This convention of ignoring the growing stock and its changes over time renders the financial accounts virtually useless for purposes of evaluating the financial position and determining the profitability of a forest enterprise. Classical ratios such as return on assets cannot be correctly applied and make comparisons to other industries impossible.

The development of a voluntary cost/profitability data network for larger private forest enterprises has led to much improved cost centre/cost type accounting with allocation of costs to the main activities in the forest enterprise (e.g. Jöbstl, 1981b, 2000). Unfortunately, only in rare cases the internal cost accounting circuit, which should support management in its decision-making, provides useful information on the status and changes in the growing stock. Physical volume maintenance through comparisons of the undifferentiated allowable cut vs. the actual cut is widely used to gauge the sustainability equilibrium. However, this provides inadequate insights into the value maintenance. Suitable adaptations of the forest inventory and cost accounting methods have only been made in few exceptions (Jöbstl, 1987, 1996).

Many publicly owned forests follow government accounting rules and practices ("Kameralistik"). Recently increasing autonomy and accountability of the public forest administrations has led to growing interest in developing reporting methods that incorporate value creation from a holistic perspective including both the growing stock and externalities such as recreation, biodiversity or protection from natural disasters. While interest and research are widespread, practical advances have been made in this direction especially in Bavaria and Rhineland-Palatinate (e.g. Deisenroth, 2005).

Forest processing industries such as the manufacturing of pulp and paper, sawn wood or wood-based panels are rarely linked directly to forest ownership. Only very few publicly listed companies have notable forest holdings that require financial reporting on the growing stock. The implications of IAS (now IFRS, International Financial Reporting Standards) for forest holdings are at best indirect and long-term. In line with tradition, advances are more likely to come through tax legislation, research or education.

Private and state-owned forest enterprises in the British Isles

Several key principles of general accounting shape forestry accounting in the British Isles, where an established tradition of a strong accounting profession dominates self-regulation. The principles of true and fair view and relevance have been dominant in general accounting. The IAS is fully accepted in financial reporting and ac-

Table 1: Summary table of the regional comparison including reference to the International Accounting Standard for Agriculture

	Central Europe	**Northern Europe**	**British Isles**	**North America**	**South East Asia**	**Oceania**	***IAS (IFRS) 41***
Importance of forest sector	Medium-High	High	Low	Medium	High	Medium	*Diverse*
Principle accounting system	Two circuit (financial, cost)	Two circuit (financial, cost) – moving to single	Single circuit	Single circuit	Single circuit	Single circuit	*Single circuit*
Main drivers on financial accounting	Tax Conservatism; specific legislation in tax code	Conservatism Tax	True and fair Relevance	True and fair Relevance	True and fair Conservatism	True and fair Conservatism	*True and fair Relevance*
Main drivers in internal cost accounting	Decision-making for management	Decision-making for management	Extension to financial accounting to facilitate management decisions	Extension to financial accounting to facilitate management decisions	Extension to financial accounting to facilitate management decisions	Extension to financial accounting to facilitate management decisions	--
Growing stock in accounting of private non-listed entities	Largely not recognised; actual vs. allowable cut comparison to monitor sustainability widespread	Largely not recognised; actual vs. allowable cut comparison to monitor sustainability	Recognised at cost (at stand level); NPV internal	Recognised at cost (at stand level); NPV internal	Only recognised for plantations at cost	Recognised at cost (at stand level); NPV internal	*Recognition at net market value – indirect impact via legislation changes only*
Growing stock in accounting of stock listed entities	Rare; Recognised at different values (very conservative values)	Recognised at cost	--	Recognised at cost	Only recognised for plantations at cost	Traditionally recognised at cost but shift towards evaluation (net market value)	*Recognition at net market value (market evaluation or NPV assessment), cost for establishment phase*
Growing stock in public forest enterprises (incl. commercial operations in public ownership)	Not recognised or recognised only at historic cost; increasingly recognised with evaluations	Recognised at cost; increasingly recognised with evaluations	Recognition based on cost less depletion or on expert evaluation of net market value; Changes in forest asset are shown separately, but not booked as profit/loss			Traditionally recognised at cost but shift towards evaluation (net market value)	*Recognition at net market value (market evaluation or NPV assessment); cost for establishment phase*
Remarks	Improved models for performance accounting available as extension to cost accounting	Issue is attracting attention especially also regarding the assetisation of forest assets	Forests are shown as a separate tangible asset with no depreciation other than depletion and sales	Many forest corporations operate through timber licences; Assetisation has been an issue	Natural forest is largely in ownership of the states who license it to timber companies for management	Oceania has been driving the development of full inclusion of forest assets in financial reporting	*Experiences mixed; reviews ongoing; level of adoption regionally varied*

counting is more loosely linked with taxation than in Central Europe. This relative independence from tax has also given room to facilitate the use of a single circuit accounting system where cost accounting is an extension of the financial accounting system, which is widely used in private forest enterprises. For private forest estates, the use of single circuit systems with focus on relevant information is further facilitated by the enduring preferential treatment of forestry in taxation instigated by the very low forest cover.

In larger private forest enterprises the issue of accounting for the growing stock and its changes has been discussed repeatedly since the 1950s. Recommendations have changed and developed significantly over time (Hogg, 1995), but only few private forest enterprises have traditionally included variations of the growing stock in their accounts. Reluctance is based on the perceived complexity of the issue and the absence of reliable inventory data or (localised) yield models.

The public sector has been keen to demonstrate their achievements in planting vast tracts of land and achieving government set hurdle rates on financial returns. This agenda has coincided with the development or adoption of new methods including the assessment of non-market benefits. Since the 1970s the two main approaches to forest evaluation for accounting purposes have been the market value assessment based on the net present value (NPV) and the stand cost evaluation, which have increasingly been used together. The inherent problems of complexity and volume of compartment/stand accounts, infrequent re-evaluations, choice of interest rate or transition from cost to expectation value have recently led to the promotion of open market evaluation based on expert assessment of comparable sales on a stand basis. This open market value is reassessed in intervals of several years and readjusted annually by felling, sales or acquisitions.

Public sector accountability for profit-making activities outside the government department's mandate has increased significantly and the financial reporting standards reflect this change by adopting private sector standards and formats. While the UK Forest Enterprise has adopted the aforementioned expert panel open market value assessment approach for the forest asset, the Irish Forestry Board Coillte uses a different combination of historical cost and value approach. Due to the absence of appropriate standards covering the special nature of the forest asset within the reporting requirements (FRS 3) the Irish state forests Coillte have opted to show only historic cost of plantations in their accounts and to clarify the value of the growing stock and its changes in notes and a statement of change in forest asset. The Northern Ireland Forest Service on the other hand is proposing to use replacement cost based on value to substitute the previous NPV based method (Harley, 2000). In future the majority of the forests in the British Isles – if they remain under full state ownership or are privatised in some form – are expected to be accounted for under the IAS regime.

Nordic forest corporations

The Nordic accounting tradition resembles the main two neighbouring interest spheres. Nordic accounting used to be shaped according to the Central European model. The Nordic model later shifted to follow the British Isles/American model as it became stronger. Finnish accounting standards have a high compliance with IAS standards. Several forest corporations provide references to IAS standards in their annual reports or have adopted IAS as reporting standard for the consolidated group accounts. While the Swedish accounting standards remain distinct from the IAS, many of the Swedish forest corporations (e.g. Assidomän) refer to IAS standards in their statements of account.

The treatment of growing stock in financial accounts has been less of an issue in the Nordic countries than in the British Isles or Oceania. This is understandable regarding the long tradition of sustainable forest management and the equilibrium status, which is by and large maintained. The user of these financial statements is, however, deprived from assessing the actual (annual) performance of forest management other than in physical volume terms, which is frequently part of the annual review.

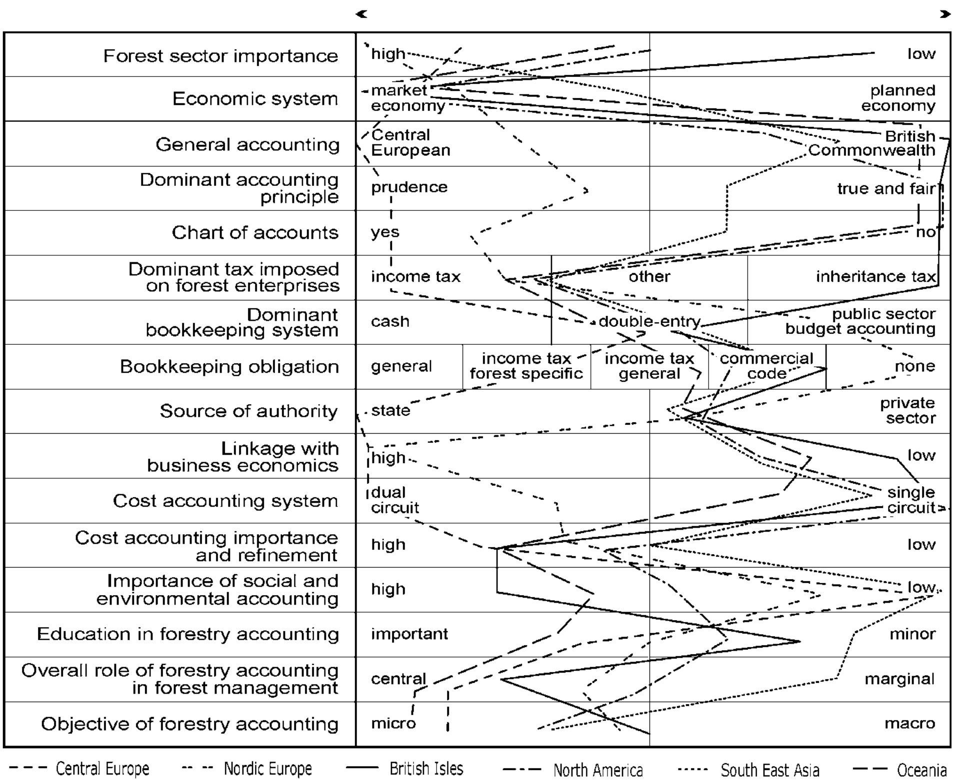

Figure 7: Tentative morphology for forestry accounting

The Swedish forest corporations showed the forest value at book value (i.e. original acquisition value) in their accounts. This value bears little resemblance to the actual value of the forest estate. The usually higher tax assessment value is also shown in the notes to the accounts, but still underestimates the value of the forest asset. Felling rights (e.g. SCA) are shown as inventories. Up until recently StoraEnso, Europe's largest forest corporation, or UPM-Kymmene did not even specify the value of their substantive Nordic forests separately in the annual statements of accounts, now they have adopted the IAS fully. Forests are part of the non-depreciating land and water assets. Norway's Norske Skog used to state the book value of the forest properties and its "write-up" in the analysis of value estimates, but now has also fallen in line with the IAS 41.

North American forest corporations

For small North American forest holdings tax – in particular income tax – is a major driver in forestry accounting, while the larger forest holdings are owned either by the federal states or provinces, the central government or forest corporations.

All joint-stock companies follow the US or Canadian Generally Accepted Accounting Principles (GAAP). IAS can be used with reconciliation to the US or Canadian GAAP, but very few companies do so and IAS is not an issue in the forest sector currently. The general accounting practices and business culture resembles the British Commonwealth system (used in the British Isles and former British colonies), but the importance of the forest sector in North America is higher and forest ownership is more dominated by large private forest industry corporations.

Many forest industry corporations manage both own timberland and forests belonging to public authorities. The majority of plantation owning companies in North America capitalise their timberland purchases and reforestation costs. These costs can include original acquisition cost, real estate taxes, lease payments, road construction costs, site preparation and reforestation costs including planning. The timberland cost stands unamortized in the accounts and is eliminated at harvest (unit of production method representing the accumulated depletion). The exact scope of capitalised and non-capitalised, annually charged costs varies between companies.

The cost of harvested timber is based on its market value, the capitalised cost and the total timber volume estimated to be available over the growth cycle. Gains on timberlands sales are reflected as a reduction of the cost of sales in the profit and loss account. In the balance sheet, forest forms part of fixed asset and in most occasions the value of the timber and timberlands can be seen in either the balance sheet or notes. Timber rights on the other hand are recorded as intangible assets and depreciated on a straight-line basis.

There appears to be very little change occurring in the shift from the now widely used cost-based approach to forest evaluations in accounting. The developments occurring in Europe and Oceania, however, will ultimately impact North America as a key financial market and arena for consolidation of the global forest industry. The ongoing assetisation trend is fuelling the need for annual performance measurement at 'true and fair' values.

Latin American forest corporations

Due to the financial links with the United States, most large Latin American forest corporations follow North American accounting practices. Many of these large companies are also quoted on North American stock exchanges and follow the generally accepted accounting principles of the United States (US GAAP) as basis of presentation. This allows all foreign companies to report in US Dollars rather than local currency, reducing the direct impact of inflation. Reconciliation to local accounting practices is frequently required (e.g. Argentina, Brazil, Chile[3]). The acceptance for the IAS is increasing from a low base, depending on whether it develops in a European or North American fashion. Often timber resources are stated at cost, less accumulated depletion on a production unit (stand) basis.

South East Asian plantation and concession forest holdings

Malaysia or Singapore's accounting system largely follows the British Commonwealth model and many of the accounting standards are based on the IAS with modifications to reflect the particular local situation. The latter is also true for Indonesian and Thai accounting standards. In general one accounting circuit is used for both financial and cost information.

There are significant differences between the forest management practices in virgin/natural tropical forests and plantation forests (esp. rubber wood). For the natural forests the existing forest inventories can only provide very limited input for value-based assessments of the forest resource. The time horizon with respect to "rotations" is largely undefined. Most of the region's natural forests remain in state ownership and are licensed to concessionaires for harvesting and management over a licence period. Forest operations that have forest asset value, account for this value as a part of their other assets. The timber concessionaires include the rights in timber licences or land use rights at cost as a separate category under the fixed assets. These timber licences or land use rights are depreciated using the straight-line method over the lifetime of the licence. If their duration is unlimited they are not depreciated.

[3] Note: Chile is going for a gradual convergence to full IFRS over a three-year period from 2009 to 2011 as the first Latin American Country.

For the increasing areas under plantations, rubber wood and fast growing species such as Acacia for pulpwood, inventories and management plans exist in some detail. Plantations are treated as fixed assets, which are capitalised at cost of its initial establishment. Formerly most of these assets where not amortised, but written-off to the profit and loss account at harvest. The Malaysian Accounting Standards Statement No. 8 from 1997 requires all plantation cost to be capitalised and amortised over the useful life, which is relevant to rubber wood and oil-palm plantations where timber or fibre is only a by-product.

Oceania forest corporations

General accounting in Australia and New Zealand follows the British Commonwealth accounting model, reflecting the dominance of the accounting professions and the pragmatism underlying key accounting principles. Taxation and fiscal rules have little or no impact on accounting profits and financial reporting. The Australian Accounting Standards (AAS) and the New Zealand Equivalents to International Financial Reporting Standards (NZ IFRS) are very close to the IFRS. Due to the importance of the forest sector in Oceania the standard development specific to forestry has advanced further than elsewhere.

Australia and New Zealand still have significant natural forest areas as well as an important and growing plantation resource including fast growing pine species and eucalypts. For the private and state owned forest enterprises in the region the inclusion of values of growing stock in the financial accounts has become important in understanding returns to the shareholders (Adams, 1994; Roberts et al., 1995; McBride and Peirson, 1996).

Most of the productive forest estate has been planted in recent years, with significant proportions of the forestland only coming into full production during the next years. This is important for understanding some of the accounting practices. Up to now a variety of measurement bases and techniques have been employed. These range from historic cost to market value estimations (Hargreaves, 1980; Davy, 1987). The forest asset has equally been treated differently in the balance sheet, where it was sometimes entered as current inventory, fixed asset or special regenerative asset. These values are not necessarily also used for stand-based management, which utilises an extension to the main accounting circuit to control stand related performance.

New Zealand's large forest corporations (e.g. Fletcher Challenge Forests or Carter Holt Harvey) have traditionally shown a carrying value of plantation forest crop at the original acquisition/establishment cost of the standing forests plus capitalised costs for each stand until it is mature for harvesting. According to this approach, the capitalised costs of each stand are written off to the profit and loss account at the time of harvesting. Cost capitalisation and carrying value are limited such that the total cost capitalised cannot exceed the estimated recoverable amount of the stand assets. This takes age, condition, location, intended end use and management regime into account. Revenues from harvesting are taken into the profit and loss account when realised and the related capitalised costs are then written off to the profit and loss account as depletions. In some cases there is a distinction between development forests (i.e. no substantial harvest to date), where all cost is capitalised and production forests (i.e. after the first commercial harvest) where all costs of harvesting and re-establishment are taken directly to the profit and loss account. Until recently the Australian practices of accounting for forest assets have been similar.

Limitations of the cost-based approach such as the indifference to price changes and value accretion in the growing stock have rendered the results of this accounting approach irrelevant to many accounting information users. In New Zealand the additional disclosure of NPV calculations has only partly been able to address scepticism. Today substantial annexes with supplementary forest information aim to address the assumptions and sensitivities of the used evaluation approaches.

In recent years Australia has been at the forefront of capturing the forest asset and its changes in the financial statements of forest enterprises. The attempt to find a pragmatic solution providing relevant and comparable information on the performance of forest management has led to a paradigm change. Most of the large forest corporations and different state forests had largely adopted a historical cost approach to the forest assets. This is now being replaced by a net market value established through evaluation on the basis of comparable transactions or, if that is not possible, using the NPV method. The forest assets are shown in the balance sheet as a special category of assets. The unrealised gains and losses connected with changes in the forest asset are equally recognised.

Australia has developed an accounting standard for self-generating and regenerating assets (Australian Accounting Standard AASB 1037). The formulation of standardised practices can, however, not solve the fundamental problems of evaluation and uncertainty in absence of readily available net market values. The envisaged operative date has been deferred due to the realization of the above outlined problems. The transition phase has its own problems where value differences between historic cost of forest assets and net market value are distorting profit measures considerably.

The State Forests of New South Wales use this evaluation-based approach in their annual accounts. Softwood plantations are valued annually using a market evaluation model that calculates the net change in value resulting from price and volume movements. Plantations younger than 12 years, or before first commercial operations are valued on the basis of establishment cost. The native forests under sustainable management are also recognised in the accounts at market value. Sample inventories are carried out with a five-year interval to check the modelled growth estimates. Adjustments to the growing stock value are recognised in the balance sheet under the separate category for Self-Generating and Regenerating Assets. Market value increment/decrement is recognised in the profit and loss account as a correction to the operating profit. In 1998, the size of the important market value decrement was roughly twice the size of the operating profit. This showed the possible impact of such an evaluation approach.

The distinction of market-driven value adjustments due to price fluctuations (booked as reserve changes) and the wealth-creating effects of biological growth (booked as revenue) are important in the new approach for the physical capital maintenance concept. Value changes due to changing market conditions have sometimes proven to be substantial and transitory.

International Accounting Standard 41 Agriculture

The development of an International Accounting Standard (IAS) covering forest assets resulted in the release of the International Accounting Standard (IAS) *41* 'Agriculture' by the International Accounting Standards Board (IASB)[4]. It changed agricultural accounting from a domestic issue dealt with by individual countries to a global issue. As part of international harmonisation, International Financial Reporting Standards (IFRS) are to be adopted by all listed companies within the European Union from January 2005, regulators in Australia require international standards for the statutory accounts of all domestic companies from January 2005, and New Zealand has followed in 2007. A survey by Deloitte and Touche (2003) suggests that more than 90 countries will either require or permit IFRS for listed companied by 2005 (Herbohn, 2009).

The standard largely follows the developments in Oceania (IASC, 1996, 1999, 2001; Elad, 2004). The familiar key problem is the evaluation and the distinction of realised and unrealised gains or losses resulting from increments, harvest and market value fluctuations in the forest stands, which has long been discussed in forestry accounting (Jäckle, 1934; Brabänder, 1965). The requirements for interim reports on a quarterly basis only exacerbate the problem. These require market price changes in cyclical industries such as the forest industry to be examined with significant care.

[4] Note: In 2001, the International Accounting Standards Board (IASB) assumed accounting standard-setting responsibilities from its predecessor body, the International Accounting Standards Committee (IASC). The International Accounting Standards (IAS) were recently renamed as IFRS (International Financial Reporting Standards).

Under *IAS 41*, biological assets relating to agricultural activity are to be measured at fair value[5] less estimated point-of-sale costs on initial recognition, and at each reporting date. Gains or losses on initial recognition and from a change in fair value of a biological asset are to be included in profit or loss for the period in which they arise. In addition, a gain or loss on initial recognition of agricultural produce harvested from a biological asset less point-of-sale costs is to be included in profit or loss for the period in which it arises. Alternate evaluation methods are permitted under *IAS 41* if an active market does not exist for a biological asset. Fair value can be determined with reference to the most recent market transaction price, market prices for similar assets, sector benchmarks, or the present value of expected net cash flows. In circumstances where there is little biological transformation, or the impact of biological transformation on price is not expected to be material, cost can be used to approximate fair value (Herbohn, 2009).

The standard also requires the disclosure of physical quantities in the annual report, reinforcing the need for improved inventory schedules and growth models that are constantly recalibrated for the respective inter-inventory period. This "return" to physical quantities and the envisaged requirement for a sensitivity analysis of the net market value underlines both difficulties in measurement and reliability of forest asset information. The latter is the main shortcoming of the pragmatic solution.

6. CONCLUSIONS

- Considerable differences in the business environment and cultures around the globe are reflected in forestry accounting practices.
- Forests and forestry are perceived very differently around the globe. Accounting information management is organised differently; depending on the way information is presented stakeholders understand forests differently.
- Forestry accounting also shapes the perspective society has on forestry and forests. Accounting not only provides a tool supporting management in its decision-making, but also makes information available to external addressees.
- For small holdings, tax and legislation are usually the most relevant influence factors shaping forestry accounting, while for the larger entities the framework becomes wider and the network of influences affecting forestry accounting is more complex.
- The evaluation and accounting treatment of forest assets remains the core problem for forestry accounting, also reflecting the largest differences in systems utilised and perspectives taken.

[5] Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction.

- The main forestry-related issue for forestry accounting revolves around valuing the self-generating and appreciating asset of the forest stands. In most cases the incomplete inclusion of the forest assets in the accounting system ends up being more confusing than helpful in measuring and reporting performance of the forest enterprise. Cost-based approaches are still widespread, but in terms of relevant information on the performance of forest enterprises these measures have to be considered as largely useless. Values reflecting some historic value or a tax value are equally misleading for external users. The striving for (market) value-based measures of performance including stocks and flows of the forest enterprises main productive asset – the forest stands – is beneficial to improving comparability and relevance of accounting information.
- The development of multinational forest holdings through rapid globalisation of the forest industry requires practical conventions to present the forest holdings in their entirety – i.e. including the value fluctuations of the worth of the growing stock – to investors and to a management which will be in less contact with everyday developments on the ground.
- Existing harmonisation efforts, including the IFRS, do not take the different business environment and forest management practices into account sufficiently. Accounting practices, which may appear practical, relevant and reliable in one place, cannot be transposed one to one around the world. Adaptations to local circumstances are necessary – e.g. highly productive plantation forests, multi-functional temperate natural forests or tropical concession forestry – to provide both management and other stakeholders with meaningful information.
- The IAS 41 covering self-generating and regenerating assets such as forests has increased awareness and discussion, but has certainly not brought a scientific solution nor is it likely to bring – due to limited coverage (e.g. in the Americas) – a common global approach to the longstanding problem of forest assets in accounting.
- The quality of inventories remains the most crucial element in all value-based approaches to include forest assets in accounting and thereby performance measurement. The ongoing downsizing efforts effecting inventories in particular, also increase the need to improve the dynamic modelling of forests.
- The identified differences in forestry accounting systems and practices together with the significance of the shortcomings in most systems proof that there is still significant need for further international research.

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GREEN ACCOUNTING OF HICKSIAN INCOME FROM SPANISH CORK OAK FORESTS

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ABSTRACT

The current application of the national Economic Accounts for Forestry (EAF) measures commercial flows in a simplified production account assuming a physical and forest economic steady state. For consumable fixed capital, it takes into account only the depletion of human-made fixed capital. In addition, the EAF focuses particularly on final output, ignoring any forest intermediate output, for instance, hunting and grazing rents. Environmental outputs are also ignored in the EAF measurements, whether they relate to public visitors' consumption of environmental services or landowners' private environmental use (amenities self-consumption). This paper explains and applies an Agroforestry Accounting System (AAS) that overcomes these limitations and allows for homogeneous aggregation of commercial and environmental values (using exchange values, and not welfare measurements, for the latter). We apply the AAS to two multiple-use Mediterranean forests: the Alcornocales (Cádiz-Málaga) and the Monfragüe (Cáceres) cork oak forests. Our results show that on-site private environmental income is larger in the Alcornocales forest, while public environmental income is higher in the Monfragüe forest. Production intensity, as measured by total cost, is higher in the Alcornocales forest, owing to the significantly higher cost of the mountain cork oak silviculture in this case study. The EAF measures 61% and 72% of AAS social net value added in the Alcornocales and Monfragüe cork oak forests, respectively.

Keywords: Multiple uses, cork oak forest, commercial income, environmental income.

1. INTRODUCTION

A growing interest in mitigating the deterioration and destruction of natural resources has led the public institutions in charge of national accounts and the international bodies to develop new methods to cover all flows of goods and services generated by forests and changes in the capital endowment of forests (ISWGNA, 1993; Nordhaus and Kokkelenberg, 1999; Eurostat, 2002; United Nations et al., 2003).

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There is a general consensus that "production-based measures usually rely on Hicksian income, which is the standard definition of net domestic or national product used in the national income accounts [regulations] of virtually all nations today" (Nordhaus and Kokkelenberg, 1999, p. 35). In this respect, the Economic Account for Forestry (EAF) system of the European Union defines the Hicksian income as "the maximum amount which the beneficiary can consume over a given period without reducing the volume of his/her assets" (Eurostat, 2000, p. 87).

Theoretical literature also proposes the use of the net domestic product (NDP), which is closely linked to the concept of Hicksian income (Hicks, 1946, pp. 172-173), as the most appropriate national income figure given its welfare interpretation, under a given set of ideal conditions. Weitzman (1976) laid the theoretical foundations for such use, and later research extended the concept to cover natural and environmental resources (e.g. Dasgupta and Mäler, 2000; Heal and Kristrom, 2001). With this background, Vincent (1999) proposed a theoretical model of sustainable total income specific to forests; he examined the issues of which items to include and how to adjust for the displacement of inter-sector incomes in forests. However, the theoretical results of these developments are far from showing a complete and homogeneous integrated approach to measuring total Hicksian income (Heal and Kriström, 2001, p. 74).

The definition of Hicksian income used in this study is as follows: the sustainable total income of a forest is the flow (income) of money (real or imputed) generated during an accounting period (one year) which, being wholly consumed within that same accounting period, leaves the forest with the same value of economic wealth (capital) at the end of the period as it had at the start in real terms, in the absence of new discoveries of wealth and net transfers from outside the forest. In this paper, we estimate the forest Hicksian income as the EAF net value added (NVA_{EAF}) extended to forest governmental expenditures and environmental services.

Hicksian income provides a substantial theoretical advance with respect to the way income is now measured by national accounting systems. To date, forest income has not been calculated completely in accordance with the national accounts standard *European System of Accounts* – ESA – (Eurostat, 1996). Instead, the satellite system EAF is in use; this scheme fails to consider non-wood products, environmental values, forest governmental expenditures and the forest capital balance (except for human-made durable goods depreciation). The Eurostat working group that has been looking at how to include environmental values in the economic accounts of European forests has proposed the pilot accounting system *The European Framework for Integrated Environmental and Economic Accounting for Forests* – IEEAF – (Eurostat, 2002), which takes into account the capital balance of a forest, as required by the enacting ESA regulation. However, the inclusion of monetary environmental values is missing since they "are not part of official statistical programmes [given that] the methods and assumptions used in the valuation studies are not standarized, and many theoretical and practical problems are still being debated" (Eurostat, 2002, p. 45).

In this study, we base our measurement of the Hicksian sustainable total forest income on the authors' Agroforestry Accounting System (AAS) methodological proposal. AAS presents a method of Hicksian income calculation which, in line with the prescriptions of theory, estimates sustainable total income within the applied national accounting system (Nordhaus and Kokkelenberg, 1999; Vincent, 1999; Lange, 2004). The connection between the AAS and the recommendations provided by the theoretical literature on forest green accounting is developed in recent articles by Campos (1999), Caparrós et al. (2003), Campos and Caparrós (2006), and Campos et al. (2007a).

The concept of Hicksian income may apply to the estimate for both social and private incomes. Major differences may arise depending on the significance of environmental services and governmental forest expenditures, as shown in the applications presented in this study. In particular, private total income includes goods and services that accrue to employees (there is no self-employed labour cost in this application) and the forest owner (including the forest owner's self-consumed amenities); while social total income extends the private income at market prices (i.e., without subsidies net of taxes) towards environmental outputs (taking into account only those consumed by public visitors in this application) and governmental forest expenditures. That is, we include all private and some public forest goods and services outputs and costs, both commodities and non-commodities.

Cork oak forests are located in the Mediterranean climate zones of Western Europe (Italy, France, Spain and Portugal) and North Africa (Tunisia, Algeria and Morocco), covering over 2.2 million hectares, with a 33% and 66% share in the two continents, respectively (CE Liege, 1999). In this study, we apply the EAF and AAS approaches to two Spanish forests and compare them: the Alcornocales and Monfragüe cork oak forests. Both are very similar in terms of land size and ownership distribution between private and public owners, but they differ in altitude and climate.

The Alcornocales case study was carried out in the Alcornocales Natural Park (ANP), located in Cádiz and Málaga provinces (south-west Spain). ANP extends over 167,767 hectares and has a complex geological structure, ranging from steep though moderately high mountains in the northern and central parts, to the southern lowlands of Campo de Gibraltar. Annual rainfall is between 677 and 2,094 mm depending on the specific location (BOJA, 2004), resulting in a high level of relative humidity (average 75%), in a humid Mediterranean climate. The Monfragüe case study is located in Cáceres province (central-west Spain), near the Sierra de Gredos range, about 250 kilometres from Madrid in a relatively flat area. It registers average annual rainfall between 363 and 693 mm (Fernández and Mateo, 2005), and has a continental Mediterranean climate.

Sole-boundary forest properties in Monfragüe and Alcornocales are frequently large estates mostly belonging to non-industrial single private owners, often over 500 hectares. Therefore, large private landowners use employees when they take direct charge of the private forestry, livestock and crop activities of their property (Campos et al., 1996; BOJA, 2004).

This work measures the forest sustainable income of an ideal permanent cork tree regeneration management. The Alcornocales and Monfragüe assisted ideal natural regeneration cycle of cork oak is 144 years (Montero et al., 2003 and 2005). Cork is stripped every nine years from the cork tree at the age of 37 and 28, respectively, when virgin cork is harvested for the first time. Silvicultural treatments are carried out during the cycle to maintain the level of cork productivity constant over time. These activities include regeneration cut-off, pruning, shrub clearing, thinning, felling of dead trees and final felling. Winter cork is a joint product with firewood from pruning and thinning treatments. Underwood vegetation is assumed to be grazed by cattle and big game (red deer and roe deer), which is hunted.

The applications presented are interesting in themselves, but their special role is to exemplify the usefulness of AAS in comparing, on a uniform basis, the commercial and non-commercial values generated by two multiple-use private cork oak forests in an institutional arrangements subject to public nature conservation regulation (since they are protected forest areas).

The rest of the article is structured as follows. Section two sets out the methodology, and is divided into three sub-sections. The first sub-section describes the simplified form of the AAS approach, the second one provides a general analysis of the values that have been included in the income estimate, and the third one briefly outlines the two AAS applications. Section three shows the results of Alcornocales and Monfragüe EAF and AAS income comparison. Section four discusses the improvements obtained by the AAS methodology compared with the results obtained with the current EAF national forest accounting rules and with the recent developments proposed by international accounting institutions. Finally, section five puts forth our main conclusions.

2. METHODOLOGY

2.1 The agroforestry accounting system (AAS)

The AAS divides data into three different accounts (Campos, 1999; Caparrós et al., 2003). The production account records the total cost incurred throughout the accounting period by the activities giving rise to the total output of the forest; the difference between total cost and total output is the forest-owner's residual net operating margin (benefit), assuming all the forest work is done by employees (as are the cases examined here). Variations from initial and final inventories and asset values of the accounting period, and their inflows and outflows, are reflected in two balance accounts: the production-in-progress balance and the fixed capital balance. The first balance presents as residual value the revaluation of the initial production-in-progress at the end of the accounting period, while the second balance treats as residual value the revaluation of the initial durable goods (goods that last for more than one period) involved in the economic activities of the forests (fixed capital goods).

However, a uniform income comparison of the two forests cannot be made directly for any year in the cycle; the variation can be significant, according to the specific time of the cycle at which measurements are taken. Therefore, to compare the two forests, we use two ideal cork oak silvicultures and simulate hypothetical steady states for generating an average-year result for the complete cork oak silvicultural cycle. This means that there are no capital gains other than those arising from the effect of discounting the initial standing production- in-progress. Given the steady state assumption, we are able to estimate the different figures and the AAS versus EAF comparison, using a simplified production account (see Campos (1999), Caparrós et. al. (2003) and Campos et al. (2007a)). That is, in steady state we can avoid considering gross natural growth (GNG), production in progress used (PPu) and capital balances[2].

The AAS methodology distinguishes between social income and private income. The simplified production account under AAS (Table 1) allows for the calculation of NVA (private or social) using the following identities: $NVA_X = TO_X – IC_X – FCC_X = NOM_X + LC_X$, and $NOM_X = TO_X – TC_X$, where NOM: net operating margin, TO_X: total output, TC_X: total cost; LC_X: labour cost, IC_X: intermediate consumption, FCC_X: fixed capital consumption; and the subscript X indicates private (P) or social (S) value.

In a steady state, the AAS private total income at market prices ($TI_{MP,P}$) equals the private net value added at market prices ($NVA_{MP,P}$) obtained from the simplified production account (Table 1). The AAS steady state $NVA_{MP,P}$ should be the same as the ESA $NVA_{MP,P}$. However, this is only true for the theoretical ESA, since current applications at national level are incomplete. The EAF actually measures an incomplete forest's private net value added at market prices ($NVA_{EAF,MP}$) which, in

[2] The steady state assumption makes it possible to estimate forest Hicksian social total income (TI_S) as the sum of AAS social net value added at market prices ($NVA_{AAS,MP,S}$) plus social production in progress revaluation (PPr). $TI_S = NVA_{AAS,MP,S} + PPr = TO_S + GNG – IC_S – PPu – FCC_S + PPu – GNG = TO_S – IC_S – FCC_S = NVA_{MP,S}$. Where $NVA_{MP,S}$: AAS simplified social net value added at market prices, TO_S: AAS simplified social total output, IC_S: AAS simplified social intermediate consumption and FCC_S: AAS simplified social fixed capital consumption.

fact, undervalues the real private income generated in the cork oak forests by the aggregated values of the resource rent (grazing rent and hunting rent) and owners' amenities outputs. That is, we have:

$$NVA_{EAF,MP} = TO_{EAF} – IC_P – FCC_P,$$

$$TO_{EAF} = CS + WC + FW + OI_P,$$

$$TI_{MP,P} = NVA_{EAF,MP} + GR + HR + SC = NVA_{MP,P},$$

where TO_{EAF}: EAF private total output, CS: summer stripped cork, WC: winter cork, FW: harvested firewood without bark, OI_P: private own investment, GR: grazing rent, HR: hunting rent, SC: owners' environmental self-consumption, IC_P: private intermediate consumption, and FCC_P: private fixed capital consumption.

In this study, the AAS social total income (TI_S) includes private income at market prices ($NVA_{MP,P}$), public environmental services consumed by public visitors with free access, and cork oak forest governmental expenditures. That is, the estimated TI_S aggregates the different incomes generated by individual uses, regardless of the recipient, i.e. the forest owner, the employees and the recreational visitors. Thus:

$$TI_S = NVA_{MP,P} + VR + VC + OI_G – IC_G – FCC_G + LC_G = NVA_{MP,S},$$

where VR: public visitors' recreation output, VC: public visitors' conservation output, OI_G: governmental own investment; IC_G: governmental forest intermediate expenditures, FCC_G: governmental forest capital consumption expenditures, LC_G: governmental forest employees compensation, and $NVA_{MP,S}$: social net value added at market prices.

In the steady state, the forest owner's total capital income (benefit) coincides with the net operating margin (NOM_P) or net operating surplus (NOS_P), where the latter is the aggregate of operating subsidies net of taxes on products (OST) and NOM_P:

$$NOM_P = TO_P – TC_P,$$

$$NOS_P = NOM_P + OST.$$

As with private benefit, social capital benefit coincides with social net operating margin (NOM_S) (where TC_G is governmental total cost ($IC_G + FCC_G + LC_G$)):

$$NOM_S = TO_S – TC_S = NOM_P + OI_G + VR + VC – TC_G,$$

Immobilised capital (IMC) for the accounting period is aimed at providing a standardised value for the average social or private investment allocated during that period to obtain the forest social or private capital income. Private immobilised capital (IMC_P) in the steady state is estimated based on private capital incomes (NOM_P) and the observed current cork oak forests' private profitability rates (r_P), both at market prices[3]. In the case of social immobilised capital (IMC_S), we discount the future value of social capital income at a given assumed social discount rate (r_S). Therefore, the private or social immobilised capital of the Alcornocales and Monfragüe steady state is obtained from the quotient of capital income (NOM_X) and profitability rate (r_X): $IMC_X = NOM_X/r_X$ (where X = P, S).

2.2 Values included in the steady state simplified production account

This sub-section sets out the values considered under AAS so as to ensure that all relevant items are included and avoid double counting. The production account comprises outputs and costs arising during a period, providing the information needed to calculate net value added at market prices. We detail the methods proposed for the output and cost valuation by looking directly at the market and by simulating markets.

2.2.1 Direct market values

Prices for commercial goods and services are offered objectively by the market and are directly observable; hence, estimating such prices is a relatively simple – though laborious – process. This is the case with the commercial output values of cork, firewood and own investment and with all the considered costs, either private market costs or governmental expenditures. Since no property in the area is at the steady state, commercial data could not be obtained from a single property. However, data from different estates and in-depth interviews with silvicultural firms working in the two regions enabled us to simulate the revenues and costs obtained in a hypothetical ideal steady state silviculture at constant prices (Campos et al., 2003 and 2005).

The use of prices from similar markets is proposed as the first criterion for cases where no market prices are observable. Hultkrantz (1992) uses this method for estimating the values for several non-timber forest products partially traded in the markets in Sweden (see also United Nations et al. (2003, chapter 8)), and so do we for hunting and grazing resource rents (using local market prices), having been valued at forest gate imputed market prices (Rodríguez et al., 2004, p. 89; Campos et al., 2006a).

2.2.2 Simulated market values

When no similar market prices exist, exchange values (price times quantity), and not consumer surplus values, are estimated (Vanoli 1998, p. 363). This procedure is

[3] The Alcornocales and Monfragüe immobilised capital comprises mainly land (including standing trees). We assume that land prices are not influenced by governmental subsidies and we then we consider private capital income and profitability rates at market prices to calculate immobilised capital.

quite common in the central regulatory national accounts framework (ISWGNA 1993). In the methodology followed here (Caparrós et al., 2001 and 2003), the procedure is applied to public and private environmental services. In principle, nothing distinguishes a service like public recreation (presently outside the market since access is free in our case studies) from a non-timber product like berries in Sweden (presently outside the market since picking is free (see Hultkrantz (1992)). Nevertheless, since no market for recreational services of forests exists, it is necessary to simulate it to determine what the price would be if the services were internalised by the market. In the case of the private use of amenities, its capital value is internalised in the land market price but this does not happen with the flow value and we also need to simulate a market.

For public recreational use, the first temptation is to use consumer surplus measurements (or any other welfare measure) provided by contingent valuation studies (see Skånberg (2001) or United Nations et al. (2003, chapter 9)). However, this implies assuming that all visitors pay their maximum willingness to pay (WTP) and this is too strong an assumption if the objective is to simulate a real market. Therefore, this application assumes that the owner can only choose one price for the recreational access and that his/her revenues depend on demand. This study further assumes that the forest-owner sets the price for the public visitors' access to his/her property in order to maximise his/her revenues (assuming a linear demand function, this maximisation occurs for the median, i.e. the price that half of the population is willing to pay).

This price provides an upper limit for the market revenue of the recreational services supplied by the forests (costs still need to be deducted). A lower limit will be given by the costs of the services, assuming that the owner sets the price in order to cover the costs[4] with no margin (or with a given 'standard' margin). The former option implies a monopolistic solution assuming that no variable cost exists (the monopolist would maximise his/her benefit and, with no variable cost, this implies maximisation of revenues) while the latter option is a perfect market solution. The real market price would be in between and, in the particular case studies considered here, it would probably be closer to the monopoly solution, since the areas studied are relatively unique in their respective regions. Thus, we use the value of the monopoly solution for aggregation.

The issue of the number of units consumed remains. The conventional procedure (Hultkrantz 1992; Skånberg, 2001) consists of multiplying the simulated market price by all the units consumed outside the market; thus, assuming that price-setting does not reduce consumption. This assumption is acceptable if the influence on the overall results is small (Pearce and Moran, 1994). Nevertheless, establishing a price obviously reduces the number of units consumed. Specifically, if the price for the re-

[4] Since costs are assumed to be constant, marginal and average costs are equal.

creational service is equal to the median of the WTP, only 50% of current visits would be ready to pay (Caparrós et al., 2003)[5].

In Alcornocales, the public visitors' free access recreational services were valued with a dichotomous-choice contingent valuation (CV) questionnaire given to 429 public visitors and, in Monfragüe, with an open-ended CV questionnaire to 336 visitors (for details see Oviedo et al. (2005) and Campos (1998), respectively). For aggregation purposes, we multiply the average WTP[6] obtained by 50% of estimated visits.

Conservation is a concept that could be estimated, theoretically, for society as a whole but, due to data limitations, we focus solely on visitors. In Alcornocales and Monfragüe, public visitors' conservation services were valued using an open-ended CV questionnaire given to 450 and 329 people, respectively (for details see Oviedo et al. (2005) and Campos (1998), respectively). In Alcornocales, visitors were asked to state the WTP for this concept for an annual habitat conservation fund. This way, each visitor could pay a different amount and his/her maximum WTP could be collected (Caparrós et al., 2003). Thus, the Alcornocales public visitors' conservation value is estimated by multiplying the mean WTP (without considering zero answers) by the percentage of visitors (and not visits) that would contribute to that fund. In Monfragüe, visitors' WTP for habitat conservation was added to the visitors' entry fees for recreation, and only half of the total visits times the mean WTP value was considered.

This study also estimates the environmental services (in a broad sense) that the owner of the cork oak forest self-consumes (Martin and Jefferies, 1966; Samuel and Thomas, 1999; Campos and Caparrós, 2006; Raunikar and Buongiorno, 2006; and Campos et al., 2007a). These environmental services include private recreational services, the possibility of inviting friends, the country way of life, etc. It is proposed that owners' self-consumption be valued in the central national accounting framework with market prices (and in the SEEA (United Nations et al., 2003)). Unfortunately, market prices for the flow of these services are not available. Potential owners would be willing to pay for these private uses when they decide the price to pay for a piece of land. Thus, a hedonic price approach could give us the part of the land price that corresponds to this use. Nevertheless, this approach has two main drawbacks, one that applies generally and one that is more particular to

[5] A similar criterion is supported by the Eurostat Task Force on Forest Environmental and Economic Accounting: "For a service with a zero price, the consumer surplus represents the area under a stated demand curve, and often the valuation studies allow deriving the shape of this demand curve. This can then be used to determine a 'quasi-market' value of the service. If the demand curves are linear, it can be shown that the maximum hypothetical 'quasi-market value' [price] of output would be 50% of the consumer surplus. Analyses of the forms of demand curves derived from CV method studies show that they tend to be convex rather than linear, which implies that the 'quasi-market' value will be less than 50% of consumer surplus" (Eurostat, 2002, p. 48).

[6] In Alcornocales, since the CV question was dichotomous, the mean and the median were the same. In Monfragüe, where the CV question was open-ended, we chose using the mean (higher than the median).

our case studies. The general problem is that our study focuses more on flow values[7] (output and net value added) and these values can only be obtained from a capital value once the discount rate is fixed (an always extremely delicate task)[8]. The particular drawback comes from the low number of oak estate transactions in the areas of our case studies, which makes the hedonic approach application a difficult task. Therefore, we chose an alternative option.

In purely financial terms, owners may be losing money by keeping their properties, since they might obtain higher revenues in alternative investments. The difference between their present market capital income and the capital income in an alternative investment is what they are actually ‘paying’ for the environmental services that they enjoy[9] (Campos and Riera, 1996, Campos and Caparrós, 2006; Raunikar and Buongiorno, 2006). Nevertheless, this is only a lower limit for the market price that landowners are ready to pay for these environmental services. To find the upper limit, we asked landowners about their maximum WTP for the private environmental services that they enjoy (the question was framed in terms of the maximum amount that they were ready to lose before selling their property). This is the upper limit because, if they had found somebody ready to pay more than this amount, they would have sold their property “to other investors who have similar feelings for the land” (Pope and Goodwin, 1984, p. 750). The real market price is somewhere between these two limits. Nevertheless, if the interviewed landowners (a sample of the current landowners) are sufficiently representative of all the landowners-market-agents, the price (owner’s WTP) would be close to the average value of the maximum level of losses in order to sell (otherwise transactions would never take place). Thus, we use the upper limit for aggregation purposes.

Landowners’ amenities self-consumption was valued using an open-ended CV questionnaire given to 19 and 35 non-industrial private cork oak forest owners, in Monfragüe and Alcornocales, respectively. The sample covered 15% and 27% of the territory where private amenities are consumed in Monfragüe and Alcornocales, respectively (Campos and Mariscal, 2003; Campos et al., 2006b).

3. COMPARISON OF ALCORNOCALES AND MONFRAGÜE RESULTS

3.1 Total output

The main commercial output of each forest is cork (summer plus winter stripped corks), as expected from a cork oak forest, contributing 60% and 68% of the

[7] Kallio (1999) estimates owners’ WTP for environmental goods and services self-consumption as a flow, although in terms of utility.
[8] Samuel and Thomas (1999) follow this subjective approach to valuing the owners’ amenity annual flow equivalent opportunity cost.
[9] To do this calculation, we need to know the appropriate interest rate, which is less difficult to obtain than the discount rate, since they do not always coincide.

Table 1: AAS and EAF[1] cork oak forest steady state net value added at market prices comparison (2002 € per hectare)

Class	Alcornocales cork oak forest					Monfragüe cork oak forest				
	Private			Public	AAS social total	Private			Public	AAS social total
	EAF	Omitted by EAF	AAS private total			EAF	Omitted by EAF	AAS private total		
	a	b	c=a+b	d	e=c+d	a	b	c=a+b	d	e=c+d
1. Total output (TO)	543.0	264.1	807.1	20.1	827.2	513.2	158.5	671.7	23.5	695.2
Summer stripped cork (CS)	*459.3*		*459.3*		*459.3*	*433.4*		*433.4*		*433.4*
Winter cork (WC)	*21.2*		*21.2*		*21.2*	*20.5*		*20.5*		*20.5*
Firewood (FW)	*36.6*		*36.6*		*36.6*	*42.2*		*42.2*		*42.2*
Own investment (OI)	*25.9*		*25.9*	*9.1*	*35.0*	*17.1*		*17.1*	*0.5*	*17.6*
Livestock grazing rent (GR)		*16.7*	*16.7*		*16.7*		*16.2*	*16.2*		*16.2*
Hunting rent (HR)		*38.1*	*38.1*		*38.1*		*42.1*	*42.1*		*42.1*
Amenities self-consumption (SC)		*209.3*	*209.3*		*209.3*		*100.2*	*100.2*		*100.2*
Public visitors recreation (VR)				*5.1*	*5.1*				*10.5*	*10.5*
Public visitors conservation (VC)				*5.9*	*5.9*				*12.5*	*12.5*
2. Total costs (TC) (3+4+5)	413.3		413.3	58.5	471.8	256.1		256.1	18.3	274.4
3. Intermediate consumption (IC)	99.1		99.1	9.1	108.2	35.8		35.8	1.8	37.6
Private (IC_P)	*99.1*		*99.1*		*99.1*	*35.8*		*35.8*		*35.8*
Governmental (IC_G)				*9.1*	*9.1*				*1.8*	*1.8*
4. Labour costs (LC)	288.3		288.3	39.6	327.9	203.2		203.2	16.0	219.2
Private (LC_P)	*288.3*		*288.3*		*288.3*	*203.2*		*203.2*		*203.2*
Governmental (LC_G)				*39.6*	*39.6*				*16.0*	*16.0*
5. Fixed capital consumption (FCC)	25.9		25.9	9.8	35.7	17.1		17.1	0.5	17.6
Private (FCC_P)	*25.9*		*25.9*		*25.9*	*17.1*		*17.1*		*17.1*
Governmental (FCC_G)				*9.8*	*9.8*				*0.5*	*0.5*
6. Net operating margin (NOM) (1-2)	129.7	264.1	393.8	-38.4	355.4	257.1	158.5	415.6	4.7	420.3
7. Net value added (NVA_{MP}) (4+6)	418.0	264.1	682.1	1.2	683.3	460.3	158.5	618.8	20.7	639.5

[1] EAF: European Union National Economic Accounts for Forestry, AAS: Agroforestry Accounting System.

Alcornocales and Monfragüe private total outputs. Cork is also the main single social total output in both case studies (Table 1).

Private total output is higher in Alcornocales than in Monfragüe, especially regarding the private self-consumption of amenities output, since this output in Alcornocales is double that of the Monfragüe one (Table 1). Social total output is 19% higher in Alcornocales. The reason is again the Alcornocales private amenity output, since Alcornocales EAF commercial output is only 6% higher than the Monfragüe one, whereas most of the total output is commercial, both private and social (Table 1). Since the currently applied EAF system focuses on incomplete forest commercial outputs (cork, firewood and human-made own investment), current national accounts capture 67% and 76% of the Alcornocales and Monfragüe social total outputs, respectively.

Considering owners' self-consumption of environmental services (amenities), since Monfragüe's commercial private profitability rate is closer to the market interest rate, we obtain a lower amenity real opportunity cost than in Alcornocales. Private use of amenities contribute with 26% and 15% of private total output in these forests, respectively (Table 1).

The CV questionnaires used to estimate the visitors' free access recreation and conservation values yield significant differences[10], although both show that the 'price' per visit under consideration is relevant in these cork oak forests. The numbers of estimated annual visits reached 2.0 and 0.5 visits per hectare per year in Monfragüe and Alcornocales, respectively (Campos, 1998; Campos et al., 2007b). In regard to visitors, Alcornocales has low annual rates (visitors are not relevant in Monfragüe for aggregation), where there are 0.3 visitors per hectare per year[11]. However, only two-thirds of visitors stated that they would be willing to contribute to the habitat-conservation annual fund. When we aggregate the simulated market values explained in the methodology section, the result is that public visitors' recreation and conservation services account for 1% and 3% of total social output in Alcornocales and Monfragüe, respectively (Table 1).

3.2 Total cost

The Monfragüe forest has a lower total cost per hectare than the Alcornocales forest. The social total cost of Monfragüe is 58% of the Alcornocales one, and 62% as regards the Monfragüe private total cost (Table 1). This difference is chiefly due

[10] The difference in the WTP for recreational use is partly explained by the payment vehicle: an entry fee at Monfragüe and increased trip expenditures in Alcornocales, where the mean WTP was €10 and €22 per visit in 2002, respectively (Campos, 1998; Campos et al., in press). Monfragüe's WTP value was updated to 2002 market prices.

[11] The CV survey showed that a visitor goes to Alcornocales 1.64 times per year.

to the higher amount of private labour employee compensations and governmental expenditures in the Alcornocales forest. In Alcornocales, the private cost is 88% of social total cost while, in Monfragüe, this ratio rises to 93%. As with social output, current national accounts are closer to the true value in the case of Monfragüe.

3.3 Net value added

The Alcornocales forest generates 7% more social net value added at market prices per hectare than Monfragüe (Table 1), while the difference is relatively higher (24%) for private net value added at factor cost (Table 2). However, if we use conventional EAF social net value added at market prices ($NVA_{EAF,MP}$) for comparison, the opposite is true since Alcornocales generates only 91% of that produced at Monfragüe $NVA_{EAF,MP}$ (Table 1).

In Alcornocales, $NVA_{EAF,MP}$ reflects only 61% of social net value added at market prices ($NVA_{MP,S}$), while in Monfragüe it reflects 72% (Table 1). Therefore, $NVA_{EAF,MP}$ is a closer measure of $NVA_{MP,S}$ in the case of Monfragüe. This is due principally to the higher contribution from private environmental income to the total income measured in the Alcornocales forest.

In Monfragüe, similar magnitudes are obtained for social and private (at factor cost) net value added (Table 2), unlike Alcornocales, where the latter accounts for 17% more than the former (Table 2). The distribution of $NVA_{MP,S}$ between labour and net operating margin also differs for Alcornocales and Monfragüe, since employee compensations are relatively larger in Alcornocales (48% of $NVA_{MP,S}$) than Monfragüe (34% of $NVA_{MP,S}$).

3.4 Net operating margin and profitability rates

Social capital income at market prices (social net operating margin) and private capital income at market prices (private net operating margin) are 18% (Table 2) and 6% (Table 1) higher in Monfragüe than in Alcornocales, respectively. This should imply higher market values for forestland in Monfragüe than in Alcornocales, if the same investment private profitability rates were observed, but this is not the case. For the former, we estimate a private profitability rate at market prices of 4.0% and, for the latter, 5.5% (Ovando et al., 2006).

Market land prices are much higher in Alcornocales than expected if its private net operating margin value is discounted by the Monfragüe estimated private investment profitability rate. The estimated private immobilised capital is 30% higher in Alcornocales than in Monfragüe. Since the asset values of public visitors' environmental services are unobservable, social immobilised capital in both forests could be estimated as imputed value after assuming a forest social discount rate (Pearce

Table 2: AAS[1] cork oak forest steady state incomes, immobilised capitals and profitability rates results (2002 euros per hectare)

Class[1]	Private				Social		
	Commercial		Environmental	Total	Commercial	Environmental	Total
	Market prices	Factor cost[2]		(Factor cost)			
	a	b	c	d=b+c	e	f	g=e+f
1. Net value added (NOM+LC or NOS+LC)							
Alcornocales cork oak forest	472.8	592.2	209.3	801.5	453.9	229.4	683.3
Monfragüe cork oak forest	518.6	548.0	100.2	648.2	515.8	123.7	639.5
2. Net operating margin or surplus (NOM or NOS)							
Alcornocales cork oak forest	184.5	303.9	209.3	513.2	126.0	229.4	355.4
Monfragüe cork oak forest	315.4	344.8	100.2	445.0	296.6	123.7	420.3
3. Immobilised capital (IMC)							
Alcornocales cork oak forest				9,845.0			14,216.0
Monfragüe cork oak forest				7,556.4			16,812.0
4. Profitability rate (NOM/IMC or NOS/IMC) (%)							
Alcornocales cork oak forest	1.9	3.1	2.1	5.2	0.9	1.6	2.5
Monfragüe cork oak forest	4.2	4.6	1.3	5.9	1.8	0.7	2.5

[1] AAS: Agroforestry Accounting System.
[2] The factor cost values include the operating subsidies net of taxes on products.

and Ulph, 1995; Whitby, 2005). Applying a 2.5% social discount rate for capitalizing the social net operating margin, we obtain a social immobilised capital that is 44% and 122% higher than private ones in Alcornocales and Monfragüe, respectively (Table 2).

The Monfragüe private and social commercial profitability rates at market prices are 121% and 100% higher than the Alcornocales ones, respectively (Table 2). This difference decreases when net subsidies and environmental services are considered, where the Monfragüe total private profitability rate at factor cost is only 13% higher than the Alcornocales one (Table 2). If we include only commercial values in the estimate for the private profitability rate, the difference is even higher: the Monfragüe private commercial profitability rate at factor cost is 48% higher than the Alcornocales one (Table 2). Total social profitability rates are assumed to be the same in both forests (Table 2).

4. AAS VERSUS EAF APPLICATION DISCUSSION

AAS is essentially an applied approach to green national accounting. Thus, we will discuss in this section the results obtained applying the AAS methodology to those that would arise applying conventional EAF accounting, or the extensions recently debated by official statistical institutions (Eurostat, 2002; United Nations et al., 2003). For this purpose, we will focus on Table 1.

The first column (for Alcornocales and Monfragüe, respectively) in Table 1 shows the result that would be obtained by applying the current forestry conventional national accounting (EAF method in Europe). On the output side, current EAF focuses on cork, firewood and human-made own investment. On the cost side, only private costs are taken into account in the EAF approach.

The second column in Table 1 shows the values theoretically included in the ESA regulation but which are currently not included in EAF. Recent developments propose measuring most of these values in an essentially similar way to the one that we used. Non-timber goods and services are supposed to be included in future national forest accounting systems according to Eurostat (2002) and United Nations et al. (2003) recommendations.

On one hand, the value of livestock grazing is currently included indirectly in conventional accounts in the agricultural sector (EAA), although it would be more appropriate to include it as an output of the forestry sector (Vincent and Hartwick, 1998, p. 25). Grazing resources are valued using market prices for renting pastures, and not using market prices for artificial feeding (a good approach for a close substitute), as proposed in other applications (Skånberg, 2001, p. 51; Merlo and Croitoru, 2005, p. 28). In Alcornocales and Monfragüe, market prices for a forage unit from rented grazing is about 50% cheaper than the same forage unit obtained from commercial hay at the farm gate (Rodríguez et. al., 2004, p. 89; Campos et al., 2005).

On the other hand, owners' amenities self-consumption is conceptually an ESA output, since the market includes this in the value of forestland. However, the difficulties to estimate a flow value imply that even recent developments do not include this value (Eurostat, 2002; United Nations et al., 2003). The AAS proposes its inclusion, but the difficulties to obtain an accurate flow value are recognised.

On the costs side, the main contribution of the AAS system is to include governmental expenditures (fourth column of Table 1) for measuring social total income in the forest under consideration. In the *System of National Accounts* (SNA), "Government administration is a non-market service with no identifiable product sold in markets, so it is valued in national accounts at its cost of production" (Lange, 2004, p. 80). However, including governmental expenditures on the output side runs a strong risk of double counting if the services produced have already been valued; e.g. fire-prevention and fire-fighting efforts (the lion's share of public expenditures in this application) have a direct impact on the generation of private output. Thus, we include governmental expenditures only on the cost side, assuming that there is no additional missing public output from governmental expenditures.

The fourth column in Table 1 also presents public environmental output values, in addition to commercial ones (government own investment). These values are the most controversial ones, and current proposals do not expect them to be included in national accounts in the near future (Eurostat, 2002; United Nations et al., 2003). The main reason is the lack of homogeneity between the exchange values considered in conventional national accounting and the welfare measurements (in terms of consumer surplus) yielded by non-market valuation techniques. To overcome this difficulty, we estimate exchange values for public environmental values (visitors' free access recreation and habitat conservation values), trying to measure the output that could be produced in the forest if public access has a price (a single price for all visitors, not their mean maximum WTP times total visits). That is, we use non-market valuation techniques to know the demand function (assuming no income effect) and we assume that the owner sets a single price (except for a conservation value in Alcornocales, since a voluntary payment to a fund was used in the CV question).

Nevertheless, assuming the existence of markets that actually do not exist implies counting money in the forestry sector that was actually spent somewhere else. That is, visitors would pay the price assumed (according to the CV studies), but they actually did not and thus they spent it somewhere else. That is, "the challenge is to utilize non-market values in the forest sector, which are estimated in the macroeconomic or general equilibrium context of analysis. The value must be consistent and comparable with market values in the large system of accounts so that the forest sector is truly integrated into the larger economic system" (FAO, 1998, p. 4).

This problem also applies to the imputed owner's self-consumption of real estate property rent in conventional national accounting (SNA/ESA). That is, as already happens in conventional accounting, if the method proposed in this paper would be followed nation-wide, part of national income would not be "real" money and the same part of national consumption would also not be paid with "real" money. But, in any case, homogeneity with real exchange values would be pushed as far as possible, and homogeneity with the solution proposed in current national accounts for values such as the rent of one's own house would be almost complete (at least in the case of the owner's self-consumption of amenities). In other words, there are other exceptions in conventional national accounting that depart from the observable market prices in the SNA framework, and "a rigorous restriction of the SNA to market transactions would seriously limit its analytical power" (Bartelmus, 1998, p. 269).

5. CONCLUSIONS

This study presents and applies a methodology that allows for uniform comparison of private and social incomes generated by the forestry sector of a multiple-use cork oak forest. We made commercial and non-commercial measurements, both for cork oak forests of the Alcornocales mountain range and the Monfragüe flat range. For non-commercial services, we measured three environmental outputs in each forest using the contingent valuation technique (the visitors' free access recreation and conservation values, and the owners' amenities self-consumption).

The results show that public visitors' environmental benefits make a very low contribution to social total income in both case studies, and considerably less in the case of the Alcornocales cork oak forest. In both cases, private environmental self-consumption by landowners is high, especially in the Alcornocales forest, and it explains a substantial part of the market price of the forests; hence the estimate for these benefits should be a priority for future research.

Regarding the forest green national accounting debate, the main conclusion to be drawn from these applications is that including environmental values (particularly free access recreational use and owner's amenities self-consumption) can be done on the basis of an applied framework using information from non-market valuation techniques and adapting rules currently being used in conventional national accounting.

As expected, when the relative importance of the environmental values is low, as compared with the commercial values, conventional national accounting approximates to the true total income generated in the forest (but this is only true if the forest steady state is the current situation); if environmental values are important, the opposite is true. The exchange values for these environmental services, obtained by simulating markets, prove to be relatively important (as compared to commercial values) in the two case studies under consideration. These results probably do not match *a priori* perceptions in Spain, especially concerning the relatively high importance of amenities self-consumption in cork oak forests, so that a systematic application of these types of methodologies can prove to be very useful for rigorous public forestry policy-making.

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INCORPORATING NON-TIMBER OBJECTIVES IN FOREST MANAGEMENT PLANNING ON PRIVATE LANDS: A CASE STUDY OF THE CUMBERLAND PLATEAU OF TENNESSEE, USA

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ABSTRACT

The Cumberland Plateau region, extending from northern Alabama to northern Kentucky in the United States, has been the focus on considerable debate during the past five years concerning the proper balance between traditional resource utilization practices and non-timber activities. The Plateau, which is more than 80 percent privately-owned, has been identified as a region that contains one of the highest concentrations of biodiversity and endangered species on the North American continent. Additionally, the region has supported a significant forest products industry that has expanded in recent years and coal mining pressure is increasing on the Plateau with rising energy costs. Moreover, the region attracts recreationists for a wide range of activities, including kayaking, rock climbing, backpacking, and caving. As a result of the increased pressure for all uses, several efforts have been initiated to address the effects of the competing demands on the forests of the Plateau. This paper will address these issues from the perspective of identifying the economic tradeoffs resulting from expanding the definition of forest management to include a range of non-timber considerations.

Keywords: Forestry, forest management, ecosystem services, and non-market valuation

1. INTRODUCTION

Incorporating nontraditional values into management decision-making for lands that historically have been used for timber and minerals is problematic at best. This is particularly true for the Cumberland Plateau of the southeastern United

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States. While the region has supported a large forest industry as well as coal mining and oil and natural gas extraction operations for the past century, debate over land use and management has intensified over the past decade. This can be attributed to a number of factors including a growing population, often with values in conflict with traditional resource use; rising energy prices; increasing demands for timber from the Plateau; an expanding interest in ecotourism opportunities; and growing recognition of the biodiversity of the region.

This paper reports on recent efforts to address the conflicting demands being placed on the land base of the Plateau by developing a framework to incorporate non-timber values into land use and management decisions by private and public landowners. Before discussing the framework, however, the paper provides a description of the ecological, economic, and social history of the region and reviews prior research related to the conflict in management objectives.

2. THE CUMBERLAND PLATEAU

The area encompassed by the research is defined as the Northern Cumberland Plateau of Kentucky and Tennessee, and consists of 28 counties (12 counties in Kentucky, 16 in Tennessee) (see Figure 1). The Cumberland Plateau is home to one of the most biologically diverse and rich ecoregions in North America (Druckenbroad and Dale, 2004; TNC, 2003; Noss et al., 1995). Yet the region has a long history of poverty, limited economic opportunities, and sagging educational standards (Haaga 2004). Recent data suggest that the economic gap between Plateau

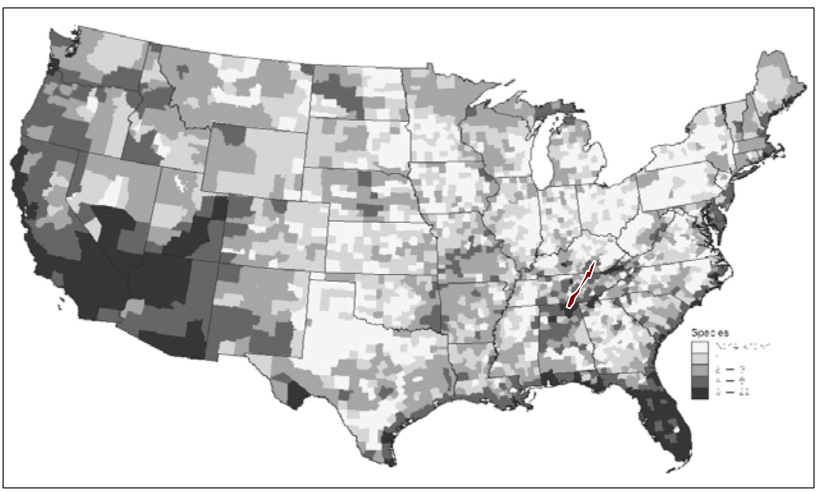

Figure 1: Location of Cumberland Plateau, USA

counties and their respective state economies is widening. In the 1970s, for example, the average per capita income for Plateau counties totaled 70.5 percent of the state per capita income. By 2001, the Plateau average had declined to 57.4 percent (U.S. Census Bureau, 2004). Much of the economic problems of the region can be linked to the education levels of the region which continue to lag behind state averages. In Tennessee, for example, only 64 percent of the adult residents completed high school, compared to 76 percent of the state's residents. Similarly, less than 10 percent of the region's adults earned a college degree compared to 17 percent for the state. Similarly, less than 56 percent of adult plateau residents in Kentucky completed high school and less than 9 percent completed college. These compare to state averages of 74 percent of Kentucky residents completing high school and 16 percent completing college (U.S. Census Bureau, 2004).

The Plateau contains some of the most diverse temperate forests in North America which some conservationists view as requiring critical habitat protection and restoration (Ricketts et al., 1999). Forests are the predominant land cover of the region, comprising 70 percent (Schweitzer, 2000) of the land area. Fewer than 5 percent of the region's residents are employed in the fields of forestry, farming, or fisheries (Bradley et al., 2001). Although the area's forests have been high-graded, they are an important source for several sawtimber and wood fiber mills in the region. Due to limited economic employment in the region, a relatively high percent of the employed people living in the area commute to commercial centers outside the area for work.

The region supports a significant forest products industry, with more than 250 wood-using mills located on the Plateau. The bulk of these entities are comprised of rough lumber mills (39 percent of all wood-using mills), pallet mills (20 percent), and grade lumber mills (13 percent). Moreover, a significant portion of wood harvested from Plateau forests, are processed in other regions, most notably east Tennessee. The forest products industry on the Cumberland Plateau in Tennessee counties contributed more than $900 million in Total Industrial Output (TIO) to the region's economy in 2000 and employed more than 5,700 individuals directly in the forest products companies (English et al., 2004). Interestingly, the Plateau's share of the state's forest industry-based TIO and employment for primary forest products was 7.3 and 10.3 percent, respectively. These percentages dropped to 2.9 and 3.6 percent for secondary forest products. Coupled with the fact that the region provided 20 percent of the state's roundwood production, these numbers indicate the degree to which primary and secondary wood processing are occurring in other regions of Tennessee and surrounding states.

More recently, the area's natural resources are being recognized for their unique character, rich biodiversity, scenic beauty, and potential for ecotourism. Recreational assets include 486,000 areas of public land in 3 national park units; 36 state parks, natural areas, and forests; 22 wildlife management areas or refuges; a national scenic river; and 3 state scenic rivers. The World Wildlife Fund, The Nature Conservancy (TNC, 2003) and The Natural Resources Defense Council (NRDC, 2004) have all recently named the Cumberland Plateau's ecoregion as housing one of the most biologically diverse temperate forests in the world as well as one of the most biologically diverse freshwater ecosystems. Both TNC and NRDC have recently launched programs to help conserve what they see as the region's sensitive and threatened natural habitats.

3. RECENT WORK ON THE CUMBERLAND PLATEAU

A number of studies have been conducted by researchers at The University of Tennessee since 2000 related to land use and forest management. Several focus groups and landowner surveys and interviews have been conducted to determine landowner motivations and attitudes and how management decisions are made. Most of the research reveals that the Cumberland Plateau landowner population is changing, with more emphasis being placed on non-timber values such as recreation, wildlife, and aesthetics. Moreover, landowners are becoming more interested in management activities that are less intrusive on the land and provide greater opportunities to enhance a range of values.

Two studies have been conducted since 2000 to assess the economics of non-timber values on the Cumberland Plateau – one assessing the demand for and economic impact of outdoor recreation opportunities in the region and a second study which evaluated landowner preferences for selected forest amenities.

3.1 Recreation Demand and Economic Impacts (Sims 2003)

This study was conducted on the Obed Wild and Scenic River (OWSR) which is located in Morgan County, Tennessee – on the eastern boundary of the Cumberland Plateau. The OWSR is a nationally known rock climbing area, with a wide range of difficulty present for climbers. Rock climbing surveys and interviews took place over a 12-month period and were disaggregated into 7 recreation sites that were divided into 3 survey units. The recreation sites in this area include private lands, Nature Conservancy holdings, and National Park Service administered lands. The surveys consisted of short (<2 minute) on-site interviews as well as mail questionnaires for those who agreed to participate. Three hundred and two interviews of rock climbers were conducted and, 292 agreed to complete the mail survey. Of those 292, 140 returned the survey for a response rate of 48%. The survey process followed procedures similar to those outlined by Dillman (2000).

A model of a recreational rock climber's choice of the number of visits to make to the OWSR was modeled using a traditional individual travel cost model (TCM). The model estimated has a Poisson distribution with the general specification being:

$$Y_i = \exp(\text{PRICES}_i, \text{QUALITY}_i, \text{DEMOGRAPHICS}_i, \text{error term}) \quad (1)$$

The model estimated also corrects for endogenous stratification, which occurs with onsite sampling. With on-site sampling, the likelihood of a person being sampled is related to the frequency of their visits. In the Poisson specification, subtracting one from the reported number of trips adjusts the annual number of trips downward to reflect the fact that those who take a higher number of annual trips are more likely to be sampled (Englin and Shonkwiler, 1995). The specific model specification is as follows:

$$\begin{aligned} \ln TRIPS = {} & B_0 - B_1{*}TC - B_2{*}SKILL + B_3{*}RCGRP + B_4{*}INC + B_5{*}MILES \\ & + B_6{*}BLDR + B_7{*}DAY + B_8{*}CLIMBS + B_9{*}SUB \end{aligned} \quad (2)$$

where TRIPS is the estimated number of rock climbing trips taken; TC is travel costs for a rock climbing trip to the OWSR; SKILL is the individuals skill level based on a sport climbing grade; RCGRP is a dummy variable to represent membership in a rock climbing club or group (1=Yes, 0=No); INC is the individual's annual income before taxes; MILES is the miles traveled to the OWSR; BLDR is a dummy variable to determine whether the individual is a boulderer (1=Yes, 0=No); DAY represents whether the trip taken was a day trip (1=Yes, 0=No); CLIMBS represents the number of climbs in the climber's ability range; and SUB is the travel cost measured in miles to all relevant substitute sites.

Personal demographics of climbers surveyed indicate that the average recreational rock climber visiting the OWSR in 2002-2003 was a single male between the ages of 20 and 30 years old, had some college education, and earned between $25,000 and $35,000 annually. Individual trip statistics reveal that sport climbing, traditional climbing, and bouldering all occurred at the OWSR with over 81% of total use being sport climbing. The average annual number of recreational rock climbing trips to the OWSR was approximately 32. On average, trips to the OWSR constituted approximately 56% of the total number of rock climbing trips taken per year. The average day trip lasted nearly 6 hours and the average multi-day trip lasted nearly 3 days. Nearly 74% of total use was day use activities. While the majority of users traveled less than 50 miles to reach the OWSR, a small group traveled much further.

Analysis of travel cost data revealed that total expenditures for the average rock climbing trip to the OWSR totaled $46.70.[4] A breakdown of spending behavior reveals that the greatest percent of this cost resulted from food and beverage costs as well as costs of transportation to and from the area. Compared to these costs,

[4] This estimate does not include the cost of travel time and depreciated equipment costs.

Table 1: Definition of Poisson Regression Variables

Variable	
TC	Expenditures incurred while visiting the OWSR in addition to the cost of travel time and depreciated equipment costs
SKILL	Climber's skill level based on U.S. sport climbing rating system
RCGRP	Dummy variable = 1 if member of a rock climbing group or organization
INC	Annual personal income of the respondent
MILES	Miles traveled to climb at the OWSR
BLDR	Dummy variable = 1 if respondent participates in bouldering
DAY	Dummy Variable = 1 if respondent was on a day trip
CLIMBS	Number of climbs in climber's ability range
SUBS	Average travel costs measured in miles for traveling to substitute sites

lodging expenses were significantly smaller likely due to the large proportion of individuals that camped on both public and private property. Of the $46.70 in expenditures incurred, $17.97 (38.47%) occurred in Morgan County. Expenses incurred in Morgan County mostly came from food and beverage purchases.

Definitions of Poisson regression variables are listed in Table 1. The results of the Poisson equation are listed in Table 2. As expected by theory, the price variable, TC, was negatively related to trips and was significant at the 1% level. A 10% rise in travel costs would produce a 3.4% decrease in number of climbing trips taken to the OWSR. The respective substitute price variable coefficient had a positive sign and was also significant at the 1% level. Thus, even a fairly unique rock climbing site like the OWSR is considered by users to have substitutes. It is also shown that an increase in income will tend to lead to more trips taken. Specifically the income elasticity of demand for rock climbing trips to the OWSR was 0.19. This implies that a 10 percent increase in income would result in a1.9% increase in rock climbing trips taken to the OWSR. Survey results also indicate a positive relationship between day use and number of trips. This is most likely attributed to the fact that day users often live closer to the area resulting in more trips taken through the course of the year. The explanatory power of the regression is reasonably good given the individual cross-section data.

Table 2: Results of Poisson Regression

Variable	Coefficient	Std Error
Constant	2.0062**	0.4935
TC	-0.0051**	0.0017
SKILL	0.1431	0.1016
RCGRP	0.2534	0.1404
INC	0.0696**	0.0266
MILES	0.0017*	0.0009
BLDR	0.1855	0.1272
DAY	1.2018**	0.2527
CLIMBS	-0.0010	0.0009
SUBS	0.0048**	0.0019

N = 140
R-Squared = 0.433
Chi-Squared = 2011.434
Restricted Log Likelihood = -2109.853
** significant at the 1% level
* significant at the 5% level

The estimates of consumer surplus are listed in Table 3. The value per-trip of rock climbing in the OWSR was estimated at $196. Individual consumer surplus per season was found to be $2,648.45. This is obtained by multiplying the per-trip estimate by the estimated number of trips per year. The estimate of total annual consumer surplus experienced by rock climbing visitors to the OWSR is listed in Table 3 as well. As can be seen, the estimate of nearly $327,000 is quite large considering the number of user days.

Table 3: Consumer Surplus for Rock Climbing at the OWSR

Annual Individual Consumer Surplus	Individual Per-Trip Consumer Surplus	Per-Day Consumer Surplus	Annual Consumer Surplus OWSR
$2,648.45	$196.08	$130.72	$326,797.39

3.2 Forest Amenities (Wells 2002)

This second study applied a stated preference instrument to assess the willingness of residents in the Emory-Obed Watershed of the Cumberland Plateau to pay for forest amenities. Discrete choice (DC) modeling, which is one of several conjoint analysis methods, has traditionally been applied in the marketing literature. Recently, DC has become a popular measurement tool for environmental economists. Our study employed a random utility model to describe the choices of participants among 11 alternative forest amenity enhancement plans. The forest amenities specified in our survey are quasi public goods because they are not entirely nonexcludable and indivisible in consumption. The specific amenities included in our survey include wildlife habitat, scenic beauty, stream quality, and recreational access.

The participants were asked to evaluate three plans simultaneously for five repetitions, in what is referred to as a choice set, and then select the plan in each set they most prefer. Across all five choice sets one plan remained constant, representing the status quo (no management). Within each choice set the plans were decomposed into five attributes (recreation, scenic beauty, stream quality, wildlife habitat, and voluntary contribution) and three quality levels. An enhancement plan was described to the participant as a written guide, developed by a resource professional, that a landowner would follow in order to improve the level of forest amenities. In return for following the plan, the landowner would receive monetary compensation from the participant through a third party, non-governmental organization. We presented the compensation mechanism to the participants as a means of helping landowners who manage their land to do so in a manner that provides the most public benefits and for landowners that do not manage their land, the incentive to do so and in a socially desirable way.

Two versions of the survey (identical in all respects expect the specification of the status quo, where we informed respondents of possible further loss of forest amenities due to residential development) were mailed to a total of 3,000 residents in the 2 counties. In addition to the respondent selections, each address was geocoded to determine the amount of forest and natural land cover in a one km buffer around the respondent. This additional information was included in the multinomial logit model to explain differences in willingness to pay across respondents. Approximately 11 percent of the surveys were returned out of the 3000, which is not an unusual rate for similar surveys. Analysis of the non-respondents revealed no non-response bias.

Overall, respondents were willing to contribute to increase the provision of selected forest amenities (Figure 2). Specifically, of the 1860 scenarios evaluated (each of the 372 respondents evaluated 5 scenarios each), the respondents were willing to pay some level of compensation in 1301 of the scenarios.

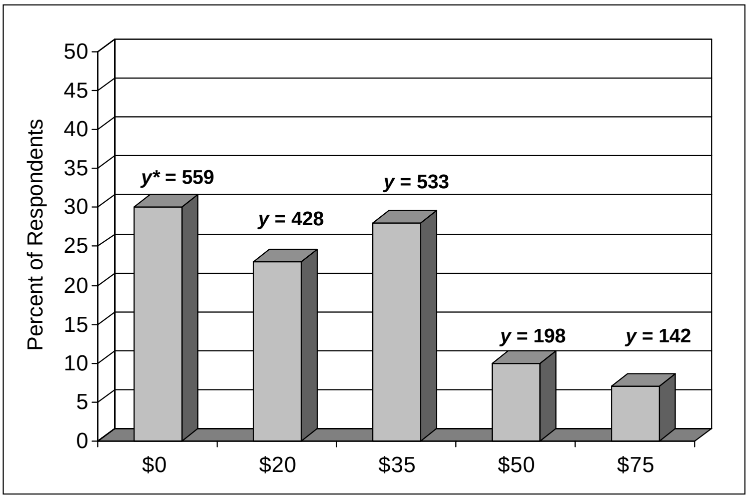

Figure 2: Histogram of Choice by Payment

One interesting differences among willingness to pay for amenities. Specifically, statistical tests, based on the Cochran-Mantel-Haenszel test statistic, provide evidence of some lack of support by forest landowners for forest amenity provision. To conduct the specification of this test, we created a dichotomous variable separating nonlandowners, who own less than 5 acs, and landowners. We then observed how many choices were made by group for either the status quo or a forest amenity enhancement plan (Option B or C in the survey). As Table 4 illustrates, nonlandowners choose one of the forest amenity enhancement plans significantly more often then landowners. Thus, there seems to be a serious disconnect between demand for forest amenities, represented by nonlandowners, and supply of amenities, represented by landowners. A similar test was conducted for the impact of development information on choice. Information included in the survey that forest amenities might be lost to residential development served as an incentive, or positive inducement, to respondents to choose one of the forest amenity enhancement plans.

Table 4: Association Tests for Responses by Specification of Landowner Type and Status Quo

Specification	Choice	
	Status Quo	Forest Amenity Improvement
Landowner Type		
Less than 5 ac	380 (28%)	990 (72%)
More than 5 ac	181 (37%)	309 (63%)
CMH χ2(df = 1)	14.5071*	
Status Quo Information		
No Development	345 (33%)	700 (67%)
Development	216 (26%)	599 (74%)
CMH χ2(df = 1)	9.2161*	

4. PLAN OF ACTION

The results of the two studies described above illustrate some of the extensive non-market goods and services provided by Cumberland Plateau forests, as well as the willingness of users and residents to pay for their continued availability. As the demand for these nontraditional forest uses continues to increase, landowners and forest managers will be faced with developing new management alternatives and policy makers will be required to devise policies to encourage these changes. As part of this work, we have initiated a research program to develop the information needed to incorporate the nonmarket values into land management activities on the Cumberland Plateau. Specific goals of the research program are to:

1. Establish local groups to participate in identifying research needs and economic development opportunities,
2. Assess feasibility of markets for ecosystem services to incorporate private incentives in decision making,
3. Develop new public incentives to encourage provision of a wide range of goods and services,
4. Investigate potential for new markets to adapt to available raw materials and encourage alternative outcomes, and
5. Explore policy and market effects on development and land use decisions assess impact from changes in landowners and motivations.

Specific user/resident research will include surveying Plateau residents to ascertain the value of biodiversity conservation relative to other important values; determine residents' understanding of the importance of biodiversity conservation; identify residents' sense of environmental stewardship, especially regarding the importance of natural resource availability for future generations; determine residents' values about the importance of protecting threatened or endangered species; determine the strength of values regarding protecting threatened and endangered species on the Plateau relative to other quality of life concerns; and identify residents' preferences for what methods are used to balance natural resource use and protection relative to threatened and endangered species.

Ecosystem service valuation research will involve conducting a preliminary feasibility assessment of such markets in the region. Specific tasks will include reviewing past and ongoing efforts in the U.S. to establish markets for ecosystem services, identifying the components of successful markets, and assessing the likelihood of success for such markets on the Cumberland Plateau. Assessing the feasibility for the Cumberland Plateau will require identifying potential services for development such as carbon, water quality and quantity, and biodiversity. Target services will be selected based on the results of the initial phases of the study and the ease at which such services can be measured and funds obtained for establishing markets.

Work on land markets will include collecting data on current and historical values for agricultural, commercial, forested, and residential land on the Cumberland Plateau; assessing trends in land ownership and tract size; and determining the relationship between loss/gain of forest land and land values. Once data have been collected, determining the relationship between loss/gain of forest land***,*** forest cover types***,*** and land values will entail developing models to assess the relative relationships between land values and land use. The results will provide insight into how land use decisions are affected by markets and identify where future development may occur.

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FOREST SERVICES VALUATION SYSTEM APPLIED TO FOREST PLANT ZIDLOCHOVICE OF THE FORESTS OF THE CZECH REPUBLIC STATE ENTERPRISE

Luděk Šišák[1]

ABSTRACT

Monetary valuation of socio-economic importance of forest services for the society is a considerably difficult and complex theoretical and practical issue. Forest services are not uniform considering their socio-economic impact on the society and their relationship to the market. The system of valuation of socio-economic importance of forest services for the society was derived for the conditions of the Czech Republic (CR) in 2002, adapted in 2005 and applied as a case study to the area of forests administered by the Forest Plant Zidlochovice belonging to the state enterprise Forests of the Czech Republic.

The Forest Plant Zidlochovice is situated in the south-eastern part of the CR and administers 22.5 thousand ha of forests in an area important for different forest services, especially timber production forest service, hunting and game management (many game reserves 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 reserves 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.

Methods of valuation of socio-economic importance of forest services are differentiated by their socio-economic essence in the society, by purpose of their employment and input data availability. Valuation of market services is based on the mean year income from timber sale, hunting and game management on incomes from the respective activities, hydrological services by costs of prevention, soil protection services by costs of compensation, CO_2 sequestration by shadow prices of trade with CO_2. Pricing of health-hygienic and cultural-scientific forest services of a non-market essence is performed by expert approach using comparative method, i.e. comparing their socio-economic importance to the socio-economic importance of market services as for example timber production.

Results of valuation are important for decision making in forest management in the area and will also be used in calculations of socio-economic effectiveness of multi-

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purpose forest management by the managerial staff of the Forest Plant Zidlochovice and by managerial staff of the state enterprise Forests of the Czech Republic.

Keywords: Forest services, market services, non-market services, valuation, Czech Republic

1. INTRODUCTION

Monetary valuation of socio-economic importance of forest services for the society is a considerably difficult and complex theoretical and practical issue. It applies not only to non-market forest services (positive externalities of forests and forestry) but also to market services. The values represent a socio-economic and political category. They are understood as degrees of benefits to the given societal subjects. The valuation may be characterised as a process of expressing the degree of the use, i.e. the significance of the services to the given social (societal) subject.

Forest services form a complex socio-economic system. In regarding the character of many forest services' systems it is obvious their structure is not and cannot be stabilised because it is formed considering different objectives and purposes, at different places and times, in different social conditions. Forest services' systems are always purpose-built.

Speaking about major problems of valuation of non-market forest benefits, the purpose of valuation is frequently raised (both by the theoreticians and practitioners) in the Czech Republic (CR). Generally, the monetary expression of non-market forest benefits importance can be used especially for the following activities:

- identification of share of forests' importance for natural and social welfare of the country,
- analyses of the state and development of social demands for forest benefits,
- expression of socio-economic effectiveness of multiple and sustainable forest management,
- decision making about land allocation between forestry and other kinds of land use,
- assessment of value of social losses caused by damaging of forests,
- stimulation of effective and wise use of forests, of all their goods and services,
- improvement of forest planning and of forest running processes in the frame of multifunctional forestry.

Obviously, the forest services are not uniform in terms of their socio-economic content. They differ in socio-economic essence of their impact and in their role in the society. Methods of forest services valuation vary also by socio-economic background of the respective society, by purpose of pricing and by data availability. Different ways of forest services valuation were used by individual countries were used e.g. by Merlo, Croitoru (2005). Also Blum (2004) presented different possibilities of forest services valuation.

System of pricing of socio-economic importance of forest services for the society, regarding the aspects mentioned above, was derived in the Czech Republic in 2002 (Šišák, Svihla, Sach, 2002), adapted in 2005 (Šišák et al., 2005) and applied as a case study to the area of forests administered by the Forest Plant Zidlochovice, a part of the state enterprise Forests of the Czech Republic.

Forest Plant Zidlochovice is situated in south-eastern part of the CR administering 22.5 thousand ha of forest lands scattered on the administrative area of 110 thousand ha. The forest area is important for different forest services, especially timber forest service, nature protection forest service (floodplain forests on the area of conjunction of rivers Morava and Dyje), recreational forests (Lednice-Valtice area), and others. Apart from the above mentioned aspects, forest plant Zidlochovice is the most known establishment specialised in hunting, game management, game reserves and pheasantries in the CR. Forest management in Zidlochovice area can be considered as a typical multipurpose forest management in the CR. There were identified all basic forest services generally differentiated by their socio-economic content (Šišák, Svihla, Sach, 2004):

- ☐ **market forest services** (production functions, internalities)
  - timber production service
  - hunting and game management service
  - other market services
- ☐ **non-market environmental forest services** (externalities)
  - with mediated market impact (with measurable market, i.e. economic, impacts)
    - non-wood forest production services
    - soil-protective services (site soil erosion protection, protection against eroded soil deposits in water streams and reservoirs)
    - hydrological (water management) forest services (protection against maximum runoffs and minimum runoffs in water streams, water quality in water streams, reservoirs and resources)
    - air protective forest services (protection of air quality, climate, CO_2, NO_x sequestration)
  - without measurable market impact
    - health-hygienic forest services (recreational and health influencing)
    - cultural-educational (nature protective, educational, scientific and institutional) services.

2. METHODOLOGY

Methods of socio-economic valuation of forest services are differentiated by their diverse socio-economic essence and impact on the society (mentioned above), purpose of their employment in the society and input data availability (Šišák, Svihla, Sach, 2002; Šišák et al., 2004).

The forest is a dynamic and renewable environmental resource. This fact is considered by valuation of forest services. Therefore, derived pecuniary values are differentiated into the annual and capitalised forms reflecting the fact that forest services can work, can be damaged, or even lost in respective localities temporary or perennially. Capitalised values were derived from year values by capitalising them using 2% interest rate. This interest rate is the so called forest interest rate usually applied for similar cases in the Czech theory and practice in the respective legislation (Šišák et al., 2005).

2. 1 Timber production forest service

Timber production forest service proceeds through the market. Therefore, it can be valued by virtue of yield methods, cost methods, comparative market methods and by combinations of them. Individual methods of valuation are applied differentially in accordance with purpose of valuation, giving different results.

The value of timber production forest service for owners/tenants on one side and for the society on the other side differ significantly. What we now encounter in relation with leaving certain parts of forests to so called spontaneous processes (without use of such forests for market production purposes) by requirements or even orders by governmental nature protection (conservation) agencies. The production services can be restricted or completely eliminated in favour of nature protection or conservation forest service.

The public socio-economic importance and value of market services (for the society) is much broader and higher than the value for private persons like owners and tenants. The public value of market services consists not only of net income for a forest owner but also of value of working places, wages and salaries of employees, of values of means of production used in production processes, taxes paid to public budgets, and of all other outputs of market forest services used in the society. The value of timber production for the society was experimentally derived from the current values of timber market sales in the period 1999-2003.

2.2 Hunting, game and dear production service

Hunting, game and dear production forest service proceeds through the market. Therefore, it is of the same socio-economic nature as timber production service.

The service can be valued by the same methods, like the yield methods, cost methods, comparative market methods and by their combinations.

The socio-economic value of hunting, game and dear production forest service for the society was experimentally derived from the values of incomes embracing game and all other commodities from hunting and game management in the period 1999-2003, current prices. The values were calculated for both the open hunting areas and for closed hunting areas with intensified hunting and game and dear production service in game reserves and pheasantries in the area of Forest Plant Zidlochovice.

2.3 Non-market production service of the forest

Non-market production service of the forest consists of production and picking of forest berries, mushrooms, medicinal plants and other products free of charge by forest visitors. These products attain the character of externalities of a mediated market character. The volume of their harvest and their social significance is surprisingly high in the CR.

The mean socio-economic value of non-market production services of the forest for the society was experimentally derived from the shadow market values (current prices) of main non-wood forest products collected by forest visitors in amounts in the period 1999-2003 (Šišák, 2006).

2.4 Hydrological (water management) forest services

Hydrological (water management) forest services consist of reducing maximum runoff in water streams, enhancing minimum runoff in water streams and protecting water quality (especially against contaminations with nitrogen oxides). Such forest services influence market relations, they have a mediated market character.

Socio-economic valuation of the hydrological forest services was based on the “costs-of-prevention approach”. The costs were calculated for technical measures like retention reservoirs and other constructions and technical equipment substituting the respective hydrological forest services reducing maximum runoff in water streams, enhancing minimum runoff in water streams and reducing the content of nitrogen oxides in water streams and reservoirs.

2.5 Soil protection forest services

Soil protection forest services represent protection against soil loss by water and wind erosion on steep stony and skeleton sites (introskeleton erosion on respective localities), and protection of water streams and reservoirs against deposits of eroded soil parts. The services are of the same socio-economic essence as hydrological forest services. They influence market relationships; they have a mediated market character. Socio-economic valuation of the soil protection forest services was based on the “costs-of-compensation approach”, which means that the value was calculated by costs of measures compensating or removing damage caused by the loss of its protective function.

Socio-economic value of the forest service related to protection against soil erosion in the respective stony and steep localities (intro-skeleton erosion) was derived on the base of extra costs of reforestation of the land including the bringing of new soil and stabilisation of the soil in given plots. Socio-economic value of protection service against eroded soil deposits in water streams and reservoirs was calculated using the costs of the removing the soil deposits from the respective water streams and reservoirs.

2.6 Air protection forest service – CO_2 sequestration

Air protection forest services, especially CO_2 sequestration, have similar socio-economic character to hydrological and soil protection forest services. They influence market relations as trade with CO_2 permits is developing. Nevertheless, it is true that carbon-emission trading can become a direct market-based good in near future. Socio-economic valuation of CO_2 sequestration was based on average unit price of international trade with CO_2 permits in Europe and year amount of CO_2 sequestered in timber increment. The price was based on published data on Greenhouse Gas Market, published in Geneva (2003) by the International Emission Trading Association IETA.

2.7 Health-hygienic (recreational, health) forest services

Health-hygienic forest services reflect the fact that people use forest environment for recreational relaxation and health purposes. They are of intangible, non-market nature. For expressing the socio-economic value of health-hygienic forest services expert approach was employed. Expert approach is quite well known and elaborated including attempts to apply it in practice in the CR. One of such valuation systems derived by Skypala (1988) is still used in the legislative practice (Forest Act No. 289/1995 in the parts dealing with fee for the withdrawal of forestland designated for the fulfilment of forest services). Both annual value and capitalised value are distinguished. The need of annual values and capitalised values is presented by Holecy (1998).

Expert method was based on comparison of mean general socio-economic importance of the health-hygienic forest services to the mean general socio-economic importance of timber production forest service. Thirty nine Czech experts in forest services from all important research institutions in the CR were questioned about their preferences regarding relative socio-economic importance of the respective services and timber production service. The resulting expert ratio is 0.33. The mean general value of health-hygienic forest services was derived from the timber production forest service value by this rate. Local values were differentiated by forest frequentation (Šišák et al., 2002).

Valuation of non-market forest services based on the “consumer-surplus approach” and on the “willingness-to-pay” calculations is still not generally exploited in the CR. There were performed partial pilot surveys of recreational forest service importance based on experimental Contingent Valuation Method within the whole CR. But under present socio-economic conditions the results were not satisfying. The results reflect the fact forests have always been freely accessible to everyone regardless the form of ownership. The recreational service is obviously not felt as something strongly deficient or on the fringe of deficit for users (Šišák et al., 1997, 2000). The methods still seem to be considerably hypothetical, theoretically and practically complicated and organisationally and financially exacting. However, they may provide interesting and applicable results for some purposes.

2.8 Cultural-educational forest services (nature conservational, educational, scientific and institutional)

Cultural and educational environmental forest services manifest the fact that forest environment represents one of the least changed environmental components by human activities. The forest environment is an irreplaceable source of knowledge of the nature and its evolution, relationships of natural environment and society. The services are important for science, research, education, they represent objects of activities pursued by various scientific, educational and cultural institutions. Like health-hygienic forest services the cultural-educational forest services are of an intangible non-market essence.

For expressing the socio-economic value of cultural-educational environmental forest services the expert approach was employed using comparative method, i.e. comparing their general mean socio-economic importance to the general mean socio-economic importance of timber production service. It was the same procedure as in the case of health-hygienic forest services. Resulting ratio is 0.28 in the frame of the CR and it is used for expressing mean general socio-economic value of the cultural-educational forest services in the CR. Local differentiation was based on the landscape zoning that represents different qualities and grades of nature protection (Šišák et al., 2002).

3. RESULTS

In the frame of Forest Plant Zidlochovice, the socio-economic values of individual forest services vary to a great extent by respective forest site and forest stand, by environmental, social, cultural and economic factors in individual localities. Compared to average values and their fluctuation in conditions of the CR, majority of services' values in the Forest Plant Zidlochovice area is higher and the scope is more limited than in the area of CR.

Table 1: Unit socio-economic values of forest services in the area of Forest Plant Zidlochovice (EUR/ha)

Forest services	Year value	Capitalised value
Timber production	302.5	15,129
Hunting and game management	56.7	2,837
Non-timber production	13.3	668
Hydrological – maximum runoffs	2.7	122
Hydrological – minimum runoffs	11.1	552
Hydrological – water quality in streams and reservoirs	23.1	1,153
Soil protection – introskeleton site erosion	0.5	23
Soil protection – soil deposits in streams, reservoirs	0	0.3
Air protection – CO_2 sequestration	38.8	1,940
Health-hygienic	136.1	6,807
Cultural-educational	217.4	10,870

Values were originally derived in Czech Crowns (CZK) and then transformed into EUR by an average currency rate 1:29. Values are expressed in two forms – average annual values and capitalised values. Capitalised values are calculated from average annual values (considered as perpetually repeated) by formula: average annual values/forest interest rate. Expert consensual level of so called forest interest rate is 2% in the CR. Results are presented in Tables 1 and 2, and in Figure 1.

Timber production forest service

The average value of timber production (market) forest service is higher than the CR average 269 EUR/ha annual value and 13,443 EUR/ha capitalised value. Nevertheless, the average figures vary substantially by qualities of forest site and forest stand production factors in Zidlochovice from 54 EUR/ha to 417 EUR/ha year value, and from 2,689 EUR/ha to 15,129 EUR/ha capitalised value.

Hunting, game and dear production service

The average year value of hunting, game and dear production (market) forest service on open areas reaches 6 EUR/ha of forestland. Capitalised value equals 293 EUR/ha. But the average year value of hunting, game and dear production (market) forest service in game reserves and pheasantries (in which the Zidlochovice forest plant is specialised) reaches 64 EUR/ha annual value and 3,179 EUR/ha capitalised value. The average values are higher than those in the CR.

Non-market production service of the forest

The area of Forest Plant Zidlochovice is not very important for non-wood forest commodities production and collection by forest visitors because of climate, forest site and stand conditions. As only certain amounts of mushrooms are collected on the area and no forest berries the presented values are under the average values of the CR, reaching 45.3 EUR annual value, and 2,267 EUR/ha capitalised value.

Hydrological (water management) forest services

The average values of maximum runoff reduction in water streams, based on soil type, terrain features, soil cover factors and public needs in individual localities, are lower than the average figures from the area of CR as the forests in mostly flat landscape with low precipitations have no such importance like in majority of the CR. The same can be said about values of minimum runoff enhancement in water streams and values of water quality protection in water streams and reservoirs.

Soil protective forest services

Average capitalised value of soil protection against erosion, against soil loss on respective localities, varies about 7,897 EUR/ha and average year value about 158 EUR/ha. But the figures are calculated only on steep stony and skeleton sites that are very rare in Zidlochovice area. So, the average unit values calculated from the total Zidlochovice area are very low compared to the CR.

The values (annual and capitalised) of protection service against eroded soil deposits in water streams and reservoirs are very negligible, approaching to 0 EUR/ha under conditions of the Zidlochovice area (flat landscape, small amount of precipitations, sandy soils).

Air protection forest services – CO_2 sequestration

The values of CO_2 sequestration are higher than the CR average 37.9 EUR/ha annual value and 1,724 EUR/ha capitalised value. Nevertheless, the average figures vary substantially by qualities of forest site and forest stand factors in Zidlochovice.

Health-hygienic (recreational, health) forest service

Average year values of the health-hygienic forest service are higher than the average value of the CR. But figures differ by site, stand and public demand aspects in Zidlochovice area, generally from 88.7 EUR/ha to 259.3 EUR/ha annual value, and from 4,436 EUR/ha to 12,967 EUR/ha) capitalised value.

Cultural-educational forest services (nature conservational, educational, scientific and institutional)

Average values of the health-hygienic forest services are higher than the average value of the CR. Nevertheless, the values differ substantially by categories of protected areas from nature protection point of view and by forest site and stand qualities in Zidlochovice area. The annual values vary generally from 58 EUR/ha in commercial forests to 312 EUR/ha in forests of national protected reserves, and from 2,898 EUR/ha to 15,602 EUR/ha capitalised value.

Table 2: Total socio-economic values of forest services in the whole area of Forest Plant Zidlochovice (in 000'EUR).

Forest services	Year value	Capitalised value
Timber production	6,256	312,816
Hunting and game management	1,279	63,938
Non-timber production	301	15,057
Hydrological – maximum runoffs	54	2,718
Hydrological – minimum runoffs	247	12,294
Hydrological – water quality in streams and reservoirs	513	25,659
Soil protection – introskeleton site erosion	11	530
Soil protection – soil deposits in streams, reservoirs	0	6
Air protection – CO_2 sequestration	802	40,120
Health-hygienic	3,069	153,421
Cultural-educational	4,900	244,999
Total	17,432	871,558

As regards the whole forest area of the Forest Plant Zidlochovice (22.5 thousand ha), the most important is the timber production service sharing 35.9%, followed by cultural-educational services (nature protection forest service) sharing 28.1% and by health-hygienic services (recreational service) with 17.6% and by hunting and game management service with 7.3%. The percentages are presented in the following Figure 1.

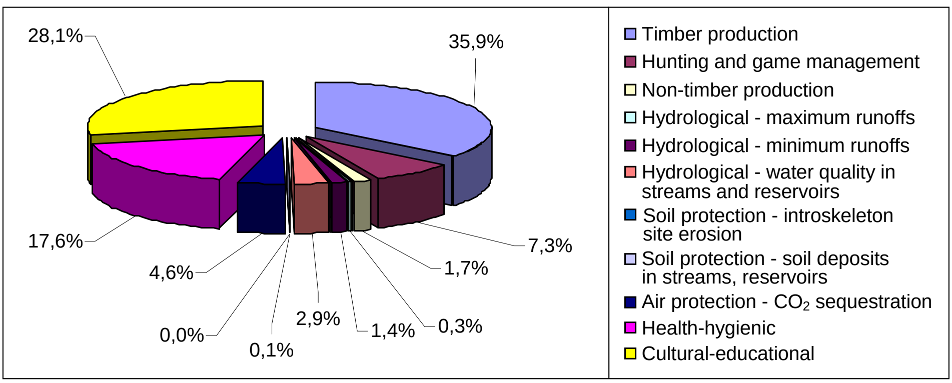

Figure 1: Total socio-economic values of forest services in %

4. CONCLUSIONS

Results of employment of forest services valuation system (derived experimentally for the Czech Republic) to the area of Forest Plant Zidlochovice show that the valuation system can be applied for valuing socio-economic importance of forest services for the society in concrete localities and cases. Simultaneously, the results prove big socio-economic importance of forest services for the society in the respective area.

It is true that monetary valuation of socio-economic importance of forest services for the society is a considerably difficult and complex theoretical and practical issue. Forest services are not uniform considering their socio-economic impact on the society and their relationship to the market. The system of valuation methods used for different forest services should reflect the socio-economic impact on the society but also socio-economic and cultural background of the society and input data availability.

Valuation of market services is based on the mean year income from respective markets (timber sale, hunting and game production). Valuation of hydrological forest services was done by costs of prevention, soil protecting services by costs of compensation, CO_2 sequestration by shadow prices of trade with CO_2. Valuation of health-hygienic and cultural-scientific forest services of a non-market essence was performed by expert approach using comparative method, i.e. comparing their socio-economic importance to the socio-economic importance of market services (timber production).

In valuation of forests services, especially of a non-market nature, is and always will be a considerable share of subjective factors (as no objectification of prices through the real market mechanism exists). Nevertheless, the obtained values can be applied for different purposes in practice. The application and mutual comparability of such values depends to a great extent on consensus in the frame of respective community as a whole. Results of valuation are important for decision making in forest management in the area and will also be used in calculations of socio-economic effectiveness of multipurpose forest management by the managerial staff of the Forest Plant Zidlochovice and by managerial staff of the state enterprise Forests of the Czech Republic.

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EFFECTS OF THE KYOTO PROTOCOL ON THE OPTIMAL ROTATION PERIOD FOR A POPLAR PLANTATION

Elena Mingarelli, Giordana Droghei and Lorenzo Venzi[1]

ABSTRACT

This paper sets the objective of verifying, in economic terms, various managerial hypothesis for a forest plantation, based both on wood production and on carbon storing and/or their combination. A poplar plantation will be considered and the value of its biomass will be estimated confronted along with the operational options of the Kyoto Protocol. The article 3.3 of the Protocol allows to compute carbon storing by afforestation and reforestation, only beginning from 1990, whilst article 3.4 allows additional activities which can be considered. At present, Directive EU 87/2003, which regulates the exchange of emission permits in Europe, does not allow for carbon credits coming from the agro-forestry sector. Within this context this paper is set, aiming at showing possible opportunities offered to the sector.

Poplar plantations in Italy are covering a surface of 83.000 ha, mainly located in Piedmont and Lombardy, with yearly yields around 1.171.346 m^3 of round wood. In the last decade the traditional production has experienced an average decrease of 21%, as a response to new market requests and development policies.

The capacity of an eco-system to store carbon depends on its characteristics, the size of its unitary biomass, and the type of silvicultural system adopted. Moreover, forest harvesting subtracts to the wood ecosystem biomasses which can release the embedded carbon either in short time (fuel wood) or store it in medium-long time (wooden artefacts). Considering all that, the comparison between the economic benefits deriving from the traditional cropping of poplar and those coming from the addition of subsidies envisaged by the Kyoto Protocol, opens new opportunities which can have strategic impacts on the forestry sector. Summing up, it is expected to determine and quantify the effects derived by these different scenarios and combination of goals, respondent to the concept of multifunctionality, both for timber and carbon storing, on rotation length, employment and income.

Keywords: Agro-forestry activities, Kyoto Protocol, optimal rotation period and poplar plantation

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The paper is a joint effort by the three co – authors. However par. 1 and 6 have been jointly written; par 3. and 4.3 have been written by G. Droghei, and par. 2, 4.1, 4.2, 5 have been written by E. Mingarelli

1. INTRODUCTION

The present paper sets the objective of defining the optimal rotation period of a poplar plantation and considering in addition the financial implications deriving from the Kyoto Protocol. The case study relates to a poplar plantation having determined the value of stands with reference to round wood, together with carbon accumulation following the thesis of an entrepreneur who could also benefit the opportunities offered by the Kyoto Protocol.

In order to fulfil the Kyoto Protocol obligations, Country-Parties can either act on the reduction of the quantity of green-house gas (GHGs) emissions, or on the increase of absorption by carbon sinks from eligible agro - forestry activities (LULUCF[2]).

Within that context this paper aims at finding out the effects on the definition of the optimal rotation, both in qualitative and quantitative terms taking into consideration the effects derived from the foreseeable market for credits of CO_2. The methodological framework adopted for this analysis is the search for optimal rotation period according to the "incremental" approach and the "discounted costs and revenues" approach. The paper, after brief analysis of the northern Italian poplar industry, deals with the technical and managerial features of a single poplar plantation and, by considering alternative discount rates and alternative timber yields revenues, defines the optimal rotation period. After that the financial provisions from the Kyoto Protocol are introduced, citing the most likely (not yet defined) hypothesis of financial contribution as agro-forestry credits, and afterwards the consequences of this on the rotation period will be discussed. The comparison between financial benefits derived by the poplar growth and the provisions of the Kyoto Protocol leads to new scenarios with implications of strategic meaning for the cultivated forestry sector.

2. THE ITALIAN POPLAR INDUSTRY

The poplar industry in Italy has been, and still is, one of the most relevant components of cultivated silviculture. The national timber harvest in recent years has stabilised around 9.24 million m^3 (ISTAT, 2002) out of which 60% (5.5 million m^3) as fuel wood and 40% (3.8 million m^3) as round wood. The latter is made up of poplar for 45% (relating to a surface of 82.9 thousand ha, equivalent to 1.21%). 86% of total harvested timber comes from woodland, whilst the remaining part is obtained in areas "out of forest". Forest farms in Italy have always been managed according to multiple production models (fuel wood, poles for agricultural crops, food for animals, soil protection etc.) because of locational factors, agrarian structure, economic problems related to farming organization in hilly and mountain areas. In-

[2] Land Use, Land Use Change and Forestry

come derived from woodland appeared so far mostly as an integration to agricultural produce and forestry products were considered destined to self consumption. Notwithstanding the improved socio – economic conditions, Italian woodland is still highly oriented to outputs of low value and low technological quality. In this context of marginal conditions, policies for rural development can provide an opportunity for timber plantations to improve local conditions by providing a chain of investments, planning supply flows and technological improvements in the output (Zanuttini and Cielo, 1998).

Poplar plantations, as an industry, appear a suitable opportunity to investigate because of the homogeneity of the output, the fast and high yield increases and the easiness of timber processing. All this provides the poplar species with requisites able to satisfy market needs to a large extent and with great success in recent years.

In Italy poplar plantations are mostly embedded in the agricultural system and particularly located in flat land, near rivers, in the northern part of the country. In the year 2000, according to the 5th Agricultural Census, 88% of the total poplar acreage is located in Piedmont, Lombardy, Emilia Romagna, Venetia and Friuli Venezia Giulia. However, 63% of it belongs to the first 2 quoted regions.

In the decade 1990-2000 the poplar plantations have been reduced of 21%, but even more relevant (37%) has been the decrease of the number of farms which produced that crop.

The national yearly yield of poplar has been estimated at 1.17 million m^3 of round wood (ISTAT, 2005), a level strongly below that of imported quantities almost 10 years ago, when the Italian timber industry was much more active (Coaloa, 1999, cited by Coaloa and Vietto). However, this is not unusual since poplar plantations have always been affected in the past by cyclical (10 years) patterns, due to market pressures, macro - economic cycles, and speculative manoeuvres.

This pattern, however, in the most recent years has been disrupted (Giau, 1995, cited by Cielo et al.) because of the enlargement of the areas under poplar plantation stimulated by the measures of the Common Agricultural Policy, the drop in the demand, the low quality for poplar timber, and low request for tops and branches no longer able to cover harvesting costs (Zanuttini and Cielo, 1998, cited by Cielo et al.). This situation, determining 3% as internal rate of return on poplar investment, as bad as it is, still experiences almost satisfactory economic conditions, wherever locations are suitable for proper climatic conditions allowing high and fast timber yields (Coaloa and Vietto, 2005).

Future market conditions are very difficult to ascertain because of conflicting trends, i.e. the substitution of new poplar investments with other valuable timber species (Reg 2080/92 et seq.); demand for imported poplar to countervail domestic supply shortage; other destinations for poplar wood (as chipping, etc).

At the moment the most suitable poplar saplings come from clone I-214 which couples fast growing records and sturdy attitude towards pests and diseases. It covers almost 50% of the total population.

Poplar plantations are very close in management to agricultural crops, since they require usual agricultural practices in terms of soil harrowing, fertilization, irrigation, chemical treatments and so on. Unless poplar trees are set in suitable environmental conditions, it is very likely that stress conditions will materialize, with heavy consequences on harvest timing and yields.

3. THE IMPLICATIONS FROM THE KYOTO PROTOCOL

As it is well known since the industrial era, the World Global Warming has steadily grown, due to the increase mainly of CO_2 and CH_4. Since 1997 the United Nations Framework Convention on Climate Change (UNFCCC), with its Kyoto Protocol, has provided policy guidance to contrast this trend by inducing a decrease in the green house gases emissions and enhancing carbon sinks. At global scale we refer to an annual emission in the atmosphere between 5.9 and 6.7 billion tons of carbon (C), equivalent to 21.6 – 24.6 billion tons of CO_2 (Apat, 2005).

Total world forests amount to 3.9 billion ha, representing 30% of total world surface. They play a very important role on the physics and chemistry of the atmosphere and the green house effect, since they are able to store large quantities of carbon in the above and below biomass as well as soil (Brown, 1996: Ciccarese et al., 2005 cited by Apat, 2005). According to Prentice et al., 2001, terrestrial ecosystems sink every year from the atmosphere a net amount of 0.5 - 1.5 billion tons of carbon (Apat, 2005). The Kyoto Protocol states shared binding rules to reduce green house gas emissions by the Annex I "industrialized and economy in transition countries" which ratified it, with the objective of globally reducing with reference to year 1990 the emissions by 5.2%, of the six most relevant GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6).

In order to reach this objective the countries of Annex I can activate the most suitable policies and measures in the energy and transport sector, and a series of activities tied to soil use and management. Certified amounts of CO_2 absorbed resulting from eligible LULUCF activities, will be used by "Country-Parties" in their GHGs national balances in order to compensate emissions.

LULUCF eligible activities are those dealt with in art. 3.3 of the Kyoto Protocol (namely, afforestation, reforestation, deforestation) which took place since 1990 and those which are dealt with in art. 3.4 of the Kyoto Protocol (forest management, cropland management, grazing land management, revegetation). It must be remembered that art. 3.3 activities are mandatory whilst those of art. 3.4 are likely to be selected according to the interests of the single Country-Party of the Kyoto Protocol.

As far as the Italian situation is concerned, at present several of these actions have still to be performed, such as certified absorption/emission balances of green house gases for activities related to art. 3.3 and 3.4 of the Kyoto Protocol. According to our National Emission Reduction Plan (2002), the average potential absorption of eligible LULUCF activities in the first commitment period of the Kyoto Protocol (2008 – 2012) is equivalent yearly to 10.2 Mtons CO_2.

By the year 2006 it will have to be stated which of the additional activities quoted by art. 3.4, Italy intends to implement in order to satisfy the objectives of the Kyoto Protocol and meanwhile define in detail those activities. It must be underlined that once a defined land-area is included in the National Balances, the country will be responsible for the corresponding amount of GHGs as a debt, in case a reduction of stocks occurs due to adverse natural or anthropogenic causes. According to this rationale, analyses are carried out to evaluate the contribution of the agricultural sector in terms of carbon sequestration and poplar plantations are considered in the 3.4 article provisions.

Agro-forestry carbon credit typologies which can be used within the Kyoto Protocol are twofold:

- The RMUs (Removal Units), derived from the activities considered by the art. 3.3, art. 3.4 and from art. 6 (Joint implementations);
- tCERs/lCERs, (temporary and long-term carbon credits), derived from project activities of art. 12 (Afforestation and Reforestation in the CDM).

All these credits can be accounted for at the end of the first period of commitment in the Kyoto Protocol ending in 2012 and their economic value will be determined according to the outcomes of the National Registry of agro-forestry carbon sinks, managed by the Ministry for the Environment and according to the incentives to promote carbon sequestration activities. For this reason, it is premature to forecast and state the relevant official prices of credits.

At the moment, however, there is no possibility of trading these credits among private enterprises within the European Emission Trading System (A. Brunori, 2005-2006). The only chance could be offered by a strategic political agreement at national level to incentivate agro-forestry activities generating RMUs credits, to be used at national level in order to fulfil national obligations related to the Kyoto Protocol.

As for the implementation of this paper, we shall set an hypothesis on the possible range of prices, based on 4 elements, that is 10.00 €/tCO_2, 20.00 €/tCO_2 30.00 €/tCO_2 and 50.00 €/tCO_2.

4. MATERIALS AND METHODS

4.1 The poplar plantation site

For the purpose of this paper we refer to a site in Piedmont, where poplar plantations are customary (and consequently providing good growth conditions), of the extension of 1 ha in an open field, previously used as barren agricultural land. The site shows average climatic and geo-pedological features for northern Italy and is situated in a flat area along a river with deep and fertile soil. The management model applied to this case and the sequence of cropping activities is presented in the following Table 1.

The biomass growth table and derived suitable commercial assortments, have been obtained from data collected (Prevosto, 1965) in Piedmont (Table 2). This research aimed at determining growth dynamics of clone "I-214",in relation to the planting space, analysing inventories in 1.223 different poplar plantations. The same district provided information relating to carbon storing, which were collected in the area adjacent to our site.

Table 1: Cropping model of the poplar plantation and its nominal values

	Description	Cost (€/ha)	Year																Total (€/ha)
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Site preparation	Light ploughing (depth 40 cm)	222	x																222
	Harrowing	127	x																127
	Basic fertilization	254	x																254
	Saplings planting (planting space 6x5 m)	879	x																879
	N. 333 two years poplar saplings	862	x																862
Cropping activities	In situ fertilization	90 ÷ 140		x	x	x													320
	Pruning	60 ÷ 200		x	x	x	x												662
	2-3 Harrowings	60 ÷ 127		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1161
	Irrigations	240			x	x	x	x	x	x	x	x	x	x	x	x			2880
	Pests and diseases sprayings	20 ÷ 240			x	x	x	x	x	x	x	x	x	x	x	x	x	x	1185

Table 2: Biomass, assortment and related revenues (comparing different prices)

Time	Bio-mass ton/ha	Plywood (diameter > cm 22)				Sawnwood (diameter < cm 20)				Pulp			Chips		
		%	Bio-mass ton/ha	Revenues 1st quality €	Revenues 2nd quality €	%	Bio-mass ton/ha	Revenues 1st quality €	Revenues 2nd quality €	%	Bio-mass ton/ha	Reve-nues €	%	Bio-mass ton/ha	Reve-nues €
				90	70			65	47			40			22
3	36	5	2	162	126	30	11	697	502	40	14	576	25	9	198
4	66	5	3	295	230	30	20	1269	915	40	26	1050	25	16	361
5	101	15	15	1366	1063	30	30	1958	1412	40	40	1619	15	15	334
6	144	15	22	1943	1511	30	43	2784	2007	40	58	2302	15	22	475
7	190	35	67	5988	4657	30	57	3678	2652	20	38	1521	15	29	627
8	241	45	109	9777	7604	25	60	3893	2806	20	48	1931	10	24	531
9	298	45	134	12057	9378	30	89	5761	4153	15	45	1786	10	30	655
10	354	50	177	15912	12376	30	106	6842	4933	10	35	1414	10	35	778
11	404	51	202	18162	14126	30	121	7810	5630	10	40	1614	9	36	799
12	448	52	233	20962	16304	30	134	8667	6248	11	49	1971	7	31	690
13	487	54	263	23644	18390	30	146	9414	6787	11	54	2141	5	24	535
14	517	55	284	25582	19897	30	155	10000	7209	10	52	2067	5	26	568
15	541	57	309	27774	21602	30	162	10476	7553	8	43	1732	5	27	596

The prices of the commercial outputs (f.o.b. on trucks), have been gathered from local trading companies (Chamber of Commerce of Torino, April 2004); the costs for tree planting and crop activities have been collected from the Regional Agro-forestry Handbook for Public Works of 2005, or from the local press and official records (Table 1 and 2).

The model which is reported in our calculations refers to the top productivity conditions, (Class: Extra), that is a situation which allows the best yield with the implication that as much as we move far from the optimum, incomes will be reduced, or rotation will be longer.

The economic analysis is performed by defining the optimal rotation period (by two methods) under the assumption, first, that the poplar plantation will yield round wood of top quality and, second, that a discount rate of 3% will adopted.

As a second step, a sensitivity analysis has been performed under the hypothesis of discount rates different from the previous 3%, namely 2% and 4%, so as to evaluate the impact on rotation of the opportunity costs assigned to the biomass value. Finally, variations in prices and revenues (as result of different outputs from the biomass) have been set and computed to ascertain the impact of this variation.

4.2 The definition of optimal rotation period

The definition of the optimal rotation period is a crucial decision by forest managers. It implies, as it is well known, considerations both of silvicultural and financial nature. Of course, the socio-economic conditions, relating to the relationships between ownership – enterprise – labour, will influence the decisional framework and the focus on objectives and the optimization process.

From the point of view of an entrepreneur facing the problem of harvesting the biomass from his field, the objective function relates to the income which can be obtained by this operation over the growth period necessary to achieve the most suitable final product.

Several methods are available to cope with this problem and we have chosen two approaches which can be suitable for our purpose: i) net present value of costs and revenues; ii) incremental values.

i) **Net present value of costs and revenues**

This is the usual method which allows to discount at present and aggregate all costs occurred during the life of the plantation and confront them with the intermediate and/or final revenues from harvesting. The timing of the harvest moves according to the difference between the aggregated discounted values above quoted, i.e. maximising the difference between revenues and costs and considering an unlimited sequence of cycles on that plot.

The formula used is:

$$F = \frac{P_t}{(q^t - 1)} - \frac{Rq^t}{(q^t - 1)}$$

where

F = the real estate value, using Faustmann's formula;

$\frac{P_t}{(q^t - 1)}$ = the total value of revenues discounted at present;

$\frac{Rq^t}{(q^t - 1)}$ = the aggregated value of costs discounted at present.

ii) **Incremental values**

This approach is related to the balance between the gains obtained by the incremental value of the biomass for "one year more" and the costs born for waiting for that interval of time. In the costs are also considered the missed opportunity of delaying the availability of cash coming from harvesting the biomass at present.

We used the following formula:

$$\Delta P_t \leq P_t r + (P_t - Rq^t) \bullet \frac{r}{q^t - 1}$$

where:

ΔP_t	=	marginal revenue at year t determined by biomass and its yearly increases at present market prices;
$P_t r$	=	the interest on the biomass measured with reference to the market value at current interest rate;
$(P_t - Rq^t) \bullet \frac{r}{q^t - 1}$	=	yearly periodic assessment of costs and revenue where R represent the plantation costs and P_t is revenue.

Both approaches provide the same indication about the rotation period strictly from the financial and silvicultural points of view. These results will be discussed in paragraph 5 and will be considered as the basis for further considerations when the opportunities given by Kyoto Protocol will be added to this structural analysis.

4.3 Available income from Kyoto Protocol

Let us consider an afforestation project on agricultural land to implement a poplar plantation and the carbon quantity stored by this crop during its growth, relating it to the underground storage of that field (soil and roots) and to the biomass of the poplar trees (timber and leaves) net of emissions. The results were utilised in order to calculate the likely income derived by granting agro-forestry credits following the rules of art. 3.4 of the Kyoto Protocol.

According to those rules, the variation has to be estimated in the quantity of carbon stored inside five tanks (aboveground and belowground biomass, litter, soil organic matter, deadwood) and in the flows of green-house gases, other than CO_2, along the five years of the period considered (2008 - 2012), and, subtract from these values those of the **baseline** year 1990.

This **baseline** refers to the green-house gases existing before setting the poplar plantation on that field. In addition it has to be subtracted from the above CO_2 estimated in the five tanks, net of emissions, the **leakage** derived by green-house gases flows, which materialize outside the area of the plantation because of the effect of the plantation itself. As far as it relates to our case, the values for baseline and leakage are assumed equal to zero. In order to calculate the credits, we shall deal with CO_2, CH_4 and N_2O all expressed in CO_2 equivalent. The value of the emissions (CO_2, CH_4, N_2O) given in CO_2 equivalent relates to all those deriving from industrial production of fertilizers and pesticides used during cropping season. The emissions produced by the use of farm machinery related to the project (Tedeschi et al., 2005) will also be considered

The equation implemented for credits calculation is given as follows:

$$Net\ CO_2 = \Delta CO_{2\ (2012\text{-}2008)} - 5x\ CO_{2\ (1990)} = RMUs$$

where :

Net CO_2 = is the anthropogenic carbon stock, net of emissions and equal to the number of credits RMUs generated by this project (poplar plantation);

$\Delta CO_{2\ (2012\text{-}2008)}$ = is the total stored carbon during the project period (2008-2012), net of emissions.

$CO_{2(1990)}$ = baseline

As far as it relates to this paper, CO_2 yearly data considered (from aboveground and belowground biomass), both per year and cumulated, refer to a poplar plantation lasting 15 years (data estimated on the basis of personal communication from Lucia Perugini, April 2006).

These data have to be added to those relating to soil absorption, equivalent to 2.27 tCO_2/ha/year. To the above mentioned data must be subtracted emissions equal to 1.27 tCO_2/ha/year considered as an average between the intensity of various cropping activities (European Climate Change Programme, cited by Tedeschi et al., 2005). The estimate of the GHG balance by a poplar plantation as stored carbon, has been determined in order to provide a financial evaluation of the income obtainable as RMUs from this sort of project.

So far the sale of agro-forestry credits has not actually been implemented and we propose therefore a wide range of very likely values for our calculations, because of the complexity of market operations and the large amount of determining variables affecting values these credits.

Table 3: Available income from credits under different hypotheses of price

Years	Total net cumulative absorption	Sale of agro-foresty credits (€/ha) according to 4 hypothetical values			
	(tCO_2/ha)	10€/tCO_2	20€/tCO_2	30€/tCO_2	50€/tCO_2
1	1,18	11,80	23,60	35,40	59,00
2	9,76	97,63	195,27	292,91	488,19
3	23,19	231,97	463,95	695,92	1.159,88
4	41,39	413,92	827,85	1.241,78	2.069,63
5	65,24	652,45	1.304,90	1.957,35	3.262,25
6	94,60	946,01	1.892,03	2.838,05	4.730,09
7	129,15	1.291,57	2.583,14	3.874,71	6.457,86
8	167,68	1.676,88	3.353,76	5.030,64	8.384,40
9	209,58	2.095,82	4.191,65	6.287,48	10.479,13
10	252,85	2.528,53	5.057,06	7.585,60	12.642,67
11	293,83	2.938,30	5.876,61	8.814,91	14.691,53
12	332,66	3.326,67	6.653,34	9.980,01	16.633,36
13	365,99	3.659,99	7.319,98	10.979,98	18.299,97
14	393,06	3.930,62	7.861,25	11.791,88	19.653,13
15	406,36	4.063,65	8.127,30	12.190,95	20.318,25

In Table 3 are provided available incomes by the sale of these credits derived by agro-forestry activities, assuming that they could be paid 10€/tCO_2, 20€/tCO_2, 30€/tCO_2 and 50 €/tCO_2. These values however, are within the limits set for not agro-forestry credits, relating to the quotation of the European Emission Schemes, which on May, 8th, 2006, quoted 12.8 €/tCO_2, and only a month ago quoted 30 €/tCO_2 and then, moreover, we consider to set the upper limit a rather high value (50€/tCO_2).

On top of all this, it should be mentioned that these credits can be obtained only by "carbon certified" plantations, which bear a cost relating to the assessment of the quantity absorbed of CO_2. These operations are rather complex and the expertise is not yet easily available to cope with the potential demand. We realize that this is a limit but, for the time being, we shall proceed without considering this further cost.

5. ANALYSIS OF RESULTS

As shown in Figure 2 and 3, the timing for the optimal rotation is related to the discount rates adopted. According to the calculation following both methodological approaches mentioned in paragraph 4 the optimal rotation at 3% discount rate is 14 years.

The revenues discounted to the present increase according to time, reaching a maximum and then decrease because production (and so the increment of value) is not able to contrast the discount effect.

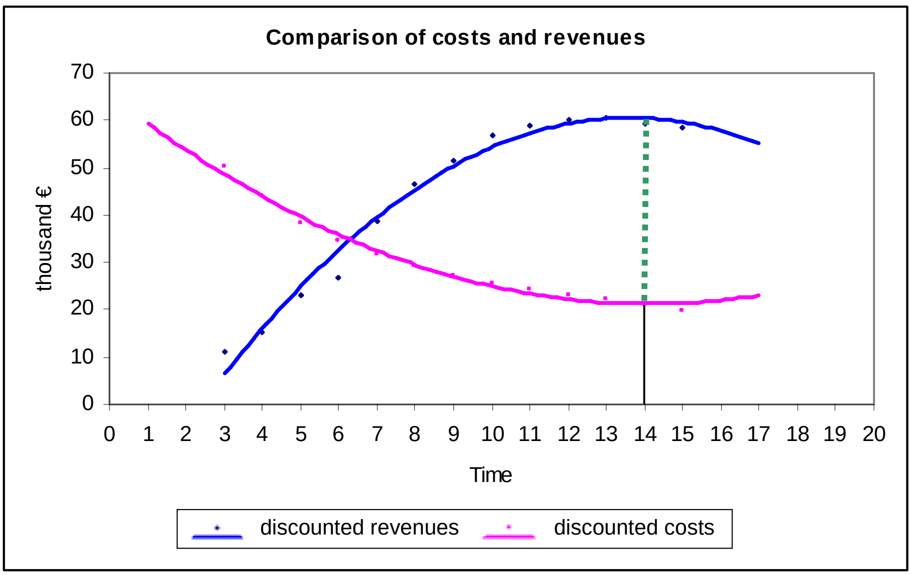

Figure 1: Estate value of poplar plantations producing first quality timber at different rates

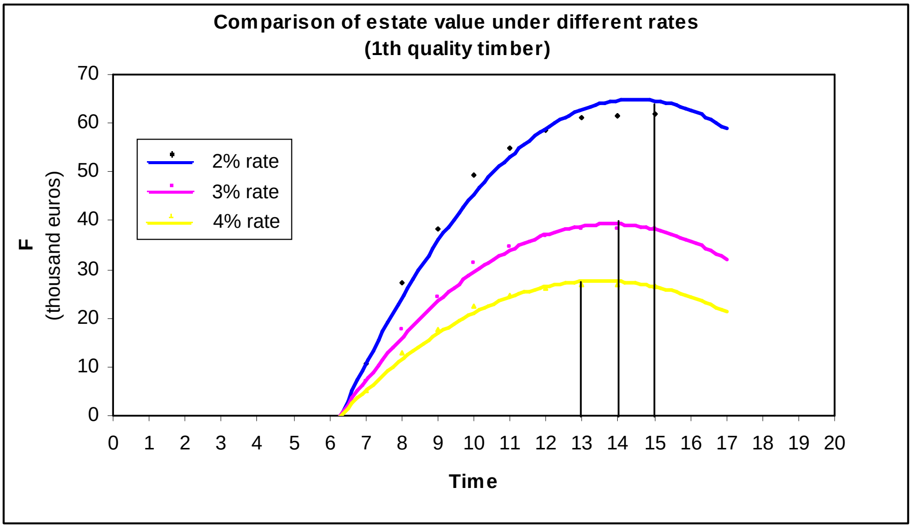

Figure 2: Estate value of poplar plantations producing first quality timber at different rates

This maximum value of profit coincides with the point where discounted marginal cost is equal to discounted marginal revenue and where the value of wood land, according to Faustmann, is highest (Figure 1 and Table 4). Moving to 2% and 4%, as the Figure 2 shows, discount rate, the rotation period is 15 and 13 years accordingly, with the evidence that there is a shift of 1 year for each variation of 1%in rate (Table 5).

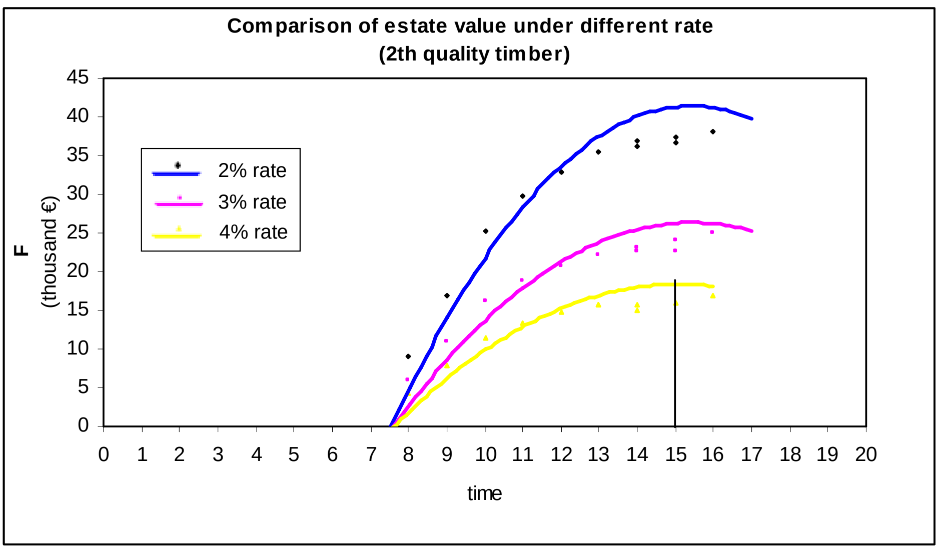

Figure 3: Estate value of poplar plantations producing second quality timber at different rates

Table 4: Optimal rotation: comparison of results of different methods and timber quality (thousand €)

	Incomes and their variations				Incremental approach					Estate values 1st quality timber			Estate values 2nd quality timber		
Time	1th quality	2th quality	%	Time	DPt	DCt 2%	DCt 3%	DCt 4%	Time	r 2%	r 3%	r 4%	r 2%	r 3%	r 4%
0	-	-		0	-	-	-	-	0		-		-	-	-
1	-	-		1	-	-	-	-	1		-		-	-	-
2	-	-		2	-	-1,18	-1,16	-1,14	2		-		-	-	-
3	1,04	0,81	-22	3	1,04	-0,87	-0,83	-0,80	3	-62,93	-41,54	-30,85	-59,14	-39,04	-28,99
4	1,90	1,47	-22	4	0,86	-0,42	-0,38	-0,33	4	-49,25	-32,35	-23,90	-44,13	-28,98	-21,42
5	3,64	2,78	-24	5	1,75	-0,16	-0,10	-0,04	5	-31,89	-20,84	-15,32	-23,62	-15,43	-11,35
6	5,18	3,96	-24	6	1,54	0,37	0,45	0,53	6	-21,61	-14,05	-10,28	-11,91	-7,74	-5,66
7	8,86	6,46	-27	7	3,68	0,77	0,87	0,98	7	-5,43	-3,51	-2,55	10,74	6,95	5,05
8	12,45	9,12	-27	8	3,59	1,05	1,18	1,31	8	7,89	5,08	3,68	27,32	17,58	12,72
9	15,72	11,34	-28	9	3,27	1,66	1,80	1,94	9	15,71	10,06	7,24	38,16	24,43	17,59
10	19,61	14,04	-28	10	3,89	1,52	1,69	1,87	10	23,92	15,23	10,91	49,36	31,43	22,51
11	22,67	16,23	-28	11	3,06	1,59	1,75	1,92	11	28,31	17,93	12,77	54,77	34,69	24,71
12	25,55	18,31	-28	12	2,89	1,76	1,97	2,19	12	31,41	19,79	14,02	58,40	36,79	26,06
13	28,45	20,38	-28	**13**	**2,89**	1,81	2,05	**2,27**	**13**	33,82	21,19	14,93	61,29	38,40	**27,06**
14	30,49	21,82	-28	**14**	**2,05**	**1,85**	**2,09**	**2,34**	**14**	34,51	21,51	15,07	61,66	**38,43**	26,92
15	32,52	23,21	-29	**15**	**2,02**	0,00	**0,00**	**0,00**	**15**	34,88	21,62	**15,06**	**61,81**	38,31	26,69

As we move from the basic example presented to variations in terms of outputs from the harvest and we consider a lower revenue, due to poor quality of timber, the optimal rotation at 4% discount rate will fall at 15th year, while for the other two discount rates timing will further exceed (Figure 3). Just considering variations in timber prices between 23% – 28%, as the difference between first and second quality of commercial assortments, the period of rotation will vary by two years. It could be inferred, therefore, that for each decrease of 10% – 15% in prices, there is an increase of 1 year.

All this means that if market values of poplar timber decrease, as happened in the last decade, the real estate value of poplar plantations will decrease, unless rotation periods are prolonged, with strong implications both on the economic / financial side and the technological quality of timber (Table 5). Under these developments a cautionary suggestion to poplar growers would be to be extremely careful about the location of new plantations, since if market conditions keep worsening, only the most suitable locations (high productivity) will be eligible for economic success.

Adding now the revenue coming from the opportunities offered by Kyoto Protocol provisions the whole system is modified. Again the two decision approaches will be here followed, modifying only the revenue side (increasing) and, for the time being, not the costs (certification costs are not foreseeable). This provides a tentative solution which will be necessarily modified when the latter information will be available. As shown in Table 5 and in Figure 4.

At the moment we found that the combination of timber and credits is shortening the rotation period (as expected), but, moreover, we can quantify that as one year decrease at 3% rate, whatever are the values are attributed to agro-forestry credits.

Table 5: Summary of optimal rotation periods

Optimal Rotation	Revenues from 1th quality timber and credits												Revenues from 2th quality timber and credits												Revenues from timber					
	€ 10			€ 20			€ 30			€ 50			€ 10			€ 10			€ 20			€ 30			1th quality			2th quality		
	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%	2%	3%	4%
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14	x																									x				
15										x	x	x	x	x	x	x	x								x					x
16																													x	
17																												x		
18																														

However, at 2% rate, the value of credits makes quite an impact on the period, that is that at credits priced below 20€/tCO_2 it shortens by 1 year, and above and included 20€/tCO_2, it shortens by 2 years. On the contrary, at 4% rate, whatever value assigned to credits, the optimal rotation period coincides with the one determined for timber only.

6. CONCLUSIONS

The main objective of this paper has been the evaluation of the impact that possible subsidies derived from the implementation of the opportunities given by the Kyoto Protocol can determine on the optimal rotation period of a poplar plantation.

For this reason, we examined, to begin with, a poplar plantation defining its optimal rotation period, comparing various hypothesis both on discount rates and on the commercial values of timber assortments. As a result from this analysis, the optimal rotation period could vary from 15 to 13 years, respectively with discount rates of 2% and 4%.

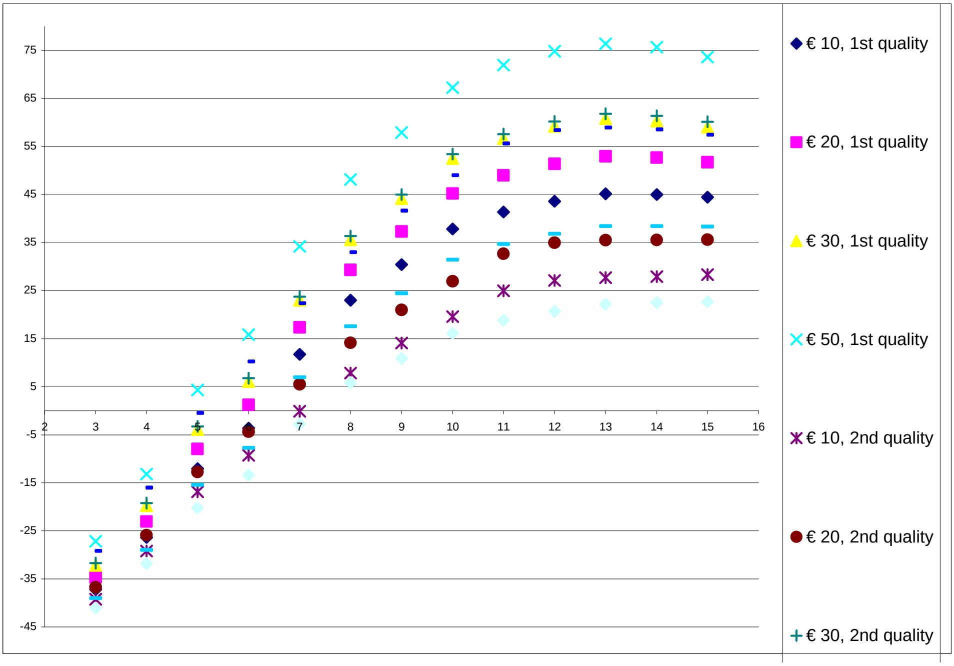

Figure 4: Summary of optimum rotation period

After that, to this revenue values coming from poplar timber, have been added the income coming from the sales of carbon credits, related to that poplar plantation at different ages, using a hypothesis on the forthcoming market prices for these credits.

The results have demonstrated some specific characters: as a general matter (as it was already expected) the addition of the Kyoto Protocol credits has shortened the rotation period of the poplar plantation, the length of which varies as a function of the considered discount rate and the values attributed to RMUs.

Moreover we can detect some trends: first of all, considering Kyoto Protocol contributions, the shortening of rotation period is only and partially a function of the discount rate and on the value of credits, since it keeps stationary around a time length of 13 years.

Only when discount rate and timber values are considered at their lower levels, it is possible to detect some variations in the results, that is timing is slightly prolonged.

However a second result has been obtained that is that in the absence of Kyoto Protocol the changes in time of the length of rotation period are much more clear cut and constant (1 year per 1% point and / or 1year every 10% variation in prices), when with the Kyoto Protocol the rotation period keeps rather stationary.

From this consideration, it is possible to attribute a levelling effect to the opportunities given by Kyoto Protocol in the agro-forestry context. It could be interpreted as a compensatory attitude by Kyoto Protocol to the present decreasing capacity of poplar plantation to generate income (as experienced in recent years) and to support poplar supply under present poor quality conditions.

All these considerations have to be treated with caution due to the limited information about certification costs, essential to the definition of the level of credits to be transferred to the growers.

This paper, hopefully, has provided the framework for a decision about the optimal rotation. Whenever more precise data on credits, certification costs, credit transaction costs is available it is hoped that, by following this procedure, it will not be too difficult to provide more suitable information about the optimal solution.

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Section IV: Organizational Perceptions and Learning

FOREST ENTERPRISES' PERCEPTIONS ABOUT MULTIDIMENSIONAL REPORTING-SYSTEMS

Christoph Hartebrodt, Konrad von Wedel and Silke Bitz[1]

ABSTRACT

The evidence of social and ecological responsibility is gaining importance inside and outside the forest sector. This paper reports on the use of new multidimensional types of reports in the forest sector. In order to gain insight in the potentials of multidimensional reporting and reasons that prevented a more intensive use of these reports in the forest sector, a survey was conducted amongst 400 enterprises (private and public forest enterprises, pulp and paper industry, sawmill industry and forest contractors) in Germany, Switzerland and Austria. This report gives an overview on the results of the survey with respect to the present use of different types of reports, the appraisal of the core-objectives and the basic structures of multidimensional reporting (MR) systems in the narrower range of forest enterprises and contractors.

In general the enterprises perceived limited benefits of the present reporting, however there was a clear positive correlation between size of the enterprise and benefits received from the reports. There are clear distinctions between the different types of enterprises with regard to the core target groups and the present use of various reporting schemes. There is a relevant difference concerning the appraisal of principles of multidimensional reporting between private and public forest enterprises and contractors. The perception of different dimensions and contents of the Global Reporting Initiative scheme varies notably. There is still a trend towards 'greenwash-reporting' especially within the group of private forest enterprises.

Some forest enterprises hope that they will receive relevant benefits from new (multidimensional) reporting systems. It should be taken into account that multidimensional systems require resources and professionals; therefore they should remain a voluntary instrument. Especially the greater private forests are ambivalent towards MR, mainly due to the increasing stakeholder integration in these approaches. However, it can be expected that multidimensional reporting can be a

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suitable approach for greater public forest enterprises with more than 50 employees which play a substantial role in the countries involved in the survey. Given that politicians are one core-target group for the reporting activities of public enterprises, multidimensional reporting systems are an appropriate medium to promote communication between forest management and political decision makers. In addition, they can promote a better understanding between forest enterprises and an ambivalent public.

Keywords: Corporate Social Responsibility GRI–Reporting, multidimensional, stakeholder-communication; target groups, triple bottom line

1. INTRODUCTION

Compared to two or three decades ago there is a notable increase of control of enterprises by society. Especially the Rio Conference in 1992 forced enterprises to deal constructively with the issue of sustainability (Cahyandito, 2005, p. 1). The public interest has a strong focus on the social and ecological performance, even more than on the economical success of the enterprises. Therefore enterprises need to implement corporate responsibility[2] (CR) strategies (Loew et al., 2004, pp. 7-15). Managers are facing the problem that there is yet no single framework of generally accepted standards and tools for managing CR. Presently there are approximately 300 CR-tools that exist globally. This indicates both, the underlying demand and the hardly manageable number of different approaches, resulting in deficits in comparability and reliability. Companies, which incorporated the CR into their management processes, typically use a number of different tools (Ligteringen and Zadek, 2006, p. 1).

Among other instruments, such as certification, standardisation (e.g. ISO, SA8000) and multidimensional (performance) management systems, multidimensional reporting is one approach belonging to the group of CR-tools. According to a German saying 'act well, and talk about it', it can be assumed that there is a need to communicate efforts and success to the public. Consequently the European commission recommends the implementation of new report-types (EU, 2001, p. 8). Moreover there is an increasing debate, whether mandatory reporting schemes should be implemented (Engemann und Scheunemann, 2005, p. 9).

The CR approach boosts the deliberations concerning new reporting schemes, but the integration of non-financial contents in reporting is not really new. During the last

[2] Abbreviations used in the paper: CR = Corporate responsibility; MR = Multidimensional reporting PriFoE = Privat forest enterprises; PubFoE = Public forest enterprises; Cont. = Forest contractors; All = All enterprises; SME = Small and medium-sized enterprises; GRI = Global Reporting Initiative; CSR = Corporate Social Responsibility

decades a lot of attempts have been undertaken to integrate non-financial contents into business reports leading to different types of reporting, such as social, environmental and sustainability reporting. National and sectoral initiatives and reporting traditions produced an almost unmanageable number of types, subtypes and individual reporting schemes resulting in a low acceptance and lack of comparability. The EU-commission points out that there is a need for standardisation for contents, format and auditing of the individual report's quality (EU, 2001, pp. 19-21). Since 1999 the Global Reporting Initiative (GRI, 2002, pp. i-10) developed a reporting scheme (MR) that has met increasing acceptance. Meanwhile more than 800 enterprises are using this standard worldwide. With regard to the use in the forest sector this standard is up to now mainly confined to the industrial sector. Only few forest enterprises (producers of round-timber and forest contractors) have adopted multidimensional reporting (ÖBF, 2005, pp. 1-93; Terranova, 2004, pp. 1-58; Coillte, 2003, pp. 1-67). However, the EU encourages even SME to implement such new reporting schemes, including all small and large forest enterprises.

Preliminary studies provided evidence that there is only poor knowledge on reporting in the forest sector. Therefore our research focused on the present use of different report types, its appraisal and the attitudes of different types of enterprises towards new types of reporting. The combination of a status-quo analysis and the present perception about the multidimensional approaches allow a detailed insight into the potentials and impediments related to these new reporting schemes in the forest sector. The GRI concept, which is presently the most relevant development in multidimensional reporting (MR) is used predominantly but not exclusively as a reference.

2. CONTEXT

2.1 The present role and quality of reporting

It is widely accepted that corporate communication is based on a set of different communicative measures (Bruhn, 2003, p. 2; van Riel, 1995, p. 26). Timely, credible and consistent information on an organisation's social, environmental and economic performance is a key element in moving towards sustainability. Communities, investors, governments and business need reliable information to effectively address the development challenges of the 21st century' (Sigma, 2006, pp. 1-9). Among other instruments such as certification and quality management systems multidimensional reporting is one approach to demonstrate the efforts and successes outside the financial dimension. Therefore reporting can play a significant part in the communication strategy (Sigma, 2006, pp. 1-9; comp. Cahyandito, 2005, p. 39) and its importance is widely accepted (Loew et al., 2004, p. 32; Zollinger, 2000, pp. 66-69). During the last decade new types of multidimensional reports, e.g. triple bottom line reporting, CSR-Reporting and the GRI-Reporting have been developed. Especially the latter one is meanwhile widely accepted in the industrial sector with more than 800 enterprises using this standard.

Nevertheless an assessment of the present reporting provides evidence that the quality and perception of the present reports is limited. Baetge (2004, pp. 5-13), Engemann und Scheunemann (2005, pp. 38-42) and Zollinger (2000, pp. 70-77) show on the base of different evaluation schemes that on average less than 50% of the possible results were achieved. Cahyandito (2005, pp. 229-230) points out that the readers of the reports are not yet accustomed to the new reporting schemes. This leads to the conclusion that the objectives of these reports are up to now only partially achieved.

The high number of new reporting schemes shows that there is obviously a significant uncertainty which type of report can cover the wide range of demands of the internal and external recipients (Loew et al., 2004, pp. 75-80).

2.2 Forest Reporting

Forest enterprises are facing an extreme external influence. Oesten and Roeder (2002, p. 121) classify them as ‘quasi societal institutions’. This implicitly supposes that communication with various stakeholder groups should be an important issue in forest enterprises. Our extensive literature study revealed that there is comparably poor knowledge on the use and the perception of different types of reports within the forest sector, except for the internal managerial accounting and reporting.

Forest reporting has a long tradition. For centuries statistical documentation of timber-products and/or proceeds dominated (see e.g. Hövell, 1993; Brandl, 1970). Even after World War II statistical documentation was prevalent. The statistical yearbook of the department of forestry of Baden-Württemberg from the year 1953 is, for instance, composed of 99% silvicultural and monetary data (LFV, 1955, pp. 1-403). In Rhineland–Palatinate the ratio was 19% text to 81% data (RLP, 1957, pp. 1-153). Both reports focus on the monetary and silvicultural dimension.

During the last decades some attempts have been undertaken to integrate more non-financial and non-silvicultural contents into the reports. By the late 70s social balances are published, offering deeper insights into the social functions of forestry (LFV, 1980, pp. 1-27; LFV, 1979, pp. 1-23; Kenk, 1975, pp. 86-90). The late 90s brought an increasing integration of ecological contents in the business reports. These reports can be characterized as extended business reports, partially structured or influenced by the Helsinki-Criteria (BMLFUW, 2005, pp. 1-110; LFV, 2002, pp. 1-33). Only a few forest enterprises published MR in the recent years. The use of standardised reporting concepts (e.g. GRI-Reporting) is mainly confined to the pulp and sawmills; only a few forest enterprises publish such new types of reports (ÖBF, 2004, pp. 1-93; Terranova, 2004, pp. 1-58; Coillte, 2003, pp. 1-67).

3. MATERIAL AND METHODS

The survey was based on a structured questionnaire. We only included enterprises which are expected to publish reports. This preselection was based on a literature and internet-study. The survey period started on June 28th and ended three months later on September 30th, 2005. The total population (including the enterprises of the timber industry) amounted to 412, within the three (narrower forestal) groups discussed in the paper 135. After nine weeks all enterprises received a reminder. We received 126 questionnaires completed, of which 80 came from forest enterprises and contractors (Table 1).

Table 1: Sub-collectives, population and response-rate

	PubFoE	PriFoE	Cont.	Total
Germany (N)	26	34	10	70
Austria (N)	13	18		31
Switzerland (N)	28	6		34
Population (N)	67	58	10	135
Respondents (N)	43	25	12[1]	80
Response-rate (%)	64	43	120[1]	59

[1] Some forest enterprises are active in forestry and offer forest services, they classified themselves as forest enterprises and contractors. They are included in the analysis of both categories.

43 public forest enterprises and 25 large private forest enterprises responded to our survey. Due to the increasing importance of forest contractors, this group was included in the survey with a population of 10. The number of forest contractors was limited because only a few of them published reports and had therefore experiences with external reporting systems. The overall response rate was 59%.

Especially with regard to the size of the enterprises there was a wide difference between the individual groups. The PriFoE and Cont. had predominately up to 10 employees (63% and 45%), about one third has between 10 and 49 employees. Thus the PriFoE and Cont. can be characterized as comparable in terms of the enterprise size while the PubFoE are significantly larger (57% > 50 employees).

The survey focused first on demographic aspects of the individual enterprise, objectives and target groups of the present reporting. In addition, we asked for the appraisal of basic objectives and structures of multidimensional reporting and assessed the perception about different indicators based on an excerpt of the GRI-indicator set. We received frequency distributions with regard to the present reporting schemes. The perception about the multidimensional reporting approach and the GRI-indicators was tested using four point Likert scales, with subject-related response scales. The respective response scales and scores are specified in the context of the respective figures and tables.

We used the Mann Whitney U-Test, which is suited for small population, for testing the statistical difference between the individual collectives. We used three significance levels: Highly statistically significant (p<0.01 = **) statistically significant (0.01 < p < 0.05 = *) and moderately statistically significant 0.05 < p < 0,1 = [*]). The significance level is included in the Figures 1 to 3 and 5 to 7 and in Table 2, which illustrates the significance levels of the Figures 4 a to c.

4. RESULTS

4.1 Report Types

There was a relevant difference between public and private forest enterprises concerning the use of the various report types. Both, public and private enterprises issued mainly traditional report types like business reports and financial balances. Nonetheless the share of multidimensional reports like environmental and sustainability reports in PubFoE was four-fold higher compared to the PriFoE. The contractors took an intermediate position. Traditional business reports and balances were predominant; but a quarter of the respondents stated that they issue sustainability reports. This is a higher share compared to the PriFoE and meets the level of the PubFoE (Figure 1).

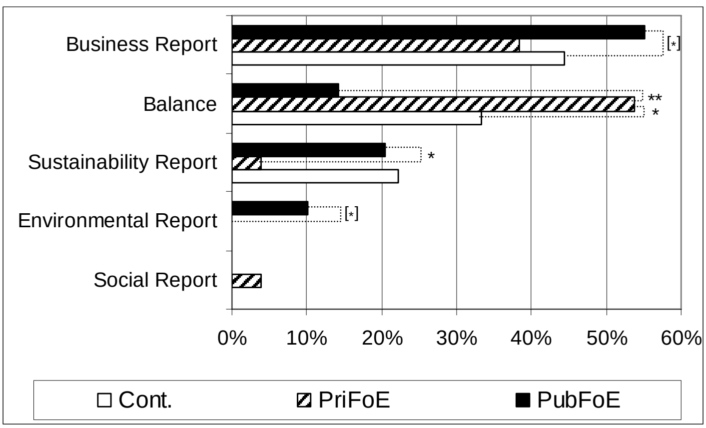

Figure 1: Report types issued by public, private forest enterprises and forest contractors

4.2 Reporting media

An assessment of different reporting media showed relevant distinctions between the individual groups. In our (forced) four point Likert-scale a mean higher than 2.5 indicated a predominantly positive evaluation[3]. All groups viewed print reports as an appropriate way to get in contact with the stakeholders (Mean: 3.1 to 3.4). Internet based reports were rated as a feasible solution for PubFoE (2.9) and on a lower

[3] Likert-scale: 4 = strongly agree (++), 3 = moderately agree (+), 2 = moderately disagree (-), 1 = disagree (--)

level for Cont. (2.6) but not for private forest enterprises (2.1). The latter group classified dialog-oriented 'reporting' concepts, such as stakeholder-panels or round-tables as less suitable (2.4). On the contrary Cont. emphasized the importance of these types of external communication (3.7). Figure 2 depicts the appraisal and distinctions between the groups.

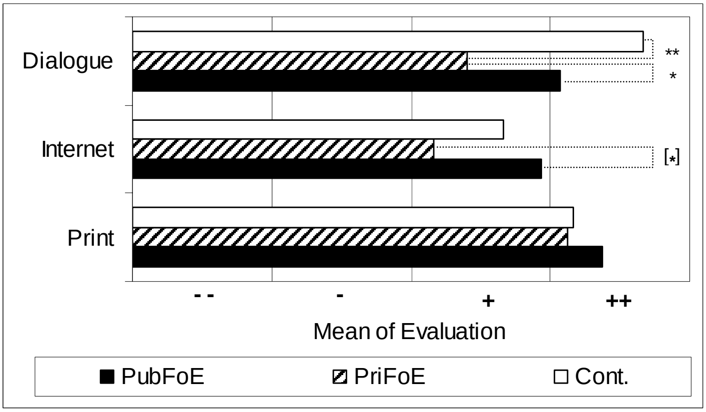

Figure 2: Appraisal of different reporting media

4.3 Perceived benefits from reporting

The present form of reporting offered limited benefits to the forest enterprises. Only PriFoE with 10 to 49 employees predominantly stated that they receive large benefits. It could be shown that 67% (<10 employees) and 43% (10 - 49 employees) of the reporting smaller public enterprises characterize the benefits as low. The satisfaction of the private forest enterprises was higher compared to the public enterprises[4]. Figure 3 indicates that there is a qualitative correlation between size of the enterprises and approval of the current reporting systems.

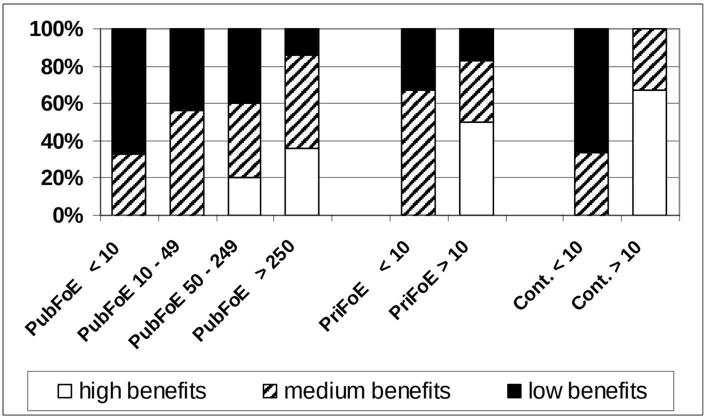

Figure 3: Benefits of reporting in different collectives and size classes

[4] There are no PriFoE with more than 49 employees. The number of contractors with more than 50 employees is irrelevant (2).

4.4 Target groups and actual readers

One issue of interest was which main target groups were addressed with the existing reports vs. which reader groups were actually reached. After an extensive literature research it can be shown that there is only a partial consensus, how to derive and define a restricted number of reader- and target-groups. Almost all researchers define employees and customers as relevant groups. We used the term 'public' as an overarching item for media, consumers and the public. Branch-member is used as a synonym for all business partners (including suppliers, shareholders …). We asked in addition for the role of politicians as readers and target groups, as we included a relevant number of public enterprises in the survey (Comp. e.g. Cahyandito, 2005, p. 15; Gröner, 2000, p. 31; Fichter and Loew, 1999, p. 17; Clausen et al. 2002, p. 60). The comparison between reported target groups and reported readers showed that overall the politicians appeared not be reached effectively. This was especially true for the PubFoE with the politicians as the most important target group. Additionally, the PubFoE stated that they are not able to reach another important target group sufficiently - the public. Like all the other groups, the PubFoE reached mainly branch members and their own staff.

The perceived discrepancies were even more extensive with regard to the PriFoE. The total absolute value of the deviation was at a maximum for targeting vs. reaching politicians, the public and customers. Overall, the contractors have the lowest deviation in reaching their intended readership. However, again politicians and customers are underrepresented as readers and the reports reach the members of their own staff more than intended (Figure 4 a-c and Table 2).

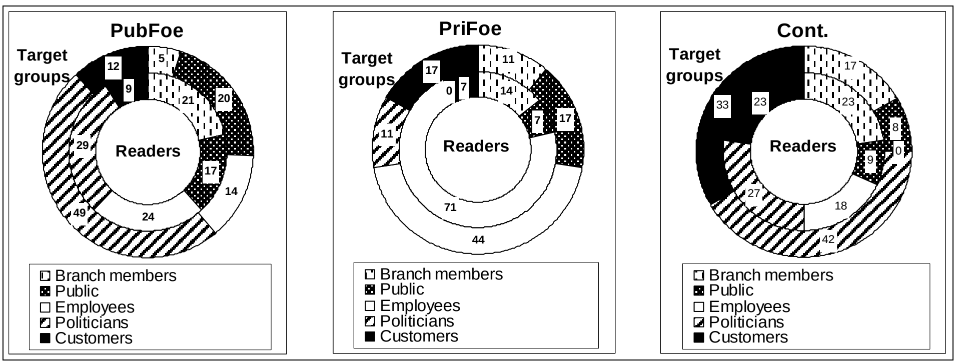

Figure 4 a-c: Readership and target groups

Table 2: Statistical significance of differences of Figures 4a-c

	Group	Group	Reader	Target-Groups
			Sig. - Level	
Branch-member	PubFoE	PriFoE	**	
Public	PubFoE	PriFoE	*	
Politicians	PubFoE	PriFoE	**	**
Politicians	PriFoE	Cont.	*	
Customers	PriFoE	Cont.	[*]	

4.5 Expected outcomes of multidimensional reporting

We asked about the most relevant expected outcomes of a successful multidimensional reporting. The PubFoE and the contractors underlined the possibility of an improvement of the reputation by the public and they stated that sustainability reporting is an appropriate tool for the improvement of the relationship between enterprise and stakeholder-groups. Only a few respondents saw a relevant role in terms of a reaction to external criticism and as a possibility to close a credibility gap. Within the group of PriFoE all areas reached a comparable level. Only the use of reports as a method to react to external criticism was of lower importance, but almost twice as frequently compared with the PubFoE.

4.6 Appraisal of the basic objectives of multidimensional reporting

We expected poor knowledge on the key objectives and structures of multidimensional reporting systems. Thus the basic objectives and core-structures were reduced to a restricted number and commonly used terms. We asked for four basic objec-

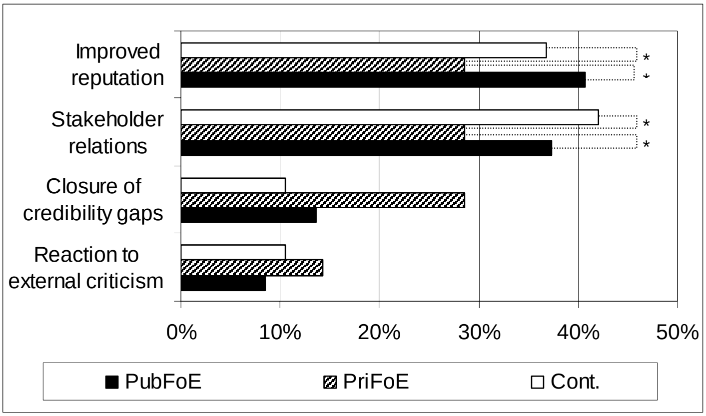

Figure 5: Expected outcomes of multidimensional reporting

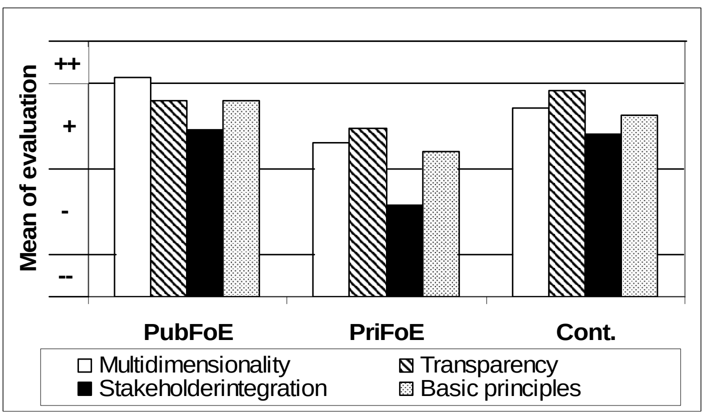

Figure 6: Objectives of multidimensional reporting

tives and structures that divide MR reporting from traditional reporting schemes such as balance sheets and business reports.

The PubFoE gave in general a more positive evaluation of the basic objectives and structures of MR (over all mean = 3.3). Especially the multidimensionality was highlighted (mean = 3.6). The appraisal of the PriFoE was more or less ambiguous (over all mean of all objectives 2.6) and negative with regard to the stakeholder-integration. The contractors make evaluations that are more or less comparable with PubFoE (overall mean 3.1) and tend to be positive (Figure 6).

4.7 Appraisal of the different dimensions and criteria of the multidimensional reporting concepts

We analysed the evaluation of the different dimensions on the base of a selection of GRI indicators. All subcollectives accepted the ecological and economical dimension. Especially the group of the PriFoE chose the economical dimension to a greater extent. In contrast to this finding it can be stated that the social GRI-indicators presently do not meet the expectations of the enterprises in the forest sector (Figure 7).

There was a large difference in the evaluation of individual indicators out of the GRI indicator set. Indeed there is a notable halo-effect of the present financial oriented reporting schemes. Especially PriFoE and PubFoE accept the economical indicator-set. A low standard deviation indicates a wide consensus in that matter. As shown below (Figure 7) the acceptance of social criteria was lower, except for the contractors who made ambiguous evaluations in all dimensions. With regard to the standard deviation it can be shown that this result is related to the refusal of individual criteria. It is obvious that sensitive issues, such as the amount of donations, the number of unionists or fines due to ecological contraventions are partially rejected. The more the data are already part of typical business reports (e.g. number of employees, costs, turnover) or traditional financial reporting sphere, the more the inter-

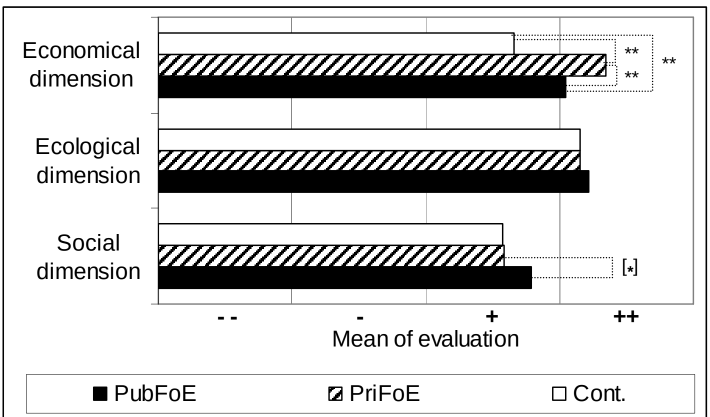

Figure 7: Appraisal of the three dimensions in the different enterprises

viewees accepted an integration into the reporting schemes (Table 3). Ecological issues are not part of the present reporting schemes, but the enterprises obviously accept the need to give information in this area.

Table 3: Overview on the appraisal of different GRI indicators

	PubFoE		PriFoE		Cont.		All	
Social Criteria								
Number of Employees	3,37	+	3,17	+	3,27	+	3,27	+
Accidents	1,90	+	2,18	-	1,75	-	1,94	-
Vocational training	3,26	+	2,70	+	2,92	+	2,96	+
Number of unionists	3,31	-	2,82	+	3,33	-	3,15	-
Donations (Parties)	2,07	-	2,04	-	1,67	-	1,93	-
Mean	2,78	+	2,58	+	2,59	+	2,65	+
Standard deviation	0,73		0,47		0,82		0,66	
Ecological Criteria								
Area (enterprise / treated)	3,36	+	3,33	+	3,46	+	3,38	+
Energy consumption	3,15	+	3,15	+	3,09	+	3,13	+
Water consumption	3,21	+	3,11	+	3,16	+	3,16	+
Material consumption	3,12	+	2,92	+	3,21	+	3,08	+
Mass of waste	3,25	+	3,23	+	3,06	+	3,18	+
Fines	3,24	+	3,20	+	2,94	+	3,13	+
Mean	3,22	+	3,16	+	3,15	+	3,18	+
Standard deviation	0,08		0,14		0,18		0,11	
Economical Criteria								
Net-turnover	3,35	+	3,41	+	3,18	+	3,31	+
Costs	3,12	+	3,59	+	2,81	+	3,17	+
Wages	3,21	+	3,59	+	2,55	+	3,12	+
Subsidies	2,57	+	3,14	+	2,27	-	2,66	+
Taxes	3,00	+	3,00	+	2,54	+	2,85	+
Mean	3,05	+	3,35	+	2,67	+	3,02	+
Standard deviation	0,30		0,27		0,34		0,26	

5. DISCUSSION

The large share of traditional business reports and balances shows that reporting in the forest sector follows traditional patterns (comp. Figure 1) at present. Multidimensional external reports are obviously not identified as a suitable method to take influence on the stakeholder-perception until now. Even public enterprises, which are basically supposed to provide evidence that their activities meet social demands, still use predominantly traditional types of reporting.

Neither general satisfaction with the present reporting systems nor the appraisal whether the reports reach the target groups can be used as an appropriate explanation for the underlying scepticism towards and the restricted use of new report-types. There is a correlation between the global satisfaction and the size of the enterprises, but even the majority of managers of the larger PubFoE showed a medium or low satisfaction with the present reporting systems. The enterprises are aware that they reach predominately branch members and their own employees, whereas they intend to reach the public and political decision makers. This can be used as a feasible explanation for the present reporting schemes. Branch members and the employees are accustomed to the traditional report-types and are generally thought to be less interested in social and ecological implications of the enterprise, in contrast to politicians and the public. Former approaches like social or environmental reporting have not provided enough benefits in the perception of the decision makers and did not result in greater efforts to implement new types of reports. Additionally, the lack of a clear and undisputed framework has to be identified as one impediment that prevented a heavier use of new types of reports (see Ligteringen and Zadeck, 2006, p. 1). The enterprises cover, consciously or not, at present the expectations of the main reader groups and fail consciously to address important stakeholder-groups.

There is a clear distinction between the different groups of enterprises with regard to specific objectives and structures of multidimensional reporting. The appraisal in the PubFoE is predominately positive, partially very positive. The PriFoE are sceptical towards a role of MR in stakeholder-integration and transparency. They have not accepted the 'quasi public' role of forest and view multidimensional reporting more as a risk than as an opportunity to deal constructively with the demands of society. It is an open question whether this attitude is anticipatory. Obviously Cont. perceive a stronger need to document their efforts and success in terms of CR. The share of Cont. publishing such MR is higher compared with the PriFoE, despite the fact that they show a comparable (enterprise) size class distribution. They generally feel that stakeholder-oriented forms of reporting and new reporting media are desirable.

There is a 'shadow' on the positive appraisal within the group of PubFoE and Cont. The respondents like the idea of stakeholder-integration and transparency better than the consequences of standardised reporting systems. In a way the appraisal of individual criteria out of the GRI core-indicator set shows that the enterprises favour apparent and uncritical criteria like number of employees or total forestal area of the enterprises. The more indicators are suited to generate public criticism the more they are refused. The 'greenwash', considering reports as a method to provide only positive information (comp. Johnson, 2004, pp. 2-3; Jeuthe, 2003, pp. 18-23; Greer and Kenny, 1996, p.14) is still viable, but is thought to make the public sceptical and untrusting. One conclusion from our study is that forest enterprises like to achieve the benefits of the MR but they are presently not ready to adopt the underlying ideas of MR.

A relevant number of items showed a positive correlation between the size of the enterprise within the individual groups of enterprises. It became obvious that these MR-systems are more relevant for greater enterprises, which gather automatically greater public interest than smaller units. However, it is not only a matter of size. The Cont. have to be classified as small enterprises as well, but they make more positive evaluations in terms of the objectives and structures of MR systems – despite the fact that there is a considerable overlap to the group of PriFoE. It also became evident that the use of media besides the traditional print-versions is viewed to be more important by PubFoE and Cont. compared with the group of the PriFoE. This corresponds with the appraisal of the potentials of MR. Both, PubFoE and Cont., emphasize an improved reputation and the role of MR in the field of stakeholder-relation, which can be characterized as 'proactive'. MR as a reaction to bridge credibility gaps and as reaction to external criticism can be characterized as reactive. They are of lower significance within the PubFoE and contractors, but more relevant in the appraisal of PriFoE. Reporting is presently not actively managed by the decision makers in PriFoE enterprises.

A long lead-time is necessary to create data gathering systems for new parameters. This explains why companies tend to report issues, which they are familiar with. Reporting on new topics requires the development of dedicated systems to collect the necessary information; this may be a major impediment for forest SME.

6. CONCLUSIONS

Enterprises have to identify their main target groups. The more the public and political decision makers are the main target group, the more it seems to be necessary to overcome the traditional patterns of balance sheets and one-dimensional business reports. Stakeholders have a predominately positive attitude towards sustainability reporting, 85% are interested or very interested. The contents in MR are mostly viewed as trustworthy (Cahyandito, 2005, pp. 147, 203). Therefore, the basic preconditions for a successful and effective communication are rather good. For greater (public) forest enterprises and contractors, which can probably integrate such types of reports in their marketing strategies, MRs are therefore a reasonable approach to play an active part in the communication policy. It can be expected that internationally used and widely accepted standards will enhance public and political confidence.

Where employees and branch-members are in the reporting focus one can be sceptical if annual reports are a (cost-) effective solution to meet their specific demands for information.

Standardised reporting schemes like the GRI Reporting seek relevant resources to provide the information needed to fulfil the specific demands of information. The size of the forest enterprises is a major impediment concerning MR. Enterprises must have a good management and information systems in order to be able to provide reliable data for an MR (WBCSD, 2002, pp. 27-29). These organisational conditions require specialised data-management and hence a minimal size of the enterprise. Economic data are regularly available from the financial and/or managerial accounting and therefore relevant and accepted in all enterprise categories and size classes. Research in the field of multidimensional management systems provides evidence that non-financial data are normally not available in the present accounting systems (Hartebrodt et al., 2009; Horvath & Partner, 2004, p. 22). They require additional data collection and specialized knowledge with regard to reliability and validity. Without accounting and statistical knowledge such systems cannot be maintained and are not able to provide high quality data. On that account the scepticism of smaller business units is reasonable.

This leads to the conclusion that the possibility of an incremental development of MR will not bridge the difficulties for the majority of the forest enterprises in Central Europe. A heavier use of MR in the German-speaking forest sector, which can be characterized as SME, requires the development of a restricted set of core indicators rather than a sector-supplement as proposed by the GRI-Guidelines. Otherwise it cannot be expected that MR will be adopted by a relevant number of forest enterprises outside the public sector. The statement of the World Business Council for Sustainable Development (2002, p. 29): 'If guidelines are over-ambitious the cost of the reporting process and the report itself may be prohibitive for some companies' has to be underlined with special regard to the restricted size of the forest enterprises. Nevertheless, an incremental approach (GRI, 2002, p. 12) can be considered as a relevant facilitation for interested greater (public) enterprises and contractors.

On the one hand the desire for a standardisation and an obligation to publish MR reports is comprehensible with regard to the need to establish a corporate social responsibility. The ongoing discussion whether mandatory reporting standards should be established should consider the structural preconditions of the individual enterprises. At present such a mandatory reporting scheme is neither rational nor desirable with regard to the existing structure of forestry.

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A SYSTEM THEORETICAL DISCUSSION OF ORGANIZATIONAL LEARNING PROCESSES IN THE FOREST ADMINISTRATION OF BADEN-WÜRTTEMBERG, GERMANY

Björn Uerpmann[1]

ABSTRACT

The parameters for the actions of forest administration of Baden-Württemberg (Germany) are changing ever faster and are becoming increasingly more complex. 'Organizational Learning' could be an answer to the increasing complexity and rapidly changing conditions. Upon closer inspection, however, organizational learning processes are very complex processes as well. For example: what is erroneously perceived to be 'information-transport' is actually a communication process that has to fulfill several preconditions so that the information does not change along the 'transport-route'. Consequently, one can assume that a state forest administration can merely consider information in its learning process that is actually communicated by the employees. Apparently this information is, however, not exclusively determined by the environment. One can rather surmise that the information is selected through communication in a dynamic process in which the employees refer to organizational rules and consider relevant facts in their environment. It is difficult to describe such processes only with terms like 'instrumental rationality', 'profitability' or 'power' that the business administration theory traditionally operates with. On the other hand a large organization like a state forest administration cannot follow the changes in the environment seamlessly, but always has to consider aspects of organizational adaptation. Therefore it is all the more alarming, if the mechanisms of self-adaptation remain unexplained, or if causalities are assumed that do not facilitate the description of the organizational learning process in a manner that would allow the derivation of actions for a management of knowledge that is oriented towards influencing this adaptation.

Against this background, this paper discusses a system theoretical model that enables a functional depiction of 'organizational cognition'. The term model is employed like it is in cybernetics: As a function whose appliance leads to what shall be called 'organizational cognition'. For this purpose, the state forest administration is modeled as system that selects information from its environment by means of communicating via structural couplings of their employees. Information is not understood as being available ontologically, but rather as differences that have to be selected via observations (determined by organization-specific rules and values), in order to then be combined into organizational knowledge via communication.

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Based on empirical observations of several elements from learning processes in the state forest administration of Baden-Württemberg, this model enables a deductive-nomologic manner of attaining statements that can describe key factors that should be considered with regard to knowledge management. This paper focuses on the key factor of organizational renewal by adopting a "logic of the business", which allows to generate multiple communicational crosslinks that are necessary to cope with varying problems that need different solutions every time.

The paper explicitly deals with the learning of organizations as well as the management of these organizations as information processing, structurally determined systems, and not with the learning of employees and the management of individual learning processes of employees. It appears important to emphasize this point because these are separate processes that do influence each other but often follow different requirements. For example, an organization must learn to "unlearn" in order to enable its employees to contribute their learned knowledge.

Keywords: Forest administration, organizational learning, complexity, social system theory.

INTRODUCTION

Forestry has become a highly complex affair ever since it dedicated itself to comprehensive sustainability: numerous, often contradictory and temporally separated societal demands on the forest have to be implemented in a complex ecosystem that can only be moulded over very long time spans in contrast to the often rapidly changing societal demands.

Deliberations on dealing with this complexity are not a novelty in scientific forestry research. So far, however, the research was mainly focused on the description of the complexity in the environment and on programs to deal with it. It has hardly been considered that the respective level of environmental complexity is created through the manner in which information is processed and that the processor of information (i.e. a person or organization) therefore is assigned a key role in dealing with complexity. Crucial in this regard is the assumption that the environment always possesses more complex structures than those moving within it. The degree of recognized complexity depends on the information processing capacity of those who move within the environment. The higher their self-complexity, the higher the degree of environmental complexities that can be recognized and processed within their process of information processing.

Information processing systems, regardless of whether they are people, animals or organizations, have to reduce the environmental complexity to more simple relationships in order to be able to operate with it in the first place. Subsequently, however, they can reconnect these individual relationships and thereby, depending on the type of linkage and the applicable rules, construct an enormous self-complexity with the structures they use to process information with.

Organizations – as information processing systems (see below) – reduce the environmental complexity to more or less logical and rational causalities. Through this type of reduction and the subsequent cross-linking of causalities, in combination with rules of how to behave in each specific case, the recognized environmental complexity will initially be reduced, but subsequently self-complexity will rise once again.

Too high a self-complexity, however, slows down the information processing process and can lead to operational blockages. In the information processing process, it is ultimately important that the cross-linking of different information allows the organization to recognize events in their environment in a timely manner in order to be able to react to them in an adequate manner so that the events do not have any negative effects on the organization.

From these assumptions it follows that changes in the environment are not instructive to organizations but that organizations are determined by their structures with regard to the processing of information. The existing organizational structures are responsible for how the environment and the changes therein are perceived, which information is gathered in this regard and how it is processed. In reference to organizational learning, this means that a change in environmental conditions does not automatically generate a sensible organizational learning process.

In summary, one can note that the “structure“ of information processing is decisive for dealing with complexity, but that the structural design is determined by its own complexity and not by the environmental complexity to be processed. During the construction of these “structures”, one can observe in organizations that, during the reduction and subsequent elevation of their self-complexity, the structures organize themselves in such a way that degrees of freedom are lost, whereby short term advantages in dealing with complexity are gained. In the long term, however, it is necessary to maintain degrees of freedom so as to be able to react to future changes in the environment in a flexible way (Uerpmann, 2006a). With regard to organizational learning, this results in the necessity for organizations to learn to unlearn previously learned causalities and the related operating instructions, if a change in the environment should make it necessary to describe them with the help of new causalities (Hedberg, 1981).

Because this problem can also be observed in the forest administration of Baden-Württemberg, this paper will discuss how this problem could be approached from the perspective of LUHMANN’s Systems Theory (Luhmann, 1998).

MATERIAL AND METHODS

The organizational learning processes of the forest administration of Baden-Württemberg are observed using the reorganization of the administration into an efficient service organization as an example. Several pivotal factors of organizational learning processes in the administration are worked out with the help of qualitative interviews. Building on the gained results, a model is developed that illustrates one possible way of considering the observed phenomena in their functional relations. Different theoretical approaches from the area of cognition sciences are combined into a model of the 'learning organization', for this purpose. Building on the abstract relations of second order cybernetics, a mechanism is created that is based on a circular-causal cybernetic processing of information and a structural coupling of various systems. Several aspects of LUHMANN's sociological System Theory are integrated into the model for the transfer of the described relations onto the case of interest here. They make it possible to take into account that information in the administration evolves from social relationships between employees. As a consequence, it is thus possible to model an autonomous social system that links information to knowledge through communication in organizational learning processes, and that develops an organizational intelligence. For this, it is necessary, however, to briefly portray how organizational information processing takes place. This will involve highlighting the process of organizational cognition of the forest administration empirically as well as theoretically.

Qualitative interviews and empirical findings

By observing learning, one has to confront the problem that cognitive structures are not empirically accessible as reference relations of information. One can observe merely those actions that result from current cognitive links. Based on the actions, the idea is to now extrapolate the processing of information and the organizational depth-structure lying behind it in a rearward-facing approach. The actions are not observed directly, but rather identified in a dialogue, by asking the dialogue partners, how they act in certain situations. The basic assumption was that "to some extent, direct questioning can yield information about what a person does or has done. This is accomplished by eliciting descriptions of behaviors, actions, activities, and experiences that could have been observed had the researcher been present when they occurred. The interviewer usually asks for an account of, say, a particular event, a specific experience, or a typical day's activities." (Jones, 1996 p. 34) The design of the interview and the approach of the analysis was inspired by a paper from HOFINGER (1996), which empirically studied the cognitive structures of individuals in this manner. A transfer onto the analysis of cognitive structures in organizations also becomes possible in the case of social systems, if a model is created that allows to deduce the processing of information and possible learning triggers from actions in a rearward-facing manner.

The data were collected by way of structured oral interviews. Each interview lasted approximately two hours. Five interviews were evaluated. The interviewees were active in higher management positions of the administration at the time of the interview. The structure of the interviews was preset by various impulses, which were supposed to encourage the dialogue partners to describe, how they act on behalf of the organization as persons of importance, why they act in a particular way as opposed to another, and to especially state, which technical information they process hereunto. The structure of the questions and the questions themselves were tested and modified in several pre-tests.

Because employees can merely be questioned in place of the organization, the specific approach consisted of analyzing the data to the effect of how:

- employees of the state forest administration select information for the organization, based on the organizational depth-structures;
- employees communicate, meaning, how the psychic systems are cross-linked and how this creates an organization-specific communication from which new organizational knowledge then arises as communication evolves through communication;
- individual employees attempt to influence organizational communication and how they perceive themselves and the entire organization in doing so;
- organizational learning processes eventually lead to visible conduct of employees.

The organizational processing of information and the depth-structure of the organization lying behind it were developed from the wealth of actions described in the interviews. For this purpose, the data were hermeneutically analyzed. The analysis especially focused on the type of structures that observations result from and which structures they are bound to. Furthermore, the data were analyzed to determine what the specific triggers for organizational learning might be, meaning, which observations lead to such a change of the structure so that observations with the new structure are made differently. Additionally, the data were analyzed to determine how that form of organizational communication takes place, which is assumed to be the medium of organizational knowledge.

The result of the analysis of the interviews yielded:

- that the forest administration finds its identity in the symbolic term of sustainability;
- that the administration perceives the forest, a society for which it manages the forest in trust, and the policy that confers the mandate hereunto as relevant environments;

- that dilemmas exist both between the perceptions regarding the relevant environments as well as between the identity and the perceptions regarding the environments, which make it difficult for the administration to select and to process information and to derive decisions hereupon. Previous attempts to influence organizational learning are in the opinion of the interviewees only partly appropriate for contributing to an improvement of information processing in the existing situation.

A theoretical model to describe organizational learning in the forest administration

Considerations regarding the processing of information in the forest administration shows that the decisions and actions of employees follow specific organizational rules. If, for example, a forest is declared a protective forest then this is at best an indirect reaction to impulses coming from the environment (demands of customers / stakeholders). It much rather represents an act that is composed of the product of hundreds of individual decisions of employees, who take into account programs, routines, norms, values and other organizational rules. This is what enables organizations to act sensibly, just as it is described for humans by the cognitive sciences. Only that for humans it is thoughts, instead of a specific communicational linking of organizational rules, that make it possible for them to behave in a specific way (Laßleben, 2002).

The example shows that a forest administration selects and processes information in the frame of the above mentioned structures with the help of specific organizational sensors and that it is not only the individual employee or the environment, which is responsible for this but also the specific “cognitive structure” of the respective organization.

The descriptive literature on learning organizations often considers only superficial structures of the organizational information processing and thus focuses on technical aspects of the distribution of information within an organization. But the basic problems are usually rooted deeper.

For a more basic approach it has to be taken into account that information can only derive from observation and that observation is always paradoxical in its construction. Observations are based on differences, and information based on observations always depends on the point of view, which determines what is seen and which information is selected accordingly.

With regard to the criteria of difference used during observation, circumstances can for example be observed as true, thus following the difference of *true* versus *false*. However, circumstances are never absolutely true, but only in relation to other criteria of difference used to observe the first one. Whether something is true or not can for example be observed using the difference of *scientific* versus *magic*, which determines the context within which something is true or false (Maturana et al., 1987). It follows that the observed circumstances can only be true because they are considered to be true in this context. Such paradoxes result from the particularities of information-processing in self-referential systems and are usually unproblematic for the observer, because what is invisible from his point of view is not crucial for his observation. Functionally the paradox is suppressed by using it as viewpoint. Thus, from the scientific point of view it is possible to observe something as true or false – without, however, having the opportunity to differentiate with regard to the point of view at the same time. Such paradoxes become problematic only when they emerge to consciousness for whatever reason, because paradoxes which become obvious prevent subsequent use of the criteria of observation behind which they were hidden (Luhmannn, 1990a). This may lead to a transitional disorientation of information processing among those who applied the respective criteria up to that point. New criteria of difference for observing the respective circumstances, still considered to be relevant, are not jet available, and the old ones produce paradoxical information.

With regard to the viewpoint it makes a difference if something is for example observed from an economical, legal or moral point of view. Thus the data available with regard to a decision, will be connected to information depending on the point of view that was used for the basic observation – and they will lead to differing decisions respectively.

There is no doubt that organizations can and must use different points of view in order to select information. An organization, which pursues economic objectives, will not only consider the difference of profit versus loss, but also that of legal versus illegal. Every organization needs criteria which organize the applied criteria of difference so that the information is generated which is necessary to bring about its objectives. Otherwise it is likely that the organization will become disoriented or even loses its identity.

It is interesting to observe that organizations can be grouped with regard to their leading criteria of difference according to functional systems of society (Luhmann, 1990b). Academic institutions take their lead criteria from the functional system of science, parties take them from the political system, courts of justice from the legal system, churches from the religious system etc.

It is, however, not imperative for an organization to use a clearly defined leading criterion of difference to organize its information processing. Organizations can also use different criteria coequally at the same time and organize their information processing by guidelines, which could for example have the form of if-then-causalities in order to control the criteria of difference to be used in specific cases. If the environment of an organization is becoming more and more complex, the if-then-causalities also have to be linked together in a more and more complex way, thus to enable a meaningful selection of information. Under such circumstances the information processing is becoming more and more time-consuming, inflexible and ever more difficult to coordinate.

It seems to be promising to take a deeper look at the information processing of organizations. In this regard the administration is consequently reduced to an information processing system and thus seen as cognitive system which consists of elements that can engage in links by way of relational associations. The elements that it consists of are “communications” that constitute a communication process. The administration thus consists in its last elements of fleeting occurrences of information processing that relate to each other meaningfully and that can thus combine themselves into a process of information processing. This makes it possible for the administration to create a functionally closed and self-reproducing information processing structure. Specifically the fact of functionally closure serves as the precondition for cognition. This becomes clear if one recognizes that the environment is always more complex than a system capable of processing information can ever be. The environment contains countless elements that can be differentiated as data principally and countless others that cannot even be noticed because of the lack of suitable receptors. Only a structurally closed system can dissociate itself from the abundance of data. Systems open to the environment, on the other hand, would be externally controlled reflex systems. Everything would flow into them. They could not cope with complex system environments because they would not be able to develop the necessary self-complexity because of the impossibility of a point-to-point-relationship with an environment that is always more complex.

The basic elements of the communication-based structure are comprised of a quite specific linking of information, message and comprehension. Whereas comprehension as the last component unites information and message. Comprehension in a way monitors the other two components to some extent. It generates the duality of information and message through differentiation and puts them in context to one another. This completes the communication sequence.

It is important to state that the communication sequence ends with comprehension. Thereby it is left up to the comprehending one in which direction she or he – through independent internal influence on her/his own state – orients her/his cognitive sphere. Communication is then not an action anymore in the sense that the one could causally influence the other. It rather emerges and develops its own dynamic that is generated because the selection of the subsequent element depends on the previous structural connections of the prior communication elements. In order to make a selection connectable, the notifier considers which preconditions could lead to comprehension – for an acceptance or rejection by the receiver that is – and selects his messaging behavior and the information that he wants to convey with it based on these viewpoints. This results in a causal symmetry that can be described as circularity within the communication. The notifier anticipates the selection of comprehension and the follow-up communication dependent upon it and makes his messaging behavior a function of it. The chosen messaging behavior in turn determines the selection of comprehension once again.

In relation to organizations this means that they are continually stimulated to produce new communication elements that can be connected to the previous ones. They do this in a process of communicatively categorizing environmental events, thereby reproducing themselves continuously. Because they exclusively reproduce themselves through their own elements, meaning communication, organizations can be characterized as structurally closed. Organizations are therefore independent of their respective environment with respect to the processing of information. They permit themselves to be irritated by their environment and are thus stimulated to communicate, but outside influences do not become relevant until they have been transformed into information by the system and have been absorbed into the communication process.

The contact of the structurally closed systems with their environment takes place by way of so called structural couplings. Systems Theory refers to structural coupling whenever the system (in our case the organization) alters its structures because of an irritation by the environment. Of decisive importance is that while outside stimuli are indeed able to initiate a change in the structure, the manner of structural change depends on the prior relations among the elements which constitute the structure. Due to the closure and the conditions of the structural coupling, systems have the ability to select data they deem relevant.

By embedding data into a context of system relevance, information emerges from this data. The Systems Theory therefore defines information as differences that make a difference. The presupposed relevance means that information is a date different to all the other data which somehow matters to the system. Information is therefore always relative to the system.

Knowledge results from information by tying information to a second context. This second context does not consist of relevance criteria like the first but of meaningful experience patterns instead. Knowledge results by tying information into previously existing, meaningful experience patterns – which results in structures that guide operations. These are structures created from cross-reference relationships which allow orientation. One speaks of intelligence, if this happens in a successful manner. Accordingly, intelligence can then be understood as a mechanism that puts knowledge in relation to goals and strategies – whereby it becomes possible to make actions a function of knowledge (Willke, 1996).

The process by which an information processing system recognizes and categorizes information in its environment in order to change or confirm its current cognitive structure shall be called learning.

Knowledge is thus neither something that is objective nor static. It is not static because it is constantly complemented and restructured. It is not objective because the criteria of how it is complemented or restructured are guided by the already existing knowledge – and not by an "objective" environment.

Because organizations do not consist of employees but rather of communication and because at the same time only these employees can participate in the structurally closed organizational communication, the employees shall be designated as "internal environments" of the organization. They are thus something independent but are structurally coupled with the organization in a very specific form at the same time: They are the only ones who have the opportunity of selecting the information necessary for the continued existence of the organization. They monitor the environment on behalf of the organization and supply it with the necessary information.

This process of communicative observation under the guidance of organizational rules is structured in a very specific manner. According to the Systems Theory, the structure of organizations does not consist of just any communication elements, but rather of those that are decisions by their nature. Based on the Systems Theory, the structure – and thus also the cognition – of organizations originates from and consists of decisions.

A decision is – according to the Systems Theory – defined as an action that reacts to expectations. The action is oriented along expectations and on being expected. For the expectations, it orients itself along the anticipated future. For being expected, the act draws its sense from the past. Through the duality of the simultaneous reference to previous and subsequent acts, decision-making becomes a modus operandi that is predestined for generating a coordinated selection of information and operating relationships: The observed object takes form, contingency is fixed and uncertainty is transformed to certainty and the decision made also directs expectations towards further actions. This forces the continuance of the structural evolution on the one hand and limits what is potentially possible in the subsequent selection with the previous decision. In the Systems Theory, deciding is therefore acting that creates its own future based on a self-created past.

Communication on the basis of decisions enables organizations to produce „Order from Noise" (Foerster, 1981). A restriction of the allowed relations takes place: Everything can no longer follow everything; the system becomes selective. From the inexhaustible pool of data, only certain links can still be selected. A specific organizational structure thus emerges that requires specific selections for each specific case. This selection thereby has a self-conditioning effect because the condition conditions further conditions. So called self-values are created – if one has finally decided on sustainable management then this implies certain objectives that in turn imply certain programs.

PROBLEM STATEMENT

Combining the empirical results and the theoretical model allows to deduce problems of organizational learning in the forest administration of Baden-Württemberg. Some of them shall be briefly portrait here. Conclusions for a possible solution approach will be drawn in the following chapter.

The forest administration consists, as described, of fleeting elements of information processing and, as dynamic system, falls apart from one moment to the next only to arise again. The specific structure emerges in the way of self-conditioning. The conditionings of the information selection and processing have no permanent effect, however, and are only effective as long as further conditionings continually intervene. This enables the administration to react to unforeseen events in an orderly and self-organized manner and allows to act in a specific manner as further communication can be cleared or blocked. This means the administration learns in the above-defined sense and develops its own organizational intelligence, whereby it can make its actions dependent on learned knowledge.

What persists as a problem, however, is the fact that the environment is not instructive for the forest administration and that it can thus also learn the wrong things. This means that the administration can change or confirm its structure in a manner that makes it impossible to react to developments in its environment in an adequate manner.

Interestingly enough, according to LUHMANN (1984), organizations mostly fail because they do not succeed in developing their own structure in a manner that would allow them to react sensibly to changes in the environment. Specifically administrations have a tendency of always orienting themselves more along their past. They march backwards into the future, so to speak, by always orienting themselves more along guidelines once issued in the course of their historical development and thereby producing decisions ever more often that lose their sense relevance for the future. This phenomenon can also be observed in the ontogenesis of the forest administration and is one of the reasons for the named dilemmas and for the observed problem to improve the organizational learning.

If one takes into consideration that a large social system – like the forest administration is – obviously cannot follow the changes in the environment seamlessly but rather has to always consider aspects of adaptation, and that one has to fear that they ultimately do not fail because the environment is too complex but because of its unsuccessful self-adaptation, then it is vital for the continued existence to work towards successful self-adaptation that is less determined by reactions upon external pressures from the past but more by the possibility of entering into flexible structural links of information processing.

At the moment it seems to be difficult for forest administrations to constantly adjust to changing public demands made on forestry and the forest as such. In a time of public sensitivity with regard to the protection of nature and the environment, the management of forests is increasingly seen as disturbing interference with nature, which principally needs to be questioned. Forestry as such, which was basically accepted without public interference for decades, finds itself exposed to massive objections from third parties. The permanent pressure for legitimation and ongoing conflicts with numerous groups with particular interests, often enjoying strong public support, lead to a phenomenon which can be described as a "crisis of identity" (Detten, 2003). This lead to a certain lack of orientation with regard to information processing, which also concerns the decisions based on it. In principle the forest administration of Baden-Württemberg is aware of this problem. However, up to now primarily superficial structures of the organizational information processing were considered and it was realized that problems exist with regard to the distribution of information within the administration. Although there are certain problems in this respect, the basic problems seem to be rooted in the absence of original reference centers to judge and classify information. Upcoming approaches that were directed at deeper organizational structures have unfortunately been interrupted by an administrative reform of the state administration in Baden-Württemberg. But the need for a more basic approach is still existing.

Since the change from the so called “Kielwassertheorie” (it was assumed that all social and ecological benefits would follow automatically in the wake [i.e. Kielwasser] of the economical forest production) to a sustainable and nature-orientated forestry (with coequal social-, economical and ecological functions of forestry) the forest administration of Baden-Württemberg commonly applies various criteria of difference in a coequal way for the selection of organizational information. Important differences are nature/technique, site improvement/-degradation, profit/loss, legal/illegal and maintenance of power/loss of power. Thus the definition of sustainability is nothing more than an enumeration of terms which somehow seem to be important for sustainability. But all of these criteria of difference can only describe particular aspects of sustainable forestry. As shown, parallel application of different criteria is problematic, if there is no final criterion, which allows to determine the correct criterion or mix of criteria of difference that has to be applied for observing each specific situation.

The parallel application of different coequal criteria within the forest administration is probably a result of the fact, that a differentiated functional system of sustainability could not jet obtain form within society, by separating from the other social systems and by using its very own code. Even so it seems lately as if such a system is developing (Earth Summit in Rio de Janeiro and following processes in policy and society), the forest administration is actually in a situation where it has to switch between different social systems to pursue its business. The forest administration oscillates between the functionally differentiated social system of politics, justice, economy and science. (Uerpmann, 2006b)

The problems resulting from the absence of a functionally differentiated social system of sustainability, and thus from the missing of a lead-criterion of difference for a coordinated selection of organizational information, are solved by the administration with the help of if-then-causalities. It is enacted, which decisions should be taken in specific situations. The problems deriving from an absence of an unanimous definition of sustainable actions in forestry (Höltermann, 2001), from which decisions could be derived, somehow seems to circumvented it self by its vague formulation as enumeration: de facto this leaves a lot of space for manoeuvring and allows a selection of information, which is mainly determined by the implicit ideas of the staff members about sustainability. Thus the forest administration can make decisions and keep up its self-reference without having an explicit, consistent definition of sustainability (Uerpmann, 2006a). Decisions, which follow from information that is selected in such a way, are not necessarily bad. Their quality depends to a high degree on the expertise and the wisdom of the one, who is making the decision. But they have several problems in terms of maximizing the performance of the whole administration, because they tend to be unorganized and inconsistent and as a main problem they are not directly available for management approaches: in the extreme example management is like communicating in the times of the Babylonian confusion of tongues. The consequence is not only an increase of transaction costs but also a boost of the possibility to avoid (awkward) decisions, even if they should be made according to the strategy of the administration, as the employees encourage one another that things could also be understood differently. But deciding not to decide leads only ostensible to more degrees of freedom. It is like hiding in the fog: invisibility is gained but jet time runs by, chances elapse and the possibility of getting lost rises.

More strictly formulated and enforced if-then-causalities are only an answer to the problem if at the same time sustainability could be defined in such a stringent form that it can be reproduced in a consistent way through the if-then-causalities. If this is not the case, such efforts will turn out to be counterproductive with regard to the organizational information processing, because in the best case they will just hinder the members to bring in their expertise and wisdom according to the specific situations, without supplying them with new solutions to deal with the situations and in the worst case it will trigger a process of self-deconstruction (Dupuy, 2002).

After the actions and decisions of the forest administration have moved into public vision, it became difficult to argue, why the mix of the used criteria of difference as well as their application for observing whether an action is sustainable or not, would meet the public demand the best. The critical view of the public also generated questions with lots of paradoxical answers, which followed from the heterogeneous mix of criteria, which were applied to observe the phenomenon of sustainability (Detten, 2001). The result is a disorientation within the administration in addition to the already existing problems in the organizational flow of information – a disorientation in regard to the question about what information should be selected and how it should be processed in respect of the idea of sustainability.

If sustainable forestry remains in the focus of forest administration, it seems necessary to re-coordinate its organizational information processing in a way that enables the organization to achieve this intention. An operational form of the applied criteria of difference has to be found, which is accepted within the administration as well as by the public. Otherwise it is doubtful if long-term organizational learning will be possible without fixing a new view-point, which will allow to observe sustainable actions without producing paradoxical information.

The literature on organizational learning knows little about the discussed problems and about methods for its resolution. Very interesting in this respect are the thoughts of WEICK (1996) about processes of renewal in organizational learning. If they are transformed into a system-theoretical approach and applied to the formulated problems of forest administration, it seems promising to search for a new point of view based on the aim of acting in a sustainable way, which then allows to produce decisions depending on information that was generated and processed both with regard to specific situations and with regard to the underlying intention of always acting sustainably.

SOLUTION APPROACHES

As it is generally impossible to generate point-to-point agreement between any information processing programs and the environment due to the generally existing complexity decline between environment and system, it is very likely that programs which are based on models of deterministic algorithms reach their limits with an increasing complexity. In such situations the abundance of eventualities, which have to be integrated through defined servo loops, disrupt such information processing systems very quickly.

In a fast changing environment it might be better to take nothing for granted, in order to obtain the flexibility that is needed to react to unknown „realities“. It seems more promising to give room to a self controlled management of the organization by the organization itself and to let the necessary intelligence derive from structural coupling with the environment.

This would require to strengthen the organizational culture of the administration as key factor for successful organizational self-regulation (Baecker, 2001). By referring to organizational culture every member will be able to derive his or her actions as she or he refers to the double sided expectations, which formulated by the organizational culture. This will enable him or her to react in a creative way to challenges without losing contact to the actual tasks. At the same time all other partial systems of the organization with whom he is dealing – be it individual members or whole divisions – can cooperate and apply their particular abilities to the respective task.

As discussed above the forest administration is dynamic systems. This enables it to adjust to changing environments. Nevertheless it has a structure and can develop diverse structural-historic Eigen-values, to which they always refer. Identity is created through a process of meaningful selection by condensation and confirmation of meaningful events in the interplay of self- and external reference. This means that during this process only self-identical Eigen-values are created. They are then the particular qualities of the forest administration, obtained through learning, and refer to ordered restrictions, which only allow a system-specific selection of information. This identity, as observed and discussed by the organization itself, can be described as its culture and is identical to its self-description and self-delimitation. The challenge is to transfer this culture into a form, where it "consciously" culturally recreates itself constantly. This at first seems paradox, as culture is seen as something durable and conservative. Organizations, too, are usually conceived as durable, although their stability finally originates in a dynamic way. The conceived dependability of organizations is due to the fact that organizational decisions always refer to each other. With regard to their organizational learning they can then obtain the flexibility and creativity, which they need so urgently because of the momentary turbulence of their environments without losing their specific way of dealing with information.

Such a self controlled management of the organization by its organizational culture has a form which can be compared to neural networks: The intelligence develops from elements, which allow to generate multiple communicational cross linkings that are necessary to cope with varying problems that need different solutions every time (Varela, 1990). Information processing according to these principles can react fast and adequately to any specific situation. The point of reference is the respective task, which assumes shape in a process of external- and selfreference, through the difference between environment (i.e. externalreference) and self-understanding as derived from the organizational culture (i.e. selfreference).

The implementation of the “culturally” controlled self organized organizational learning process is realized by applying normative management approaches as they are described by OESTEN and ROEDER (2002). This will, however, not happen through the norms themselves, which are the framework for strategic and operative decisions, but rather through self referential organizational culture which provides the point of view from which information is selected to be used as guideline for the orientation of organizational intelligence towards the respective tasks.

Thus the dynamic, which inheres in the process of selfreference and externalreference, that enables the organization to adopt to new situations, is utilized as the process is consciously taken on in the organizational communication in the form of the organizational culture (Uerpmann, 2006a)

Or in other words a mechanism of unlearning (Hedberg, 1981) or renewal (Weick, 1996) is induced, which is organized as a selfcontrolled process, forcing the forest administration to reflect the restrictions to its cognition, which are created through the selfconditioning information processing and enables it to generate new situation specific knowledge by integrating the employees as intelligent beings.

To avoid that the forest administration is loosing itself in disorientation, leading criterion for the coordinated information processing is needed, which permanently organizes the dynamic alteration of self reference and external reference according to the aims of the forest administration or in other words a logic of the organizational business of forest administrations has to be formulated to manage the organizational learning.

In economic enterprises the 'logic of the business' results from the difference of 'profit' and 'customer satisfaction'. Customer satisfaction creates profit, and the degree of customer satisfaction is determined by its influence on profits (Baecker, 2002). This logic provides enterprises with the highest possible flexibility without obscuring their goal. They can shift from the production of appliances to the provision of services without losing their identity (Weick, 1996). A conscious discussion of the 'logic of the business' has enormous advantages for the management of knowledge in an organization. This can be the base of a creative knowledge management of the self-organizing organizational learning processes. The practical relevance is that processes of self-control within the organizational information processing can be reflected by the organization in a way which is not technocratic but cybernetic, and that the organization can influence these processes according to its goals.

Direct transfer of this logic from an economic enterprise to a state forest administration is impossible. However, it ought to be possible to find a comparable logic for the business of sustainable forestry. According to the interviews the self-understanding of the forest administration is aimed at managing the forest in a sustainable way to the satisfaction of society. Unfortunately the necessary decisions and actions to full fill this aim can neither be derived from the "nature" of forest, nor can they be founded on welfare as an extra-moral value (Höltermann, 2001)., which is a paradoxical circular causality. But nevertheless a structure can be created by considering sustainability as difference of the nature of forest and society, which allows to open another difference between socially determined desires on one side and the forest on the other, which can only be transformed within the limits of natural restrictions. The difference of welfare and nature is - so to speak - symbolized through sustainability. This happens in a process in which sustainability observes the actual and future customer demands and the natural restrictions and puts them in a relation, in which one difference is giving form to the other.

Sustainable forest management could thus be the point of view for all administrative observations. This would create a closed circle of cross-references, leading to a non-arbitrary endogenous structure. Sustainable forestry would then be the unit out of the difference 'fulfillment of public requirements' versus 'sustainable provision of natural forests' would also correspond to the original assignment of German public servants as described by Isensee (2004).

Comparable to the logic of economic enterprises an operative closure of recursivity emerges which allows a coordinated selection and processing of information. According to the self-referring process of organizational decisions the logic of sustainable business facilitates the selection of information in regard to the expectation of the future and at the same time they condition the expectation regarding the decision hereunto.

Thus it does not only enable the employees to include new knowledge into decisions, it actually requires them to do so. Decisions can always be reflected with regard to the expectations they were based upon. An answer must then be given to the question whether these expectations referred to the difference of forest and society. In doing so external reference is granted and thus it is possible to overcome the problem of walking backwards into the future by referring to enactments which focus primarily on past decisions.

With the introduction of the logic of the business a dynamic is brought into the cognitive structure of the forest administration which produces flexibility with in continuity. Flexibility is generated by utilizing the dynamic of social systems in the organizational learning process and continuity is induced by the underlying logic of the difference criterion for the selection of information, which is always staying the same. This enables a flexible but yet coordinated selection and processing of information.

The result with regard to organizational learning of the forest administration is a strengthening of direct coupling to relevant environments. At the same time it becomes possible to react in a flexible way to necessities resulting from the coupling. This also prevents the application of preconditions, which have long become obsolete. Forestry and forest administration become intellectual accomplishments which are, however, not achieved by individuals but by the organization itself. (Baecker, 2001)

This seems to be crucial for the work of forest administrations. It could be a way to coordinate the complex ecosystem with the complex system of public demands. The challenge to manage a forest, which can only be influenced over long periods, so that requirements are fulfilled, which are not even known at the time when actions have to be taken, is the best example for the difficulty of these problems. They can only be solved step by step. State forest administrations have to take care, always to be as flexible as possible with regard to the natural baselines (Bücking, 2002). However, they must also themselves be flexible enough as social systems to make use of the natural flexibility that they try to produce with regard to changing public requirements, but also with regard to implementing new scientific insights into natural facts.

CONCLUSIONS

In conclusion, state forest administrations remain flexible when they act in a way that they retain the possibility for free choice of their actions in the future as well. Thereby the choice of actions must remain within the system. The described logic of the business potentiates the flexibility through permanent change, and offers at the same time the continuity and consistence that is necessary for a coordinated selection of information, which is induced through the constant logic behind the difference. According to the organizational decision process and thus also according to the organizational cognition this would correspond to the ethical imperative of VON FOERSTER (1999, p. 41): act always in a way which increases the options.

It can be summarized, that implementing a logic of sustainable business and strengthening the organizational self control would allow to integrate the concept of sustainability as "safeguarding the ability to manage contingency" (Höltermann, 2001, p. 100) successfully into consideration about managing forest administrations by integrating sustainability as difference into the organizational learning process. Thus a new level is created within the cognitive structure of forest administrations.

In addition to the level dealing with questions of how to influence the environment in order to achieve maximum flexibility, this new level could deal with the question how to influence the own cognitive structures in order to make them fit for reacting most flexibly to environmental contingency. In terms of systems-theory one might say that observer and observations are linked in circular causality on a reflective level of self-observation. Thereby problems with regard to flexibility can be considered, which originate from the fact that organizations always have to decide in the presence, and that the basic assumptions with regard to the future always remain insecure. Attention will then no longer be focussed mainly on results, which should be generated within the environment in order to remain flexible, but also on the question of how the administrations should orientate their own cognitive structures so that they can still remain flexible when – contrary to expectations – a "faulty" result is obtained within a surrounding system. A forest administration has achieved real flexibility when it remains able to act sensibly even if the future that actually comes true is different from the assumed predictions, which originally formed the initial positions of already realized decisions and actions.

LITERATURE

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Other Papers

A SHORT OVERVIEW OF FORESTRY IN GERMANY

Wolfgang Tzschupke[1]

ABSTRACT

A short overview on the actual situation of Forestry in Germany based on several key-figures (forested-area, timber-stocks, forest-owners, tree-species, periodic yield-rates etc.) is given.

INTRODUCTION

Although some of us are German or have good knowledge of German forestry, we still thought that it might be useful to start our program with a short presentation on forestry in our country.

Within the European Union Germany is one of the most important countries for forestry: Although the area of forest cover may be less than that of other countries such as Sweden or Finland, the mean stock volume - with some 320 m³ per hectare – is the second highest value in the EU. Only the forests of Austria contain more timber, its total stock-volume standing in first place.

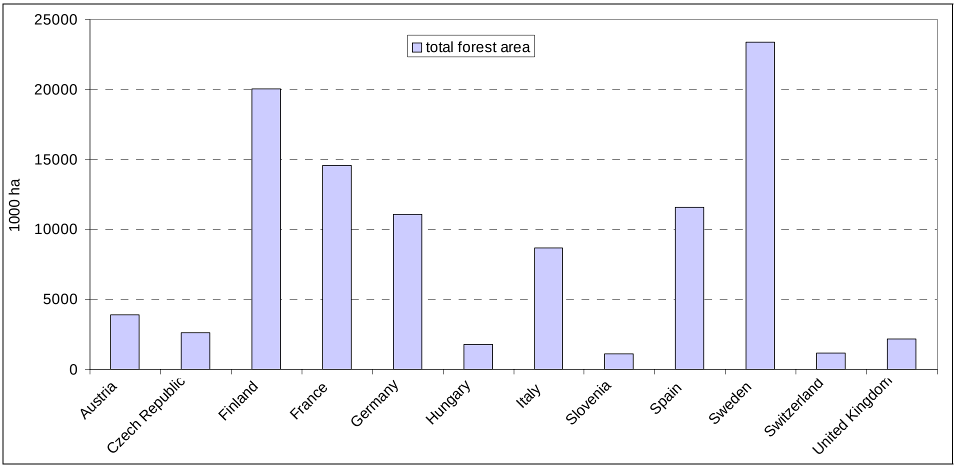

Figure 1: Forest-areas in Europe

Within Germany the regional distribution of forest is diverse. The greatest forest complexes exist in mountain regions and in regions with extremely poor soils, where agriculture was not successful.

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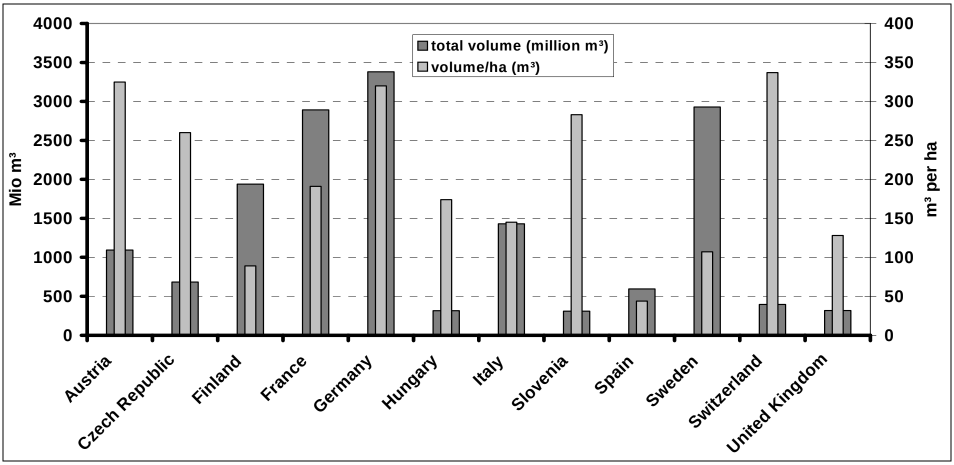

Figure 2: European timber-stocks

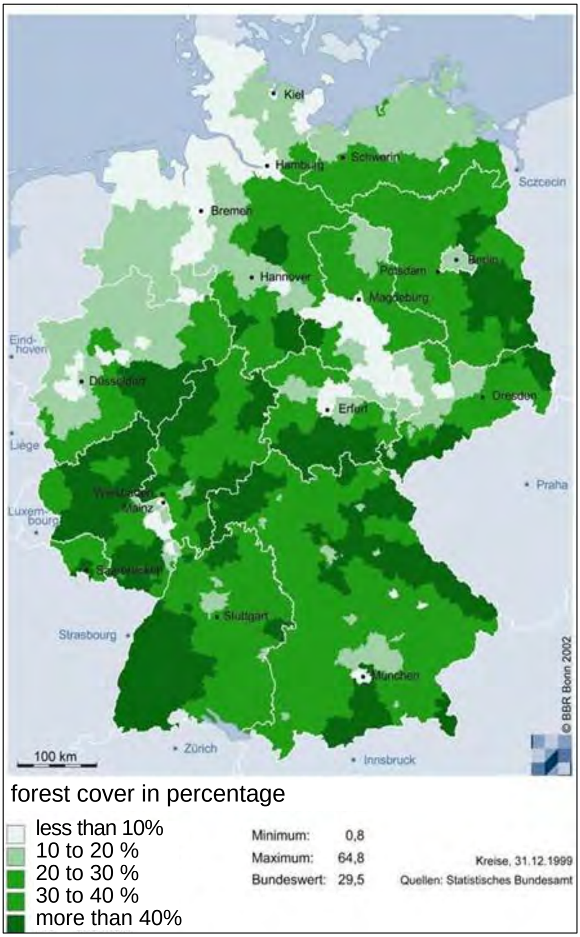

Figure 3: Regional distribution of forests in Germany

OWNERS AND ORGANISATION OF FORESTRY IN GERMANY

Nearly half of the German Forests are owned by private landowners, whereas 30 % belong to the German States (the Federal republic owns only 4% which are generally areas used by the military) and about 20% of Germany's forests are owned by community councils.

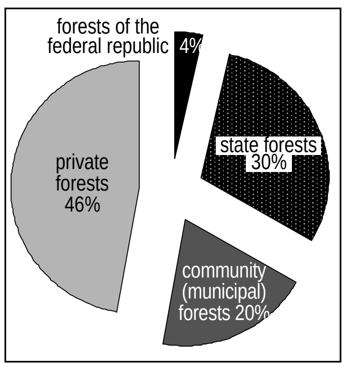

Figure 4: Repartition of the German Forests into owner-classes

Table 1: Private Forest Owners and Forest enterprises in Germany

size-class (ha)	number of enterprises	total forest-area (ha)	mean area per enterprise (ha)
< 10 ha		3,185,279	< 2.0
10 - 50 ha	15,807	290,744	18.4
50 - 200 ha	2,564	248,952	97.1
200 - 500 ha	735	228,801	311.3
500 - 1000 ha	289	201,705	697.9
> 1000 ha	181	668,241	3691.9
Total		4,823,722	

The group of the private forest owners however is very diverse: Along with several hundred owners with more than 1000 hectares, there are more than one million forest-owners with forests smaller than 10 hectares (see Table 1).

The organisation of Forestry in Germany is traditionally dominated by the state forest services and in many states municipal forests are also managed by the state forest services.

Private landowners are free to manage their forests independently or with help either from private consultants or from the state forest services on a contract basis. Owners of smaller forests (<200 ha) in particular use the support of the state forest services. These services are offered for very attractive fees, not at all covering the real costs of the services. On the other hand owners of larger forests generally have their own personnel.

SILVICULTURAL CHARACTERISTICS

Before man interfered with the forests of Central Europe, they were dominated by a single species: beech (Fagus sylvatica); coniferous trees occurred above all in higher mountain regions. In the last three centuries however forest owners and forest managers had a preference for two coniferous species: Norway Spruce (Picea abies) in the mountains and Scots Pine (Pinus sylvestris) in lower areas. This is why our forests are currently characterised by coniferous trees (see Figure 5). Two reasons were generally responsible for this development: 1.) Spruce and Pine were easier to plant and to grow than other species and 2.) in the 19th and 20th century the market had a greater demand for coniferous timber than for deciduous timber. Since 30 or 40 years the silvicultural objectives have changed however, our national inventories indicate an increase in deciduous trees.

So today nearly 100% of our forests are man-made. Whereas in former times pure, even-aged plantation stands were standard, today nature orientated regeneration

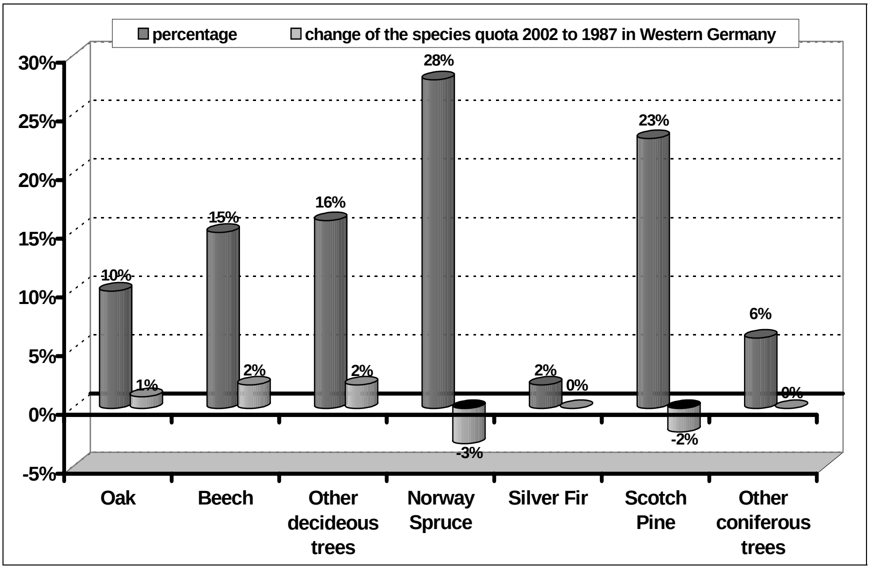

Figure 5: Development of the repartition of species

and management principles dominate and the percentage of uneven-aged mixed stands is therefore constantly increasing.

Another surprising result of the last national inventory was the unexpectedly high periodic yield rates (see Figure 6), which to a certain degree explain the remarkable increase in timber stocks.

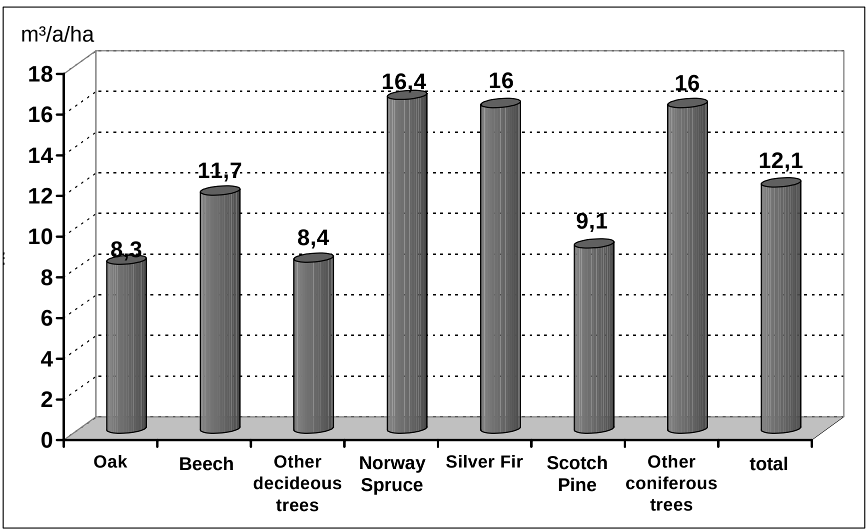

Figure 6: Periodic yield rates of the most important species in Western Germany between 1987 and 2002

MULTIFUNCTIONAL FORESTRY

80 to 90 percent of our forests are regularly utilized; the remaining 10 to 20 percent are small private forests without regular interventions or areas which are protected for ecological or conservation reasons.

But this does not mean that the forest management principles in Germany follow a concept of segregated objectives. To the contrary forest management generally attempts to reach several objectives simultaneously according to the individual objectives of the forest owners this is what we call multifunctional forestry (see Table 2).

Table 2: Objectives and functions of Forests in the state of Baden-Württemberg

Objective/function	% of the total forested area
Protection of water extraction areas	32%
Protection of soils	14%
Protection from climatic and other harmful airborne depositions	11%
Dominance of spa-related management objectives	18%
Timber production	95 to 98%

ECONOMIC RELEVANCE OF GERMAN FORESTS

For a long time we ignored the great economic relevance of our forests and of the commercial branches directly or indirectly dependent on timber or on the forests. As a result of several investigations carried out by SCHULTE and his collaborators such as MROSEK we now realise that the continuously expanding economic cluster of industries dependent on forestry and wood forms one of the largest economic branches in Germany. It employs more than 1.3 million people and reaches an annual turnover of nearly 200 billion EUR (see Table 3; see also the paper of MROSEK).

Table 3: Key economic figures from Germany's forest and timber-industry

Annual timber exploitation	55 million m³ (71% of the annual increment)
Employees in forestry	98,000
Turnover of forestry	2 to 2.5 billion €
Employees in wood-dependant branches	1,324,323
Turnover of wood-dependant branches	180.85 billion €
Annual production of sawed timber	19.5 million m³
Annual production of paper	21.7 million tons
Annual production of pulp	2.8 million tons

FINAL REMARKS

The continuing economic globalisation, the constantly growing worldwide population and the increasing shortage of many energy and industrial resources like oil, iron or copper is already causing a growing demand for timber, not only in Germany but all over the world. It is therefore of utmost importance that our management principles adjust to the changing global conditions.

COMPARISON OF DIFFERENT METHODS FOR THE VALUATION OF FOREST ASSETS

Wolfgang Tzschupke[1]

ABSTRACT

Currently there are more and more German public forest enterprises (state and municipal) who are beginning to value their forest assets (soils and stands) for the balance sheet. Until recently however, due to German federalism, no common conventions on the best valuation method existed and therefore applied valuation-methods differ significantly. The consequence is that valuation results are not comparable and - which is probably more derogatory - the meaning of the results are very different.

For this reason an investigation was carried out to compare different valuation-methods with several variants using the silvicultural and financial data of an existing municipal forest. The results once again confirm the need for commonly accepted valuation rules and methods.

Keywords: forest assets, valuation methods, balance sheet

1. INTRODUCTION

The necessity for the valuation of stands and soils as main assets of a forest enterprise and the best way of carrying out such a valuation has been a controversially discussed issue in Germany for a long time (see Jöbstl, 2000 and Tzschupke, 1992) Since no legal regulations existed forcing forest-owners to document the value of their stands and soils in a balance sheet, this discussion had remained purely academic.

Meanwhile however this situation has changed. Public forest owners in Germany are starting to introduce a system of double entry book keeping. Within this reform many of them have also decided to value their stands and soils within the next few years.

Although the general necessity of valuing and documenting the forest assets within the balance-sheet has been confirmed, there remains a significant need for research and discussion concerning the best valuation methodology - especially if we consider the situation in the German states where every state has its preferred solutions. Thus the municipal authorities in Baden-Wurttemberg carry out a very simple valuation using a common flat value independent of the individual forest structure,

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whereas the authorities in Hessen already practice a valuation following the age-related valuation method (Offer, 2005).

This unsatisfactory situation can only be explained by the presumption that the respective managers have no common notion regarding the objectives of valuing their forest assets. At the moment there is a tendency to simply produce a figure using any possible means. Its relevance however seems to be considered only of secondary importance.

The following report attempts – as a continuation of previous investigations (s. Doerry, 1999 and Tzschupke, 2000) – to analyse and comment on the specific strengths and weaknesses of the existing valuation methods, assessed with regard to their use within a balance sheet.

2. THE INVESTIGATED MODEL-ENTERPRISE

For this investigation we were able to use silvicultural and key economic figures from a large municipal forest enterprise in the Black Forest. One source of these figures was the results of two inventories with permanent sample plots (a method similar to the well-known Swiss “Kontrollmethode”) carried out in 1991 and in 2001. The other was the management-plans of 1991 and 2003.

The most important figures of this enterprise are summarized in Table 1. These figures reveal that we have to carry out our investigation in a typical coniferous enterprise, with a large percentage of selection- or selection-like-forests (“Plenterwald”).

An exceptional problem is the reliability of the yield-estimates from the 1991 Forest-Management-Plan which can only have been established using the traditional regional yield tables. If we use the values presumed to be correct at the time, then

Table 1: Comparison of the most important natural key figures of the forest-enterprise investigated; A = 1. 10. 1991; E = 1. 1. 2003

Key-figures	A	E	E in % of A
1	2	3	4
Composition of tree species			
Norway spruce and Douglas fir	2166 ha	2017 ha	93.1%
Europ. fir	655 ha	758 ha	115.7%
Scots pine a. Larch	246 ha	230 ha	93.5%
Beach and other decideous trees	100 ha	181 ha	181.0%
Areas without forests	165 ha	166 ha	100.1%
Total area	3332.6 ha	3352.4 ha	100.6%
Selection forests	537 ha	723 ha	134.6%
Volume per ha	411 Vfm	442 Vfm	107.5%
Mean annual increment in 100 years per ha	8.8 Vfm	11.6 Vfm	131.8%
Period. increment per ha	9.6 Vfm	12.2 Vfm	127.1%

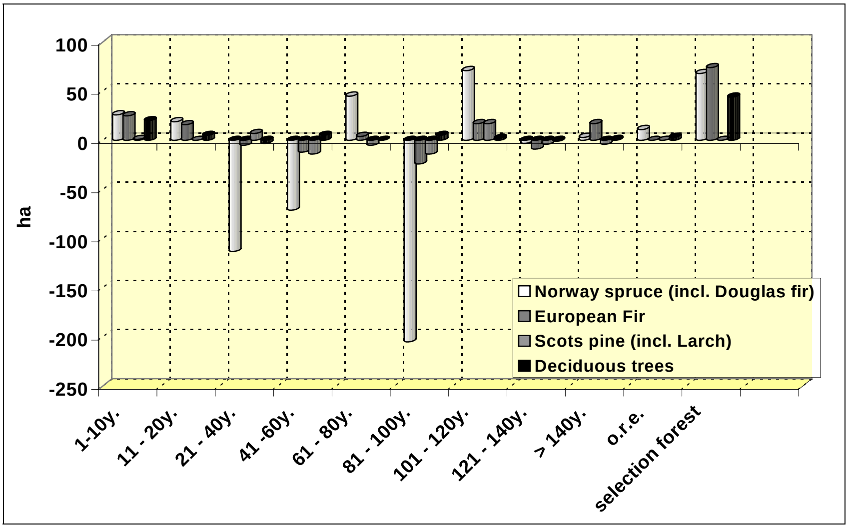

Figure 1: Alteration of the hectare-quotas of the main-species within the age-classes – 2001 compared to 1991

the periodic annual yield rates show an increase of more than 30 % from 1991 to 2001. This is more than unlikely; but we have as yet to ask how one should handle such obviously unreliable but officially confirmed data.

Of further relevance is the fact that the heavy hurricane of Christmas 1999 ("Lothar") also affected the enterprise. However, compared to other forest regions, the unplanned wood volume of approx. 70,000 cubic meters felled by the storm (corresponding to 200% of the current annual harvesting rate) was still relatively bearable.

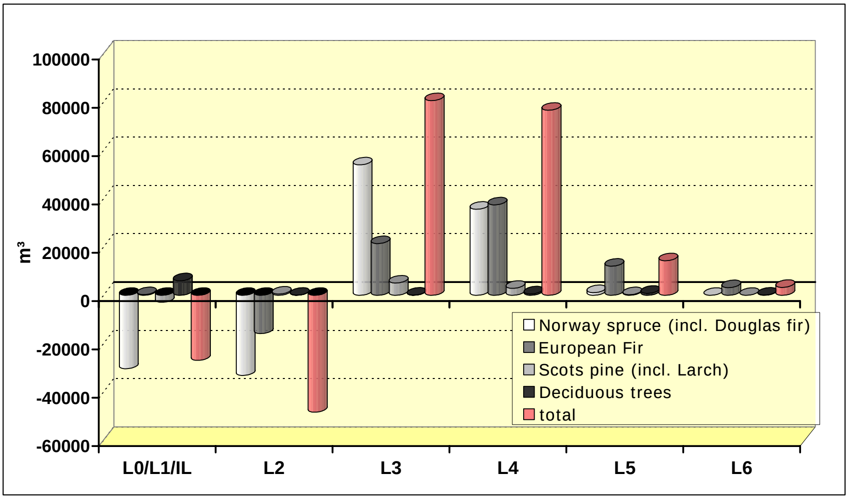

Figure 2: Alteration of the timber-stocks per sort-class – 2001 compared to 1991 (L0/L1/IL c.d. < 19 cm, L2 c.d. = 20 – 29 cm, etc.)

In addition the predominance of spruce and fir and significant stock increases, the periodic alterations in age class quotas and in timber stocks per sort class (see Figures 1 and 2) are also of importance in the asset valuation for the balance sheet.

Unfortunately in Baden-Wurttemberg the current inventory methods do not allow the quality of the existing timber stock to be ascertained.

3. DATA SOURCES AND VALUATION METHODOLOGY

As already mentioned the required natural data (surfaces, volume of stocks, annual increment rates etc.) could be taken from the results of the periodic inventories of 1991 and 2001 based on permanent sample plots and furthermore from the 1991 and 2003 Forest-Management-Plans.

The net timber prices, the percentages of quality classes and the plantation costs were approximately calculated based on local and regional statistics.

Since the data available referred to different deadlines, the opening valuation depended on data from the years 1989 to 1991, whereas the closing values had been calculated with data from 2001 to 2003. Therefore the opening values are indicated by “A” and the closing values by “E” and not by a specific year.

Altogether three different valuation methods were tested with two or three variants respectively (see also Table 2):

- **Net-asset-value-method** based on the volumes of the sort-classes as listed in the 1991 and 2001 inventories.
- **Age-related value method** according to the German Federal valuation rule (WaldR2000).
- **Company net present value**, this is the capitalised earnings value

With the **Net-Asset-Value-Method (NAVM)** the volumes per species and sort class – as ascertained by the two sample plot inventories – were valued with their respective contribution margins. In those cases where the contribution margins were negative, their values were equated as 0 EUR. In addition younger stands without significant commercially usable timber were valued using their plantation costs. This concerned all spruce and fir stands younger than 21 years and all other stands not older than 60 years.

The **Age Related Value Method (ARVM)** according to the German Federal valuation-rules (WaldR2000) is based on Blume’s formula:

$$V_a = (V_f - c)*f + c;$$

where V_a is the age-related value, V_f is the expected final value at the end of the rotation time, f is a reduction factor, depending on the species, the age of the stand and its yield class and c is the plantation cost of the valued stand.

In the first step V_f and c were calculated using local prices and costs in the starting period of 1989 to 1991 and the closing-period of 2001 to 2003. In the second step the individual age-related values for each species could be calculated.

The **Company Net Present Value Method (CNPVM)** was performed on the base of the established net returns from the beginning and the end of the considered balance period. Two variants were calculated: One variant was based on the published real net returns of the model enterprise and the other on normalized net returns that eliminated the above-average local expenses for spa facilities.

As it would not have been possible to calculate reliable differentiated forecasts for the future net returns, the published net returns were equated as a constant steady return which was then capitalized with an interest rate of 4%.

All variants were calculated with Excel and therefore it was easy to alter the input-data.

Table 2: Overview on the applied valuation variants

Variant	Areas per tree species and age class	Mean yield in 100 years	Stocks per sort classes	Market-prices and costs
Net-Asset-Value-Method				
1.1	n.n.	n.n.	A =1991; E = 2001 (Sample based inventory)	Data for both A and E from 1990/1991
1.2	n.n.	n.n.	A =1991; E = 2001 (Sample based inventory)	Data for A from 1990/91 and for E from 2001/2003
1.3	n.n.	n.n.	A =1991; E = 2001 (Sample based inventory)	Data for both A and E from 2001/2003
Age-related-Value-Method according to WaldR 2000 (Blume's formula)				
2.1	A =1991; E = 2003 (FM-Inventory)		n.n.*	Data for both A and E from 2001/2003
2.2	A =1991; E = 2003 (FM- Inventory)		n.n.*	Data for A from 1990/91 and for E from 2001/2003
2.3	A =1991; E = 2003 (FM-Inventory)	Data for both A and E from 2001/2003		
Company-Net-Present-Value-Method				
3.1	Published local net return; for A = 80 €/ha, for E = 55 €/ha			
3.2	Normalized net return; for A = 254 €/ha, for E = 49 €/ha			

*n.n. = not needed

4. RESULTS

As Table 2 shows, only the results of the variants 1.2 and 2.2, 1.3 and 2.3 and 3.1 and 3.2 can be directly compared with each other.

Variant 1.1 which uses the same contribution margins for the final valuation as for the starting valuation (i.e. the prices and costs from 1990/1991) indicates an increment of the values of 17.5 %. This rate depends on the silvicultural development of the enterprise and is an indicator of the performance of the silvicultural management; the influence of the different prices and costs at the beginning and at the end having been eliminated. Variant 1.3 – also calculated with identical contribution-margins (but this time with the data from 2001/2003) – shows a similar result.

On the other hand variant 1.2 was calculated using the prices and costs at the beginning as well as at the end of the balance period. After 2000 the timber prices decreased dramatically and so it is not surprising that the final value is 35 % less than the starting value. This reduced asset value indicates a significant economic loss that could not be compensated by the remarkable increase in timber stocks.

Table 3: Comparison of the value of the forest assets (stands and soils) calculated by different variants (see Table 2 also)

Variants		Value at the beginning A (1990/91)	Value at the end E (2001/03)	Alteration E to A	Alteration E to A in %
NAVM	Variant 1.1	51,922,614 €	60,973,802 €	9,051,188 €	17.5%
	Variant 1.2	51,922,614 €	33,329,193 €	-18,593,421 €	-35.8%
	Variant 1.3	29,375,352 €	33,329,193 €	3,953,841 €	13.5%
ARVM	Variant 2.1	37,261,571 €	42,866,065 €	5,604,494 €	15.0%
	Variant 2.2	60,185,541 €	42,866,065 €	-17,319,475 €	-28.8%
	Variant 2.3	42,220,923 €	42,866,065 €	645,142 €	1.5%
CNPVM	Variant 3.1	8,870,159 €	6,124,276 €	-2,745,883 €	-31.0%
	Variant 3.2	28,227,122 €	5,419,713 €	-22,807,409 €	-80.8%

The age-related values (variants 2.1 to 2.3) that were calculated with Blume's formula according to the valuation rules of the German Federal Ministry of Finance vary to the same extent as the Net-Asset-Values (variants 1.1 to 1.3). Again the large influence of the basic data can be observed: If – as it is the case in variant 2.2 – all the data relates to the starting and ending period, then the result is a heavy loss of value. If however, one assumes the same prices and costs for the starting and final value, then the result reflects the alteration of the occurrence of species and stocks within the balanced period – as shown by the result from variant 1.3

The age-related values are significantly influenced by the yield classes of each species and as already mentioned, the 1991 established yield rates appear to be too low. Consequently the starting value in variant 2.3 was calculated with the same yield classes as had been ascertained in 2003. In this case the starting and final values differ only slightly. However this is not surprising as the respective stock volumes are of no importance in Blume's formula.

The values which had been calculated with the Company Net Present Value Method (variants 3.1 and 3.2) depend above all on the future natural and financial return. However as this data cannot be accurately predicted it was decided to use the respective ascertained yield rates and contribution margins for both the starting and the final valuation.

The model enterprise investigated was and continues to be characterized by expenditures on forestry-related spa activities that are higher than the regional average. Therefore a second calculation with the CNPV-method was carried out (variant 3.2) with a 20€ reduction of the published costs. In addition the market prices for the sold timber were much higher in 1990/1991 than in 2001/2003. As a result the net present value at the beginning was logically much higher than the net present value at the end.

5. FINAL CONCLUSIONS

At first glance the forest asset values calculated may be surprising and to a certain degree implausible or even irritating. Of course it was to be expected that the company's present net values would be significantly lower than the age-related values according to the German federal valuation rules. This is due to the use of a capitalization interest rate of 4 % which is much higher than the real return rate (which normally varies between 0 and 2% and which is often even negative). However it could not be foreseen that the net asset values would vary within the same range as the age-related values.

Another fact that could be emphasized is the significant influence of the respective basic data used: It is for this reason that on the one hand all those variants where the prices and costs were identical for both the starting and the closing valuation indicate a more or less significant increase in the asset values. On the other hand those variants where the prices and costs of the respective periods were used indicate a significant depreciation of the assets.

A serious problem is the reliability of the established natural basic data, especially the yield classes. As long as the data is not really reliable then the results of any asset valuation can be doubted. One possible solution for this problem could lie in some broadly accepted valuation conventions that regulate how to handle such uncertain data.

Furthermore a suitable method for the investigation and consideration of the current quality of the timber stock has to be discussed (s. Lohr). And – last but not least – the choice of an adequate valuation method depends on the specific objectives of the valuation.

If the market value of a forest enterprise is required in Germany then a mixed value is normally derived from both the age-related value and the net present value. If however the assets have to be valued for the balance-sheet, then the Net-Present-Value-Method would be preferable because these values correspond best to the current German accounting rules (principle of careful valuation). Yet this value is only partially suited for an evaluation of the success or failure of an enterprise within an annual accounting period.

In a case where the evaluation will be used for the control of the development of the forests then a balance of the net actual values would be more adequate; the alteration of the net actual values correspond directly with development of the timber-stocks. Yet it has to be remembered that the net actual value of a forest is a purely theoretical figure as it would not be possible to realize it in a short time – at least under German legal conditions.

Regardless of the objectives of the valuation and the value balances, all considerations ultimately lead to the conclusion that it is impossible to calculate a broadly accepted "true" forest value. However this is of no consequence if the objective of the valuation is the control of the financial development of the forest assets and the effectiveness of its management; such a "true" value is not really required. The relative development of the forests and the success or failure of the management within one balance period can be correctly identified if the starting and closing asset values are balanced using identical methodological conventions.

In those cases however where only the silvicultural success has to be checked then it would be sufficient to continue to monitor the development of the stands and stocks using only natural key figures (e.g. mean volume per hectare) as has been done in Germany for more than 200 years.

6. SUMMARY

German state and municipal forest owners continue to discuss and begin in part with the financial valuation of their forests with various and consequently incomparable methods. Meanwhile three different valuation methods were applied on the valuation of the forest-assets of a greater municipal forest-enterprise in the Black Forest; the net-asset-value-method (NAVM), the age-related-value-method (ARVM) and the company-net-present-value-method (CNPVM) – with several variants. The

results differ more or less depending on the method applied and the basis data used. The results confirm the urgent need for an agreement on the objectives and the methodological conditions for the valuation of forest assets if comparable results are to be desired.

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INVENTORY, RECOGNITION AND MEASUREMENT OF THE GROWING STOCK IN FORESTRY ACCOUNTING - AN APPROACH WITH SPECIAL FOCUS ON TIMBER-QUALITY-ASSESSMENT

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ABSTRACT

The currently applied profit and loss accounting of forest enterprises in Germany doesn't resemble the actual periodic performance, as it is mainly cash flow based. The special features of the balancing and profit and loss in forestry accounting – notably the independence of the so-called operating result from the actual development of the growing-stock value – provide only partial information and strongly necessitate an enhancement of the profit and loss accounting in forestry enterprises. The application of the International Financial Reporting Standards (IFRS/IAS) would change this situation, because changes in value of the growing stock are also relevant for the periodic income statement. The demand of public and private forest owners for information concerning the current value of their forest growing stock has recently been increasing. Especially in state-owned forest enterprises, the increasing pressure to succeed requires an expansion of the internal revision instruments. The volume-oriented sustainability monitoring needs to be methodically complemented based on the current demand for information.

Hence, a new methodology of measurement has been developed to valuate the growing stock as the most important asset of forest enterprises to amend profit and loss accounting in forestry. The main objective is to assess the financial performance during a period by setting up a balance sheet that includes changes in the value of this special asset which combines the traits of a plant and a product, and consequently the characteristics of fixed and floating assets.

The aspired profit and loss accounting by means of accounting with asset comparison requires an adequate and mostly objective valuation of the growing stock based on detailed and statistically verified inventory data. Only in this case the comparison of the results of two inventories or valuations is methodically feasible and convenient.

That's why a method has been developed that allows for a computer-aided valuation of trees based on data of a Continuous Forest Inventory and a reliable survey of timber quality. The growing-stock valuation is carried out by means of a value-

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oriented inventory sampling procedure. As a result, the average growing-stock value per hectare [€ per ha] productive forest area is made available. The statistical key figures of the valuation clearly show that the value inventory can statistically be verified, contrary to the general opinion. Even changes in value of the growing-stock can be assessed very accurately by using follow-up inventories. Thus, a long-term adjustment of the growing-stock asset value in the balance sheet is made possible, which can then be used for the determination of the periodic financial performance.

To realize a structure- and quality-differentiated monetary valuation of the growing stock for the purpose of profit and loss accounting, a method has been developed, that allows for transparent, reproducible, and reliable results by using modular computer software.

1. INTRODUCTION

The established systems of profit and loss accounting in forestry don't consider the value of the timber growing stock when determining the periodic financial performance, although it is the most essential component of the operational assets of a forest enterprise (Lemmel, 1956; Speidel, 1984; Beck et al., 1998). This simple form of profit and loss accounting arises from usually used techniques of the forest inventory and depends on two basic assumptions. Assuming that the value of the growing-stock volume remains constant due to sustainable management and that the timber utilization exactly matches the current annual increment in quantity and quality, the cash-flow is generally interpreted as the operating result.

This may in part be due to the common methods of forest inventory and forest management planning, which do not provide sufficient information on the growing-stock structure and thus not allow for an accurate quantification of the relatively large sampling error of growing-stock volume at the enterprise level. At all times, the reliable evaluation of timber quality and the elimination of the dominant influence of volatile timber prices on the growing-stock value have posed additional problems.

Any increase of the growing-stock value by means of a bigger growing-stock volume or an improvement of timber quality are hence not considered in the calculation of the operating result; likewise, the systematic exploitation of high-quality or easily marketable assortments are disregarded. Paradoxically, even an increasing growing-stock volume and its depreciation are possible at the same time. This fact presents a danger in times where forest enterprises face an increasing pressure to succeed (Müller, 2000). Therefore, the ambition of some State Forest Services in Germany is to expand its sustainability monitoring beyond the sustainability of the growing-stock volume to the sustainability of value and assortments appears to be the logical consequence. However, if reliable information on the development of the growing-stock value is missing, any disclosure of the operating result will remain incomplete and may be the basis for wrong decisions (Jöbstl, 2000).

The subject of growing-stock valuation receives special attention in relation to the changes of the legal form of state-owned and municipal forest enterprises. Irrespective of the designated form of profit and loss accounting, the change of legal form and the introduction of double-entry accounting necessitate an initial valuation of the growing stock in order to incorporate this figure into the balance sheet. It seems thus reasonable to develop a valuation method that can not only be used once for the valuation in connection with the opening balance sheet (Deisenroth, 2005; Offer, 2006), but also provides the basis for a substantiated monitoring of the operating performance. So the target of the research project was to develop an adjusted valuation method suitable for the monetary valuation of the growing stock for the purpose of income determination and sustainability monitoring.

2. PREREQUISITES FOR VALUATION OF GROWING STOCK

A method for an adequate monetary valuation of the growing stock to map any type of the above-mentioned changes requires an accurate calculation base in terms of the species mixture as well as the diameter and quality structure. A valuation without an accurate inventory of the natural conditions ultimately does not mirror their true value and therefore cannot shed light on possible periodical changes in value. Only a Continuous Forest Inventory (CFI) provides the required information in terms of the growing-stock structure with a sufficient degree of detail and sufficient statistical verification. Solely a measuring method whose results feature the quality of a statistical estimation will minimize subjective elements during the acquisition of primary data on the one hand, and confidently quantify the sampling error of the estimation on the other hand.

Further it’s an advantage of the sample plot inventory that the measured and recorded primary data retroactively allows for flexibility during analysis. Even after the data acquisition is completed, a specific analysis with regard to subsequent problems is possible, e.g. an analysis of the inventory data with regard to the growing-stock volume of certain diameter classes or of retroactively defined units of report (e.g. forest types). The use of concentric plot circles with corresponding callipering limits has proven its worth. Depending on their diameter, all trees are measured within a single sample circle of a certain radius as defined by step-in diameter values. The phenomenon of a higher variability of the area-related growing-stock volume with increasing tree diameter is thus considered in the plot design. Consequently, this results in a significant decrease in sampling time and effort while ensuring accurate results for volume diameter classes.

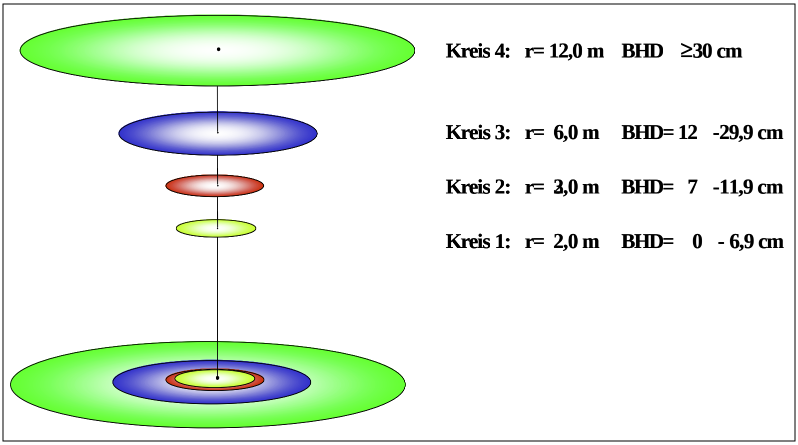

Figure 1: Plot design with concentric sample circles and corresponding callipering limits

Continuous Forest Inventories are often designed as inventories with a systematic grid, because this ensures an efficient work flow while evenly representing the entire forest enterprise. However, under certain conditions, the accuracy of random sampling can be increased by application of stratified sampling while maintaining the number of samples and the sampling expenses per hectare (Loetsch and Haller, 1964; Saborowski, 1992).

For this purpose, the productive forest area is subdivided into strata. Each stratum is assigned all areas that are as similar as possible in terms of the target variable (e.g. growing stock per hectare) in order to maximize the differences between the individual strata. Ideally, the assignment of strata is based on a digital basic forest map in a GIS with linked information of the stands. The criteria used for stratification (e.g. stand age), by means of which all areas are assigned to a stratum, preferably ought to be strongly correlated to the target variable (e.g. cbm per hectare). After the total productive forest area has been assigned to the strata and the associated sampling points have been identified, the random sample can be analyzed by strata (Formula 1).

By an effective stratification it's possible to decrease the sampling error significantly (Formula 2) compared to the simple analysis and in consequence to increase the precision of the estimation. During sampling design and analysis one should take advantage of this fact in order to either increase sampling accuracy or to decrease sampling costs.

Formula (1)

$$\overline{X_{strat}} = \sum_{j=1}^{k} g_j * \overline{X_j}$$

$\overline{X_{strat}}$ Total population mean as result of the stratified sampling

k Number of strata

g_j Sampling Weight (relative Size) of stratum j

$\overline{Xj}$ Stratum mean in stratum j

If, prior to the inventory, area-related information is available on stocking, e.g. from an older inventory or from the stand-based data of the forest management plan, it can be very supportive to an efficient inventory planning.

Formula (2)

$$S_{\bar{x}(strat)} = \sqrt{\frac{1}{n}\left(\sum_{j=1}^{k}(g_j * s_j)^2\right)}$$

$S_{\bar{x}(strat)}$ Sampling error of total population mean

s_j Standard deviation of stratum j

n Number of samples

Using pre-stratification all sampling points have to be distributed amongst the strata based on the information about strata heterogeneity with regards to the target variable (e.g. cbm per hectare; Formula 3), and in such a manner as to allow for maximum accuracy of the estimation at a given number of plots (Cochran, 1972).

Formula (3)

$$n_j = \frac{g_j * s_j}{\sum_{j=1}^{k} g_j * s_j} * n$$

n_j Number of samples in stratum j

Hence, this pre-stratification routinely leads to different sampling densities within the different strata, which results in varying grid distances when plots are distributed systematically (Figure 2).

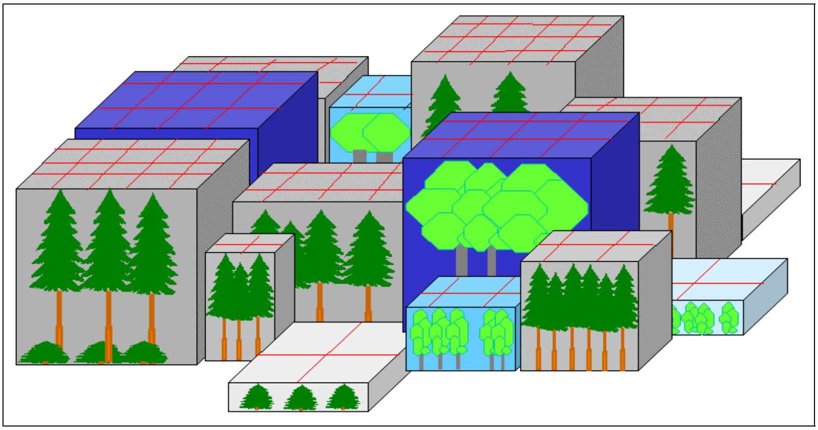

Figure 2: Varying sampling densities within the strata

If, on the one hand, a minimal sampling error is wanted and, beyond that, only limited financial resources are available for data acquisition, the method of stratification has to be strongly recommended. If reliable information about the growing stock and a digital forest basic map for inventory planning are available from other sources e.g. from previous inventories, pre-stratification will be the most efficient solution. In the tested exemplary enterprise, the Saxon Forest District of “Schönheide”, only 903 sampling points were needed to obtain the results presented below, instead of approx. 3400 sampling points in a commonly used regular 2-ha grid. The variable costs for field data acquisition are thus accordingly reduced and more than offset the additional work and expense for a more intensive inventory preparation.

The use of varying grid distances in combination with a dynamic stratification criterion like the age of the dominant tree species causes a successive change of strata affiliation for all areas and sampling points. Hence, a follow-up inventory could theoretically involve certain distortion effects that complicate a comparison of results. In order to avoid this phenomenon, a wide systematic base grid for the overall forest enterprise area was integrated into the inventory design irrespective of the variable within-strata grids, which can be drawn on for inventory comparisons at different points in time without any restrictions.

The permanent installation of sampling plots has obvious advantages in conjunction with the statistical analysis of a follow-up inventory compared to a temporary installation of sampling points. Therefore, the permanent alternative is in principle to be recommended when the focus is on changing variables like the periodic increment or the difference in value. All sampling points in the presented procedure have to be available for follow-up inventories and are thus permanently and invisibly marked with an iron tag. Their exact location is recorded with a GPS unit. Consequently, the described method of a stratified random sampling inventory with a systematic base grid is, with respect to the collection of reliable quantitative data and the efficiency of the procedure, the ideal type of inventory for the purpose of growing-stock valuation.

4. QUALITY INVENTORY AND TIMBER QUALITY ASSESSMENT

The established methods of assessing standing timber quality mostly have proven inadequate for providing information about the qualitative structure of the growing stock, because either the required objectivity and the reproducibility that are essential for comparisons at different points in time could not be assured, or the practicability of the procedure was not sufficient (see Arnswald, 1935; Brabänder, 1957; Wiegard, 1998; Willmann et. al., 2001). Therefore, within this project, emphasis was placed on the development of methods and procedures of standing timber quality assessment that live up to the expectations in terms of high objectivity and reliability. Two alternative methods of assessing standing timber quality have been developed differing with respect to the degree of objectivity and the inventory expense.

Within the scope of the 'Tharandter Erdstammmethode' ('Tharandter Butt Log Method'), a measuring assessment method for large timber, individual quality parameters (e.g. branches, sweep and crook, tapering, damages) of the butt log of sample trees are measured and recorded by type, size and location to a height of 7 m (Figure 3). Irrespective of the inventory process, this type of assessment allows for a computer-aided, automated sorting process of the butt log with a maximum degree of objectivity and flexibility.

An attribute-oriented quality assessment was chosen for the segment above 7 m. Based on the quality-determining attributes whose occurrence and severity can be assessed for the standing tree, the upper log up to the base of the crown is assigned to a quality class. Resulting from the definition of differential criteria, the illustration of each quality class with images of typical trees and a wide differentiation within the quality classes that not only correspond to the common four grade classes for logs, a high degree of objectivity has also been achieved for the upper section of the bole.

Figure 3: Measuring branch diameters according to the 'Tharandter Erdstamm-methode' ('Tharandter Butt Log method)

On the basis of the collected data, the sample trees are virtually sorted by a flexible grading software. For the butt log, the developed sorting module relies on the individual, measured quality parameters, which are matched with the numerically defined quality criteria of the different grades (e.g. HKS B, C, or D) using a logical grading algorithm. Thus, the butt log of each sample tree is broken down into sections of varying quality grades. Subsequently, the sorted trees are grouped into quality clusters. Trees with the same combination and sequence of log grades (e.g. D-B-C) are assigned to the same quality cluster.

Within each quality cluster, one model tree is generated for each 1-cm diameter class. Using a special interface, the cross cutting and the volume calculation of the model trees according to the pre-defined, common grading rules can be carried out with the software ‘HOLZERNTE 6.2’ (FVA, 2004).

The timber quality assessment with the ‘Tharandter Erdstammmethode’ should not be carried out for all trees measured during a sampling inventory due to the intensity of the assessment. Hence, a sampling design has been developed that defines the timber quality assessment as a subsampling procedure for the upper diameter classes of the value-relevant tree species. After analysis of the subsample, the timber quality assessment results in frequency distributions of the quality clusters for each surveyed diameter class, which shed light on the qualitative structure of the respective diameter class. The expenditure of time of the ‘Tharandter Erdstammmethode’ amounts to approx. 10 minutes per sampled tree.

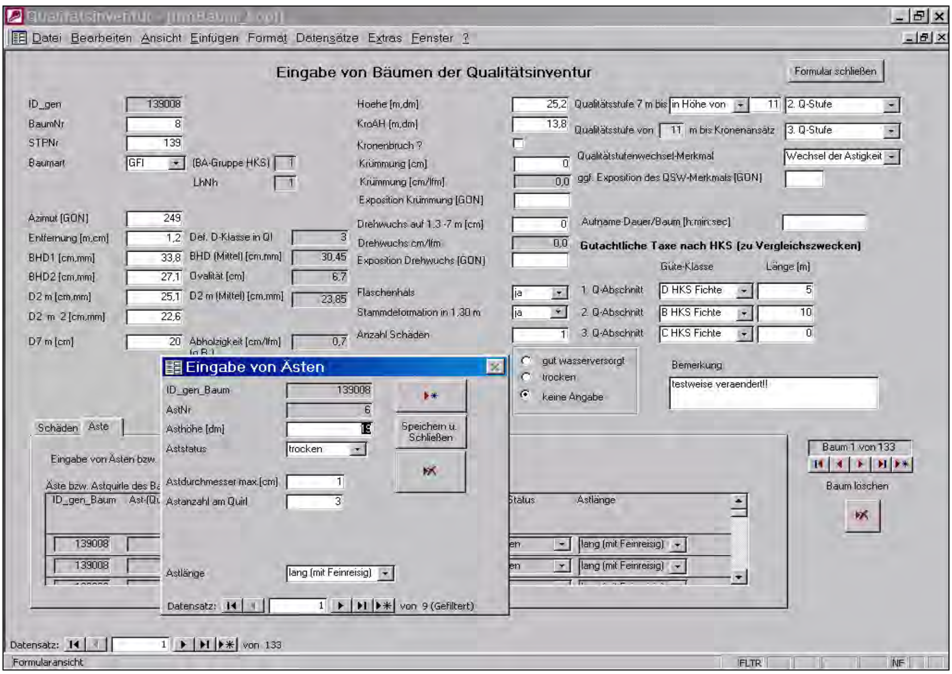

Figure 4: Input form for the measured tree parameters of the software ‘HQI’

In view of the fact that the expenses of the timber quality assessment are just as important a criterion as the intersubjective reliability and reproducibility when evaluating a method with respect to its practicability, a second, alternative method of timber quality assessment has been developed.

The ‘Tharandter Combined Growing Stock and Quality Inventory’ is a more cost-efficient method with only slight limitations regarding the assessment objectivity and the flexibility of subsequent sorting. Only some of the tree attributes that are essential for subdividing the stem into sections of different grades are assessed directly at the standing tree, e.g. the extent of damages and the DBH. Some attributes are functionally estimated, e.g. the base of the crown, the branch diameter, and the height of red rot of spruce stripped by deer. In addition, the lower bole is assigned to a defined and illustrated quality class by means of an attribute-oriented grading procedure.

Based on the measured and calculated attributes and under consideration of the assed quality class of the butt log, the stem is also sorted into sections of different grades using a grading algorithm of the software ‘HQI’. Again, quality clusters are formed and model trees generated for each 1-cm diameter class, which are subsequently virtual cross cutted (software ‘HOLZERNTE 6.2’) and used as the basis for the calculation of the direct product profit.

The distribution of stems (Stz) amongst the quality clusters (QC) can be separately analyzed for all diameter classes as a frequency distribution (Overview 1). It must be pointed out that the timber quality assessment that considers all inventory trees is, in fact, a cluster sampling. In order to calculate the standard error of each Ratio, which is necessary to determine the confidence limits of the proportion, the commonly used formula for calculating ratios based on random sampling is invalid, and Formula (4) has to be applied instead.

The exemplary analysis of the timber quality assessment presented in Overview 1 for a single diameter class presents an additional instrument for monitoring the timber quality structure. On the basis of these results, changes in the qualitative composition of the growing stock can be analyzed after a follow-up inventory. Positive tendencies due to selection thinning and a good, quality oriented yield management become as apparent as negative tendencies caused by overcutting of precious high-quality timber.

Table 1: Frequency distribution of the quality clusters for the diameter class 30-39 cm

Baumarten-Gruppe	*BHD-Klasse (DK)*	*Qualitäts-Cluster (QC)*	*Anteil des QC an Stz der DK*	*Standard-fehler*	*Standard-fehler - %*	*Konfidenzintervall*
Fichte	30-39 cm	B	**11,7%**	1,0%	8,8%	9,6% - 13,7%
Fichte	30-39 cm	B;C	**14,3%**	1,0%	7,2%	12,3% - 16,3%
Fichte	30-39 cm	D;B	**31,8%**	1,4%	4,4%	29,0% - 34,6%
Fichte	30-39 cm	D;B;C	**29,9%**	1,3%	4,5%	27,2% - 32,5%
Fichte	30-39 cm	D;C	**4,6%**	0,6%	13,9%	3,3% - 5,8%
Fichte	30-39 cm	C	**4,6%**	0,6%	12,3%	3,5% - 5,8%
Fichte	30-39 cm	D	**3,2%**	0,6%	17,7%	2,1% - 4,3%

Formula (4)

$$S_p = \sqrt{\frac{1}{\bar{x}^2}\left(\frac{s_Y^2 + P^2 s_X^2 - 2Ps_{YX}}{n}\right)}$$

S_p	Standard error of ratio P in cluster sampling
P	Ratio of Stz in QC (y) to Stz in diameter class (x)
s_Y^2	Variance of the number of trees in QC (y) in diameter class (x)
s_x^2	Variance of the number of trees in diameter class (x)
s_{xy}	Covariance of (y) and (x)
n	Number of plots with trees in diameter class (x)

Both inventory procedures of timber quality assessment have been tested for practical implementation. The developed quality analysis software 'HQI' that was within the scope of the project is suitable for both methods.

5. METHODS OF VALUATION

Exclusively the valuation by the stumpage value appears reasonable when selecting a method of growing-stock valuation for the purpose of profit and loss accounting and monitoring of value sustainability. Thereby, standing assortments and sold assortments can be measured by applying the same standards. The 'International Financial Reporting Standards' (IFRS/IAS), which explicitly regulate the recognition and measurement of biological assets in standard 41, prescribe the use of the fair value for the measurement of standing timber.

Standing Timber and other biological assets should be measured at fair value less estimated point of sale costs (IAS 41.12), the so-called direct product profit. A quoted price in an active market is the most reliable basis for determining the fair value of an asset (IAS 41.17). So the direct product profit based on current market prices and standardized logging costs was chosen for measurement of the marketable timber. Moreover, only a positive direct product profit is considered for growing-stock valuation. The unit of measurement is initially the individual tree, whose direct product profit is calculated as the sum of the positive direct product profit of its assortments. If the sum of the direct product profit of the individual assortments of a model tree results in a negative direct product profit for the whole tree, the modified felling value of the tree equals zero.

Young stands are hence valuated at zero until the production of the first marketable assortments with a contribution to profit. Therefore, the value of the growing stock does not arise from costs, but solely from trees growing into marketable dimensions, thus directly affecting gain. Contrary to other suggestions (Borchers, 2000; Müller, 2000), the presented method rejects the integration of cost values into the valuation due to logical reasons. For example, expensive artificial regeneration whose economic value remains incalculable for a long time can not compensate for the selective harvesting of high-quality assortments. However, the random sampling inventory lends itself to monitoring the state of the natural regeneration in terms of area, composition and quality, Hence, an inappropriate consideration of the regeneration during growing-stock valuation is not necessary.

After calculating and analyzing the results of the timber quality assessment with the software 'HQI' and after calculating a specific and up to date valuation table for an enterprise (Figure 5), the valuation of the inventory trees can be carried out. The software 'SPI-Bewertung' (SPI-valuation) valuates each inventory tree with its stumpage value based on the calculated model trees. A separate, calculated model tree or data set is thus required for the valuation in each 1-cm diameter class, each quality cluster and each tree species group. After all individual trees of the random sampling inventory have been valuated as described; the entire inventory can be analyzed as an inventory for value estimation. However, the sample unit for this analysis is the plot, contrary to the timber quality inventory where it is the individual tree. The value analysis corresponds to the growing-stock analysis, but the sampling variable is not the growing stock per hectare (cbm per hectare), but the modified stumpage value per hectare (€ per hectare). Using the sample plot inventory of the Saxon Forest District of

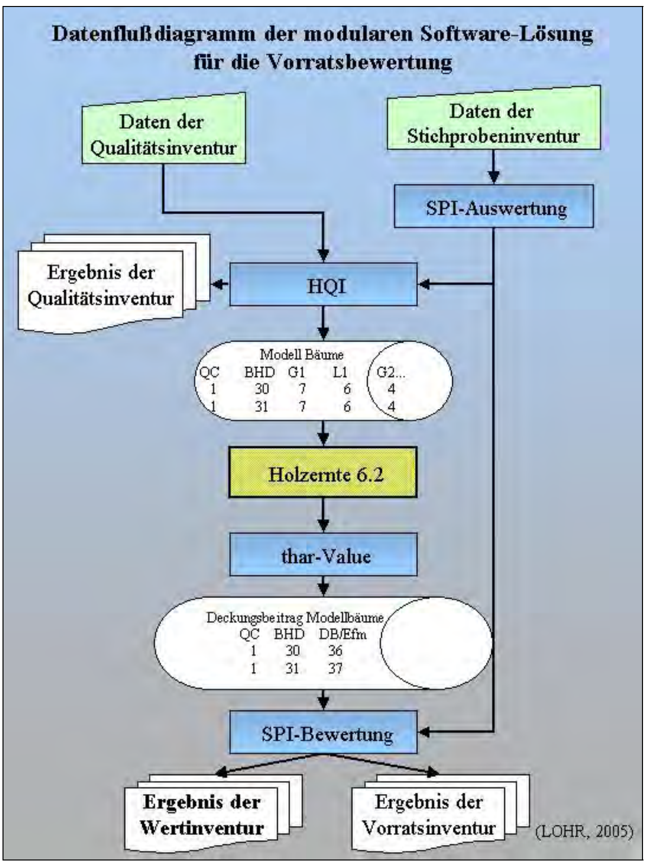

Figure 5: Flowchart of the quality-differentiated growing-stock valuation

‘Schönheide’ as an example, a paradigmatic monetary valuation of the growing-stock has been carried out.

Tree species of inferior relevance for growing-stock volume and value have not been valuated according to timber quality. For the groups of tree species ‘Other coniferous species’, the HKS quality grade C was consistently assumed in view of the concept of prudence. Hardwoods have been valuated with a modified stumpage value of zero due to their rare occurrence, generally low quality and the low relevance for the entire growing-stock value. This seemed reasonable for a prudent growing-stock valuation with respect to its purpose, because with a percentage of 91.4 % only spruce is of actual importance for the overall growing-stock value of the enterprise.

6. RESULTS

A comparison of the results of the stratified random sampling with a higher density of sample plots (7,596.5 € per hectare) to those of the simple analysis of the systematic base grid (7,566.9 €per hectare) shows as well as the low sampling errors of the growing-stock value of 2.2 % and 3.7%, that a growing-stock valuation by means of a value inventory of the developed type can indeed provide statistically verified results.

Due to the fact that certain diameter classes are of particular relevance their individual value needs to be calculated in € per hectare in addition to the whole growing-stock value of the enterprise and the growing-stock value within the strata. Thus, a differentiated value monitoring can be achieved even for the different diameter classes of importance.

Table 2: Growing-stock volume per hectare and value per hectare resulting from stratified analysis

Nr.	Stratum	Flächenanteil	Plots	Vorrat/ha	$S\bar{x}$ V	$S\bar{x}$% V	Wert/ha	$S\bar{x}$ W	$S\bar{x}$% W
1	LH 1-40	1,15%	33	149,8	22,2	14,8%	2776,9	702,9	25,3%
2	LH 41-80	1,55%	76	262,2	16,4	6,2%	2881,8	541,1	18,8%
3	LH 81-12	0,09%	16	378,4	39,4	10,4%	3910,8	1374,1	35,1%
4	LH 120<	0,28%	26	387,7	63,8	16,4%	4808,6	1607,7	33,4%
5	NH 1-40	19,85%	119	196,1	15,9	8,1%	2268,5	282,5	12,5%
6	NH 41-80	40,03%	351	370,5	8,7	2,3%	6169,6	242,0	3,9%
7	NH 81-12	31,25%	200	448,4	11,3	2,5%	12203,1	435,6	3,6%
8	NH 120<	5,79%	82	431,6	26,8	6,2%	13279,3	924,8	7,0%
gesamt			903	359,6	5,6	1,56%	7596,5	165,9	2,2%

Apart from the high precision of the growing-stock volume estimation (359.6 cbm per hectare, sampling error of 1.56 %), the stratified random sampling inventory also leads to a very precise estimation of the monetary growing-stock value (7,596.5 € per hectare, sampling error 2.2 %). It has to be noted that due to the applied valuation basis, which does not consider cost values for young stands and valuates hardwoods with 0 € per cbm, several plots feature a value of 0 € per hectare and this fact normally leads to an increase of the variance of the growing-stock value estimation.

One the one hand, the marginal sampling error of the average growing-stock value is required for a reliable estimation of the total growing-stock value by means of projection on the total area. The larger the enterprise area, the more important a marginal sampling error hence becomes. On the other hand, a small sampling error is also desirable for making a meaningful estimation of changes in growing-stock volume and value on the basis of follow-up inventories (Formula 5).

Table 3: Analysis of growing-stock volume and value differentiated by tree species and diameter class on a systematic base grid (n= 576).

Baumarten-Gruppe	BHD - Klasse	Vorrat [Vfm/ha]	Sx Vorrat	Sx% Vorrat	Wert [€/ha]	Sx Wert	Sx% Wert
Fichte	07-11	3,1	0,4	11,7%	0,00	0,0	0,0%
Fichte	12-19	20,2	1,5	7,6%	15,09	3,3	21,7%
Fichte	20-29	78,2	4,3	5,5%	1013,54	59,4	5,9%
Fichte	30-39	108,8	4,1	3,8%	2407,04	97,7	4,1%
Fichte	40-49	82,5	4,1	5,0%	2678,76	142,5	5,3%
Fichte	50-200	37,6	4,3	11,5%	1349,46	151,0	11,2%
Summe Fichte		*330,5 (92,3%)*			*7463,88 (98,6%)*		
sonst. Nadelholz	07-11	0,2	0,1	53,7%	0,00	0,0	0,0%
sonst. Nadelholz	12-29	7,3	1,2	16,8%	7,77	1,5	19,6%
sonst. Nadelholz	30-200	11,1	1,5	13,3%	95,21	17,1	17,9%
Summe sonst. Nadelholz		*18,6 (5,2%)*			*102,97 (1,4%)*		
sonst. Laubholz	07-11	0,2	0,1	52,5%	0,00	0,0	0,0%
sonst. Laubholz	12-29	1,6	0,4	21,9%	0,00	0,0	0,0%
sonst. Laubholz	30-200	0,7	0,4	66,0%	0,00	0,0	0,0%
Summe sonst. Laubholz		*2,5 (0,7%)*			*0,00 (0%)*		
Buche	07-11	0,2	0,1	51,1%	0,00	0,0	0,0%
Buche	12-29	3,0	0,7	22,9%	0,00	0,0	0,0%
Buche	30-200	3,3	1,3	38,3%	0,00	0,0	0,0%
Summe Buche		*6,5 (1,8%)*			*0,00 (0%)*		
Summe		**358,0 (100%)**			**7566,86 (100%)**		

Formula (5)

$$S\overline{wertdiff} = \sqrt{SW_A^2 + SW_B^2 - 2 \cdot r \cdot SW_A \cdot SW_B}$$

$S\,wertdiff$	Standard error of the value difference for permanent inventories
SW_A	Standard error of the growing-stock value at point in time A (Initial inventory)
SW_B	Standard error of the growing-stock value at point in time B (Follow-up inventory)
r	Coefficient of correlation

Theoretically, a follow-up inventory that also features a sampling error of 2.2 % would allow for an estimation of the change in value with an error of 3.7 % when assuming a realistic correlation coefficient of 0.94. Given this marginal sampling error, a monitoring of value development and an estimation of changes in value by means of the developed method appears to be feasible for the purpose of profit and loss accounting (see Table 1).

Table 4: Example for an estimation of value difference and corresponding sampling error

	Value per hectare 2000	Value per hectare 2010	Periodic difference of value per hectare
Mean (value)	7596,5	6000	-1596,5
n	903	903	903
Sx	165,9	132,0	59,9
Sx%	2,2%	2,2%	3,7%

Besides the information on the growing-stock, the bases of calculation for the monetary valuation are of essential importance. Depending on the objective, there are different possibilities of valuating and calculating value differences. On the one hand for example, in order to quantify a value enhancement of the growing stock during a 10-year period as a silvicultural achievement and to exclude market influences e.g. timber price fluctuations or changes in technical production costs, it seems reasonable to valuate both inventories using identical bases of calculation of one single point of time (e.g. only the prices and costs in point of time t2; see Figure 6). On the other hand, a correction of the growing-stock value, based on current conditions and the determination of the overall periodic financial performance are aimed for, the basic calculation principles of each respective point in time ought to be used.

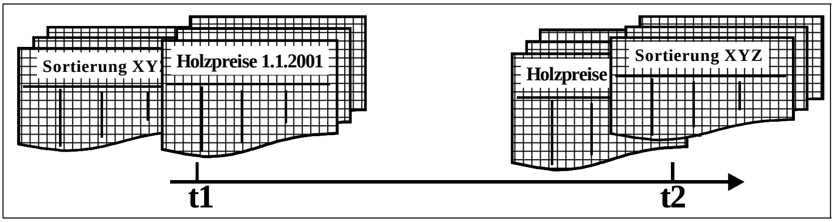

Figure 6: Valuation with different prices and costs for different key dates

7. PROPOSAL FOR REPORTING CHANGES IN VALUE IN ACCOUNTING

Living biological assets like the growing stock of a forest enterprise not only do not deteriorate through wear and tear, like other fixed assets e.g. machineries and equipment do, but undergo a natural physical transformation process, for example riping or growing. As one result of this physical transformation, the biological assets may increase its volume or enhance its quality. Obviously this changes might cause changes in value of those assets as well (Fah, 2003). Contrary to the conservative regulations regarding valuation of the German Commercial Code (HGB), the appreciation in value is generally possible according to the fair value-oriented International Accounting Standards (IFRS/IAS). Moreover, certain special features of the primary production are considered in Standard 41 e.g. changes in value due to growth, harvest or deterioration that are of particular importance for profit and loss accounting in Forestry and to guarantee a true view of the income statement. IAS 41.12 prescribes the measurement of all biological assets, also the growing stock, at their fair values and all arising increases or decreases in the fair values have to be recognized in the profit and loss accounting.

The change in growing stock value can be divided into the changes of market (lumber prices and felling costs) and the physical changes of the growing stock like changes in timber volume, changes in proportion of timber assortment and changes in timber quality (IAS 41.51; Pentinnen et al. 2004). Similar to the calculation, the representation of changes in the value of the timber growing stock in accounting can be based on different methods depending on the objective. However, an explicit separation in accounting of natural caused and price-determined changes in growing-stock value simplifies a correct interpretation of the operating result.

Depending on the type of change, i.e. an appreciation or a depreciation of value, the change in value ought to be considered in different ways in accounting following the concept of prudence and the recognition-of-loss principle. Depreciation in growing-stock value should be measured differentiated according to the above-mentioned components, but should have negative influence on profit and loss account immediately and without any restrictions. Depreciation in growing-stock value ought to be accounted as additional expenditure from depreciation of biological assets following the IFRS/IAS (Buchholz, 2002).

The appreciation in value ought to be accounted as additional income following the internationally common calculation of the income statement (Buchholz, 2002). A differentiation according to volume- and price-determined income components increases transparency and reduces misinterpretations. In order to prevent a valuation-caused risk for the enterprise and guarantee a true view of the sum of value appreciation in the balance sheet, a special valuation surplus has to be created equaling the total amount of all value appreciations. In the case of an unavoidable (re-)depreciation of the growing-stock value, this surplus has to be released first.

A special asset register for the forest growing-stock illustrates its value development throughout all periods and the valuation key dates. A separated disclosure of market price-determined and silviculturally-related changes in growing-stock value in the asset register is recommendable.

Table 5: Proposal for the asset register of the growing stock

Asset register for growing stock												
year	stock begin-ning	addi-tion	outward move-ment	transfer booking	appreciation			deppreciation			stock end
					total	due to volume	due to market	total	due to volume	due to market	
2000	2000000	0	0	0	100000	80000	20000	0	0	0	210000
2010	2100000	0	0	0	0	0	0	400000	300000	100000	1700000
.											
.											

The suggested way of accounting in forest enterprises allows for a complete review of the performance and identifies the hidden reserves of a forest enterprise in the balance sheet, which have been really incalculable when relying on the hitherto existing methods of valuation. A useful monitoring system has been developed, which is able to disclose the revenue of a sustainable, quality-oriented silviculture as well as possible, unperceived depreciation of the growing-stock value.

8. PROSPECTS: THE OPERATIONALISATION OF VALUE SUSTAINABILITY IN THE CONTEXT OF ANNUAL PLANNING

There are several possibilities of an operational integration of value sustainability into the annual business planning at the enterprise level. The proposal described below is meant to be understood as a convention that allows for an assessment of value sustainability between two inventories, and thus implicates certain underlying assumptions.

The average of value increment under current market conditions is calculated on the basis of two inventories that are valuated annually with identical, recent key date conditions. If the average of value increment of the former inventory period, analogue to the increment of growing-stock volume, is interpreted as the current increment of growing-stock value, it is available as the annually updated result of the calculation.

Regardless of special situations that justify a deviation from a well-balanced, even flow harvesting management or a reduction of growing-stock volume at all, the current annual increment of value represents the upper limit of value sustainable harvesting. A harvesting plan that allots significant more utilization while using an identical basis of calculation cannot be considered truly sustainable in terms of value and should be avoided.

In this context, it has to be pointed out that the value sustainability for a period can only be determined ex post by means of a follow-up inventory and a valuation of the respective growing stock. The current annual value increment that has been derived on certain assumptions can, however, serve as an orientation for designing a truly sustainable harvesting management in terms of timber value.

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TIMBER PRODUCTION IN THE ITALIAN ALPS: AN EVOLVING PARADIGM IN FOREST MANAGEMENT [1]

Daria Maso, Davide Pettenella and Laura Secco[2]

INTRODUCTION

In Italy, in the Southern part of the Alps, a substantial decreasing level of timber production activity can be observed in the last two decades. This decline can be traced back to three main reasons: (a) fragmentation of the local timber supply due to the landownership pattern, the lack of horizontal integration and the general small-scale level both of harvesting and of sawmilling activities; (b) market globalisation with the shutting down of many small- and medium-size sawmills or their internationalisation, mainly to Eastern Europe; (c) the remarkable decrease of profitability in forest management domestic activities oriented to the production of industrial roundwood.

This third aspect has been investigated in detail by a recent study (Ciotti and Pettenella, 2006) that is summarised in the first part of the paper. The second part analyses the structural changes in forest management deriving from the breakdown of the domestic timber market. Two development paths, both referring to Non-Wood Forest Products and Services (NWFP&S) markets development, are presented. Finally, in the conclusions the factors playing a key role in successful NWFP&S marketing are briefly discussed.

THE DECLINE OF PROFITABILITY OF INDUSTRIAL ROUNDWOOD PRODUCTION

In the Southern part of the Alps forests are traditionally managed with the purpose of high quality sawnlogs production. The main species are spruce, fir, beech and larch. Domestic market has been traditionally very open and exposed to the strong competition of Austrian export of sawnwood (Italy is the most important export market for Austria in this sector). Other exporters, such as Germany, Russia, Poland, Czech Republic, Ukraine, etc. have been increasing their market penetration in Italy in recent years.

[1] This paper was prepared on the results of Working Group 3 of the European COST Action E30 on the "Economic integration of urban consumers' demands and rural forestry production". A Sub-Group of the Cost Action has been working on the marketing related aspects connected to the development of NWFP&S (Jáger, 2005). The authors acknowledge the contributions of other members of the Sub-Group: L. Ciccarese, S. Dragoi, A. Hegedus, A. Hingston, S. Klöhn, A. Matilainen, S. Posavec and T. Thorfinnsson.

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An analysis on domestic timber prices and production costs (referring to the period 1955-2005) has been carried out to understand the weakening position of the Italian producers. The area of Comelico, in the Northern part of Veneto Region, close to the Austrian border-line, was selected. There, structural factors such as ownership structure, forest management practices, investments in forest roads and other infra-structures construction did not change significantly in the last decades. In Comelico, well stocked forests, mainly of spruce and larch, are traditionally intensively managed by ancient local communities ("Regole"). A network of 3-5 small sawmills (3-5,000 m^3 of processed roundwood/year/sawmill) operates in the area.

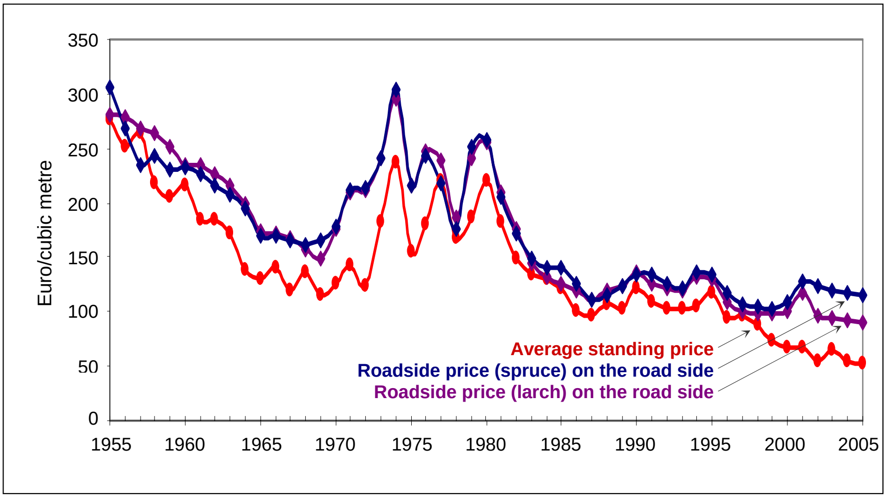

Figure 1: Average real prices of conifer industrial roundwood in the Southern Alpine Region (1955-2005), Source: Ciotti & Pettenella (2005)

The outcomes of 1,330 timber public auctions have been considered; those related to sanitary cuttings or timber damaged by storms have been excluded. As can be observed in Figure 1, in the 51-years-period considered by the survey, the weighted average real prices of the main species (spruce) decreased from 276 to 52 €/m^3, with a reduction of about 82%.

These results are coherent with the timber prices trends analysed in the nearby province of Trentino (Pettenella and Rodighiero, 1998) and with the outcomes of a more detailed, long term analysis carried out for a large single community forest in Val di Fiemme (Pettenella and Zorzi, 2000).

Also the average annual cost of labour, the most relevant variable in influencing profitability in forest management, has been taken into consideration in Comelico case-study, making reference to forest workers and to employees in the wood-working industry. The two variables (wood prices and cost of labour) have been used for defining an indicator that can be considered a good *proxi* of profitability: the number of working hours that can be paid by selling 1 m^3 of wood.

As it can be seen from Figure 2, with 1 m^3 of wood sold in 1955, the cost of 141 working hours of a forest worker was covered. In 2005 only 5.3 working hours are covered, with an indicator decrease of 96%. If the price of wood is referred to the cost of industrial labour, the decrease is of 94% (which means from 76.4 to 3.82 working hours), similarly to what happened for the wood-working SMEs (from 72.3 to 4.1 hours).

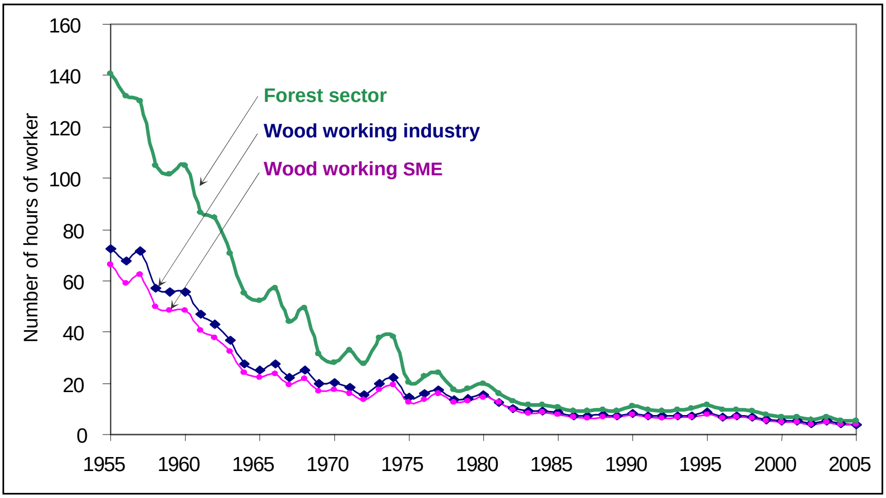

Figure 2: Number of working hours in forest that can be covered by selling 1 m^3 of wood (standing tree value)

Profitability is also influenced by other factors, namely labour productivity, capital costs, interest rates, etc. In the harvesting operations carried out in Comelico only forest workers productivity has changed in the period 1955-2005, due to the introduction of cable systems. However this innovation has increased the productivity of forest workers of no more than 20%, with no remarkable effects in the general trend presented in Figure 2.

The market conditions for industrial wood of the main broadleaved species of the region (beech) are even worst, as explained in Box 1. On the other side, Italy is experimenting a clear improvement of market conditions for fuelwood with an increasing demand mainly of broadleaves and small diameter logs. This trend is in contrast with the main management policy carried out in Southern Alpine forests – as well as in other Italian regions – in the last 50 years: a gradual conversion of broadleaves coppices to mixed highforests, with increased rotation periods (i.e. for spruce even-aged highforest: from 110-120 years to 230-140 years). These more close-to-nature silvicultural systems are now well far to be economically sustainable.

Box 1 – **Timber market for beech**. The Cansiglio forest is located on the border between Friuli Venezia Giulia and Veneto regions. It is a 6,000 ha unevenaged mixed forest with beech as predominant species (see http://www.tragol.it/Cansei/cansei.htm). The forest has a long, well documented history getting back at the time of the Republic of Venice when it was managed to produce timber for the oars used by the arsenal. Recently, the main market for high quality beech logs was a local sawmill producing the Magnum ice-cream sticks, a good example of a high value chain. Few years ago the sawmill, as many other plants in the area, was shut down and production site moved to Romania. As a consequence, no facilities for kiln drying are longer available in the region and, notwithstanding a huge demand for beech dried sawnwood by the local furniture industries, wood in the Cansiglio forest is sold at a flat price of 30 €/m^3 (standing tree price) and wood assortments are not differentiated (see Photo 1) having fuelwood and industrial wood the same price.

Along with this evolving structural change of the timber market for mountain forests, there has been a shift of the focus in wood production from mountains to plains, and from semi-natural forests to plantations. Already 65% of the domestic supply of industrial wood is coming from 80,000 ha of poplar plantations growing on the high productive farmland of the Po valley, while the remaining 10 M ha of mountain semi-natural forests are producing only 35% of the internal supply.

In order to maintain all the public, non marketable functions of Alpine forests, an increasing role is played by traditional and new NWFP&S marketing. There is a clear evidence that, also in the most productive forest areas traditionally managed for wood production, the sales of some recreational services (e.g. mushrooms collection permits) represent a much more relevant source of income for the forest managers than timber sales. It is therefore interesting to analyse why and how what used to be considered "secondary products" is often nowadays, and not only in the Alps but also in other Italian forested areas (Merlo and Croitoru, 2005), the primary source of revenue for forest managers and owners.

Photo 1: Beech industrial wood and fuel wood sold at undifferentiated price in the Cansiglio forest

NWFP&S MARKETING DEVELOPMENT PATHS

For the NWFP&S suppliers in the Southern part of the Alps, it is almost impossible to operate in mass markets: Christmas trees from Denmark, foliage from Ireland, aromatic herbs from Albania, Finnish frozen or Croatian and Bosnian fresh mushrooms are all examples of products more competitive than those coming from the domestic Italian market. Labor cost, scale economies and supply critical mass are competitive factors of foreign suppliers in the mass markets (Collier *et al.*, 2004).

In such a situation, two strategies are possible for the Italian producers (Figure 3):

1. to transform mass products or services into specialized NWFP&S, niche or "cottage" products and services like food or drink specialities, normally with very high added values;
2. to transform mass or niche products or services into complementary products and services.

1. Specialized products and services: they are typically products and services well differentiated, often available in relatively limited quantities (e.g. specialities like truffles).

Segmentation and correct customer information are important instruments for the development of these NWFP&S markets, since they are typically targeted to very narrow customer groups.

While mass markets include mainly traditional products and services, many specialized products are "new" products or rediscovered traditional products, which were already almost forgotten or out of commercial use for a long time (Mantau *et al*., 2001).

Quality assurance, standardisation and certification are important instruments for product differentiation and give the possibility of *premium prices*.

As for timber, NWFP&S can be certified and labelled according with sustainable forest management and chain of custody standards and certification systems, such as the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC), as well as according with other sets of standards such as those defined by IFOAM for organic wild products or by the European Commission for organic crops cultivation (Reg. 2092/91), by UNCTAD BioTrade Initiative for collection, transformation and commercialisation of biological resources, or by FLO for fair trade. In Italy, a small scale activity for fuelwood production has been recently FSC certified, while the aromatic essence from *Pinus mugo* has been certified under PEFC rules.

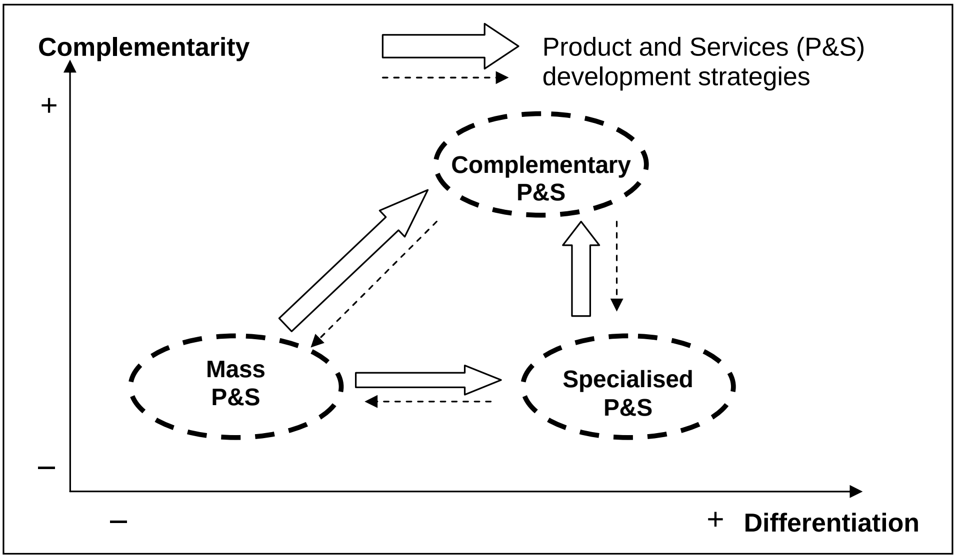

Figure 3: NWFP&S marketing development strategies

For wild food products, which are more similar to agricultural products, quality and origin certification systems have been developed by the European Commission: Protected Designation of Origin, Protected Geographical Indication (PGI) and Traditional Speciality Guaranteed. A forest area producing mushrooms (*Boletus edulis*) has been certified as PGI, while some chestnut proveniences have been certified both under these schemes and as organic products according with the European Commission rules (Pettenella, 2001).

Certification systems have been developed also for some services (e.g. the Carbon certification standards for forest investments developed by SGS and DNV or the Sustainable Tourism Management standards developed by Rainforest Alliance). However, specialized non wood forest services remain a dilemma in this context, because it does not exist for them a proper identification mechanism. Imitation by competitors is a problem for many enterprises that are offering recreational and educational services. Often ideas are imitated, like forest adventure parks (www.jungleraiderpark.com), or topics of courses for environmental education.

2. Complementary products and services are those products that can be sold and used in strict association due to the synergies deriving from their conjoint marketing. Complementarity is connected to different linkages among products and services; in the markets there are diverse forms of links among products and enterprises. In NWFP&S marketing a fundamental link is the one among products and services that have a specific common territory. This is the field of interest of a new branch of marketing: the so-called “territorial marketing”. In the southern part of the Alps, examples of homogeneous territory are the following:

- a valley, a watershed or a well-defined mountainous group (e.g. the Lanzo Valleys or the Ampezzo Dolomites);
- a National Park or other types of protected areas (e.g. the Gran Paradiso National Park);
- an area traditionally linked to a specific product or service (e.g. the Alba territory connected to white truffles);
- a forest in itself (e.g. the Cansiglio forest or the Tarvisio forest, respectively in Veneto and in Friuli regions).

The territory is the "common denominator" to create a consistent portfolio of products and services, to bundle marketing efforts for their coordinated promotion. Very common tools for linking various products and services are trails, roads or pathways (e.g. "*Sentiero delle Dolomiti*" – the Dolomiti trail; "*Strada della castagna*" – the chestnut road).

Analysing some cases studies of complementary products involving NWFP&S recently developed in Italy (Table 1) it is possible to define three main typologies of links connecting NWFP&S to other products and services within a same well defined territory (Figure 4):

(a) the NWFP&S is a non-marketable service (e.g. concerts organised in forests, a cross-country skiing trail, an open air museum) with the aim to attract consumers that will enforce other economic activities or that will lead visitors to buy other local products; the costs for providing the non-marketable NWFP&S can be covered by public authorities or/and by the beneficiaries of associated goods sold in the territory;

(b) the NWFP&S is a marketable good that takes advantage from being offered with synergies with other products and services of the same territory; advantages may derive from joint promotion and consequent higher volumes of sales, increased number of clients and profit level (e.g. mushrooms or berries picking permit sales);

(c) the NWFP&S is a leading marketable good offered in a territory; other products and services from the same territory

Photo 2: Art in the forest: Arte Sella in Italy, open air museum (www.artesella.it)

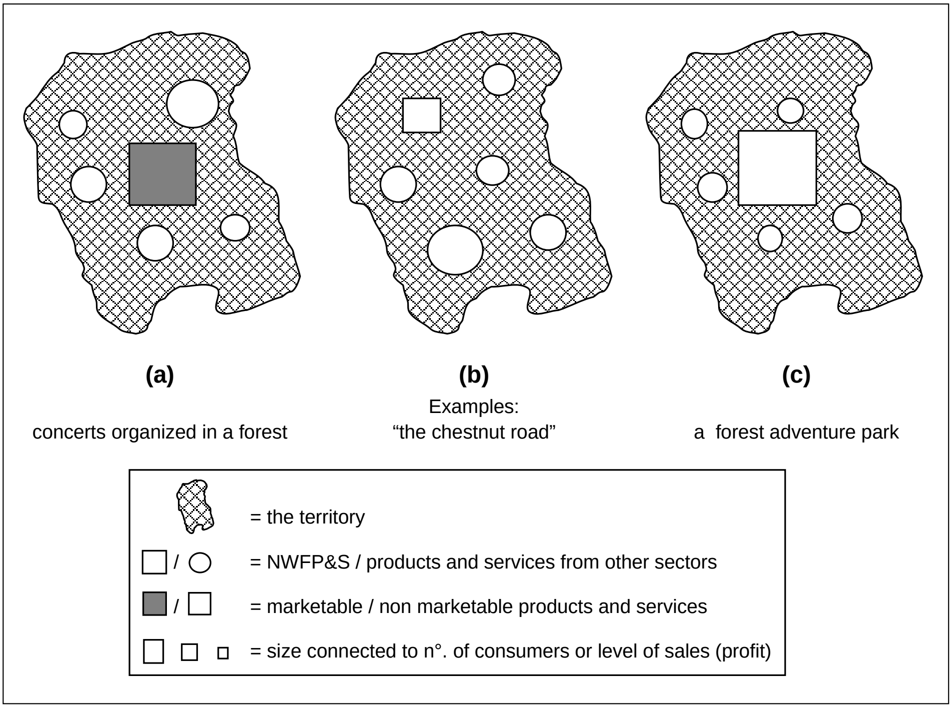

Figure 4: Main typologies of links between NWFP&S and other products and services within the same territory

are complementing and supporting this leading good (e.g. an equipment rental service associated to the NWFP&S is a leading marketable good offered in a territory; other products and services from the same territory are complementing and supporting this leading good (e.g. an equipment rental service associated to a large adventure forest park).

One of the main advantage in creating a portfolio of coordinated products and services in a well-delimited territory is connected with promotion. As already mentioned, in Italy NWFP&S marketing is mainly involving SME with limited financial resources and competences in promotion techniques. For these enterprises it is normally very difficult to reach customers' awareness while joint marketing creates synergies among different suppliers. Joint marketing is frequently a field of positive co-operation between private operators and local public authorities. E-business and e-marketing have been very powerful instruments for reducing the marketing access problems for SME working in the sector. For example, a fresh truffle can be sold on line (www.albatartufi.com/) or a gift wrap of chestnut flour may be delivered in two days by plane to costumers all around Europe (www.esperya.com).

In some cases, it is even possible to use the already exiting customer bases for new or improved products and services or to use the same production and marketing chains for different kind of products. Sometimes, complementary services or products can help to diversify the nature of the main product, so that it can be targeted to new customer groups. Also by combining several complementary services it is possible to create totally innovative products.

Quite often, in territorial marketing strategies, NWFP&S are playing an interesting role as imago products. Even when they have a minor role in the portfolio, being the most environmentally-friendly products in the area, they are used as imago for presenting the whole territory. A good example is the “Days of the chestnuts” case in South Tyrol (Box 2).

Box 2 – **Days of chestnuts in South Tyrol** (http://www.lana.net/): in the South Tyrol region chestnut maturity and the first wine of the year take place at the same time, in September and October, two months in which all the farm tourism facilities in mountain areas are underutilised. Every year different kind of chestnut fairs are celebrated. Tourists are attracted by Chestnut-trails and visits of farms to eat fresh roasted chestnuts, taste the new wine and other local specialities. Many old chestnut recipes are rediscovered and utilised during these days. Tourists can also learn everything about chestnuts from woodland to gastronomy on chestnut walks and different kinds of chestnut parties.

Complementary products and services can be located on public or private lands. Sometimes the landowner and service provider can be the same actor, but this is not always the case. Many tourism and recreational activities, for example, requires close and well-functioning co-operation between entrepreneurs and landowners. This highlights the role of management agreements, an important area of innovation in the forestry sector in Italy due both to the extensive process of forestland abandonment and to the lack of cooperative attitudes among the local economic actors.

Close and well functioning co-operation among different actors is essential for the success of any kind of complementary product or service.

In order to launch and maintain effectiveness co-operation, the role of networks e.g. associations and institutional actors is of fundamental importance. Without a good social capital, i.e. the attitude by the local actors to share their traditional knowledge as well as to coordinate their economic activities, any stable form of complementary NWFP&S marketing may hardly exist.

Table 1: Examples of complementarity involving NWFP&S

Product/service	Area	Flag product	Connecting idea	Network organization	Web link
(a) typology					
Route "*Artenatura*" (i.e. "nature and art") - temporary and permanent exposition of works of art mainly made with wood or plants and displaced along a path in the forest	Val di Sella (Trento province)		Exposition of works of art in the forest	Arte Sella, international biennial exhibition of contemporary art	www.artesella.it
Sounds of the Dolomites Festival of music, open-air concerts, in the Dolomite forests or in alpine huts	Trentino Alto Adige region		Open-air concert	Trentino joint-stock company	www.isuonidelledolomiti.it
(b) typology					
Road of Borgotaro mushroom - "Gastronomic autumn" (special menus in the restaurants) - Mushroom – vintage car trophy - Tourist packets in collaboration whit local SME association	Borgotaro (Parma)	Cep mushroom	Road	Imbrani Mutual Aid Association	www.stradadelfungo.it
Honey road - explanatory boards about the area and the honey production activity - sale of typical products - thematic menus in the restaurants - Festival of honey	Roeri area , mainly Cuneo, but also Asti province	Honey	Road	AsProMiele (Associazione Produttori Miele Piemonte) Assoc."*Strada del miele del Roero*"	www.mielitalia.it/aspromiele/stradamiele.htm
Road of Alba's White Truffle of Southern Piedmont - development (tourist, cultural, environmental, eno-gastronomic) of the area	Sothern part of Piedmont region	Alba's White Truffle	Road	Cuneo, Asti and Alessandria province sharing with Piedmont region	www.provincia.cuneo.it/turismo_territorio/tartufo_bianco.jsp
Exhibition-market of white truffle - guided tours in a truffle-ground and search demonstration - gastronomic stands also with other local products (oil, wine, delicatessen, …)	Municipality of Volterra, San Miniato and Palaia	White Truffle	Week / Exhibition-market	Association of truffle-sellers of Cecina valley (Pisa province)	www.volterragusto.com/appuntamenti/tartufi.asp
Herbs and mushrooms festivals - guided tours in search of spontaneous herbs through meadows and woods - slide projection - street market of handicrafts - gastronomic stands - special menus in restaurants	Forni di Sopra (Udine)	Spontaneous herbs Mushrooms	Festival / weekend	Tourist Service Union of Forni di Sopra Natural Park of "Dolomiti Friulane"	www.fornidisopra.org/index.php?p=1002

Product/service	Area	Flag product	Connecting idea	Network organization	Web link
"***Erbe in fiore*" (i.e. "Blossoming herbs")** - lectures - tasting - guided tours to collect spontaneous and officinal herbs (herbs garden of Casola Valsenio) **Exhibition-market of truffle** - special menus in the restaurants and gastronomic stands **Chestnut festival** **Tourist packets** including tours through some villages and the Garden of herbs, menus herbs- and typical products-based, etc.	Emilia Romagna, Province of Ravenna	Spontaneous herbs Truffles Chestnuts	Festival / Exhibition-market / holiday	"Terre di Faenza": area's society of Brisighella, Casola Valsenio and Riolo Terme Municipalities (Consortium Limited Company)	www.publica.it/terredifaenza/index.asp
"Brise" (i.e. *Boletus edulis*) festival - holiday (week or weekend) in occasion of the festival, includes: excursions, mushroom searching with export mycologists, lunches and dinners mushroom and local products-based	Valle del Vanoi, Caorua, Canal San Bovo (Trento)	Cep mushroom ("brise")	Festival / holiday	Tourist Union of Valle del Vanoi	www.vanoi.it/it/promo.html
Herbs and bath holiday packets "baths in the greenery": excursions, hydrotherapy and herb bathes	Trento Province	Spontaneous herbs	Holiday	various Tourism Companies of Trentino Region	www.trentino.to/home/index.html?_lang=it
Tourist packets involving the "*mugolio*" (aromatic oil from *Pinus mugo*) - baths with *P.mugo* oil - compress with *P.mugo* oil	Val Sarentino (Bolzano)	*Pinus mugo* oil (PEFC certified)	Holiday	Eschgfeller family	http://www.eschgfeller.com
Chestnuts festival Cultural events (lectures, movies, photos expositions, etc.) Gastronomic festival with typical products chestnut-based but also: hazelnuts-based, forest fruits-based, ceps-based, etc.	Parma Apennines, Municipality of Bore	Chestnut	Festival / weekend	Municipality of Bore	www.comune.bore.pr.it
Exhibition-market of truffle and underwood products **"*polenta*" and underwood fruits festival** **National fair of white valuable truffle** **Exhibition-market of mushroom** **Chestnuts festival** **Market-festival of chestnuts**	Marche region (Pesaro and Urbino province)	Truffle Underwood fruits Mushrooms Chestnuts	Exhibition-market / festival	Province of Pesaro and Urbino, Local Tourism Association	www.turismo.pesarourbino.it

Product/service	Area	Flag product	Connecting idea	Network organization	Web link
Chestnuts festival In association with the "weekends in Montefeltro" Integrated weekends in occasion of: mushroom festival, honey festival, chestnuts festival and truffle festival.	Central Appen-nines	Chestnuts Mush-rooms Truffle	Festivals / weekends of holiday	"Appennino" partnership project of ter-ritorial mar-keting, pro-moted by 13 Mountain Communi-ties of Tos-cana, Emilia Romagna, Marche and Umbria re-gions	www.appen nino.info
(c) typology					
Suspended routes among trees Various routes, differentiated according to the age of parti-cipants. And also: - businessmen stages/courses - organization of scholastic trips (with tours at the botanic route, etc.)	Sella Nevea (Friuli Venezia Giulia)		Adven-ture route	"Parco Avventura" Sella Nevea	www.sella nevea parco.it
Adventure Park Suspended pathways between trees	Villeneuve (Val d'Aosta)		Adven-ture route	Rafting Adventure (associated with the French or-ganisation Amazone Adventure)	www.raft ingavent ure.com/ wwwparco avventura com/it/ index_it. html
Adventure Park Suspended pathways between trees and also: - stage for businesses - hotel accommodation	San Zeno di Mon-tagna, Garda Lake		Adven-ture route	Park Jungle Adventure, with the sponsorship of the hotel-owners of San Zeno di Montagna	www.jungle adventure.it

Figure 5 tries to summarise the main factors influencing the successful marketing of NWFP&S (Font and Tribe, 2000; Marshall *et al.,* 2006). From the reviewed case-studies, product and service development and quality assurance seem to be the key-factors for marketing specialised NWFP&S, while the social capital, i.e. the capacity to cooperate among private and public actors, as well as the presence of horizontal integrations and networking in a well characterised territory seem to be the most important factors developing complementary NWFP&S.

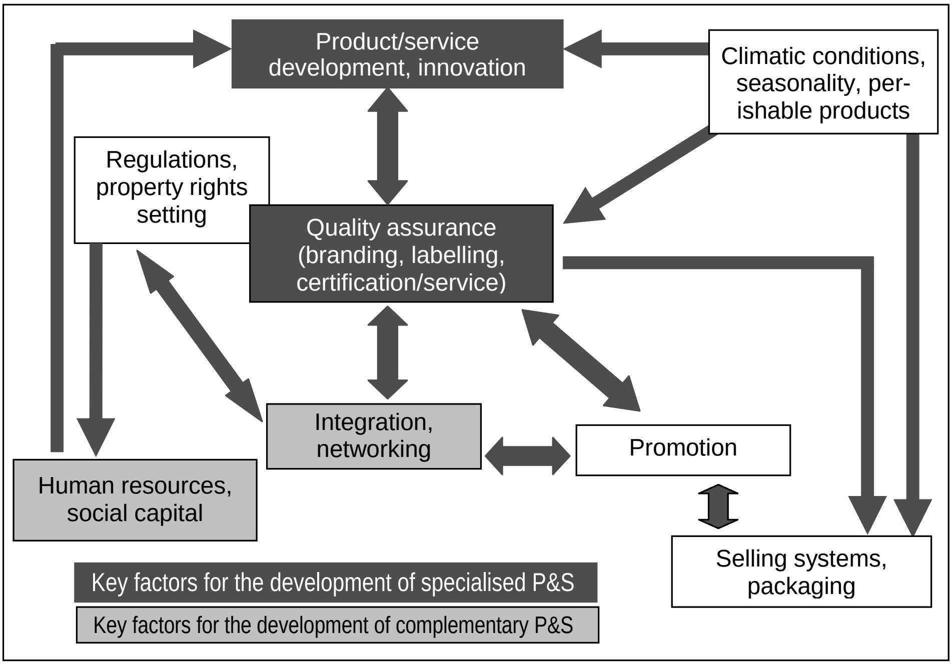

Figure 5: Main factors for successful marketing of NWFP&S

CONCLUSIONS

Looking at the recent experiences of high-advanced examples of NWFP&S marketing in Southern part of the Alpine region, it appears that some forest managers and forest owners, by shifting from a timber-based activity to a NWFP&S-based activity, are changing their traditional product-oriented approach into a more customer-oriented one. This is an important development in the entrepreneurial capacity: NWFP&S marketing requires more efforts for market research to obtain precise information on customer needs and demands. The smaller the business and the smaller the customer group, the more important are both organizational aspects for production and distribution and market research and promotion (Collier *et al.,* 2004; Font and Tribe, 2000; Mantau *et al.*, 2001). Since normally SMEs in rural areas can not access this information by themselves and have no critical mass of products or services to sell, external support, networking and integration are key factors for NWFP&S marketing. In this regard, assistance given by public institutions is in many cases essential, as well as the public acknowledgement of the positive role that an active NWFP&S economy can support in the sustainable management of forest resources.

Looking at the Italian experience in this sector, it is therefore possible to confirm the assumption made by Kotler *at al.* (1996) about the role in the marketing mix of the so called “4 Ps” (Price, Product, Place, Promotion), but also of the “2 Ps” added later (Public support and Political power). The Alpine one is an unique and fragile environment; innovation in forest resources management and use shall always be fully supported by the local community, the general public and the public authorities. This is also a pre-condition for a sustainable carrying out of economic activities, especially when these are based on techniques of territorial marketing, i.e. on the use, as a common denominator, of the image of the local natural and cultural traditional resources that are a collective patrimony.

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MEASURING TOTAL COMMERCIAL INCOMES FROM AGROFORESTRY SYSTEMS: APPLICATION TO SPANISH AND TUNISIAN PUBLIC CORK OAK FARMS

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ABSTRACT

Jerez (Spain) and *Iteimia* (Tunisia) cork oak agroforestry systems have similar environments and differ in land property rights, labour market and economic development. These human induced differences result in similarities and dissimilarities on natural resources multiple use management. On the case study of *Jerez*, ownership has the right to exclude others to use the land resources and the management is guided by social and conservation criteria. By contrast, in *Iteimia* State ownership has exclusion rights on tree uses and hunting, but the local inhabitants have free uses rights regulated by forest law on livestock rearing, firewood, charcoal and crops. Tunisian State and local users operate on the basis of maximizing the current agroforestry incomes, with little concerns addressed to forest sustainability.

National economic accounts for agriculture and forestry on commercial good and services have been regulated in nearly all countries, but statistical data are poor and application does not consider the measurement of the total income if we take into account the current regulation. On the field of multiple land use, all economic data need to be generated by the analyst to its specific purpose. This shortcoming on missing market land outputs and costs could be off set by undertaking pilot exercises that illustrate the operative feasibility of applying an agroforestry accounts system for measuring objectively total commercial incomes from actual multiple land uses.

The objective of this paper is to present the application of an integrated accounts system to *Jerez* and *Iteimia* cork oaks agroforestry systems to estimate individual and aggregated actual total commercial incomes.

The results show that *Jerez* generates a negative capital income, while maintain a significant figure of forestry internal investment. Opposite to *Jerez*, *Iteimia* actual management generates a positive capital income and a high self-employed labour income from livestock and other minor uses from household subsistence-econ-

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omy. The presence of a notable wild flora and fauna and the maintenance of an important stock of carbon in the cork oak agroforestry systems of these regions make these habitats an environmental resource of global concern. In fact, there is a chance to cooperate for conserving cork oaks agroforestry systems avoiding local development cost by applying local policy nature conservation measures, when global benefits accruing free to developed countries. This concerted perspective requires a Mediterranean agroforestry systems environmental fund that creates a compensation payment from global consumers in developed countries to local actors in developing countries.

Keywords: Public ownership, cork oak agroforestry systems, total commercial income

1. INTRODUCTION

The long history of human management of cork oaks agroforestry systems (COASs) has made for a complex form of exploitation of natural resources and a persistent declining trend on surface and tree aging. The world COAS surface is totally included in the Mediterranean-climate zones of Western Europe (Italy, France, Spain and Portugal) and North Africa (Morocco, Algeria and Tunisia), with more than 2.3 million hectares, fifty-fifty extended in the two continents (Campos, 1991, p. 207; Goes, 1991, pp. 129 and 223).

Scientific knowledge of the natural environment has not been fomented in the Mediterranean region. In addition, there is limited scientific information available on how to improve and manage the ecosystem as a whole in order to make multiple uses of Mediterranean agroforestry systems compatible with each other (Papanastasis, 1996, p. 154). As regards *Quercus* species and native pastureland, Mediterranean agroforestry systems have not benefited from innovation through scientific development. Even today, it is upheld and believed that traditional patterns should be retained in the management of their natural resources (Gómez and Pérez, 1996, p. 60), such patterns being none other than the rules dictated by experience (Montgolfier, 2003, p. 7).

The mosaic of uses and vegetations reflects the ways in which human influence has shaped the natural endowment of resources. Traditionally, one of the main commercial uses of COAS has been livestock grazing and cork stripping. Cereal and pulse crops usually occupy a small proportion of COASs surface. Vegetable fuel is still of key importance in the rural homes of the Maghreb, particularly brushwood fuel, while there are many other forms of gathered goods by rural populations. Regarding Western European COAS, however, a major highlight is the growing significance of the environmental services self-consumed by private landowners and the public at large. Western European and North African COAS possess a notable presence of wild flora and fauna and maintain an important stock of carbon which make these habitats an environmental resource of global concern (Campos, 1994, p. 104).

It is assumed by specialists and governments that the management of multiple land uses must be ruled on the basis of the public goods and services that the diversified land uses could produce (Campos, 2004). Measurement of public goods and services values is nowadays a controversial scientific issue, and there is not public regulation on environmental accounting yet. Consequently, policy makers have not statistical data on the public goods and services that could be attributed to a specific multiple land use management (Eurostat, 2002; Lange, 2004).

National economic accounts for agriculture and forestry (EAA/EAF) on commercial good and services have been regulated in nearly all countries, but statistical data are poor and application does not consider the measurement of the total income, if we take into account the current regulation (Eurostat, 1996, 2000; Campos et al., 2005a). On the field of multiple land use, all economic data need to be generated by the analyst to its specific purpose (FAO, 1998). This shortcoming on missing market land outputs and costs could be off set by undertaking pilot exercises that illustrate the operative feasibility of the employment of the agroforestry accounts system (AAS) applied here for measuring commercial total income (Campos, 2000; Caparrós et al., 2003).

Despite the economic significance of Mediterranean agroforestry systems in the Western Mediterranean basin, few study cases have measured the total commercial income with economic data that fit with income theory on land multiple uses (Rodriguez et al., 2004, 2005). Pioneering preliminary studies are being published about the total outputs of Mediterranean agroforestry systems by Ellatifi (2005) and Daly and Ben-Mansoura (2005) in Morocco and Tunisia, respectively.

The objectives of this paper are to apply an agroforestry accounts system (AAS) to *Jerez* (Spain) and *Iteimia* (Tunisia) cork oak agroforestry systems (COASs) and to estimate *in site* individual and aggregated actual total commercial incomes, accruing by public landowners and self-employed households or employees.

2. MATERIALS AND METHODS

2.1 Jerez and Iteimia cork oak agroforestry systems study cases

In Spain, the case study was carried out in *Montes de Propios* estate of *Jerez de la Frontera* (south-west of Spain)[3]. In Tunisia, the study was conducted in *Iteimia* (north-west of Tunisia)[4]. The surfaces of *Jerez* and *Iteimia* COASs are 7,035 and

[3] Jerez COAS is located inside *Alcornocales* Natural Park (ANP). ANP has 1,677 km² where private landowner possess two third of the area in the form of large size estates.
[4] Iteimia COAS is located inside *Ain Snoussi* region (AS). AS has 32.3 km² of public ownership COAS.

634 ha, respectively (Campos et al., 2005b; DGF, 2002; ODESYPANO, 2001).

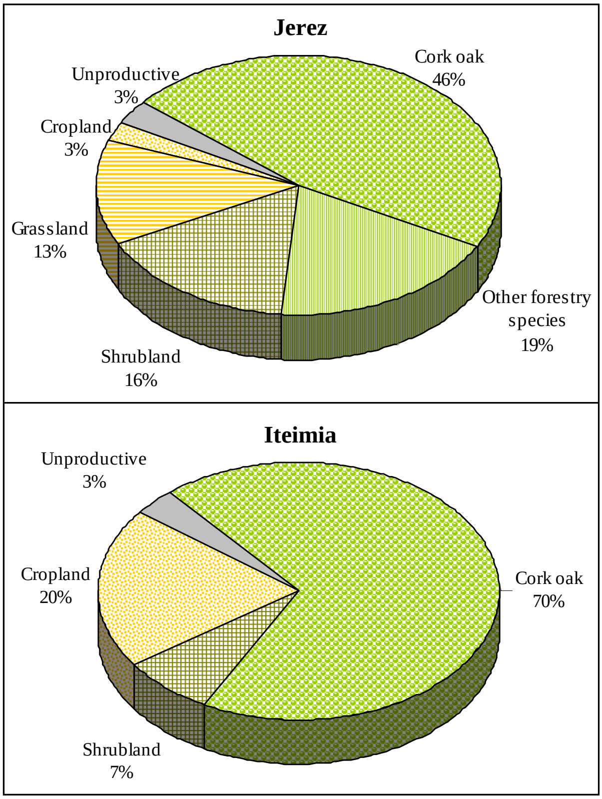

Figure 1: Jerez and Iteimia agroforestry land use (Year 2002)

Jerez and Iteimia COASs have similar natural environments, but huge dissimilarities on institutional and economic contexts. They are mountainous areas with an altitude range between 200-650 m and 400-642 m, respectively. Both COASs have a humid Mediterranean climate with an annual average rain fall of 882 mm (period 1994-2002) and 1006 mm (period 1999-2002), respectively. The main tree species are cork oak (*Quercus suber* L.), Algerian oak (*Quercus canariensis* Willd.) and wild olive (*Olea europaea* L. var. sylvestris Brot) in *Jerez*, and pure cork oak in Iteimia. Shrub species are dominated by lentisc (*Pistacia lentiscus* L.), myrtle (*Myrtus communis* L.) and strawberry tree (*Arbutus unedo* L.) in both areas. Game species differs, being the main red deer (*Cervus elaphus hispanicus*) and roe deer (*Capreolus capreolus*) in *Jerez*, and wild boar (*Sus scrofa*) and hare (*Lepus sp.*) in Iteimia.

In *Jerez* and Iteimia current *land uses* are pending on local and national economic developments. More than two thirds of the total surface is compounded by pure and mixed stands of cork oaks in *Jerez* and pure cork oaks stands in Iteimia (Figure 1). *Jerez* 1976 forest inventory gave a density of 149 trees ha^{-1} of wooded land[5] with 67 cork oaks, 34 Algerian oaks, 41 wild olive and 7 other species[6] (Campos and Salgado, 1987). Iteimia average tree density is 583 cork oak trees ha^{-1} of wooded land (Stiti et *al.*, 2004). In both cases seedlings or recruitments are not included. Cropland has less importance in *Jerez* while it becomes a major use in Iteimia, consisting in subsistence agriculture in small treeless parcels inside the

[5] Trees were accounted upper to 10 cm of diameter.
[6] Pine trees were not accounted.

forestland. In Iteimia shrubs biomass natural growth and the standing biomass stock are used for fodder, firewood, charcoal and shelter. Hence, Iteimia subsistence economy reduces cork oak woodlands overstorey to a minimum, while standing brush species biomass is rising in *Jerez* as a consequence of lower grazing pressures and the lack of firewood uses.

The institutional land property rights regimes and the management and uses regulations in *Jerez* and Iteimia exhibit relevant dissimilarities.

Jerez is a public ownership that belongs to *Jerez* municipality, where the owner has the right to exclude the entry of other persons in the forests for making use of its resources. However, the forest law (Boletín Oficial del Estado, 2003) limits the property rights of the owner in respect to some natural resources management. In addition, *Jerez* is included in the regional protected natural areas (Boletín Oficial de la Junta de Andalucía, 1988), implying that it is subjected to a good practice code regulation (Boletín Oficial de la Junta de Andalucía, 2004).

Iteimia land ownership belongs to the Tunisian State, but local inhabitants have specific usage rights. The Tunisian State is engaged in the forestry management operations from which it gets commercial benefits, mainly from cork, firewood, mushrooms, myrtle and game. Tunisian Forest law (Tunisian Republic, 1993) maintains livestock grazing among the list of usage rights that can be freely practiced by local population and allows families to make crops in some areas (Ben Mansoura et al., 2001). Forest administration is represented by the forest service manager (chief) at the area, who is responsible of forest silvicultural operations and the application of forest regulations. Forestry activities conducted are cork stripping, sanitary cutting of trees, prevention of fires and forest guarding. Also, another public administration called ODESYPANO is working on the development of rural activities with local population.

Jerez and *Iteimia socioeconomic contexts* diverge extremely in labour market regulation and local household income. *Jerez* work force is regulated in a competitive labour market and all positions are for permanent or temporary employees. *Iteimia* has a weak labour market regulation and most of works, others than cork stripping and tree thinning, are made for family workers by their own account (self-employed). In *Jerez* all the employments are employees; therefore the economic risk is on the account of *Jerez* municipality. In *Iteimia*, the economic risk is assumed by both families and the Tunisian State. Family-subsistence economy generates diverse uses of woody vegetation other than cork stripping and family commercial self-consumption is relevant in *Iteimia*, but negligible in *Jerez*[7]. The high

7 The ANP private landowners could incur in an opportunity cost to assure an environmental private amenities self-consumption (Campos and Mariscal, 2003, Coelho, 2005, Pardal, 2002). In Jerez, the nature of public landowner makes impossible to realize the private environmental self-consumption.

level of employment in Iteimia (in this case self-employed) gives a total of 532 hours per ha per year in 2002 whilst in Jerez the labour market only generates a total 18.7 hours per ha per year for the analysed data.

Average population densities was estimated in 8 inhabitants per square kilometre in Alcornocales Natural Park (ANP) in year 1996 (Consejería de Medio Ambiente, 2000) and 100 inhabitants per square kilometre in Iteimia[8] in year 2002. Annual per capita household 2003 incomes in Andalusia region, Cádiz province and ANP Municipalities were €8,787, €6,843 and €8,012, respectively. Thus, ANP income is 17% higher than the Cádiz province income and -9% lesser than the Andalusia region income (IEA, 2006). The cork oak forest continues to play a prominent socio-economic role for local households' economy in Iteimia area. The net value added for families given by diverse activities conducted in *Iteimia*, such as self-employment from livestock rearing and crops (80% inhabitants) or occasional forest employment (19% inhabitants), is estimated to be €1,000[9] per household in 2002 (Chebil et al., in press). In addition, families benefit from the employment outside the area where 25% of inhabitants are working in part-time or full-time jobs (Daly and Chebil, 2003). No comparison between Iteimia and *Jerez* per capital household income is suitable unless by considering Spain and Tunisia national currency purchasing power parity (PPP) conversion factors[10]. In this manner, the estimated Iteimia household annual PPP income is 2,333 €.

Instead of applying conventional financial investment analysis tools, which conclude that landowners and households are economically irrational when they do not rule on commercial capital surplus, a converse approach should be taken. It should be assumed that landowners and households behave within an own and different economic rationality, and then new methods of economic analysis must be found for explaining the rationality attributed to landowners and households on that prior assumption.

Jerez management criteria are concentrated on nature conservation and social guidance. The latter aim generates commercial capital income losses and high demand of permanent and temporary level of employment. This management rules on the basis of financial transfers from *Jerez* Municipality, Andalusia regional government, Spanish government and European Union. Grazing is declining and na-

[8] In 2002, *Iteimia's* local forest population was made of 110 households corresponding to 508 inhabitants at total land area.

[9] Exchange rate: 1 € = 1.34 TND (BCT, 2003).

[10] A PPP exchange rate is the number of units of a country's currency required to buy the same amounts of goods and services in the domestic market as U.S. dollar would buy in the United States. An international dollar is, therefore, a hypothetical currency that is used as a means of translating and comparing costs from one country to the other using a common reference point, the US dollar (The World Bank, 2004). The ratio of conversion factors to official (US $) exchange rate in 2002 are 0.7 for Spain and 0.3 for Tunisia (The World Bank, 2004: 280). That is a relation of 2.33 between former conversion factors.

tive red cow grazes mainly in grass and crop lands. The cork output reaches the preparation[11] step at farm gate, after forestry and stripping steps. This preparation step is in part responsible of the high costs in Jerez (Campos et al., 2005b).

Iteimia management criteria lead to avoid public ownership negative cash-flow and developing local families' subsistence-economies on the basis of natural resources base and livestock improvement by introducing exotic mix meat-milk cow races (schwitz and tarentaise races). Women and children play a major contribution to livestock rearing and crops. Households behave using the forest resources with the aim of maximising self-employed income by family labour, in a context where family labour opportunity cost is nearly to zero.

2.2 Agroforestry accounts system methodology

2.2.1 Total income accounting identities

Total income (TI) measurement requires estimating the production function flows and assets values that are organized in a normalized production and balance accounts – the so called agroforestry accounts system (AAS) – during an accounting period. In any accounting period TI is the sum of net value added (NVA) plus capital gains (CG):

$$TI = NVA + CG.$$

Net value added (NVA) gives the operating income accrued from the economic activity during the accounting period[12]:

$$NVA = TO - IC - FCC = IO + FO - RM - SS - PPu - FCC.$$

Being, TO: total output, IC: intermediate consumption, FCC: fixed capital consumption, IO: intermediate output, FO: final output, RM: raw materials, SS: intermediate services and PPu: production in progress used.

Capital gains (CG) represent the income accrued from changes in prices of working in progress (inventory of existences) and durable goods (fixed assets) during the accounting period – capital revaluation (Cr) –, net of capital destructions (Cd), and adding fixed capital consumption (FCC) to avoid double accounting:

$$CG = Cr - Cd + FCC.$$

Capital income (CI) indicates the income attributed to capital services as a production factor, when the owner of affected capital demands a risk benefit from capital

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[11] This consists on boiling cork barks and classifying cork barks for stoppers and other cork-made stuffs.

[12] The NVA is shared by labour cost (LC) and ownership net operating margin (NOM) or net operating surplus (NOS).

investment. This income indicator is significant for a private owner that employs remunerated workers and less important or even negligible for economies where family self-employment is highly relevant. CI is defined as the sum of the net operating margin (NOM) or net operating surplus (NOS) and capital gains (CG):

$$CI = NOM \text{ or } NOS + CG.$$

This indicator could be measured at market prices (CI_{MP})[13] or at factor cost prices (CI_{FC}). The latter includes net operating (OS) and capital (CS) subsidies:

$$CI_{FC} = NOS + CG_{FC} = NOM + OS + Cr - Cd + FCC + CS.$$

The measurement of TI also requires a distinction between market prices and factor cost prices. Market prices total income (TI_{MP}) is measured without considering subsidies net of taxes (ST) on *goods and services* and factor cost total income (TI_{FC}) includes them:

$$TI_{FC} = TI_{MP} + ST = LC + CI_{FC}.$$

2.2.2 Total commercial income measurement from steady state agroforestry farm

The *European System of Accounts* (ESA) is the normative regulation that gives the criteria for the satellite *Economic Accounts for Agriculture and Forestry* (EAA/EAF) applied to measure the total commercial income from the agroforestry *nation farm* (Eurostat, 1996 and 2000)[14]. For applying EAA/EAF to *individual* farm scale some extensions must be developed, and this aim was the reason of the pilot *Agroforestry Accounts System* (AAS) for micro scale application in these *Jerez* and Iteimia study cases. The AAS extends the conventional EAA/EAF by considering the following items (Caparrós et al., 2003 and Campos et al. 2005a)[15]:

- Commercial production and balance accounts organize data by single economic activity and aggregate each activity values into a total agroforestry farm value.
- Total output (TO) incorporates intermediate output (IO), own account production of finished durable goods as gross internal investment (GII) and expected discounted value of gross natural growth (GNG) as final stock output.
- Intermediate consumption (IC) includes intermediate output (IO) and production in progress used (PPu).

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13 $CI_{MP} = NOM + CG_{MP} = NOM + Cr - Cd + FCC$.

14 The *Farm Accountancy Data Network* (FADN) does focus on farmer commercial income, but it does not supply data on income generated by a single activity or from the farm land unit uses (European Union, 1999).

15 The aim of this section is to summarize the AAS approach taking into account the two study cases. A detailed description of EAA/EAF and AAS comparison is presented in Caparrós et al. (2003), Campos and Caparrós (2006) and Campos et al. (2005a).

- Labour cost (LC) takes into account household self-employed labour cost (SLC) as residual value or as a conditioned imputed value with grazing resource rent.
- Fixed capital consumption (FCC) includes gross internal and external durable goods depreciations[16].
- Owner net operating margin (NOM) and owner net operating surplus (NOS) both they are pure capital operating incomes.
- Capital destruction (Cd) is a capital withdrawal in the accounting period with zero economic revenue (return) to the owner.
- Capital revaluation (Cr) is the residual value of balance accounts.

We have assumed hypothetical forestry, livestock and crops steady state. As we have shown (Caparrós et al., 2003), this entails that there are no capital revaluation other than those arising from the discounting effect of production in progress (cork oak natural growth) and fixed capital consumption. This steady state assumption makes possible to estimate *total commercial income* as the sum of commercial net value added (NVA) plus production in progress revaluation (PP_R) minus fixed capital destruction (FCd):

$$TI = NVA + CG = NVA + Cr - Cd + FCC = NVA + PP_R - FCd.$$

Jerez and Iteimia present difficulties in the measurement of final and intermediate outputs. When there is no market transaction for an intermediate output the total cost for an individual activity become a subjective measurement[17] – e.g. grazing resource rent –, but when all agroforestry activities *cost and returns*[18] are aggregated, including controlled animal activities, then the agroforestry *aggregated* total commercial income is an *objective market value*:

$$TI = SFO + IFOp + OFO + FCs + FCos - RMe - SSe - PPe - FCei.$$

Being, SFO: sales of final outputs, IFOp: final outputs of permanent (non-consumible) internal investment, OFO: other final outputs as self-consumption or donations, FCs: fixed capital sales, FCos: other fixed capital withdrawals as self-consumption or donations, RMe: raw materials expenditures, SSe: services expenditures, PPe: production in progress expenditures and FCei: fixed capital external investment.

[16] Animal FCC includes non-alive consumable durable goods and adult livestock depreciation.

[17] The NVA for an individual activity is calculated by the activity total output minus both intermediate and fixed capital consumption.

[18] It has been showed that in the steady state situation production in progress revaluation (PP_R) equals the values of production in progress used (PP_U) minus gross natural growth (GNG): $PP_R = PP_U - GNG$ (Caparrós et al., 2003).

2.2.3 Cork gross natural growth discounting value

In *Jerez* and *Iteimia* study cases one discounted output has been measured: the *cork gross natural growth*[19].

The present *gross natural cork growth value* (GNG_t) is calculated by the following expression:

$$GNG_t = \sum_{j=1}^{J} \frac{X_j \cdot Pp}{(1+r)^{T-t_j}} .$$

Where GNG_t: value of gross natural growth in year *t*, X_j: plot *j* production per year, where $j \in \{1,2,\ldots,J\}$, Pp: stumpage price of cork, r: discount rate, T: cork stripping turn, and $T\text{-}t_j$: time for reaching the next cork stripping turn in plot *j*.

2.2.4 Agroforestry household net value added

Jerez and *Iteimia* have three residual income values: *household net value added*, *owner net operating margin* and *capital revaluation*. The *household net value added* (NVA_H) under steady-state conditions can be measured objectively from market *cost* and *returns* values considering the follow items (Rodríguez, 2005):

$$NVA_H = SFO_H + FCs_H + OFOsc_H + FCsc_H - RM_{HIC} - SS_{HEIC} - ELC_H - NOM_{HG} - FCC_H,$$

$$NVA_H = R_H + SC_H - RM_{HHIC} - ICE_H - ELC_H - T_{HG} - FCci_H.$$

Being, R_H: household revenues from sales of final output (SFO_H) and fixed capital goods (FCs_H); SC_H: household self-consumption from final output ($OFOsc_H$) and fixed capital goods ($FCsc_H$); RM_{HIC}: household intermediate consumption from household own harvested raw materials (RM_{HHIC}) and external raw materials (RM_{HEIC}); SS_{HEIC}: household intermediate consumption from external services; ELC_H: employee compensations paid by household; NOM_{HG}: net operating margin paid by household to the government in concept of taxes on products net of subsidies (T_{HG})[20]; FCC_H: household imputed fixed capital consumption; ICE_H: household external intermediate consumption expenditures from external raw materials (RM_{HEIC}) and services (SS_{HEIC}); and $FCci_H$: household agroforestry external consumable fixed capital investments[21].

If we focus in the residual household net value added from livestock activities (NVA_{HL}), we could see that it includes the free grazing natural resource rent (GRR_H). Given an imputed value for household *self-employed wage rate* from live-

[19] The latter value makes the measurement of total commercial agroforestry income an impossible objective task, except for the steady state situation.

[20] It is assumed there are no operating and capital subsidies in *Iteimia*.

[21] In the steady state situation the aggregated value of household agroforestry own and external consumable fixed capital investments ($FCci_H$) equals the value of household agroforestry fixed capital consumption (FCC_H).

stock activities (W_{HLSE}); e.g.: in Iteimia case study it is subjectively assumed that the self-employed wage rate for livestock rearing activity arises the 50% of forestry employee wage rate (W_{FE}). Thus, the household grazing resource rent (GRR_H) could be estimated by subtracting imputed household *self-employed labour cost* from livestock activities (SLC_{HL}) from the household residual net value added: $GRR_H = NVA_{HL} – SLC_{HL}$.

Self-employed labour cost from other activities (SLC_{HO}), different from livestock activity, is estimated as a residual value by using the following accounting identity: $SLC_{HO} = TO_{HO} – IC_{HO} – FCC_{HO} – ELC_{HO} – NOM_{HO}$; referring the HO subscript to 'other activities'.

3. RESULTS

3.1 Animal activity

3.1.1 Grazing resources and supplementary feed consumptions

The average livestock *instantaneous stocking rates* (ISR) per hectare of utilised agricultural land (UAL) are 0.33 and 0.11 standard livestock unit (SLU)[22] in *Iteimia* and *Jerez*, respectively[23]. The total SLU energy requirements volume 375 and 627 FUs[24] per hectare in *Jerez* and *Iteimia* (Table 1). One of the features that characterises the ways controlled animals are fed in Jerez and Iteimia is the large dependence on grazing resources extracted from forest and croplands. It has been estimated that controlled animals[25] in Jerez and Iteimia extract 269 and 515 FUs ha^{-1} of forestland[26]. Thereby, grazing resources contribute with 80% and 84% of total FUs consumption in Jerez and Iteimia, respectively. External supplementary feed covers 11% and 3% of total FUs consumption in Jerez and Iteimia, and own crop supplementary feed supplies the remaining 9% and 13% of total FUs consumption. Grazing resources consumption is 77% higher in Iteimia than in Jerez per hectare basis (Table 1).

If we look at animal species separately, red deer and roe deer consume 17% and goats 41% of total grazing resources consumption (FUs) in Jerez and Iteimia, re-

[22] Only adult females and males are considered. In case of cattle and equines, we have considered animals older than 24 months, and in case of sheep, goats, roe and red deer animals older than 12 months. All standard livestock unit (SLU) are presented in adult cow equivalents (Martin et al., 1987). A SLU is defined as un-pregnant cow within a weight of 450 kg (alive) and ordinary sanitary state. A SLU is equivalent to 8.2 sheep; 7 goats, 1.5 equine females.

[23] Iteimia ISR is the sum of 0.14 cattle, 0.11 goats, 0.05 sheep and 0.03 equines. Jerez ISR is compound of 0.07 Cattle, 0.01 equines and 0.03 high game (red deer and roe deer).

[24] A forage unit (FU) represents the energy contained in a kilogram of barley, with 14.1% humidity, that is 2,723 kilocalories of metabolic energy (INRA, 1978).

[25] Livestock and controlled big game animals (red deer and roe deer) in Jerez and goats, cattle, sheep and equines in Iteimia.

[26] Forestland includes woodland, shrubland and grassland.

Table 1: Jerez and Iteimia grazing resources and supplementary feed consumption (FU ha^{-1})

Class[a]	Jerez				Iteimia				
	Cattle	Roe and red deer	Equines	Total	Goats	Cattle	Sheep	Equines	Total
Grazing	248.24	50.70		298.94	218.14	149.97	89.72	69.93	527.76
Forestland	*218.65*	*50.70*		*269.36*	*218.14*	*140.46*	*89.72*	*66.79*	*515.10*
Cropland	*29.58*			*29.58*		*9.52*		*3.14*	*12.66*
Supplementary feed	55.55	8.80	11.39	75.73	5.27	80.08	7.72	6.00	99.06
Own raw materials	*26.55*	*4.97*	*2.67*	*34.18*	*5.13*	*62.54*	*6.93*	*6.00*	*80.60*
External raw materials	*29.00*	*3.83*	*8.72*	*41.55*	*0.14*	*17.54*	*0.78*		*18.46*
Total	303.78	59.50	11.39	374.67	223.41	230.05	97.43	75.93	626.82

[a] FU: Forage unit.

spectively[27]. On the other hand, cattle consume 83% in Jerez and 28% in Iteimia of total grazing resources consumption (FUs). Regarding external supplementary feed, in Iteimia cattle consume 95% of external FUs (Table 1) while in Jerez it reaches 70%. Iteimia goats and cattle grazing FUs consumption reaches 98% and 65% of their respective total FUs annual consumption, while red and roe deer and cattle grazing FUs consumption are, respectively, 82% and 85% in Jerez (Table 1).

3.1.2 Grazing versus supplementary forage unit value

Livestock grazing and supplementary feeding have a FU cost (€ FU^{-1}) that is compounded of raw materials (grazing resource rent and supplementary feed) and labour cost spent in animal feeding (Table 2).

Grazing resource rent measurement becomes a subjective value given the lack of representative data in Jerez and the free grazing right in Iteimia. In Jerez has been

Table 2: Forage unit cost comparison[a] (Year 2002 € FU^{-1})

Class[b]	Jerez			Iteimia		
	RM	LC[c]	Total	RM	LC	Total
Grazing	0.09	0.04	0.12	0.07	0.14	0.21
Forestland	*0.09*	*0.04*	*0.12*	*0.07*	*0.14*	*0.21*
Cropland	*0.09*	*0.04*	*0.12*	*0.07*	*0.14*	*0.21*
Supplementary feed	0.15	0.03	0.18	0.21	0.03	0.24
Own raw materials	*0.11*	*0.03*	*0.14*	*0.18*	*0.03*	*0.21*
External raw materials	*0.19*	*0.03*	*0.22*	*0.35*	*0.03*	*0.38*
Total	0.10	0.04	0.13	0.09	0.13	0.22

[a] €1 = TND1.34, year 2002 (BCT, 2003).
[b] FU: Forage unit; RM: Own or external raw materials; LC: Labour cost.
[c] Labour costs represent in case of Jerez cork oak woodland 95% of total direct cost related to each FU obtained by grazing and 87% of total direct costs in case FU is obtained by supplementary feeding. Additional direct costs refer to machinery and infrastructure use for cattle management and surveillance.

[27] In Jerez, big game is a controlled animal activity (Jerez has fences to avoid red deer and roe deer withdrawals) and could be seen as an imperfect substitute of goats.

imputed the highest potential market grazing rent value of €0.09/FU[28]. Considering that Iteimia livestock rearing employs usually women and children, when a self-employed wage rate is assumed to be 50% of forestry employee wage rate (as explained above), then this assumption gives a subjective grazing rent value of €0.07/FU. In addition, grazing operations requires a labour cost of €0.04/FU and €0.14/FU in Jerez (employee) and Iteimia (self-employed), respectively. *Total grazing FU cost* is 75% higher in Iteimia than in Jerez (Table 2).

Supplementary FU raw materials and total costs are 40% and 33%, respectively, more expensive in Iteimia than in Jerez. Total cost of a FU that is provided by supplementary feeding is 50% and 14% higher than a FU that is extracted by grazing in Jerez and Iteimia, respectively (Table 2).

3.1.3 Animal total commercial income

Livestock sales (and self-consumption) are the main Iteimia outputs and its joint value of €127 ha^{-1} might be 22 times the value of Jerez cattle sales in purchasing power terms (Table 3 and Appendix 1 and 2).

Livestock net value added (NVA_L) does not include the real grazing resource rent (GRR_H). The latter has been valued in Iteimia with conditioned self-employed imputed subjective value. Hence, there is a high risk of grazing rent overvaluing. This trade-off between grazing resource rent value and livestock income is illustrated in Figure 2.

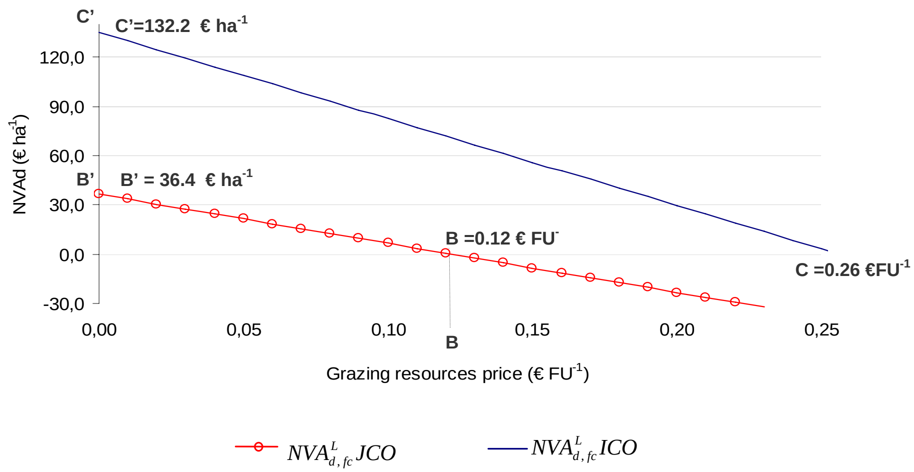
Game sales generate relative low outputs in Jerez and Iteimia (Table 3). While in Jerez game is responsible for a relevant capital income loss, in Iteimia government receives a positive game capital income (Appendix 1 and 2).

Animal activity is the primary source of labour income in Iteimia and the second in Jerez (Table 4). In Iteimia livestock is responsible for the total animal labour income; by contrast, game generates 54% of total animal labour income in Jerez. Cattle are the main source of labour income amongst livestock species, in both study cases. Cattle and goats offer 58% and 37% of animal labour income, respectively, in Iteimia (Appendix 1 and 2).

Animal subsidies and taxes are relevant in Jerez while are negligible in Iteimia. In Jerez, animal subsidies net of taxes on goods and services accounts €16 ha^{-1}; reducing animal capital income loss from €-92 ha^{-1} to €-75 ha^{-1} (Table 4). Hunting activity is the only animal activity that could generate a capital income in Iteimia and its value is nearly to zero (Table 4).

[28] In Spanish *dehesas* of Mongragüe shire – where market price for grazing resource rent is the highest – a grazing forage unit (FU) has a value of 50% of the price of a kilogram of barley at farm gate (Rodríguez et. al., 2004, p. 89).

Animal activity reaches in Iteimia a positive total social commercial income (TI_{MP}) of €101 ha^{-1}; opposite, it produces a TI_{MP} loss of €-24 ha^{-1} in Jerez (Table 4). The latter animal TI_{MP} loss could represent a negative value of €-56 ha^{-1} in terms of PPP.



JCO: *Jerez* cork oak agroforestry system; ICO: *Iteimia* cork oak agroforestry system.

NVA^{L}_{d} refers to 'livestock direct net value added', while *cf* subscript refers to factor cost indicators.

Figure 2: Jerez and Iteimia grazing rent and livestock commercial income trade off

3.2 Forestry activity

3.2.1 Cork stripping and preparation

The quantity of total stripped cork per UAL hectare and year in Iteimia is about 52% higher than in Jerez and summer stripped cork attains practically the same quantity at both sites. The quantity of other stripped cork from silviculture improvements (dead wood, thinning, tree formation pruning, etc.) is almost 5 times higher in Iteimia than in Jerez (Table 3). These quantities of winter stripped corks represent 45% and 14% of total cork stripping in Iteimia and Jerez, respectively (Table 3).

Iteimia and Jerez stripped cork market prices can not be objectively compared. This is because in Iteimia the stripped cork is sold at road site; whilst in Jerez there is a primary industrial cork preparation at farm site, incorporating new value to the cork that is being sold. The average price at farm road site in *Iteimia* is €0.40 kg^{-1} and for *Jerez* it has been imputed a subjectively imputed price before preparation of €1 kg^{-1} for fresh cork at farm road site (Table 3).

In *Jerez*, 50% of annual stripped cork is prepared (boiling barks and other minor tasks) to be sold to the stopper enterprises for an average price of €2.1 kg^{-1} (Table 3).

Before preparation at road gate, stripped cork has an output value of €107.6 ha^{-1} and €65.2 ha^{-1} in *Jerez* and *Iteimia*, respectively (Table 3). These outputs represent 6.6 and 0.5 times the animal output value in *Jerez* and *Iteimia*, being *cork preparation* the major output in *Jerez* (Table 3).

3.2.2 Firewood and other forestry outputs

Firewood in Iteimia is the only cooking and heating source of energy for local inhabitants. In Iteimia firewood harvested is 688 kg ha^{-1}, being 16.8 times more than in Jerez, whilst shrubs provide 54% of firewood and the remaining share from cork oaks sanitary felling (Table 3).

The Iteimia and Jerez firewood output values represent 10.9% and 2% of their respective cork stripping output values, before preparation at farm road site (Table 3).

Other forestry output values represent 24.9% and 4.9% of their respective cork stripping output value, before preparation at farm road site (Table 3).

3.2.3 Forestry total commercial income

Forestry activity is the primary source of labour income in *Jerez* and the second in *Iteimia* (Table 4). In *Jerez*, forestry labour income is responsible for 55.8% of forestry TI_{MP}; by contrast, in *Iteimia* it represents only 28.6% of forestry TI_{MP} (Table 4).

Forestry subsidies and taxes are relevant in Jerez and negligible in Iteimia. In Jerez, government forestry subsidies net of taxes on goods and services account for €34.8 ha^{-1}. This positive net subsidies increase Jerez forestry capital income from €55 ha^{-1} to €89 ha^{-1} (Table 4). Negative forestry net subsidies of €-2.0 ha^{-1} reduce capital income from €82.0 ha^{-1} to €80.0 ha^{-1} in Iteimia (Table 4).

Forestry activity reaches in *Iteimia* and *Jerez* a TI_{MP} of €114.8 ha^{-1} and €125.6 ha^{-1}. After forestry net subsidies, TI_{FC} increases to €159.3 ha^{-1} in *Jerez* and decrease to €112.8 ha^{-1} in *Iteimia*. This latter forestry income contributes with 95% and 48% to *Jerez* and *Iteimia* TI_{FC}, respectively (Table 4).

3.3 Crop activity

Crops play a notable contribution to household self-consumption and animal supplementary feeding in Iteimia. In Jerez it is a less crucial source of animal feeding, and it does not contribute to employees’ payment in species. Cereal grain and hay are the main crops grown at both sites, but minor leguminous plants are cultivated in Iteimia (Table 3).

Table 3: *Jerez* and *Iteimia* selected cork oak agroforestry commercial benefits (€ year 2002)

Class[a]	Units	*Jerez*			*Iteimia*		
		Quantity ha^{-1}	Price € unit^{-1}	Benefits value € ha^{-1} year^{-1}	Quantity ha^{-1}	Price € unit^{-1}	Benefits value € ha^{-1} year^{-1}
Cork stripping		108.1	1.0	107.6	164.9	0.4	65.2
Summer stripped cork	kg	*93.1*	*1.1*	*105.6*	*90.3*	*0.6*	*59.1*
Winter stripped cork	kg	*15.0*	*0.1*	*2.0*	*74.6*	*0.1*	*6.1*
Cork preparation		77.5	1.6	121.6			
Boiled cork	kg	*54.9*	*2.1*	*113.9*			
Raw cork	kg	*22.7*	*0.3*	*7.7*			
Firewood		41.0	0.1	2.3	688.3	*	7.1
From cork oak trees	kg	*31.0*	*0.1*	*1.6*	*315.0*	*	*4.3*
From shrubs	kg				*373.2*	*	*2.8*
Other firewood	kg	*9.9*	*0.1*	*0.7*			
Other forestry goods				5.2			16.3
Timber	m^3	*0.2*	*31.4*	*5.0*			
Heather bunches	units	*0.2*	*1.2*	*0.2*			
Charcoal	kg				*39.2*	*0.3*	*10.2*
Acorns collection	kg				*16.2*	*0.1*	*1.0*
Myrtle	t				*0.1*	*27.5*	*2.7*
Mushrooms	kg				*1.1*	*2.1*	*2.3*
Cattle				23.1			92.4
Calves sales	units	*	*330.0*	*13.5*	*0.1*	*334.9*	*21.3*
Breeders self-consumption and sales	units	*	*612.4*	*9.6*	*0.1*	*205.6*	*16.4*
Milk sales	l				*151.2*	*0.3*	*42.9*
Milk self-consumption	l				*36.5*	*0.3*	*10.4*
Others							*1.5*
Goats							45.3
Young goats sales	units				*0.4*	*49.6*	*21.3*
Breeders self-consumption and sales	units				*0.1*	*97.5*	*9.7*
Young goats self-consumption	units				*	*49.3*	*0.4*
Milk self-consumption	l				*32.6*	*0.4*	*12.2*
Sheep							22.3
Lamb sales	units				*0.2*	*69.6*	*12.4*
Breeders self-consumption and sales	units				*	*113.2*	*5.4*
Milk self-consumption	l				*12.0*	*0.4*	*4.5*
Others							*0.3*
Game				2.9			0.2
Big game hunting rent	licences	*[b]	*3,340.5*	*0.5*	*	*97.6*	*0.2*
Small game hunting rent	licences				*	*2.0*	*
Red deer meat	kg	*1.4*	*1.3*	*1.7*			
Red deer hunting	stags	*	*775.9*	*0.1*			
Roe deer hunting	bucks	*	*699.1*	*0.5*			
Crops				1.3			26.2
Cereals and pulse	kg	*0.3*	*1.0*	*0.3*			*12.8*
Cereal (forage)	kg				*29.4*	*0,2*	*6.2*
Hay and straw	kg	*0.2*	*6.0*	*1.0*	*112.0*	*0.1*	*7.3*

[a] Hectare of: useful agricultural land (UAL).
[b] Red deer (*Cervus elaphus hispanicus*); roe deer (*Capreolus capreolus*).
* less than 0.05 units per hectare.

Source: Based on Chebil *et al.* (in press) and Campos *et al.* (2005b).

Crop total *private* commercial income contributes with 4% and 9% to Jerez and Iteimia TI_{FC}, respectively (Table 4).

3.4 Other activities

Other activities include services and cork preparation in Jerez what gives a high relevance to this item in Jerez. Cork preparation is the reason that in Jerez other activities generate an important negative capital income at factor cost (CI_{FC}) with a value of €-51 ha^{-1} (Table 4).

Total *private* commercial income (TI_{FC}) from other activities contributes with 8% to Jerez TI_{FC} (Table 4).

3.5 Total commercial income

Iteimia and *Jerez* aggregated activities reach a total *social* commercial income (TI_{MP}) of €238.7 ha^{-1} and €118.1 ha^{-1} (Table 4). The former income could be 4.7 higher than the latter in terms of PPP. After government agroforestry net subsidies of €51.1 ha^{-1} and €-52 ha^{-1} in *Jerez* and *Iteimia*, respectively, total *private* commercial

Table 4: *Jerez* and *Iteimia* commercial incomes (Year 2002 € ha^{-1})

Class	*Jerez*						*Iteimia*			
	Cork oak woodland	Animals	Crops	Cork preparation	Services	Total	Cork oak woodland	Livestock	Crops	Total
Labour costs (LC)	70.1	67.3	9.4	57.0	7.3	211.0	32.8	98.8	21.0	152.7
Employees (ELC)	*70.1*	*67.3*	*9.4*	*57.0*	*7.3*	*211.0*	*19.6*			*19.6*
Self-employed (SLC)							*13.2*	*98.8*	*21.0*	*133.1*
Net operating surplus (NOS)	80.3	-74.4	-5.8	-50.8	0.0	-50.8	73.3	3.5	0.9	77.6
Net operating margin (NOM)	*45.5*	*-90.7*	*-5.8*	*-50.8*		*-101.9*	*75.3*	*6.1*	*1.5*	*82.8*
Net operating subsidies (OS)	*34.8*	*16.3*				*51.1*	*-2.0*	*-2.6*	*-0.6*	*-5.2*
Net value added at market price (NVA_{MP})	115.6	-23.4	3.5	6.2	7.3	109.2	108.1	104.9	22.5	235.5
Net value added at factor cost (NVA_{FC})	150.4	-7.1	3.5	2.3	7.3	160.2	106.1	102.3	21.9	230.3
Capital gain at factor cost (CG_{FC})	8.9	-1.1	-0.8	-0.2	0.0	6.8	6.7	-3.5	0.0	3.2
Capital revaluation (Cr)	*-34.6*	*-30.0*	*-3.5*	*-10.2*	*-1.3*	*-79.7*	*-4.8*	*-20.4*	*-4.0*	*-29.2*
Capital destruction (Cd)		*1.0*				*1.0*		*3.5*		*3.5*
Fixed capital consumption (FCC)	*44.6*	*30.0*	*3.5*	*10.2*	*1.3*	*89.6*	*11.5*	*20.4*	*4.0*	*35.9*
Net capital subsidies (CS)	*-1.1*	*-0.1*	*-0.8*	*-0.2*		*-2.2*				
Capital income at market prices (CI_{MP})	55.5	-91.7	-5.8	-50.8	0.0	-92.9	82.0	2.6	1.5	86.0
Capital income at factor cost (CI_{FC})	89.2	-75.5	-6.7	-51.0	0.0	-44.0	80.0	0.0	0.9	80.8
Total income at market prices (TI_{MP})	125.6	-24.4	3.5	6.2	7.3	118.1	114.8	101.3	22.5	238.7
Total income at factor cost (TI_{FC})	159.3	-8.2	2.7	6.0	7.3	167.0	112.8	98.8	21.9	233.5

Note: ha refers to a hectare of useful agricultural land (UAL). UAL is calculated by subtracting the unproductive surface area (water and infrastructures) from the total surface area (geographic).

income (TI_{FC}) increase to €167.0 ha^{-1} in *Jerez* and decrease to €233.5 ha^{-1} in Iteimia (Table 4).

Jerez activities produce a labour income of €211 ha^{-1} that is 26% higher than TI_{FC}. This result contrasts with CI_{FC} loss of €-44.0 ha^{-1} (Figure 3 and Table 4).

In *Iteimia*, labour income of €152.7 ha^{-1} is responsible for 65% of TI_{FC}. Household self-employed receives 87% of total labour income. *Iteimia* CI_{FC} has a positive value of €80.8 ha^{-1} (Table 4). Most of this capital income is appropriated by Tunisian State as landowner (Figure 3).

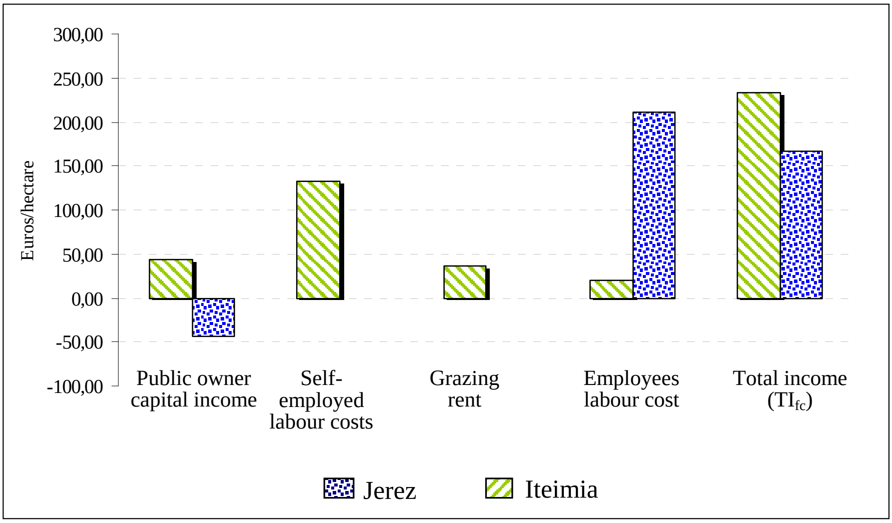


Figure 3: *Jerez* and *Iteimia* total commercial income distribution by factor production (Year 2002)

General expenditures (manager, administrative work and other minor task) represent a clear management difference between Jerez and Iteimia. In Jerez general expenditures contribute with 22% of total cost and in Iteimia this concept is only 1% of total cost.

4. DISCUSSION

The operative agroforestry accounts system (AAS) applied to Jerez and Iteimia has shown the high potential benefits of improving the shortcomings of conventional national agriculture and forestry accounts system (EAA/EAF). The current lack of official statistical data on woody natural growth and intermediate output implicated in a single activity makes it impossible to measure separately individual income, even for the nation agriculture, animals and forestry activities.

The European Union farm accountancy data network (FADN) is focussed on agriculture and livestock enterprises land owner net value added, but it could be expanded to forestland and reoriented to AAS approach that takes into account individual activities and farm incomes, and also farm income distribution by property production factor.

The presentation of the economic results of Jerez and Iteimia study-cases exemplifies public ownership management's trends in cork oak agroforestry systems at both sides of the Western Mediterranean basin.

Total commercial incomes have been measured assuming steady state situation although it is believed that it is an unrealistic assumption. From fertile soil and woody vegetation natural regeneration points of view, current Jerez and Iteimia managements are seemingly far from a stable situation. In other words, our pilot exercises generate useful data on real managements in cork oak agroforestry systems and should be seen as starting point for future sustainable income measurement.

The main limitations of the study are the following. The cork tree growth was missing because lack of natural regeneration data[29]. Mature average age of cork oaks has been documented by visits to the studies areas[30], but lack of inventory data on seedlings and recruitments make uncertain the field observation judgements on natural regeneration.

Livestock and red deer restrain the cork oak natural regeneration in Jerez and Iteimia, respectively. In Jerez, red deer appears to be the main cause for damaging natural tree regeneration[31]. In Iteimia, there are no livestock grazing restrictions[32] and the goat is the main cause of the lack of tree natural regeneration (Ben-Mansoura et al., 2001).

On the other hand, the slope of Iteimia and the soil quality favours the hydric erosion in the area, where different erosion signs occurred specially in the areas non-covered by natural vegetation and woodlands near villages (douars).

The total commercial income that has been measured does not take into account the long term decline of cork oak trees. That is, the current commercial income

[29] The advance of brushland has, in the recent past, been virtually the only means propitious to natural regeneration of European COAS.

[30] This Jerez and Iteimia cork tree aging implies that future cork physical growth per hectare will decline, but for practical reason it has been assumed that the cork growth will be stable.

[31] It is assumed that there is no current global overgrazing in Jerez, but it could be individual overgrazing for seedless and recruitments because their higher palatability.

[32] Overgrazing has the benefits of mitigating catastrophic forest fire when understory biomass is consumed by livestock. Livestock grazing on ecological corridors is an effective way to help reduce the current expense of forest-fire prevention systems. It has even been argued that pastureland corridors opened up by grazing activity add value to the landscape value and may encourage recreational use by the public (Caparrós and Campos, 2002, p. 139).

measured has been overvalued[33]. The income results show that a nature and social oriented management – as it is the Jerez case – decreases commercial capital income and increases labour income. But the apparent paradox is that in a subsistence economy – as it is the Iteimia case – self-employed households generate both high labour and capital incomes. It could be said that higher labour income is pending on nature conservation practices and investment on man made capital. In Jerez the developed economic context could be able to receive enough money transfers to the Municipality landowner. In Iteimia cork oak agroforestry system policy nature conservation measures will decrease current household livestock commercial income. In this case, the Tunisian State landowners have relevant positive capital commercial income that they could be investing in Iteimia to off set the potential household income losses.

Although this paper has measured commercial incomes from Jerez and Iteimia public cork oak agroforestry systems (COAS), it does not include any discussion on market land values. The reason is clear in Iteimia: the cork oak land market does not exist. In Jerez, a potential land market could be accepted, although in practice this market is not a real fact because of the willingness of public administration ownership. Therefore, Jerez and Iteimia incomes accruing to COAS actors are the relevant economic indicator for policy land uses in the present public ownership context, and any land asset values estimated by discounting land capital income become a normative asset value, and this subjective asset value is not a value that responds to the current public owner's behaviours.

COAS surfaces should be maintained where they are economically competitive in private and social terms over the medium and long run, and where their ecological functions favour the preservation of biological endemism and help mitigate the irreversible loss of unique habitats or endangered biodiversity, always provided that the cost of preservation can be borne by the nation concerned and the global beneficiary interest-groups. In this regard, the conservation of COAS is considered a global issue, while mainly concerning the European Union and North Africa countries.

There is an equity trade-off between forest conservation and local population subsistence needs. This could be argued taking into account global actor winners from local environmental conservation investment. Conservation measures (soil, water, tree, health, etc.) are pending on financial transfers. In view of the latter considerations, it seems reasonable to ask the authorities of the European Commission and the Maghreb to endeavour the creation of a global environmental fund (GEF). This fund should be based on rural development pay offs to mitigate the destruction of COAS in the Maghreb, through by compensating investment in ap-

[33] In the case of cork oak, silviculture takes into account the regeneration of cork tree, then, if other things being equal, the livestock income would be less than what it was estimated in the Jerez and Iteimia case studies (Campos et al., in press and Daly et al., in press).

propriate agricultural land, and encouraging cultivation methods that cause less soil erosion than present practices, in the frame of sustainable COAS managements. The high importance of the COAS surfaces that still remain, though in advanced states of degradation, advises improvement of existing areas, rather than restocking on unwooded land, except where there is a strictly environmental concern for soil and water conservation (Campos, 1993, p. 36).

Multidisciplinary research should be encouraged on assessment of the main features of Mediterranean woodlands: their historic, sociological, ecological, technological, economic and cultural features, and also the probable – or desirable – development of those features (IAMF, 2003, p. 5). There is a need for integrated research projects in order to properly combine woodland, pasture, livestock and peoples in the COAS environment (Papanastasis, 1996, p. 154).

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Appendix 1: *Jerez* agroforestry commercial production account (Year 2002 € ha^{-1})

Class	Cork oak woodland		Animals			Crops	Cork preparation	Services[b]	Total
	Forestry	Cork stripping	Cattle	Big game	Equines and beekeeping				
1. Total output (TO)	140.4	114.6	61.9	101.8	7.8	18.0	201.7	10.3	656.3
1.1 Intermediate output (IO)	23.7	105.6			4.2	8.5			142.1
1.1.1 Intermediate raw materials (IRM)	23.7	105.6				8.5			137.8
1.1.2 Intermediate services (IS)					4.2				4.2
1.2 Final output (FO)	116.7	9.0	61.9	101.8	3.5	9.5	201.7	10.3	514.3
1.2.1 Gross internal investment (GII)	34.1	8.3	24.9	13.8	0.4	2.4	8.6	1.2	93.9
1.2.2 Final sales (SFO)	9.6		13.3	2.9	0.2		121.6		147.6
1.2.3 Final stock (FSO)	72.3		23.0	82.7	2.8	5.2	70.4		256.3
1.2.4 Other final output (OFO)	0.6	0.7	0.6	2.4	0.2	1.8	1.1	9.0	16.4
2. Total cost (TC)	72.1	137.3	102.7	151.7	7.8	23.8	252.5	10.3	758.2
2.1 Intermediate consumption (IC)	4.2	90.6	59.1	100.8	5.0	10.9	185.3	1.7	457.5
2.1.1 Raw materials (RM)	2.6	1.9	29.7	13.3	1.9	4.0	179.2	0.6	233.4
2.1.1.1 Own raw materials (ORM)			24.4	5.7	1.2	0.1	176.0		207.3
2.1.1.2 External raw materials (ERM)	2.6	1.9	5.4	7.6	0.8	3.8	3.3	0.6	26.1
2.1.2 Services (SS)	1.5	6.4	6.4	5.8	0.3	1.8	6.1	1.0	29.3
2.1.2.1 Own services (OSS)			4.2						4.2
2.1.2.2 External Services (ESS)	1.5	6.4	2.1	5.8	0.3	1.8	6.1	1.0	25.0
2.1.3 Work-in-progress used (WPu)		82.3	23.0	81.6	2.8	5.2			194.8
2.2 Labour cost (LC)[a]	32.8	37.4	29.2	36.4	1.7	9.4	57.0	7.3	211.0
2.3 Fixed capital consumption (FCC)	35.2	9.4	14.4	14.5	1.1	3.5	10.2	1.3	89.6
3. Net operating margin (NOM)	68.3	-22.8	-40.8	-49.9	0.0	-5.8	-50.8	0.0	-101.9

Note: ha refers to a hectare of useful agricultural land (UAL). UAL is calculated by subtracting the unproductive surface area (water and infrastructures) from the total surface area (geographic).

[a] Labour cost includes only employees (ELC) because there is no self-employed labour (SLC).

[b] Services include housing services for recreational visitors and environmental education for children.

Appendix 2: *Iteimia* agroforestry commercial production account (Year 2002 € ha^{-1})

Class	Cork oak woodland		Livestock			Crops	Total
	Forestry	Cork stripping	Cattle	Goats and sheep	Equines and beekeeping		
1. Total output (TO)	107.0	66.9	166.3	166.9	17.2	47.9	572.1
1.1 Intermediate output (IO)	35.6				7.9	15.9	59.4
1.1.1 Intermediate raw materials (IRM)	35.6					15.9	51.5
1.1.2 Intermediate services (IS)					7.9		7.9
1.2 Final output (FO)	71.4	66.9	166.3	166.9	9.3	31.9	512.7
1.2.1 Gross internal investment (GII)	9.4	1.7	27.3	25.4	3.6	1.7	69.2
1.2.2 Final sales (SFO)	16.3	65.2	64.2	33.8	2.9		182.5
1.2.3 Final stock (FSO)	39.4		59.6	87.0	2.4	11.8	200.2
1.2.4 Other final output (OFO)	6.2		15.2	20.7	0.3	18.4	60.9
2. Total cost (TC)	33.2	65.4	162.2	165.2	16.9	46.4	489.3
2.1 Intermediate consumption (IC)	5.6	48.7	95.7	120.0	9.4	21.4	300.8
2.1.1 Raw materials (RM)	0.6	0.7	30.6	25.0	6.2	2.4	65.6
2.1.1.1 Own raw materials (ORM)			22.0	22.7	5.5	1.3	51.5
2.1.1.2 External raw materials (ERM)	0.6	0.7	8.6	2.3	0.7	1.2	14.0
2.1.2 Services (SS)	5.0	1.9	5.5	8.0	0.8	7.1	28.3
2.1.2.1 Own services (OSS)	4.3					3.6	7.9
2.1.2.2 External Services (ESS)	0.7	1.9	5.5	8.0	0.8	3.5	20.4
2.1.3 Work-in-progress used (WPu)		46.1	59.6	87.0	2.4	11.8	206.9
2.2 Labour cost (LC)	18.1	14.8	57.4	36.9	4.5	21.0	152.7
2.2.1 Employees (ELC)	4.8	14.8					19.6
2.2.2 Self-employed cost (SLC)	13.2		57.4	36.9	4.5	21.0	133.1
2.3 Fixed capital consumption (FCC)	9.6	1.9	9.2	8.2	3.0	4.0	35.9
3. Net operating margin (NOM)	73.8	1.5	4.1	1.7	0.2	1.5	82.8

Note: ha refers to a hectare of useful agricultural land (UAL). UAL is calculated by subtracting the unproductive surface area (water and infrastructures) from the total surface area (geographic).

COST-BENEFIT ANALYSIS OF CORK OAK FOREST NATURAL REGENERATION IN SPAIN AND TUNISIA

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and Paola Ovando-Pol[1]

ABSTRACT

The lack of natural regeneration and the depletion of cork oak trees have stressed the interest in cork oak forests conservation in *Cádiz* (Spain) and *Ain Snoussi* (Tunisia). The mature cork oak forests face the aging of their cork oaks. However, this has not encouraged landowners to renewing the Cadiz and the *Ain Snoussi* cork oak forest by natural regeneration. Two management scenarios have been simulated, under the first one, the cork oak would naturally regenerate at infinite horizon, whilst by the second one, no regeneration treatments are presumed which lead the cork oak trees to age until they eventually disappear and cork oak forest is replaced by an un-wooded shrubland. The objective of this paper is to compare the economic results of sustainable natural regeneration and unsustainable management of the Cadiz and Ain Snoussi cork oak forests. For this purpose, a cost-benefit analysis was conducted indicating expenditures and revenues of the whole production life cycles of cork oak forests under the two management scenarios. A group of physical and economic indicators that arrive at a steady state cork oak forest management are also measured. The market results show that sustainable cork tree management in Ain Snoussi has a higher discounted total income and a lower capital income at infinite horizon using a real discount rate equal or higher than 2 %, compared to the current cork oak depletion scenario. Whilst, in Cadiz cork oak forest renewing leads to important capital losses under current cork prices and government aids, using real market discounting rates equal or higher than 4%. In Ain Snoussi the total income distribution, under steady state conditions, shows that sustainable management is more profitable for the landowner (Tunisian State), and less advantageous for families self-employed workers. In Cadiz mature cork oak forest that would have ongoing natural regeneration of its cork oaks offers competitive capital incomes if compared with an un-wooded shrubland as land use alternative.

Keywords: cork oak forest, natural regeneration, cost-benefit analysis, forest steady state, forest total income distribution, Spain, Tunisia.

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1. INTRODUCTION

The cork oak (*Quercus suber* L.) is endemic to countries bordering the western Mediterranean European and North Africa countries. In Spain pure and dense cork oak forests cover a surface area of nearly 365,000 ha, which raise up to 475,000 ha if mixed and sparse cork oak stands are taken into consideration (Montero and Cañellas, 1999). Those cork oaks stands are spreading at three accretion regions (Costa et al., 1998). The most expanded cork oak stands appear in the Extremadura and western Andalusia savannah-like forest (called *dehesas*), while its bigger extension corresponds to the humid cork oak woodlands established at the western *Betica* mountains of Cadiz and Malaga provinces. Finally, a third cork oak area is located at the Catalonia coastline and seaboard mountains. By other side, cork oak is one of the main plant species of north-western Tunisian forests, which surface area has decreased strongly from more than 127,000 ha in 1950 (Boudy, 1952) to around 60,000 ha at present (DGF, 2002).

During several decades, Mediterranean cork oak forests have not being favoured by the governments, local inhabitants that depend upon forest resources and private landowners. The commercial economics of mature cork oak groves tends to favor their destruction in benefit of using the land for grazing proposes, logging or for cropping and infrastructure expansion, with less effort intended to renewing aging cork oak stands. The degradation rates seem to be quiet different at both sides of the Mediterranean basin. The most significant sort of *Quercus* species deforestation in Spain is invisible to official statistics, because it takes the form of forest thinning through natural death of trees due to age and other reasons (Campos, 2004). Circumstances that are combined with an insufficient natural regeneration of oaks (Díaz et al., 1997; Pulido and Díaz, 2003; Plieninger et al., 2004), apparently as consequence of overgrazing (Montero et al., 1998; Campos, 2004). In Maghreb countries as Tunisia, the degradation through abusive pruning affects to an important share of those forests (Ellatifi, 2005), while overgrazing has led to ‘a total absence of natural regeneration’ of woodland (FAO, 2001, p. 113). In this manner, some authors estimate that the aging of cork oak forests in the last few decades in Tunisia is as equivalent to the disappearance of a thousand hectares per year (Souayah and Khouja, 2001; Daly and Mansoura, 2005).

Regardless the differences on surface areas and forest deforestation rates in Tunisian and Spanish cork oak forest, the scarce natural regeneration of cork oaks seems to be constraining the future conservation of those forests. Over the past decade, in Spain under the Common Agriculture Policy reforms cork oak planting over extensive croplands has been strongly encouraged. However, natural regeneration, which appears to be a less costly alternative (Campos et al., 2003, in press; Ovando et al., 2009) does not benefit from the same European aids scheme. In Tunisia, cork oak renewing is restricted to some plots for experimental purposes, and no strong investment frame for cork oak renewing was adopted.

The wide range of serious difficulties for the forest conservation and the divergent socio-economic and institutional conditions might be barriers to the sustainable management of cork oak forests. However, from the economic perspective, it appears that the state of the economy of each region and the type of land property rights are the leading causes of the cork oaks managements carried on in Spain and Tunisia (Campos, 2004).

The aim of this paper is to analyse how different institutional (regulations and special aids for cork oak management), socio-economic situation (labour market, costs) and forest uses could affect the decision of renewing a cork oak forest. For that purpose the analysis focuses on two case studies: Ain Snoussi cork oak forest in Tunisia and Cadiz cork oak forest in Spain. Thereby, it is of interest to find out if the society (in a restricted number of economic agents[3]) and the private owners of the cork oak forest would increase their capital incomes if a continuous natural regeneration of oaks is accomplished.

Ain Snoussi and Cadiz cork oak forest have many ecological similarities, since common plant species are found in both study areas (Sebei et al., 2005; Navarro and Blanco, 2006). However, institutional aspects related to property rights, socioeconomic conditions and certain commodities and emerging amenities markets, generate important differences in respect to the type of goods and services produced by those forests.

Ain Snoussi cork oak forest is located in the region of *Ain Draham,* north-west of Tunisia, covering a surface area of about 3,230 hectares. This site has a sub-humid to humid environment, with an annual rainfall that varies from 1,000 to 1,500 mm (Oliveira et al., 2005). Ain Snoussi forest is dominated by the cork oak, which occupies the main share of this area (81%). While the rest of the surface is occupied by shrublands (3%), grasslands (2%), croplands (8%), infrastructure and other unproductive lands (6%). This area supports a high population density that mainly subsists upon livestock rearing (Daly and Ben Mansoura, 2005). Local people in Tunisian forest have access rights to graze the cork oak forests without restriction (Ben Mansoura et al., 2001). The former accompanied by the lack of rotational grazing in the forest constrains oaks natural regeneration, particularly near human agglomerations (Stiti et al., 2004; Daly et al., in press).

The *Alcornocales* Natural Park (here and after referred as Cadiz case study) is the largest continuous cork oak forest area in the Iberian peninsula, which extends over 167,700 hectares distributed from Tarifa at the south of Cadiz province to Cortes de la Frontera at the northwest of the province of Malaga. Annual precipitations are between 700 and 1,000 millimetres, resulting into a high level of relative

[3] The unique economic agents that were taken into account at this application are the private owners of the cork oak forest, local population, employees and private firms that are actually benefiting from different cork oak controlled multiple uses.

humidity, especially in the deepest valleys where fog is currently observed even in summer (Campos et al., 2005b). Forest extends over 56% of the total surface of Cadiz case study, and despite a relative decline the cork oak tree (Sánchez, 2001) remains the dominant species (over 85% of wooded area), while the Algerian oak (*Quercus canariensis* Willd.), the Zen oak (*Quercus faginea* Lam.), the wild olive tree (*Olea europaea* L. var. sylvestris Brot) and coniferous cover relatively small share of land. Non-wooded land is mainly covered by shrublands (23% of total surface) and grassland (16%), while the left part (5%) is devoted to various crops and miscellaneous uses including built areas and recreational facilities. A decrease in the stripped cork has been observed in Cadiz study case (Campos et al. 2005d). This trend is likely to continue in the future and a further reduction is expected within the thirty coming years if there is no counteractive programme (Campos et al., 2005a).

Two complementary approaches are applied for the economic analysis of cork oak forest natural generation given normative cork oak silvicultural models. The first approach consist of cost-benefit analysis (CBA) techniques (Campos et al., 2003; Martin et al., 2001), to evaluate the decision of renewing aged cork oaks from the private investor and other economic agents perspectives. The second approach focuses on assessing the economic profitability of ongoing cork forest sustainable management (steady state). The physical and economic information used for constructing cork oak natural regeneration and investment alternative scenarios net cash flows and the steady state integrated accounting structure are taken from Daly et al. (in press) in case of Ain Snoussi and from Campos et al. (in press) in case of Cadiz.

The next section set out the cork oak forest management scenarios, the goods and services considered in the analysis and their valuation criteria and the CBA and AAS approaches items and identities. The third section shows the economic results of cork oak natural regeneration and its alternative (non-investment) scenario, and summarizes the main findings in the economic analysis of the cork oak steady state. The fourth section discusses the results in the context of Ain Snoussi and Cadiz cork oak forests. Finally, the fifth section shows the most relevant conclusions.

2. METHODOLOGY

2.1 Compared forest management scenarios

We make use of normative silviculture models developed by Montero et al. (2006) and Chaar et al. (2006) for Cadiz and Ain Snoussi regular[4] cork oak stands, respectively. Former authors define growth and yield models, as well as the silvicul-

[4] The term regular is used to define cork oak forest which oak tress have the same age.

tural treatments, for the entire productive cycle of cork oak stands coming from both plantation and natural regeneration. Cadiz cork oak growth models correspond to site index II, while Ain Snoussi one to the site index III[5].

For this application only cork oak forest natural regeneration cycles growth and yield models are considered. The former authors define a set of silvicultural treatments to be carried on along the whole rotation from naturally established cork oak stand, which main objectives are to favour cork yield. Grazing exclusion, formation pruning, selective thinning, regeneration and final felling are the main forestry treatments prescribed for naturally regenerated cork oak stands. The complete natural regeneration cycle defined by Montero et al. (2006) and Chaar et al. (2006) last 144 years, counted as the time (measured in years) between to consecutive regeneration felling.

Regeneration felling, which is the earliest prescribed treatment, consists on cutting an important share of mature trees[6] in order to promote natural regeneration; in such way that on-site seeding is encouraged without renouncing completely to cork extraction given that some trees are left standing. In both cases, fencing accomplishes regeneration felling, in order to exclude grazing, for equally livestock and big game fauna, being the prescribed exclusion length 15 years in Ain Snoussi and 20 years in Cadiz. The grazing exclusion period is accompanied by brush clearing, as a mean of controlling competing vegetation. Some years after regeneration felling the final clear-cut takes place concurring with the first cork stripping of the next cork oak rotation in Cadiz, which takes place as oaks are 37 years old, and twelve years before the first cork stripping from new individuals in Ain Snoussi, as oaks are 48 years old (Table 1).

In case of Cadiz during the winter before every cork stripping a complete shrub clearing is performed, as a measure against fires and to assist cork harvesting. This operation became not necessary at Ain Snoussi after fencing is completely removed, since it is considered that local inhabitants are allowed (by ancient-usage rights) to make use of shrubs for both livestock grazing and firewood collection. Selective thinning, as well as regeneration, sanitary and final felling generates firewood as a commercial sub-product.

If natural regeneration treatments are not carried on, it is accepted that cork extractive activity would be ceased after 63 years in case of Cadiz and after 175 years in case of Ain Snoussi (Table 1), as consequence of tree number and cork productivity declining. The alternative to natural regeneration studied here is *no-natural*

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[5] The site quality II indexes cork oak stands that reach 12 meter high at 80 years old and 10 meters high at the same age in case of site quality III.

[6] Given a cork oak trees density in the period at which the regeneration felling is arranged.

regeneration that is, allowing the oaks to disappear through natural death, with shrubs replacement following the complete disappearance of trees[7].

Table 1: Selected indicators from cork oak forest natural regeneration cycles and from no regeneration scenarios

Class	Units	Cadiz[(a)] A	Ain Snoussi[(b)] B	Differences A-B	
Natural regeneration cycle					
Tree age at the first cork stripping	years	37	49	-12	
Grazing exclusion period length	years	20	15	5	
Number of cork harvests[1]		12	8	4	
Stripping turn	years	9	12	-3	
Tree age at the regeneration felling	years	145	145	0	
Density after regeneration felling	trees/ha	32	50	-18	
Tree age at the final felling	years	181	181	0	
Cycle length	years	144	144	0	
Physical turn[2]	years	208	319	-111	
Labour requirements (complete cycle)	h/ha	3,895	15,108	-11,213	(-288%)
Virgin cork yield	kg/ha	4,462	8,771	-4,309	(-97%)
Reproductive cork yield	kg/ha	55,532	25,919	29,613	(53%)
Cork oak firewood yield	t/ha	176	381	-205	(-116%)
Grazing resources consumption	FU[3]/ha	27,058	54,950	-27,892	(-103%)
No regeneration scenario					
Cycle length	years	63	175	-117	
Cork yield	kg/ha	15,855	14,236	1,619	(10%)

[1] Considering the cycle length.
[2] Age at which it is presumed that in absence of natural regeneration treatments, cork extraction activity would be abandoned.
[3] FU: Forage units according to INRA (1978) definition. In Cadiz edible growth consumption (San Miguel, A., personal communication, 2003). In Ain Snoussi edible growth production (DGF, 1995). FU quantities take into account the years of grazing exclusion required by normative silvicultures.

Sources: *Own elaboration* based on [(a)] Campos et al. (in press) and [(b)] Daly et al. (in press).

2.2 Private commercial and environmental goods and services considered in the analysis

Multiple use is a commonplace of Mediterranean agro-forestry systems (Díaz et al., 1997; Montero et al., 1998; Campos, 2004). This application is focussed on the *private multiple use* of a cork oak forest under two different management scenarios: regenerating *versus* no regenerating an aged cork oak stand as sketched in normative silviculture models. Latter restrict the analysis to goods and services controlled by forest (*official* or *in fact*) private owner[8], independently those output are commercialised or not. As well as, just forestry activity is considered, thus services

[7] Livestock and/or big game fauna grazing pressure might notably hinder natural [or human-induced] regeneration in both areas (Montero et al., 1998, Stiti et al., 2004).
[8] The private category of good and services connotes a partial or total exclusion on its consumption or use.

offered by the forest to other agro-forestry system activities (livestock rearing or game) are pointed out as forestry final outputs.

In both study cases cork[9] is the main commercial output derived from cork oak forests management (Table 2). Nonetheless, as will be shown after, the list of forest commodities actually obtained in Ain Snoussi is larger than the one accrued from cork oak forest management in Cadiz. This is the case of brush species as myrtle (*Myrtus communis* L.) or mastic tree (*Pistacia lentiscus* L) grown in both forest areas (Sebei et al., 2005; Navarro and Blanco, 2006) but only commercially extracted in Ain Snoussi, as well as, some other under-story vegetation that is used by local inhabitants as livestock fodder or fuelwood. By contrast, Cadiz cork oak woodlands land uses mosaic generates amenities (the so-called private environmental services) to their private owners, which are reflected implicitly at the land market price. Since if this revenue (a flow) in itself is not an object of transaction, it is internalized by the market when the buyer of an forest state agrees to pay a higher price per hectare (stock) knowing the welfare that he/she will enjoy from the exclusive access to an areas occupied by the cork oak forest, outside of the right-of-way (Campos et al., 2003; Campos and Caparrós, 2006).

Private property rights distribution amongst economic agents affects cork oak renewing economic analysis. Cadiz forest owners, at least private individual ones,

Table 2: Selected outputs from an average year of cork oak rest natural regeneration (year 2002)

Class	Unit (U)	Cadiz			Ain Snoussi		
		Price[2] (€/U)	Quantity (U/ha)	Value (€/ha)	Price[2] (€/U)	Quantity (U/ha)	Value (€/ha)
Cork				459.3			141.1
Virgin cork	kg yr-1	0.24	31.0	7.4	0.13	60.9	7.9
Reproductive cork	kg yr-1	1.17	385.6	451.9	0.74	180.0	133.2
Firewood				57.8			28.5
Firewood from cork oak	kg yr-1	0.03	1,222.1	36.6	0.01	2.645	26.4
Winter cork	kg yr-1	0.10	212.9	21.2			
Firewood from shrubs	m3 yr-1				3.73	0.56	2.1
Other forestry goods							24.9
Acorns	kg yr-1				175	0.06	10.6
Aromatic plants & mushrooms	ha yr-1				3.9	1	3.9
Honey	ha yr-1				10.4	1	10.4
Grazing resources rent[3]	FU yr-1	187.9	0.09	16.7	381.6	0.07	25.6
Hunting rent	ha yr-1	38.1	1	38.1	0.2	1	0.2
Private amenities	ha yr-1	209.3	1	209.3			

[1] 1€ = 1.32 TND in average in 2002 (BCT, 2003).
[2] Market prices net of subsidies or taxes.
[3] FU: Forage units according to INRA (1978).

Source: *Own elaboration* based on Campos et al. (2006a and 2006b) and Daly et al. (2006).

[9] There are two categories of cork: virgin cork is the bark of cork oak removed at the first stripping, which has a low commercial value; reproduction cork is the bark obtained in the second stripping and thereafter, at intervals of nine or more years (Table 2).

benefit from most complete properties forms, than Ain Snoussi State owner, since former have the right to derive values from the asset, to exclude others from using it (with some exceptions commented below), and to transfer the asset to others. Cadiz forest owners do not control some forest non-market outputs, as those consumed by free-access visitors and non-timber goods collectors, thus do not form part of their private incomes. As well as, private investment and forest management expenditures do not reflect entirely the economic effort made for Cadiz forest management, since an important share of fire prevention and control activities (beyond others) are assumed by the government[10]. Neither former revenues nor cost are considered for main private income and capital values calculations, but deal with at the discussion section.

From an economic perspective, Ain Snoussi forest ownership is shared by the Tunisian State and the local inhabitants (Daly et al., in press). The forest property rights of the Tunisian government are therefore incomplete. Government outputs are compounded mainly in cork and partially in firewood and other non-timber goods as resource rent. Households have the rights to use grazing resources[11], firewood and some other minor forest products. However, the State owner supports the main silvicultural investment and management costs.

All private market and self-consumption uses of the forest in Cadiz and Ain Snoussi are included in the economic analysis. As well as some goods and services as grazing resources in Ain Snoussi and the private environmental services in Cadiz, which in both study cases are out of market transactions in an explicit form, thus require direct or indirect economic valuation assessment.

Goods and services match to 2002 average market or imputed prices[12] (without considering subsidies or taxes on products). Information about prices data was collected through interviews or structured surveys applied to forest owners, enterprises and local inhabitant.

2.2.1 Ain Snoussi forest goods and services valuation criteria

Natural resources property rights and subsistence familiar economics limit the options to value non-market forest goods and labour cost, as those assumed by local inhabitants by their own in Ain Snoussi. To measure objectively the forest present discounted values at market prices, only revenues, consumption expenditures, employee's labour cost and resource rents are considered, with the estimated grazing resources rent as residual values (Chebil et al., in press).

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[10] Public expenditures (forestry administration and other public bodies) on fighting against forest fires, accounts for 36 € per average wood and shrub hectare in Cadiz case study (Campos et al., 2005b).
[11] No payments are required.
[12] 1.00 € = 1.34 TND, year 2002 (BCT, 2003)

Ain Snoussi cork oak forests and shrublands (after the disappearance of cork oak trees), cost-benefit analysis revenues are account for the following goods and services (Table 2):

(a) Cork oaks belong to the Tunisian government and the cork stripping (C) is carried out by local employees. Cork is sold by the forest administration to industrial enterprises by auction at the farm gate price, according to the cork type (Table 2).

(b) Firewood (F) comes from different silvicultural treatments applied to cork oak tress, and from shrub cutting. Market prices at farm gate are used for valuing cork oak and shrubs firewood. Cork oak firewood is sold by the forest administration, while shrubs firewood is collected by local inhabitants (especially women) for their own use.

(c) The Tunisian government hunting rent value (H) corresponds to the licenses and taxes paid to the forest administration by mainly wild boar hunters in the area.

(d) Aromatic plants (AP) are sold to enterprises at standing price. They are harvested by local families, and locally distilled. The Tunisian State receives the resource rent (the standing price) from aromatic plants as fees for the right to harvest them.

(e) Mushrooms (M) picking have the same valuation criteria as the aromatic plants. Data about quantity and prices are published by official statistics (Ministry of Agriculture, 2003). Labour quantity and costs were obtained from a structured survey directed to the local population.

(f) The honey (HO) value corresponds to the market value of the estimated productivity obtained in the forest (Daly et al., in press). There are no licenses for raising honey bees. Local inhabitants profits from apiculture activity.

(g) *Grazing* resources rent (G) is a non-market good in *Ain Snoussi* forest, which value is estimated as residual value conditioned by imputed self-employed wage rate. The forage unit price is evaluated taking into account the livestock activity net value added, which is calculated considering only final livestock outputs and pecuniary expenditures. Livestock net value added aggregates two values: self-employed imputed labour returns and grazing resources rent. Therefore, a simulation function was established using the two variables, determining the grazing resources rent by attributing households' labour different shares of local forestry (temporal) workers day-wage rate. The grazing resource price of €0.07 FU^{-1} is obtained assuming a self-employed labour day-cost equivalent to the half of local employees wage rate (Chebil et al, in press).

According to Daly et al. (in press) under the cork oak renewing scenario the maximum forage units that could be extracted from Ain Snoussi forest equals the edible production estimated by the National Pastoral Inventory for Northern Tunisia cork oak forests (DGF, 1995). Under no regeneration scenario, production extracted is figured out as a residual value between the real animals' energy requirements and the contribution of supplementary feed and fallow graze (Chebil et al., in press).

(h) Picking of acorns (A) is estimated using the number of trees by hectare and the production per tree (Nsibi et al., 2005). It is assumed that only 20 % of this production is picked up by self-employed households, and used for feeding their livestock as supplementary fodder; the remainder is consumed by livestock and wild fauna as grazing resources. The acorns unit was valued as resource rent using the equivalent forage unit (0.9) and the forage unit price (€0.07 FU^{-1}).

For the CBA, the Ain Snoussi private revenues (R_{AS})[13] identity is shown below by single items (including sales and self-consumption):

$$R_{AS} = C_{AS} + F_{AS} + H_{AS} + AP + M + HO + G_{AS} + A. \qquad [1]$$

2.2.2 Cadiz goods and services valuation criteria

Cork (C), sub-product from cork oak forest management as firewood (F), grazing resources (G) and hunting (H) rents are included as commercial outputs and valued attending to local market prices. The unique non-market output taken into account is the self-consumption of private environmental (recreational and conservation) services (ES).

In Cadiz the cork price corresponds to the average price from the last *T* year, where *T* corresponds to the turnover between two consecutive cork harvestings (nine years)[14]. All the prices are expressed in purchasing power terms of year 2002.

Private consumption of environmental service (ES) value is estimated using contingent valuation techniques (Campos et al., 2009). The ES attributed price corresponds to the average willingness to pay (in € ha^{-1}) assigned by Cadiz private forest owners to enjoy exclusively from the recreational and conservation services that their states generate, regardless of the plant cover and the land use, thus it does not affect the comparison of different land uses alternatives.

The value attributed to the hunting rent is the same for all the forestland uses and reflects the annual monetary amount that forest owners are paid for leasing their land to develop big game, net of costs and taxes. Finally, the grazing resources rent also reflect Cadiz market prices for leasing one hectare of cork oak woodland or shrubland for livestock grazing. Higher grazing resources leasing prices have been observed for cork oak woodlands than for shrublands (Table 2).

For the CBA, the Cadiz private revenues (R_C) identity is shown below by single items:

$$R_C = C_C + F_C + H_C + G_C + ES. \qquad [2]$$

[13] Only common goods and services between compared case studies are indexed by *AS* (Ain Snousi) or *C* (Cádiz) subscripts.

[14] A decrease in cork prices was observed from 2003 to 2005 (SICOP, 2005), consequently a conservative assessment criteria has been adopted for valuing cork yield in Cadiz. In addition a sensitive analysis to cork prices variation is conducted.

An additional source of private income in Cadiz are the current operating subsidies (OST)[15] defined by the Andalusia government for forest sustainable management (BOJA, 2002). Those are considered for estimating private income or net present value indicators at factor costs, which are just relevant in Cadiz case study.

2.2.3 Cork oak management expenditures

The total private expenditures (E) split up to the same costs concepts of national systems of accounts (Eurostat, 1996, 2000) that are: labour costs (LC), intermediate consumption (IC) of raw materials (RM) and services (SS), and fixed capital consumption (FCC). The aggregation of intermediate and fixed capital consumptions is defined as consumption expenditures (CE). Labour costs include both self-employed (SEL) and employees (EL) labour costs.

It is assumed that subsistence farm economies intend to optimise their own labour endowment distribution between non-paid land related activities, in order to maximise their family total income. Under latter assumptions, we make use of a simplified version of Chebil et al. (in press) self-employed labour costs (SEL) identity. In this application, SEL is estimated for each forestry good or service that is appropriated by local inhabitants, as a residual value between families revenues ($R_{AS,SEL}$) and consumption expenditures (CE_{SEL}):

$$SEL = R_{AS,SEL} - CE_{SEL}. \qquad [3]$$

2.3 Capital and total incomes

Net cash flows (NCF) present discounted values are obtained for CBA application. NCF flows are estimated as the differences between revenues and expenditures, within the entire cork oak silviculture cycle match to capital income at market prices (CI_{MP}). If operating subsidies net on taxes on products (OST) are added to CI_{MP}, private capital income at factor costs (CI_{FC}) is obtained[16].

$$CI_{MP} = R - E, \qquad [4]$$

$$CI_{FC} = CI_{MP} + OST. \qquad [5]$$

Capital income present discounted values or annual income indicators get relevance if owner's capital income maximization is the predominant economic rationality, which presumable fit to individual private forest owners in Cadiz. Latter could be arguable if forest is publicly owned or managed, as Ain Snoussi forest and 25% of Cadiz cork oak forest surface area[17]. In such cases, even if those forests are run

[15] Net of taxes on products.

[16] See Campos et al., 2008, for a detailed demonstration of NCF and private capital income correspondences.

[17] Approximately 25% of Cadiz cork oak forest surface area is publicly owned or managed by different government commissions (BOJA, 2004: 10722).

as private ventures, some social criteria could be considered on management decisions as employment generation, local families' subsistence or forest natural resources conservation. In case of Ain Snoussi, capital income reflects different shares of benefits appropriated by the land owner (Tunisian State), local families (grazing resources rent) and the private firms that collect some non-timber products in the forest; while self employment labour costs is an additional share of income that forest generates to local inhabitants.

Total private income at market prices (TI_{MP}) present discounted value aggregates both income classes: capital and labour. There are diverse ways to show the TI_{MP} identities in the CBA context:

$$TI_{MP} = R - CE, \quad [6]$$

$$TI_{MP} = CI_{MP} + LC, \quad [7]$$

2.4 Cost benefit analysis of cork oak natural regeneration

The cost-benefit analysis (CBA) is an economic tool used in order to estimate Present Discounted Values (PDV) from any investment net revenues. The consideration at the same time of market benefits and those associated to non-market goods and services consumption gives the extended feature to the performed CBA.

The present discounted values of capital and total incomes of continuous natural regeneration of the cork oaks (according to normative silviculture rules) are compared with the corresponding figures of no-natural regeneration. As mentioned before, the investment scenario consists on forcing natural regeneration of cork oak (REG) or alternatively (no investment scenario) letting cork oak trees disappear by natural mortality (NREG).

2.4.1 Present discounted values

The CBA is applied for estimating infinite time horizon PDV of cork oak private capital and total income flows (here and after *capital values*) of the investment scenarios. Infinite time horizon analysis does not require the consideration of land residual values (Samuelson, 1976).

The PDV estimation of net cash flows related to each good and services generated in a cork oak forest is estimated using a discount function (δ) defined by:

$$\delta = \delta(r) = \frac{1}{(1+r)}. \quad [8]$$

Being *r* the annual discount rate.

Different scenarios are evaluated employing six different discount rates contained in a range of 1% to 10%, presuming that depending on the type of forest owners, different profitability rates from cork oak renewing investment would be required.

Natural regeneration begins for cork oak forest in the year that all the trees have T_n years of age (T_n =1). The present discounted values for one silviculture cycle or infinite time horizon REG and NREG scenarios are estimated as detailed below.

The present discounted value (V_n) of any economic variable (y_n) (in euro ha^{-1}) along the entire cycle of a cork oak forest that is natural regenerated (REG), is denoting by:

$$V_n = \sum_{t=1}^{T_n-1} \delta^{t-1} y_n(t). \quad [9]$$

It is assumed that the application of normative silvicultures would generate identical and consecutive natural regenerated cork oaks rotations. In that case, the calculation ends up very simple. Using equations [9] the present discounted value associated with continuous regeneration ($V_{n,\infty}$) is obtained from the following equations (Campos et al., 2003):

$$V_{n,\infty} = (1+\delta^{(T_n)\cdot 1} + \delta^{(T_n)\cdot 2} + \delta^{(T_n)\cdot 3} + ...)V_n,$$

$$V_{n,\infty} = \sum_{t=1}^{\infty} \delta^{T_n i} V_n$$

$$V_{n,\infty} = \left[\frac{1}{1-\delta^{T_n}}\right] V_n. \quad [10]$$

Here, we consider a situation where the mature cork oak woodland is not subjected to natural regeneration after year T_n, and consequently, after the time needed for natural estimated mortality to finish off the forest, a transition to a tree-less shrubland takes place.

The present discounted value (V_{nr}) of any economic variable (y_{nr}) derived from a mature cork oak in which no regeneration treatments are accomplished (NREG) is defined by:

$$V_{nr} = \sum_{t=T_n}^{T_{n+m}} \delta^{t-T_n-1} y_{nr}. \quad [11]$$

Denoting V_m as the present discounted value of annual income from shrubland, we can calculate the present discounted value of a hectare of T_n years of age on which natural regeneration does not occur and after *m* years (T_{n+m}) a change in land use takes place. The infinite time horizon present discounted value of non-regenerated cork oak woodland ($V_{nr\rightarrow m,\infty}$)[18] is:

$$V_{nr\rightarrow m\infty} = V_{nr} + \left(\delta^{T_{n+m}+1-T_n} \left(\frac{1}{1-\delta^{Tm}} \right) V_m \right). \qquad [12]$$

Where, T_m is the shrub land rotation turn, which in Cadiz corresponds to the mean frequency (nine years) that small clearings are made for allowing game activity (Girón, personal communication, 2004). While, in Ain Snoussi the annual average shrubland income is considered.

2.5 Steady state of cork oak woodland annual economic indicators

Steady state is an ideal construction that implies the indefinite maintenance of the structure of ages and denseness of oaks stands per unit of total surface of the cork oak forest (Campos, 1992; Campos et al., 2003). In economic terms the steady state supposes an annual constancy in obtained incomes if the market prices and operating subsidies net of taxes on products received remain invariant (Dasgupta, 1982).

In this application, steady state is an ideal construction where the cork oak woodland endures forever naturally regenerating in each hectare of the woodland every T_n years, according to rules established by Cadiz and Ain Snoussi normative silvicultures. The calculation of economic data for any year for an average hectare of the cork oak woodland in steady state is done by adding the economic data of each variable for T_n years of the natural regeneration entire rotation cycle (1-T_{n+1}) and dividing by T_n years that sum up one hectare during the complete cycle of natural regeneration.

The methodological accounting criteria used for measuring the total private income is the same as Agro-forestry Accounts Systems – AAS – (Campos, 2000; Caparrós et al., 2003). The AAS approach structures all economic inputs and outputs into the production and the capital balance accounts. The production account incorporates all the economic flows related to the production process during the accounting period; offering the net operating margin (NOM) as the residual value from total output and cost. The capital balance account records the values of stocks and changes of production in progress and durable goods (fixed capital) used through the accounting period. Capital gains (CG) capture income from capital goods changes values. This latter figure must be aggregated to the net operating margin for full estimates of capital income at market prices (CI_{MP}).

[18] The subscript nr→m denotes the transition from non-regenerated cork oak woodland to shrubland.

A complete structure of AAS production account extends CBA revenues and expenditures concepts by considering additional outputs and costs. In steady state condition, such additions do not imply that AAS capital income figures differ from net cash flows. Given that, it is accepted that: (i) durable goods prices remain constant; and (ii) gross investment on fixed assets match to the aggregated value of capital withdrawals due to sales, destruction and devaluation of amortizable fixed assets. In this application it is assumed, that there are neither capital sales nor extraordinary fixed capital destruction, thus gross fixed investment matches to fixed capital devaluation, which at the same time equals the annual fixed capital consumption (FCC) (Campos et al., 2008). Under former conditions annual steady state capital income at market prices (CI_{MP}) matches to net cash flow if net operating subsidies are not considered. Private capital income at factor costs (CI_{FC}) and total income (TI_{MP}) figures are estimated as sketched in equations [5] and [7].

2.5.1 Output and costs in steady state

The AAS system extends the revenues concept to output concept. Production Account records gross natural growth (GNG) and gross fixed internal investment (IFO) values besides sales and market and no-market goods and services self-consumption. In addition, production-in-progress used (PPu) and the historical fixed capital consumption (FCC) values are taken into account for estimating total cost.

Silviculture treatments described in section 2.1 could have an effect over cork production that lasts for more than one accounting year. Thus, the total expenditure involved in their performance is considered as internal investments in form of *forest improvements* (IFO). In Cadiz it is supposed that the internal investment on forestry improvements and infrastructure (only fencing) is carried out by an external firm and there are no own general cost associated to forestland management (Campos et al., in press). This assumption determines that the only FCC included at the production account is the one related to the depreciation of historical forest improvements and infrastructure investments. While in Ain Snoussi, the own forest internal investment in silviculture treatments and infrastructure have a general cost associated to forest management undertake by the State owner. This assumption sets that own forest internal capital investment includes this shared State owner general cost at the production account. Thus, own forest internal investment corresponds to the sum of current ordinary direct costs in addition to government general management costs. Under steady state assumptions, in Ain Snoussi, the own internal capital investment and historical fixed capital consumption values are equal.

In steady state, the quantities of cork and firewood produced in the plot that achieves the extraction turn, is equivalent to the year gross natural growth. For simplicity, it is assumed that cork or firewood extractions are performed at the final instant of the accounting period and that cork and firewood growths are linear and uniform across their respective extractions turns. In such way, the gross natural growth (GNG) of cork oak woody products is estimated according to:

$$GNG_t = \frac{Q_t/J \cdot Ps}{(1+r)^{S-t}} = \sum_{j=1}^{J} \frac{q_j \cdot Ps}{(1+r)^{S-t_j}} . \qquad [13]$$

Being S the extraction turn of cork or firewood and Q_t the cork or firewood yield in period t, q_j represents the GNG in each j plot, where $j \in [1,2,..J]$, r the annual discount rate and Ps the cork or firewood stumpage prices[19].

Production in progress used reflect the stumpage value of extracted cork or firewood ($PPu = Q_t \cdot Ps$). PPu affects the cork stripping individual account if considered separately from silviculture treatments (Campos et al., in press, Daly et al., in press). At this application, both individual operations are aggregated.

The valuation criteria for PPu and GNG determine that at each accounting period a production-in-progress revaluation is accrued (PPr). This revaluation is originated as a discount effect, since at the end of the accounting period the time length needed to achieve the next extraction turn of cork and firewood decreases in one year (Caparros et al., 2003).

2.5.2 Capital gains in steady state

Cork oak forest in steady state situation has two kinds of capital entrances and only one of capital withdrawal. The entrances have their origin in the production account of the year, one in form of gross fixed internal investment (FCgi) on forest improvements and infrastructure, and the other one as gross natural growth (GNG). The use of production-in-progress (PPu) during the accounting period is the single capital withdrawal.

In steady state due to constant prices of capital goods and the investment levels assumptions, the initial and final assets value is the same. Thus, the different worth of capital entrances and withdrawals generates capital revaluation (Cr). Capital revaluation is originated by two contrasting phenomena, by one side a fixed capital revaluation (FCr), and by the other side, a production-in-progress capital revaluation (PPr = PPu – GNG).

Capital gains (CG) designate the income accrued from real assets revaluation (Cr) net from capital goods destruction (Cd). The FCC value is added to the former values in order to correct its double accounting[20].

[19] Cork standing prices are appraised as the difference between the cork price at farm gate and the stripping costs (cork stripping and transportation to the farm gate). In Cadiz case study cork stripping cost are augmented by a commercial benefit that an external firm would demand for performing cork stripping. Stumpage and farm gate prices of firewood match, since those are considered as silviculture treatments sub-products (Campos et al., in press).

[20] FCC value is recorded once as cost in the Production Account, and a second time for estimating the assets value at the end of accounting period.

$$CG = Cr - Cd + FFC,$$
$$CG = FCr + PPu - GNG - Cd + FCC,$$
$$FCC = -FCr$$
$$Cd = 0$$
$$CG = PPu - GNG. \quad [14]$$

3. RESULTS

3.1 Cost benefit analysis results

Tables 3 and 4 give the main results from CBA techniques application for evaluating private investment on cork oak forest natural regeneration at Cadiz and Ain Snoussi case studies. Cork oak forest natural regeneration is evaluated considering three different perspectives: the *market*, i.e. omitting operating subsidies and taxes; the private investor, i.e. considering former figures, and the society. For latter perspective (society) in Cadiz the analysis concentrates on private capital and employees' labour income figures, while in Ain Snoussi also attends to changes on local families' self-employed incomes.

3.1.1 Private capital incomes of natural regeneration

Capital values (CI_{MP}^{pdv}) accrued from monitored natural regeneration are positive in both case studies, even if discount rates (r) higher than 5% are applied. However, from pure market perspective, cork oak renewing results in a worse economic alternative than letting a cork oak stand to deplete. Later results are suitable if market demands profitability rates higher than 1%. Cork oak renewing generates income losses higher than five thousand € ha^{-1} in Cadiz if discount rates equal or higher than 4% are applied.

A discount rate of lower than 4% does not appear acceptable by an individual private owner of a cork oak forest in Cadiz (Ovando et al., 2009), thus permanent natural regeneration does not make any economic sense at market prices (Table 3). Tunisian government public investments in forest sector are usually evaluated using discount rates of 10%. Thus, the same occurs in Ain Snoussi, since only in case the forest State owner accepts a profitability of 1% cork oak renewing would be an interesting alternative of investment. In spite of this, the State owner would profit from only a share of capital benefits generated from cork oak renewing, due to its incomplete property rights over grazing resources capital value.

Net present value indicators at factor cost are the ones that a private investor looks at for undertaking an investment decision. The Andalusia government establishes some public aids for cork oak woodlands management, especially for shrubs clearing[21], which could be either received by the no-regenerated cork oak stand (Campos

[21] As forest fires' prevention intend.

et al., in press). Therefore, in Cadiz current public aids to cork oak management do not change the sign of natural regeneration benefits (CI_{FC}^{pdv}), thus either at factor costs; regenerating a cork oak forest is not a competitive economic alternative, for a private agent that requires a profitability rate equal or higher than 4%.

In case the forestland is publicly owned, cork oak forest natural regeneration might be evaluated demanding lower discounting rates than private owners do. Public ownership profitability rates requirements have not been studied in Cadiz cork oak forests. Presumably, this type of ownership could accept lower discounting rates for evaluating investments alternatives that connote forest conservation. Applying a social discount rate of 2% (Pearce and Ulph, 1995) cork oak renewing becomes the preferred alternative if benefits from current forestry government aids.

Factor cost perspective is not evaluated in Ain Snoussi, since nowadays cork oak forest management is not benefited by any kind government subsidies scheme[22]. Thus, pure market perspective results are very close to the private investor's one (Daly et al., in press).

Capital losses derived from monitored cork oaks' natural regeneration in Cadiz are notably higher, if contrasted under the same discounting rates conditions with Ain Snoussi ones (Table 3). No direct comparison between Cadiz and Ain Snoussi forest investments results is reliable, unless some consideration about purchasing power term is involved. For that propose it is presumed that the estimated relationship between Spain and Tunisia ratios of PPP conversion factor to 2002 official exchange rates[23] allows a homogeneous comparison. In such conditions, Cadiz forest investment capital net benefits (r = 1%) are 0.6 times lower, while capital losses (r > 1%) from 1.9 to 3.4 times greater than Ain Snoussi ones.

Although the silvicultural treatments prescribed by Montero et al. (in press) and Chaar et al. (2005) are similar for both cork oak stands; specially elevated labour costs[24] and the need of performing shrub clearing every nine years at Cadiz explain former results. Shrubs' clearing is a costly operation that involves about the 48% of total Cadiz natural regeneration cycle expenditures (Campos et al., in press). In Ain Snoussi, shrubs' clearing is performed by self-employed local inhabitants thus it is source of household income, with no monetary outflows for the State owner.

[22] There are some taxes on products considered for estimating factor costs economic indicators, nevertheless the effect of former taxes is marginal (Daly et al., in press).

[23] A PPP exchange rate is the number of units of a country's currency required to buy the same amounts of goods and services in the domestic market as U.S. dollar would buy in the United States. An international dollar is, therefore, a hypothetical currency that is used as a means of translating and comparing costs from one country to the other using a common reference point, the US dollar. The ratio of conversion factors to official (US $) exchange rate in 2002 are 0.7 for Spain and 0.3 for Tunisia (The World Bank, 2004: 280). That is a relation of 2.33 between former conversion factors.

[24] Days wage in Cadiz is about 8 times than Ain Snoussi ones, if their corresponding national PPP ratios are considered: 72 € day^{-1}/2.33 > 4.5 € day^{-1}.

Table 3: Net present discounted values[1] of private incomes for cork oak forest monitored natural regeneration at different discount rates (2002 € per hectare)

Class[2]	Discount rates for commercial goods and services					
	1%	2%	3%	4%	5%	10%
Capital income at market prices (CI^{pdv}_{MP})						
Cadiz						
REG	32,164.5	12,326.0	6,052.9	3,249.9	1,791.9	-390.2
NREG	26,533.7	15,371.1	11,371.8	9,243.9	7,902.6	5,022.1
Net benefits (REG-NREG)	5,630.8	-3,045.0	-5,319.0	-5,994.1	-6,110.7	-5,412.2
Ain Snoussi						
REG	13,584.9	6,307.2	4,024.1	2,986.2	2,426.6	1,532.9
NREG	10,383.5	6,651.0	5,074.8	4,170.6	3,583.3	2,321.1
Net benefits (REG-NREG)	3,201.4	-343.8	-1,050.7	-1,184.4	-1,156.7	-788.2
Capital income at factor costs (CI^{pdv}_{FC})						
Cadiz						
REG	45,108.9	19,272.6	10,962.3	7,112.3	5,009.3	1,496.4
NREG	30,218.5	18,614.5	14,267.2	11,860.9	10,294.2	6,750.1
Net benefits (REG-NREG)	14,890.3	658.1	-3,305.0	-4,748.6	-5,284.9	-5,253.7
Labour costs net benefits (REG-NREG)						
Cadiz	22,686.9	9,998.4	6,410.8	4,899.2	4,136.6	3,155.9
Ain Snoussi	3,997.8	1,994.7	1,443.4	1,201.3	1,067.6	827.7
Total income net benefits (at market prices) (REG-NREG)						
Cadiz	28,317.7	6,953.4	1,091.9	-1,094.8	-1,974.1	-2,256.4
Ain Snoussi	7,199.2	1,650.9	392.7	16.9	-89.1	39.5

[1] REG: cork oak woodland monitored natural regeneration; NREG: cork oak woodland without natural regeneration, which implies cork oak trees depletion due to natural death and transition to un-wooded shrublands in both case studies.

[2] Differences between investment and no investment scenarios lay basically on commercial values; due to private environmental benefits from Cadiz are the same for the mosaic of land uses at the study cases areas.

Source: *Own elaboration* based on Campos et al. (in press) and Daly et al. (in press).

Table 4 presents the sensitivity of cork oak woodland natural regeneration capital benefits values under different cork prices scenarios. Expected cork yield is higher if monitored natural regeneration is carried out in both scenarios (Campos et al., 2007). However, in case of Cadiz, high investment expenditures combined with the fact that along the first thirty years of the no regeneration scenario cork yield is about 50% higher than in the regeneration scenario one (Campos et al., in press), make results slightly sensitive to cork prices variations. In case of Ain Snoussi, an increase of 25% on cork prices would make natural regeneration a preferable alternative if the State owner applies social discounting rates (r=2%) to cork oak renewing investment evaluation. Latter difference between Cadiz and Ain Snoussi study cases is explained by three main issues. The first one is the investment amount required for favouring natural regeneration (higher in Cadiz), the second is the stripping turn length (higher in Ain Snoussi), and the third one related to the time distribution of cork yield in no regeneration scenarios (Campos et al., 2007).

Table 4: Sensitivity analysis of net capital benefits from cork oak monitored natural regeneration to cork prices[1] (2002 € per hectare)

Class	Prices index (prices adopted for 2002 = 1)				
	0.50	0.75	1.00	1.25	1.50
Capital net benefits at market prices					
Cadiz	-5,983.5	-5,988.8	-5,994.1	-5,999.4	-6,004.7
Ain Snoussi	-1,169.4	-756.7	-345.5	68.7	482.1
Capital net benefits at factor costs					
Cadiz	-4,505.2	-4,510.5	-4,515.8	-4,521.0	-4,526.3

[1] Discount rates: 4% for Cadiz study case and 2% for Ain Snoussi study case.

Source: *Own elaboration* based on Campos et al. (in press) and Daly et al. (in press).

3.1.2 Total private incomes from cork oak natural regeneration

From social perspective we look at the private total income present discounted value (PDV) indicators, since those consider besides capital incomes the labour returns. In both case studies, cork oak natural regeneration alternatives generate notable labour income present discounted values, higher than those generated in the case cork oak stands are not renewed (Table 3). In Cadiz, the entire labour costs figures reflect paid-workers retribution. In Ain Snoussi about one sixth of total labour costs reflect the self-employed labour contribution of local inhabitants to cork oak renewing investment, while employees retribution accounts for the rest of labour costs present discounted value (r=2%). By the alternative no-investment scenario, employees' retribution accounts for two thirds of labour costs and self-employment value for the remainder one third (Daly et al., in press).

Cork oak renewing in Cadiz enlarges labour income (in present discounted terms) from 79% to 238% (depending on the discounting assumption) in respect to the no regeneration scenario. Cork oak forest natural regeneration is a labour-intensive investment, especially at the first stages of the silviculture cycle; hence labour costs present discounted values are highly sensitive to the discount rates choice. Although, investment alternative generates important benefits in terms of labour retributions in Cadiz, total private incomes (TI_{PM}^{pdv}) from cork oak forest natural regeneration arise capital values lower than no-investment alternative, if discount rates higher or equal than 4% are applied (market discounting). From social discounting perspective ($r \leq 3\%$), the total private income capital value offered by cork oak renewing surpasses the no regeneration alternative. Thus, presumably for a public forest owner that is engaged with forest conservation and employment generation, investment alternative might be the preferred option (Table 3). If net operating subsidies are considered (TI_{FC}^{pdv}), cork oak renewing might also be an interesting investment alternative if a public or a 'philanthropic' private forest owner applies a market discount rate (r=4%), however this owner might be willing to offset capital losses for labour income gains.

In pure market conditions, the Ain Snoussi cork oak forest natural regeneration generates superior total private net present value figures than the alternative no regeneration scenario (Table 3). Total private income net benefits arise positive values (except if a discount rate of 5% is applied); which magnitudes in respect to no-investment alternative are highly sensitive to the applied discount rates. Although the relatively higher total private net present values, the self-employed labour costs (SEL) related to cork oak permanent regeneration is being reduced in respect of letting cork oaks to deplete. The investment alternative could generate important amounts of employee's labour income, almost up two times with respect to the no regeneration scenario. In sum, it is estimated that cork oak forest natural regeneration would enhance total labour income from 80% to 114% (depending on r).

3.2 Steady state results

Although the generations that accomplish successive natural regeneration will not see the cork oak woodland's steady state, it is of interest to find out the notable increases in income that would benefit the future generations if we compare this steady state situation with the maintenance of the same land under the alternative scenario of un-wooded shrubland. In the methodology section, it is noted that the steady state is an ideal construction that serves as a reference of the potential income generation of forestry activities and environmental services of a cork oak forestlands, when the only concern is regenerating the forest mass according to rules established by normative silvicultures.

Table 5 organises Cadiz and Ain Snoussi total outputs and costs information in a comprehensive production account structure. Annual output and cost flows are aggregated for cork oak silviculture treatments and cork stripping by one side, and for the other, market and non-market goods or services (Other G&S). This account sheet permits to analyse the contribution of cork oak forest multiple uses under an ideal forest management conception. At this point, it is worth to remember that steady state reflects in average annual cork oak monitored natural regeneration cycle incomes.

Cork oak forest steady state figures are analysed considering annual output and costs flows, and the annual income indicators accrued from sustainable forest management, in both case studies. In Ain Snoussi, considerations about the potential effects of cork oak sustainable management over local families' self-employed income are examined

3.2.1 Steady state output and costs

Silviculture and cork stripping accounts for about 81% of total annual output accrued from cork oak sustainable management in Cadiz and Ain Snoussi. Cork and firewood sales are the main outputs derived from the cork oak forest in steady state.

Table 5: Private production account and net operating margin from steady state cork oak forests (2002 € per hectare)

Class[1]	Cadiz			Ain Snoussi		
	Silviculture and cork stripping	Other G&S	Total cork oak woodland	Silviculture and cork stripping	Other G&S	Total cork oak woodland
1. Total output	1,135.2	264.2	1,399.3	284.7	63.2	347.9
1.1 Fixed internal investment	291.8		291.8	33.4		33.4
1.2 Final sales	517.2	54.9	572.0	152.8	15.4	168.2
1.3 Gross natural growth	326.2		326.2	96.4		96.4
1.4 Other final output		209.3	209.3	2.1	47.8	49.9
2. Total costs	1,075.8		1,075.8	205.7	24.9	230.6
2.1 Intermediate consumption	495.7		495.7	118.7	1.1	119.8
2.1.1 Raw materials	*12.3*		*12.3*	*2.2*	*0.4*	*2.6*
2.1.2 Services	*86.7*		*86.7*	*6.5*	*0.7*	*7.2*
2.1.3 Production in progress used	*396.7*		*396.7*	*110.0*		*110.0*
2.2 Labour costs	288.3		288.3	53.7	23.7	77.4
2.2.1 Employees labour cost	*288.3*		*288.3*	*51.6*	*13.3*	*64.9*
2.2.2 Self-employed labour costs				*2.1*	*10.4*	*12.5*
2.3 Fixed capital consumption	291.8		291.8	33.4	1.1	33.4
3. Net operating margin (NOM)	59.3	264.2	323.5	79.0	38.4	117.3

[1] G&S refers to goods and services.

Source: *Own elaboration* based on Campos et al. (in press) and Daly et al. (in press).

In Cadiz former final output sales arise €517.2 ha^{-1}, representing 37% of total output and €152.8 ha^{-1} in Ain Snoussi, accounting for 44% of its total output (Table 5). The Ain Snoussi expected annual cork yield (in steady state) represents 58% of the Cadiz corresponding figure. Former cork yield differences, explain just in part the variation of final sales values amongst both case studies, which are also explained by important differences on cork prices at farm gate (Table 2). Cork prices are regulated by international markets, thus it turns out to be not necessary a correction factor related to purchasing power parity (PPP) rate for establishing a comparison between both study cases. Ain Snoussi reproductive cork price at farm gate in year 2002 represents 63% of Cadiz corresponding one. Latter difference on prices seems to be related to Ain Snoussi cork qualities (Khemiri, M.T., personal communication, 2006).

By other side, it is estimated that an annual gross internal investment of €291.8 ha^{-1} in Cadiz and €33.4 ha^{-1} in Ain Snoussi are required for maintain ongoing natural regeneration; which values forms part of total annual output (Table 5). The annual expenditures on different silvicultural treatments are notably higher in Cadiz, about 3.8 times if a PPP rate is considered to adjust former values. Differences, as mentioned before are related chiefly with shrubs clearing expenditures.

The value of *gross natural growth* (GNG) of standing cork and firewood is a forestry output that conventional economic accounts ignore (Campos et al. 2005c, Rodríguez et al., 2005), in regard of considering only annual woody extractions.

Moreover, differing from the conventional accounting system (Eurostat, 2000), AAS approach includes in counterpart to GNG the *production-in-progress used* (PPu) as a component of intermediate consumption of cork stripping costs. Those conventional accounting systems omissions do not affect steady state income measurements for the whole cork oak forestland, but restrain individual silviculture or cork stripping income calculations (Campos et al., in press). Although, here former individual operations are presented together (thus not affected by GNG and PPu omissions), it is of our interest to show the importance of both accounting concepts on studied cork oak forestlands economics. In Ain Snoussi cork and firewood gross natural growth represents 28% of steady state total output, while in Cadiz 23%. At the same time, the standing value of extracted cork and firewood (PPu) accounts for 37% of total Cadiz cost and for 48% of Ain Snoussi corresponding figure.

In addition, Ain Snoussi forestry operations generate firewood from shrubs clearing that are selfconsumed by local families, worth in €2.1 ha^{-1}. Although, this little difference on shrub firewood use, the main difference on Cadiz and Ain Snoussi production accounts arise from non-timber goods and services provided by the cork oak forest to their owners and local inhabitants that depend upon forest natural resources.

Forest amenities controlled by the owner and commercial recreational activities, as big game, acquire a notable importance amongst Cadiz cork oak forestlands, representing a joint output of €254 ha^{-1} yr^{-1}. Commercial game is scarcely developed in Ain Snoussi area, thus hunting rent accrued from licences and taxes is a marginal output (Table 2). The ownership nature (Tunisian State) implies no private environmental services active or passive consumption from cork oak Forest in Ain Snoussi.

The economic value attributed to grazing resources rent, based on market observations in Cadiz (Campos et al., in press) and by simulating the trade-off between non-market grazing resource rent and self-employed labour cost (Chebil et al., in press), entail similar values. Grazing resources valuation in Cadiz is independent from forage units' extraction, since cork oak forest local leasing values are considered. Daly et al. (in press) estimate that forage units extraction in cork oak forest in steady state arise 381.6 FU ha^{-1}, which result in an annual forest output of €25.6 ha^{-1} (Table 2).

In both cases a cork oak forest in steady state has relatively low intermediate expenditures (IE)[25], since the labour costs (LC) represents about three-fourth parts of the total expenditure (E). Considering a comprehensive total costs concept, employees labour cost constitutes one of the main cost components, which accounts

[25] Note that intermediate expenditures do not consider the PPu value.

for 28% of Ain Snoussi total costs. In Cadiz employees labour costs represents a similar share of total costs (27%) (Table 5).

It is worth to mention, that in steady state, 14% of Ain Snoussi cork oak forest total output is appropriated by local families (grazing resources, firewood from shrubs and honey), while contribute with 5% of total cork oak management costs (19% of labour cost).

3.2.2 Steady state annual income indicators

In both case studies, the total annual output generated by the cork oak forest, under steady state conditions, surpasses the total cost. The main difference arises from the contribution of cork oaks (silviculture and cork stripping) in comparison to other goods and services to the net operating margin and other income figures.

Capital income at market prices (CI_{MP}) accrued from a cork oak forest in steady state arise €393.9 ha^{-1} in Cadiz and €117.2 ha^{-1} in Ain Snoussi (Table 6). Taking into consideration the PPP conversion rates, the capital income figures that can be obtained from cork oak sustainable management are slightly higher in Cadiz at pure market conditions.

In Cadiz, under steady state situation, the private environmental services explain almost 53% of cork oak forest annual capital income at market prices (Tables 2 and 6). At the same time as cork stripping and silviculture account for 30% and grazing resources and hunting rents for the remainder 17% of annual CI_{MP}. In Ain Snoussi, cork oaks contribute with about two thirds (67%) of the annual capital income accrued from former stand sustainable management. Grazing resources, honey and other outputs used by local families contribute with 31% of annual cork oak forest capital income[26], while the remainder 2% is the partial contribution of other non-forestry outputs to the Ain Snoussi cork oak forest capital income.

Table 6: A selection of private annual steady state economic indicators (2002 € per hectare)

Class	Cork oak woodland		Alternative land uses (shrubland)		Net benefits	
	Cadiz	Ain Snoussi	Cadiz	Ain Snoussi	Cadiz	Ain Snoussi
1. Labour costs (LC)	288.3	77.4	8.3	27.5	280.1	49.9
Employees	*288.3*	*64.9*	*8.3*	*12.8*	*280.1*	*52.0*
Self-employment		*12.5*		*14.6*		*-2.1*
2. Capital income (CI_{MP})	393.9	117.2	255.5	53.4	138.4	63.8
3. Capital income (CI_{FC})	513.3		266.3		247.1	
4. Total income (TI_{MP})	682.3	194.6	263.8	80.9	418.4	113.7

Source: *Own elaboration* based on Campos et al. (in press) and Daly et al. (in press).

[26] This share is estimated by considering other final outputs, self-employed labour costs and honey production consumption expenditures (Daly et al., in press).

By considering, the current net operating subsidies for Cadiz cork oak forest management, the annual capital income at factor costs (CI_{FC}) that a private owner can receive from a cork oak forest in steady state totals €513.3 ha^{-1}. In that case, the partial contribution of forestry activities and other good and services to CI_{FC} is practically the same. However, there are many uncertainties about the future subsidies scheme in the context of European Union, thus we do not go further with factor costs indicators analysis.

The total private income at market prices (TI_{MP}) figure in steady state corresponds to the *hicksian income* (Hicks, 1946) or 'total sustainable income', due to under steady state, the annual constancy on cork oak forest natural capital endowment condition is satisfied (Campos et al., 2003). In this context, total sustainable income can be stated as the maximum quantity of the economic goods and services that can be consumed during the assessed period without lowering the real economic value of the capital stock available at the beginning of the period for which the income is calculated (Campos et al., 2003; Caparrós et al., 2003).

The cork oak forest in steady state generates in Cadiz a total private income (TI_{MP}) of €682.3 ha^{-1}, with 58% made up by the private capital income at market prices (CI_{MP}) and 42% by the income of paid labour (LC). In Ain Snoussi, under steady state situation a cork oak forest produces a total private income (TI_{MP}) of €194.6 ha^{-1}, in turn made up of 60% private capital income at market prices (CI_{MP}) and 40% by the income of labour (LC). Since a share of cork oak forest capital income is appropriated by local families and third private firms, the relevant issue is the total income distribution amongst the economic agents that profit from Ain Snoussi cork oak forest management. In that case, 41% of total private income would belong to the forest owner (Tunisian State), local families employed by their own would profit from 25% of TI_{MP}, employees would receive one third of total income, while private firms that collect aromatic plants and mushrooms would obtain the remainder 1%[27].

The annual income of the cork oak forest in steady state is directly comparable with the annual income of shrubland, since it is accepted that the latter corresponds also to the steady state. Thus, we compare the average annual income per hectare of a cork oak forest in steady state, consisting of 144 ha or its multiples, and an un-wooded shrubland, consisting of nine hectares or its multiples in Cadiz (for the management reason detailed at the methodological sections) and one hectare or its multiples in Ain Snoussi.

In both study cases, cork oak forest generates higher private capital (CI_{MP}) and total income (TI_{MP}) figures than the corresponding alternative shrubland use ones. In Cadiz under pure market condition cork oak forest gives a capital income figure

[27] Note that the aromatic plants and mushroom economic values are restricted in the analysis to former goods farm gate values.

that is 28% higher than the shrubland use, and 116% if total income values are contrasted. In Ain Snoussi, cork oak forest result to be more advantageous in relation to shrubland use, since the capital income (CI_{MP}) that the first soil use generates is 120% higher than the corresponding shrubland use one and 141% if labour income is in addition considered (Table 6). However, local families' self-employed labour income would suffer an estimated decrement of 14% in respect to the income that they perceive from shrub as alternative land use.

4. DISCUSSION

4.1 Cork oak renewing by natural regeneration

Cork oak forest long-term conservation, in absence of remedial programmes, might be seriously threatened in Ain Snoussi and Cadiz, if the current cork oaks aging trends continue within the coming decades. A possible programme would be based either on artificial or natural reforestation, and could target either the maintenance or an increase in the cork oak trees planted area (Campos et al., 2005a). Artificial planting, is an expensive alternative that requires the concurrence of a strong government subsidies framework (Campos et al., 2003, in press; Ovando et al., 2009). Little effort has been made for maintaining the current cork oak forest under the past decade European Common Agriculture Policy reforms although its potential economic and ecological advantages in comparison to artificial planting.

Recent studies over cork oak and other Mediterranean oaks species woodlands, suggest that the restoration and sanitary treatments of the existing wooded stands might be more preferable, in terms of biodiversity conservation than the artificial creation of new oaks stands. Since, due to the slow *Quercus* species growth, the latter stands would require many decades for reaching the maturity, at which those forest can better provide environmental services for the biodiversity conservation (Standiford et al., 2002; Caparrós and Jacquemont, 2003).

Cork oak renewing requires from different kinds of human interventions, especially at the earliest stages of the cycle for removing competing vegetation, avoiding the entry of livestock and other wild animals and for the proper formation of the trunk. Thus, renewing a cork oak stands by natural regeneration entails remarkable levels of monetary outflows (Campos et al., 2007). Moreover, this intervention involves some opportunity costs related to grazing resources use, since temporary livestock or wild fauna exclusion is prescribed, and to cork yield, since a share of mature oaks are removed in order to induce on-site seeding. Both, investment requirements and its opportunity costs, act as discouraging driving forces for cork oak renewing.

Ain Snoussi and Cadiz cork oak forest renewing decisions simulation can well illustrate the estimated magnitude and the sort of income losses and gains accrued from cork oak regeneration treatments at both sides of western Mediterranean basin, and how does it affect to the different economic agents that depend on or profit from controlled cork oak forest goods and services. Additionally, cork oak economic indicators under steady state situation point up how, ideally, would be the situation if the forest owner should only be concerned on replacing the natural and human-made capital devaluation or destruction along the accounting period.

Under current market and government aids schemes, cork oak renewing by natural regeneration leads to important capital losses if compared to the alternative of letting the cork oak stands deplete by natural mortality, within an insufficient natural regeneration of their oaks. As the results section sets forth, cork oak monitored natural regeneration becomes a worse economic alternative for private or public owners that demand certain profitability rates from forest investment, in both, Cadiz and Ain Snoussi case studies.

Individual Cadiz cork oak forest owners implicitly demand from forestry-based investments total profitability rates equal or higher than 4% (Ovando et al., 2009). In this context, if capital income maximization drives the private owner economic behaviour, cork oak renewing is not an interesting investment alternative, since entails important capital losses although current government subsidies to certain forestry operations are considered. Even for publicly owned cork oak forest, at which the ownership may presumably demand lower profitability rates from natural regeneration, this investment would produce important capital losses. A public owner could target forest conservation and employment generation beyond its social aims. In this case, considering current forestry subsidies, even if a market-discounting rate is applied, cork oak renewing could be the preferred alternative; nonetheless, the forest owner should be willing to offset capital losses by labour income generation. In some cases, it has been observed that the public owners of cork oak forest and other Mediterranean savannah-like forest assume some capital losses in sake of certain agro-forestry systems natural resources conservation and employment generation (Rodríguez et al., 2004; Campos et al., 2005d). However, the greater share of Cadiz cork oak forest is under individual private ownership, thus normally owner will not be willing to support capital income losses, beneath an insufficient government subsidies frame.

It is worth to say, that cork oak forest market may behave short-sightedly here, since the slow disappearance through age of a significant number of stands of cork oak trees might drive up their price in the future in detriment of un-wooded pasture and shrubs. Therefore, it is very likely that the present economic values of woods, pastures and environmental services considered for economic assessment of natural regeneration undervalue their real profitability. The uncertainty about the future prices of cork oak forest goods and services may advise subsidy of natural regeneration of woodland, which is cheaper and more secure in its outcome, than some of the risk-ridden plantations (Campos et al., 2003, in press).

In Ain Snoussi, cork oak stand conservation produces capital losses if compared with the no regeneration alternative. State owner would support at the first stages of natural regeneration cycle some capital losses caused by the temporary fall in cork yield and the outflows requirements for undertaking the silvicultural treatments. While temporary restrictions on grazing resources usage, would significantly affect the local families' income, as Daly et al. (in press) set forth. In this context, cork oak natural regeneration in Ain Snoussi requires the concurrence, not only from some financial schemes for funding the initial investment expenditures, also from some mechanisms to compensate local families' income losses. By other side, if both labour and capital incomes are considered, the continuous cork oak natural regeneration generates important total income present discounted values; depending on the discounting assumptions, are higher or closer to the alternative (no regeneration) scenario. In case the State owner is interested on generating employment through forest-based activities, it might be willing to trade-off between capital and labour incomes. Employees labour income increase does not necessary offset families' self-employment income and grazing resources rent losses, considering that those activities are frequently afforded by women. Hence, encouraging cork oak natural regeneration can hardly affect Ain Snoussi households' subsistence economies, since more than two thirds of families' total income depends on livestock activity (Chebil et al., in press).

The analysis of the steady state is static, and attempts to show the differences in income enjoyed by the benefiting generations of the two alternative uses, without considering what was sacrificed or enjoyed by the generations prior to arriving at the steady state. Considering year 2002 prices, if natural regeneration of an aged cork oak forest without public subsidies was to be started today, the current and next generations would have to sacrifice a substantial part of their capital incomes that they would obtain from no-natural regeneration and the continuation of shrubland management. If the steady state is hypothetically accomplished, a cork oak forest even if its conservation entails important annual investment outcomes, generates higher capital and total income figures, than alternatively maintaining a shrubland use. Except for local Ain Snoussi's inhabitants, whose income has been reduced due to the required grazing limitations.

4.2 Cork oak multiple use economic valuation

Commodities as cork and firewood are key cork oak forest products, however, the concept of multiple-use, rooted in the commercial value tradition, has moved to a most comprehensive view of forest multi-functionality, either from private and social perspectives (Campos et al., 2001, Caparrós et al., 2003, Merlo and Croitoru, 2005, Chebil et al., in press, Rodríguez et al., 2005). Landowners are likely to emphasize private income, which in Spanish forests involve a range of recreational and environmental private services. While in Tunisian cork oak forest, local inhabitants take advantage from a most varied list of forest natural resources and commodities including grazing, non-timber products e.g. resin, aromatic plants, mushrooms, berries, and hunting. Economic valuation of former goods and services logically depend on the local markets development.

In case of Ain Snoussi, as some other subsistence economics, certain revenues or costs as grazing resources rent and self-employed labour cannot be objectively assessed using closer substitutes or alternative uses values (Lange, 2004). In Ain Snoussi, unbiased self-employed income estimation confirms that families under a subsistence economy context can accept lower economic returns for time spent on their own, even when the in situ resource value for grazing resource is nil (Campos et al., 2008). The application of market wages for valuing Ain Snoussi own account activities, yielded inconsistent results and could not explain the family economic rationality to continue with those forest activities. Grazing resources are free for local Ain Snoussi inhabitants, which not necessary entails that resources rent is nil. Grazing resources value is nonetheless constrained (by an upper limit) to the livestock activity net value added. Thus, in Ain Snoussi*,* it is not possible to find an exchange value for grazing resource forage units; unless some trade-off consideration between self-employed labour cost and grazing resources is to be adopted.

5. CONCLUSIONS

Cost benefit analysis techniques as well as an integrated accounting system have been applied for measuring present discounted and annual income indicators from a cork oak forest under sustainable and unsustainable management scenarios (in terms of the oak trees conservation) within two case studies at both sides of the western Mediterranean European and Maghreb countries. Those forests, can be considered representative from certain cork oak forest areas in Spain and Tunisia, and illustrate well the economic reasons that cork oak forest owners might have for not renewing their oaks stands by natural regeneration.

Cork oak forest aging and deforestation in Spain might be invisible to the official statistic and to their owners. The large cork oak life cycle and its relative abundance contribute to this shortened perception. In Tunisia, cork oak forest deforestation process is more perceptible, as well as, given its limited area, its future conservation may be much more threaten in the northern Africa shore of Mediterranean basin.

Private income losses derived from controlled cork oak forest goods and services if natural regeneration treatments are accomplished justify, given current cork and other commodities prices and government aids, the little private effort for renewing those oaks stands. In Tunisia, an additional constraint to cork oak renewing is linked to the negative impact that this forest investment would have over local families' subsistence economies. In sum, nowadays, current cork oak maintenance depends strongly on accurate financial and subsides frameworks, as well as, on local families compensation mechanism.

In this work, we just focus on goods and services that are controlled by the different types of forest (legal or in fact) owners, therefore total income present discounted values give an incomplete overview of cork oak renewing investment social benefits. Mediterranean woodlands covered by *Quercus* overstory can give refuge to exceptional levels of biodiversity, provide watershed and habitat, sequester carbon, offer historically meaningful landscapes, and be pleasing to the eye. Moreover, most migratory birds (from Central and Northern Europe to Central Africa), are endangered because their forest habitats are threatened by deforestation resulting from the conversion of forestland into shrubland and cropland, especially in Northern Africa (Campos, 2004). In this context, forest services to biodiversity conservation, beyond others, could justify the creation of a specific programme on cork oak conservation at both sides of Mediterranean Basin, paying special attention on mitigating families income losses derived from cork oak sustainable silviculture.

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