Abstracts

The list of abstracts is below.

Please note that only abstract that cannot be published yet is the "abstract" by Jean-Luc Peyron. (The Fedkiw abstract is now ready to circulate.)   The reason that the "abstract" cannot be circulated or published is because the information was sent in letter and not abstract form. To get the "abstract" or something that would be a placeholder, I took the material from the letter, and put it into abstract form. I hope to hear back from Jean-Luc Peyron—who may or may not want to submit—and see if the "abstract" is ok, or whether it needs to be modified.

Total number of abstracts 60
Unclear case: Roland Olschewski*, Pablo C. Benítez   Do they present??? From Roland's latest note I have this presentation cancelled.

Note also, we may receive one more abstract from S.M. Vaezin and Jean-Luc Peyron. I missed on the first pass because it was submitted in December 2008.

Accounting for uncertainty in a forest sector model using Monte Carlo simulation

A. Maarit I. Kallio

Large scale forest sector models tend to have thousands of parameters of which many have values that are unknown or not known exactly. Despite the wide use of such models in the policy analysis, potentially with some sensitivity analyses, the impact of the overall uncertainty on the results and the distribution of the resulting variable values has not been considered. However, it is important for the policy makers and other users of the results to know the robustness of the model outputs and conclusions made regarding to variations in model inputs. This study attempts to systematically account for the uncertainties in forest sector model analysis. Applying Monte Carlo simulation into a spatial partial equilibrium model for the Finnish forest sector, we look at the impacts of the uncertainty over the parametric data and output price developments on the model projections with a focus on the Finnish sawlog market and sawnwood production. As a policy example, we explore the impacts of forest conservation set-asides accounting for these uncertainties. The uncertainty in the basic parametric data seems to have rather moderate impact on the results. Instead, the unpredictability of the world market prices for the forest industry products is an important source of variation among the model projections, which means that any base line projection provided by the model should be perceived to be strongly conditional to the assumptions made on the development of the output markets. Nevertheless, the model projections for the relative impacts of forest conservation seem to be rather robust despite of the uncertainties and thus reliable, given that model otherwise mimics the conduct in the forest sector in an accurate manner.

Keywords: uncertainty, forest sector model, policy analysis, forest conservation, sawnwood production, timber market, Finland

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The evolution of land and forest value calculations and the discovery of the Faustmann formula

Esa-Jussi Viitala

The purpose of this paper is to trace the development of central forest economic ideas further back and link them more closely to the general development of economic thought than has been done previously. It is shown that although relatively sophisticated land valuation techniques have been around for centuries, it took quite long until they were applied to forests. Early insights about the opportunity cost of forest capital can be detected in the English pamplet press in the 1660s, but John Houghton in 1683 and 1701 appears to have been the first who explicitly recognized the role of opportunity cost of standing timber and bare land. He also compared the present values obtainable from forestry to those from other forms of land use with valid investment calculations. The rise of this type of economic reasoning was stimulated by the interest-rate-debate and the 'financial revolution' in England which lead to a more credible and innovative market on government loans from the 1690s. These securities were the alternative investment against which the yields and rents from more traditional investments were increasingly judged in the following decades. This perception led an Exonian land-surveyor John Richards (1730) to determine the value of a forest under both intermittent and sustained yield management. Only substantially later, these principles of modern capital and investment theory were diffused to 'forest science', conventionally regarded as having been emerged in the continental Europe.

Estimating the Change in Value of European Forestland under Climate Change

Is "Faustmann" an appropriate approach ?

Marc Hanewinkel

The paper describes an approach to estimate the change in value of European forestland under two climate change scenarios (A1FI and B2). The paper hypothesizes that range shifts of major commercial tree species in Europe due to climate change are linked to severe losses in the value of forestland. A first estimate for these losses for European forests is given based on a model for the future range shifts of important European tree species and an economic valuation of this process using a classical Faustmann-approach to estimate the change in Land Expectation Value (LEV). The input for the estimation of the LEV results from a large scale scenario simulation model EFISCEN that is based on national forest inventory (NFI) plots distributed all over Europe. The application of the Faustmann approach for this complex task is subject to a critical discussion.

The model to project possible range shifts of European trees is based on a large database of around 7000 plots of the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forest). These plots are regularly distributed over Europe in a16x16km grid. Current climate envelopes for major tree species were calibrated based on theses plots using the Worldclim database (global 1 km climate data) and combined with own GIS modelling in order to express the major climatic gradients in Europe at a 1km spatial resolution. Generalized linear models (GLM) were then calibrated and applied to the whole European territory as an expression of the current range of trees. In order to assess possible range shifts, climate maps were developed that express future conditions following two IPCC scenarios, the A1FI scenario indicating a strong warming and the B2 scenario as a moderate scenario. Three sets of climate maps for each scenario were generated representing the same climate maps as under current conditions but adjusted to expected climate changes. The calibrated GLM models were then translated into GIS maps using the future climates representing potential range shifts. The resulting shifts were analyzed for range reduction/expansion and overlap with current ranges for six major tree species groups in Europe. First results of these models indicate that mainly cold-adapted and mesic species, namely Norway spruce, one of the main commercial tree species in Europe, but also European beech and Scots pine tend to loose larger fractions of their ranges than do more drought-adapted species like oak. Under the A1FI scenario the model predicts that in the year 2100 more than 60% of the overall 160 million ha of forest in Europe (without Russia) will be covered by a Mediterranean – oak forest type that is of almost no conventional commercial value, while major economic

species like Norway spruce will be pushed back to the extremes of Europe in e.g. northern Norway.

In order to evaluate that process from an economic point of view, the value of the forestland of the major tree species was estimated using the classical land expectation value (LEV) based on a Faustmann approach as a proxy for the willingness to pay for forestland. Input of the Faustmann model were simulation results for the volume of thinning, final harvest and the remaining growing stock of the large-scale scenario model for Europe EFISCEN and actual data for costs and timber prices for major tree species in Europe. Results of this simulation show that there are considerable differences in the LEV between coniferous trees like Norway spruce and hardwoods like oak, which might expand their ranges under climate change. Range shifts of the different species were analysed for "winners" and "losers" under the given scenarios and the differences in LEV of the remaining tree species ranges were calculated for the different scenarios. The results of this first approach to estimate the effect of climate change on the value of forestland show that, depending on the interest rate applied, a loss of LEV between 100 and 800 billion Euros for an area of 160 million ha of forest (between 600 and 5,000 Euro per ha) would be possible.

The paper finally discusses the limitations of the Faustmann- approach, that must still be looked upon as a comparative static approach in this case, for such a highly complex and dynamic problem. Especially the assumptions concerning perfect market conditions, constant future prices and costs and constant timber yield are scrutinised. A first precondition to improve the model output is a further development of growth models that should be able to depict growth and yield of major forest types in Europe under climate change. A combination of process-based and empirical models leading to climate-sensitive models would therefore be necessary. The next steps of the development of the EFISCEN model based on high resolution spatially explicit NFI data are outlined. Including major risks and their development under different climate scenarios is a second necessity. Again the development of mechanistic as well as statistical models or a combination of both is essential, together with improvements in forecasting extreme events. To account for volatile timber prices, methods accounting for stochasticity such as Monte Carlo simulations should be applied. A general outline of a modelling framework taking into account these aspects is presented.

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V –VALUE OPTIMIZATION METHOD FOR FOREST PLANNING

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The traditional v-value tells whether it would be economically more rational for the forest owner to let a forest stand grow for one more year (positive v-value) or to cut it (negative v-value) and invest the cutting income to an alternative investment object offering a certain rate of return for the invested money. V -value is calculated by using the following formula: $v=I_a-p(A_t+A_l)$, where I_a is the value increment of the stand, p is the rate of return (%) offered by the alternative investment object, A_t is the timber value of the stand and A_l is the value of the bare land.

This paper introduces a v-value optimization method where the calculation of traditional v-values for individual forest stands is integrated with a modern forest planning system. Hence, one can calculate the v-values of individual forest stands for any forthcoming year, and the v-values can then be utilized when producing a forest plan. Some simplifications to the traditional v -value calculations and economic optimization of forest use have been done due to practical reasons. First, when determining decision proposals, v-values are used only for mature stands (regeneration cutting allowed). For determining the treatment schedules for young forest stands (thinning allowed) and open forest land areas (reforestation required) Finnish forest management recommendations are straightforwardly applied. And secondly, the value of bare is not included into the v-value calculations, because the option to sell the land is excluded from the standard version of the method. In general, the method optimizes forest rent among treatment alternatives restricted by the Finnish forest management recommendations.

In the case study, we used v-value optimization method for producing five different cash flow estimates for 120 hectares of private forest property in southeast Finland. The cash flow period consisted of three sub-periods; the first sub-period being 5 years, and the second and the third being 10 years. Constant timber prices and labor, machine and material costs were used in the calculations.1,2,3,4 and 5% requirements for the rate of return were set for mature stands and the official Finnish forest management recommendations were straightforwardly applied for young forest stands and open forest land areas. Also the value of forest property in the beginning and the end of the cash flow period, and the estimates for internal rates of return were calculated. Furthermore, we solved the planning problem by using linear programming. The cash flow estimates produced by linear programming and the V-value optimization were very close to each other.

The basic idea of v-value optimization is very simple and straightforward which makes the method easy to understand for forest owners. V-values calculated for individual stands and presented to the forest owner make the method transparent; one can easily see the reasoning

behind the treatment proposals. However, non-economic values offered by the forest property may also have effects on the forest owner's decision making. Hence, none of the cash flows estimated may be followed as such, but the cash flows still lay the grounds for the forest ownership strategy and the v-values calculated for the individual forest stands help the forest owner to make rational decisions. Furthermore, different additional analysis can be done by using the method. For example, capital transfer taxes can be included into the calculations in cases of forest ownership changes.

*Key words***:** forest planning, v-value, value increment, forest rent

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Financial effects of silvicultural measures in pure spruce protection forests in the Bavarian Alps

Sebastian Höllerl, Remigius Hammerl, Thomas Knoke, Reinhard Mosandl

The natural vegetation in the montane zone of the Bavarian Alps consists of mixed stands of spruce (picea abies), beech (fagus sylvatica), fir (abies alba) and maple (acer pseudoplatanus). However, large areas are now covered by pure spruce stands which require stabilizing silvicultural treatments. Research has shown that the stability of these stands can only be increased if silvicultural measures are applied at a very early stage. But these measures often generate a financial deficit. Hence, in practice, managers often omit these treatments. But this undermines protection functions of the stands.

We evaluated the financial impact of silvicultural methods. Risks caused by snow breakage, wind breakage and insects were taken into account via survival probabilities. Two scenarios have been compared. We included six harvesting methods with differing costs in the financial calculations. While in untreated plots only stand establishment and harvesting of trees at the age of 100 has been assumed, in treated plots also thinning measures at the age of 40, 60 and 80 have been assumed. We calculated net present values. Contingency risks were incorporated in Monte-Carlo simulations. The final assessment has been carried out according to two methods of investment appraisal ($\mu-\sigma$ Rule and Stochastic Dominance).

Both methods lead in most cases to the conclusion that treated stands generate a higher financial benefit than untreated stands when risks are taken into consideration.

The case study shows that the decision-making process based on financial aspects without considering risks can be misleading. But taking the risks into account, often measures that are desirable from a silvicultural point of view can also be justified financially.

Keywords: silviculture, montane zone, risk, Monte-Carlo Simulation, $\mu-\sigma$ Rule, Stochastic Dominance, survival probability.

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Faustmann Rotation and population dynamics
in the presence of a risk of destructive events

Patrice Loisel †

For the management of natural resources, the first question that arises is : what is the optimal duration of cycle production. This is the case both in forestry, aquaculture, production of renewable resources. In the case where a calculation method to predict earnings for various terms of the cycle is available, Faustmann [2] proposed a formalism based on the expected discounted yield. Many authors have successively improved or reformulated the method, Ohlin [5], Pearse [6]. Clark [1] has applied this method to natural resources, in the absence of risk of destructive events. The risk of destruction has been introduced to forest stands by Martell [4] and Routledge [10] in discrete time. Thereafter, Reed [7] has studied the optimal forest rotation in continuous time with the risk of fire. Reed and Errico [8] have formulated and solved an optimal harvest scheduling problem in discrete time with the risk of fire using linear programming. Reed and Errico [9] have developed models to predict the long-run average yield in presence of a risk of infestation by pests and a risk of destructive fire. Stenger et al. [12] were interested in natural risks incurred by forests in discrete time. More recently Thorsen and Helles [13] maximize a not discounted criterion taking into account the risk and using a population model. In the context ofrandom prices Guttormsen [3] studies a method based on dynamic programming.For the absence of risk of destructive events, all the production cycles are carried out to the same term. When the risk of destructive event exists and is taken into account, the authors cited above assume that the operator systematically decides to interrupt the current cycle and begin a new cycle. This is fully justified in the case of total destruction. In the case of a partially destructive event, to the first question about the optimal term a second question is added : should we interrupt the current cycle and begin a new cycle or is it better to continue the current cycle ? If there are alternatives, what is the criterion to choose ? To fulfill this goal in a framework of not too restrictive assumptions, first we define a criterion for choice and secondly we use a dynamic model population that allows us to follow the evolution of individuals of the system.To model population dynamics, contrary to those developed by Salo and Tahvonen [11] using age-structured models, we consider a simplified model of averaged individual type to facilitate the presentation of the proposed method and to focus the analysis on the influence of destructive event risk. The expected discounted yield is obtained via the resolution of a quasi-linear integrodifference equation.

For specific decisions and thus specific criteria, we study two particular cases. In the first case, the operator systematically interrupts the cycle in case of a destructive event, we generalize the results obtained by Reed [7] under less restrictive assumptions. We show that the results obtained in [7] are valid under the assumption that the operator does not harvest during the production cycle and that the cleaning costs in the case of destructive event be fixed. The possibility of taking into account intermediate harvesting and cleaning costs depending on the severity of damage therefore justifies the interest to introduce a model of population dynamics

and to use the proposed method. This alone fully justifies the proposed approach. In the second case, the operator continues the cycle even in case of destructive events (which makes sense if the destruction is minor) and we deduce the corresponding expected discounted yield. Once the criterion set, in the general case for a test choice based on the number of individuals we show the existence of a unique solution to the integrodifference equation and we provide a numerical algorithm to solve it. Finally we show that the proposed formalism allows to integrate in a single optimization problem, the two levels of decision-making : the tactic level, with regard to harvesting (thinning in Forestry) and the strategic level in case of destructive events with regard to the choice between two alternatives : to continue or to interrupt the cycle.

Références
[1] Clark C.W. (1976) Mathematical Bioeconomics, Wiley, New York.
[2] Faustmann M. (1849) Berechnung des Wertes welchen Waldboden sowie noch nicht haubare Holzbestände für die Weldwirtschaft besitzen. Allgemeine Forst-und Jagd-Zeitung,
25, pp 441-445.
[3] Guttormsen A.G. (2001) Faustmann in the Sea - Optimal Rotation Time in Aquaculture. XIII EAFE Conference, 18-20 April 2001.
[4] Martell D.L. (1980) The optimal rotation of a flammable forest stand, Canadian Journal of Forest Research, 10 (1), pp. 30-34.
[5] Ohlin B. (1921) Concerning the question of the rotation period in forestry. ¢2014 Journal of forest economics, vol.1, n°1-1995, pp. 89-114.
[6] Pearse P.H. (1967) The optimal forest rotation. Forest Chron., 43 pp 178-195.
[7] ReedW.J. (1984) The Effects of the Risk of Fire on the Optimal roration of a Forest. JEEM 11, pp 180-190.
[8] Reed W.J., Errico D. (1986) Optimal harvest scheduling at the forest level in the presence of the risk of fire. Canadian Journal of Forest Research, 16, pp. 266-278.
[9] Reed W.J., Errico D. (1987) Techniques for assessing the effects of pest hazards on longrun timber supply. Canadian Journal of Forest Research, 17, pp. 1455-1465

Theme 4. Studies applying the optimal rotation approach in other fields of resource, environmental or agricultural economics.

Title: Optimizing cork oak forest management scheduling in the Western Mediterranean Basin

Authors: Augusta Costa, José G. Borges and Ângelo C. Oliveira

Abstract

Quantitative techniques for natural resources management planning have been extensively used both at private and public forest planning levels. Nevertheless, most applications concentrate on modeling of systems involving timber harvesting. In the Western Mediterranean Basin cork management planning is somewhat different from traditional timber management planning. The first cork harvest typically occurs when the tree is over twenty years of age and afterwards cork is usually harvested every nine years over the whole tree life cycle. Cork oak (*Quercus suber* L.) forestry thus adds complexity to the traditional forest management problem focusing on timber. In this presentation we present recent research aiming at the optimisation of cork oak forest management planning. Specifically, it proposes an hierarchical planning approach. Firstly, a spatial classification is proposed to design management units. Secondly, an optimization technique is proposed to address optimal cork harvesting subject to strategic even flow objectives. Results from an application to a case-study in the Charneca Pliocénica of Ribatejo in Southern Portugal are presented. Model solving reported effective spatial classification of cork oak management, achievement of cork even flow objectives and a substantial increase in net present value when compared to traditional approaches to cork oak forest management planning. The adequate use of quantitative techniques for management planning may contribute to the enhancement of the decision analysis process in Mediterranean forests in spite of data acquisition and production functions being critical elements for the process of model building in this forest ecosystems.

The Optimal Rotation Problem with Variable Forestland Holding Size

Suman Majumdar*, Yaoqi Zhang

The Faustmann formula became the golden rule of forest economics during the past fifty years. A huge number of studies have addressed several limitations of the model and tried to sophisticate the traditional Faustmann model in order to bring it closer to reality. But one aspect of the Faustmann model has never been changed. The decision problem has been seen as the landowner maximizing the returns from fixed forestland by employing labor and capital. However, the traditional picture of land ownership has been changing tremendously during the last several decades. Land has become a common object of trade today with its prices available from the market. This paper argues, in the context of high degrees of land use and ownership changes, that a more general and practical approach in addressing the optimal rotation issue is profit maximization by entrepreneurs with variable land, labor and capital inputs. We introduce forestland holding size as a choice variable in the optimal rotation problem and examine the optimality conditions.

***Key Words*:** Faustmann model, entrepreneur, profit maximization, variable land size, timberland Management

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Forest Stand and Enterprise Level

Links and Solutions with Full Enumeration and Linear Programming

Ruth Dirsch

Optimal stand treatment and optimal forest planning are usually treated as separate problems, though it might be favorable for a forest enterprise to treat stands different, if certain boundaries limit the freedom of action.

Common formulations for forest level planning like Knoke et al. (2005) optimise between the two alternatives thinning and clearcutting of stands. Furthermore restrictions concerning minimum annual earnings, maximum annual cut, minimum stock level amongst others are made to consider the requirements of the owner and forest legislation. In this study, based on data from the Ostalb region in southern Germany, it was possible to test these restrictions with a scale of different stand treatment alternatives. The eight different management alternatives reached from not thinning the stand over light thinning to heavy thinning until final harvest of the whole stand, being a selection from a full enumeration of treatment options over the 30 year planning horizon. In the model enterprise this additional choice of different treatment options, compared to a given harvest programme, led to minimally better results in the objective function values. Note that this was the case, when the best harvest policy on stand level was one of the eight choices. Purely stand level optimisation with full enumeration allowed an average of 15-25% additional objective function value compared to traditional thinning schemes. The actual gain of the proposed solution linking stand treatment options with enterprise based optimisation is not to be seen in the additional value of the objective function, but moreover in the better adaptation of the actual management carrying out heavier or lighter thinnings according to the restrictions imposed.

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Economics of optimal uneven-aged management for Norway spruce

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Abstract

A nonlinear matrix model is estimated to Norway spruce using data from two experimental sites in Central Finland. The size-structured model includes submodels for transition, tree mortality and ingrowth. Density dependence is included in all model components and e.g. the transition between the size classes depends nonlinearly on total basal area and on the basal area of dominant trees. Harvesting costs depend on harvested sawn timber and pulpwood volumes and the volume of logs. The aim is to maximize preset value net revenues over infinite horizon without any *ad hoc* constraints. The problem is analysed numerically applying nonlinear programming. The computation shows that maximizing sustainable yield produces a solution path toward a steady state with about 6m3 average annual yield. The stand basal area varies between 12-15m2 Adding harvesting costs and discounting changes the solution and due to fixed harvesting cost the length of optimal cutting cycle may vary between 12 and 21 years. The outcomes of optimal uneven-aged solutions are compared with optimal even-aged outcome. Given a young initial stand with even size structure, it is optimal to apply thinning from above and manage the forest according to uneven-aged management without clearcutting. If the stand is initially older, the rate of discount is low and the size structure is homogenous with no smaller trees, it is optimal to start with thinning from above and clearcutting followed by artificial regeneration and to move toward uneven-aged management later.

Effects of carbon sequestration rewards on forest management -
an empirical application of adjusted Faustmann-Formulas

Margret Köthke, Matthias Dieter

This paper assesses effects which different economic instruments for rewarding carbon sequestration services might have on forest management. Economic incentives - addressing forest enterprises - are taken into account in forest valuation and management planning and may therefore result in changes of forest management, especially in changes of the rotation period. In this paper four different incentive schemes are considered, i.e. three activity related carbon certificates - each based on a different accounting approach - and one public subsidy on regeneration - offering lump-sum payments per hectare.
The forest valuation method used for calculation is based on the land expectation value (LEV) related to the Faustmann-Formula, which was adjusted for the value of carbon sequestration services. Changes in the optimal rotation period are expected to be induced by the amount and interactions of carbon and timber prices, harvesting and regeneration costs, and discount rates.

The findings reveal that carbon certification tends to change the optimal rotation age. Depending on the carbon price level, the rotation period is increased in all crediting approaches, but with different intensity. The duty to account for carbon emissions resulting from wood removals has the most significant effect on the optimal rotation age. When wood removal is charged with carbon debits, the increase of rotation period by rising carbon prices is boosted additionally by rising interest rates. Different thinning regimes however have only little effect on the time of maximum LEV under carbon crediting schemes.
For all crediting approaches the LEV increases as the carbon prices increase. The same effect occurs for lump-sum payments per hectare dependent on the subsidy amount, but without influencing the optimal rotation age.

Keywords: carbon credits, economic incentives, land expectation value, forest rotation age, forest management

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Conservation contracts for forest biodiversity.
Theory and experience from Finland

Artti Juutinen and Markku Ollikainen

Conservation contracting by competitive bidding is becoming popular in agriculture, but programs for forest conservation have been lacking. This paper examines theoretically and empirically a new forest biodiversity conservation program implemented in Finland called Trading in Natural Values (TNV), which is based on competitive bidding. We develop a forest biodiversity auction model and examine the actual outcomes of TNV. We find, first, that the share of the most valuable old stands for biodiversity in the key ecological forest habitats was higher in the actual TNV program than in a simulated biodiversity auction. Second, the actual bids in the TNV program were on average 400-1200 euros lower per hectare than the bids generated by the biodiversity auction model. These two features very likely indicate the presence of strong conservation motives among the Finnish landowners. Competitive bidding in forestry differs from that in agriculture in one important aspect. The number of stands with high biodiversity values is very limited in areas where commercial forestry has been practiced. This scarcity of valuable stands impacts conservation contracting in many ways. Among other things, conservation costs are high for valuable stands and increasing the size of the conservation budget enrolls more stands in the program but with lower biodiversity values.

Keywords: voluntary conservation, biodiversity auction, conservation rents

Optimum tree-stem bucking of Brutian Pine (*Pinus brutia*) Trees in Antalya, Turkey

Dr. Abdullah E. Akay[1], Dr. Hasan Serin, Dr. Mehmet Pak, Neşe Yenilmez

In producing forest products, it is essential to buck trees into high quality logs with maximum value. Performing bucking in an optimum way is an important factor to increase value in timber production. Computer-assisted methods using modern optimization techniques (i.e. network analysis, dynamic programming, and heuristic techniques) can provide the forest engineers with an optimum solution for bucking problems by quickly evaluating large number of bucking combinations for a single tree. In this study, stem-level optimum bucking algorithm was developed and implemented during a selective cutting of Brutian Pine (*Pinus brutia*) stands in the city of Antalya in Mediterranean region of Turkey. Dynamic programming (DP) method was used to develop the algorithm written with Microsoft Visual Basic (VB) Version 6.3 programming language. The results from the application indicated that using optimum bucking method increased the potential gross value and volume of the harvested trees by 10-15% and 5-9%, respectively, comparing with the traditional bucking method.

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The optimal selective logging regime and the Faustmann formula

Angels Xabadia and Renan U. Goetz

This study analyzes the optimal selective logging regime of a size-distributed forest where individual trees compete for scarce resources such as space, light, and nutrients. The decision problem of the forest manager is formulated as a distributed optimal control problem. Thus, it determines the optimal pattern and timing of harvests. The interpretation of the first-order conditions shows that the partial differential equation that describe the change in shadow price of the standing trees over time can be interpreted as the Faustmann formula. In this respect it allows a generalization of the Faustmann formula for the case of a size distributed forest.

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WHAT MAKES MOUNTAIN PINE BEETLE A TRICKY PEST? OPTIMAL HARVEST WHEN FACING BEETLE ATTACK IN A MIXED SPECIES FOREST

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Abstract

The pine forest of British Columbia is undergoing its largest recorded pest epidemic. The damage caused by native mountain pine beetle creates difficulties for the public owner of the resource, which is interested in protecting future timber supply while salvaging dead and dying pine. This paper addresses two problems that have often been over-looked: the variability and timing of beetle attack, and the variability of pine inventory in each stand. Management controls are limited to the annual rate of harvest and timber product outputs are based on shelf life – the length of time infested timber can still be used to produce lumber. Using mathematical programming to schedule harvest, our objective is to maximize net discounted returns under harvest and product flow constraints implemented by the public landowner to insure stability in the forest sector, and especially a stable supply of feedstock for bio-energy production.

The optimal short-run response is to increase harvests to reduce timber lost to the beetle and to focus on undamaged pine to obtain the greatest short term benefits. Net returns exceed those of the baseline harvest without beetle, regardless of the scenario. Any risk associated with milling damaged timber is shifted to the future, beyond the current 10-year planning horizon. Even a small change in how long damaged timber can be used in making higher-valued dimensional lumber adds significantly to net discounted returns. The forest manager must strike a balance between annual mill requirements and maximizing short term profits.

The government cannot choose a single, risk-free strategy, however. The short term benefits of focussing harvest on the highest-valued stands results in short term economic certainty, but at the risk of having to rely more on damaged timber and reduced future harvests of quality timber for dimensional lumber. Clearly, the government may decide to forego some marginal short-term benefit in favour of sustaining timber supply.

Key words: optimal timber supply, catastrophic disturbance, shelf life, multiple products and tradeoffs

Optimal Rotation Problem Revisited:
Internal Rate of Return, Land Expectation, and Profit Maximization

Yaoqi Zhang*, Suman Majumdar

In contrast with IRR and LEV, this paper proposes to use annual profits for determining optimal rotation for given land, labor and capital. It is argued that the criteria (IRR, LEV and profit) are fundamentally same. The only difference is in terms of the recipient(s) of the residual value or net value from forest management. In contrast to LEV that assumes the landowner to receive the total net value, the other factors, labor, capital and entrepreneurs, might share the rise and fall of the net value. Considering the emerging market of land and the increasing role of entrepreneurs and investors in land management, we argue that profit maximization might be a more general and suitable approach in addressing optimum rotation

Key Words: Land market, entrepreneur, capital theory, land value, forest management

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Economic Analysis of Exploitation and Regeneration in Plantations with problematic site productivity[1]

Andreas Halbritter und Peter Deegen

In the paper we study the impact of declining forest productivity on the land expectation value and the optimal rotation age. We start from the research by Lu & Chang (1996) by filling the gap between the "best" and the "worst" case. For that we extend the classical Faustmann model by availability of different recovering technologies. In general the model allows to analyse the two plantation groups: "mining the site by high productive plantation with a following management of degraded areas" and "high productive plantation and regeneration cycling" with the same comparative statics. The model, the analysis and the comparisions with the two extremes in Lu & Chang (1996) leads a detailed understanding of land use management when site productivity declining is possible. Particularly the relation between declining periods by intensive land use and land use alternatives after declining periods by regeneration can be well understand. Findings are: Not ever declining process asks for regeneration. Many declining processes can be stopped in an early time by high cash flows in after mining periods. Shortenings of the regeneration time can boost site mining intensities.

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[1] This study bases on the diploma thesis by Andreas Halbritter on coppice in short rotation time plantations.

Pressler's Indicator Rate Formula as a guide for forest management in a dynamic world of unanticipated changes

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Importance of recreational forest service in three chosen areas of the Forests of the Czech Republic State Enterprise

Ludek Sisak, Vendula Pospisilova

The paper gives information about research project for the Forests of the Czech Republic, State Enterprise (FCR) on evaluation of forest services importance for forest visitors. The project titled "Evaluation of socio-economic importance of forest services in selected localities of the State Enterprise" started in 2006 and ends in 2009. The investigation on forest frequentation, quality, quantity and structure of forest visits and forest visitors, and opinion of forests visitors about state of forests and forestry was performed in three selected areas.

Field questionnaire investigations were performed in 2008 by compatible procedures and methodology. Chosen areas and localities are intensively visited by people, they are important for different recreational purposes and improved from recreational point by different measures including marked tourist routes.

The paper deals with the forest frequentation of the individual localities. It expresses the estimated numbers of visitors throughout the whole year 2008. Furthermore the types of the forest visitors and the forest visits distribution are analysed. The other topic of the paper is the investigation of visitors' opinion concerning the current state of forest stands.

Keywords: Recreational forest service, importance, visitors' structure and opinion, Czech Republic

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On the Optimization of Legislative Periods
Similarities to the Optimization of Rotation Periods

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Abstract

First, the models known from forestry and forest economics for optimizing rotation periods (Faustmann formula) and for deciding whether a forest stand has reached maturity (Pressler's 'indicator percent') are discussed briefly. Then, some analogies are drawn between these two decision tools on the one hand and determining office terms lengths as well as scheduling new elections on the other hand. It will become clear that the relations known from the Faustmann formula could also be relevant for timing legislative periods, at least from the viewpoint of interest groups involved in the political process. However, much less parallels can be found between the harvesting dates of forest stands and the triggering of new elections. Particularly due to differing objective functions and constraints, it is not possible to analogously apply Pressler's indicator percent to politics.

Keywords: Faustmann formula; Pressler's indicator percent; rotation period; legislative period

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Size-class model based on simulated growth data

Estimation and technical analysis

Jani Laturi, Jussi Lintunen and Sini Niinistö

Stage-class models represent population dynamics in a more general way than age-class models. In a stage-class model, population dynamics can be based on a combination of measurable properties of the population rather than mere age. The model structure allows for convenient way to optimize thinning and harvesting behaviour and, therefore, it has been used for example in modelling uneven-aged forest stands. However, caution is needed when choosing the structure of a stage-class model, since model structure can have effects on modelling results. In our paper, we study the application of stage-class model to describe the development of a forest stand. The model used is Usher's size-class model with nonlinear transition functions. We assess the effects of model specification on simulated growth projections as well as on optimal harvesting patterns.

We chose to examine a mature even-aged stand, for which the availability of reliable data is best. The simulation data of the forest growth is drawn using Motti stand level growth simulator, by running it with several harvest paths and initial states. From simulated growth data of representative trees, we estimate the transition parameters of the diameter-class model using statistical methods. The study is divided into three stages: First, we simulate the growth data with Motti simulator. In the second stage, we estimate the transition proportions of the diameter-class model. The third stage is a comparative study of the effects of choice of diameter-classes on the resulting growth, timber yield and optimization of harvesting regimes.

Keywords: size-class model, estimation, even-aged stand

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Multi-Species Forest Vintages and Carbon Sequestration

Multi-Species Forest Vintages and Carbon Sequestration

Clara Costa-Duarte, Maria A. Cunha-e-Sá, and Renato Rosa

The use of forests as carbon sinks is examined by introducing carbon sequestration benefits' accounting in a multi-vintage, multi-species land allocation model. Using the carbon flow accounting method, a full proof of long run optimality of steady state forest is provided. Based on sensitivity analysis with respect to each species' speed of growth, the carbon conversion factor and the amount of carbon that is stored in long-lived wood products among species, we conclude that they impact significantly on the optimal allocation of land to forest. In particular, when the fast growing species is also the one for which a lower fraction of wood is used in long-lived products, it may be optimal to allocate to the slow growing species a larger amount of land when compared to the case without carbon. Numerical simulations are performed, illustrating and confirming the results obtained.

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Optimal Rotation under Different Stochastic Prices

Saeed Bayazidi [2] and Atsushi Yoshimoto[3]

 The optimal rotation of a stand of Scot pine in southern Finland for a private forest owner who faces uncertainty of price was the object of our study. Based on historic monthly data of Finnish stumpage price we imposed 12 different continuous stochastic models. In this article we developed a lattice construction method called two step transformation approaches that allows application of general stochastic model to a binomial method. We solved optimal rotation for multy period and included land value and compare the stochastic models optimal rotation results with those based on the deterministic Faustmann method. Optimal rotation is sensitive to type of process and it is shorter under mean reverting process than non-stationary ones. Inside the same category, optimal rotation is sensitive to the level of dependency of volatility to the price. At each certain age the optimal price to cut the stand depends on applied stochastic process so applying different type of models to historical price data gives decision makers more options to react to uncertainty of price.

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Optimal rotation solutions with mean-reverting prices and geometric Brownian motion growth

Markku J. Penttinen

Stand management programs, such as the local MOTTI, have been developed to incorporate, say, all aspects growth and yield knowledge. Moreover, the timber prices and other market information have been collected systematically for decades. The stumpage prices, for example, are available in yearly, monthly and even weekly time series. However, the use of market information in stand management is quite limited.

Recent stumpage price developments that strongly fluctuate upwards and then downwards, suggest that mean-reverting prices might be worth considering. There are two approaches: Stumpage prices can be combined in order to obtain a price series for a tree species. Then both volume growth and value growth functions are required. On the other hand, original price series by roundwood assortment could be used. Then, separate value growth functions are required for both logs and pulpwood. Both approaches are considered here. The volume growth is assumed to have a geometric Brownian motion risk component and alternatively no risk component at all. The notion of this contribution is to study the existence and uniqueness of solutions and to construct solutions for possible programming and further product development.

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Adaptation and Mitigation to Climate Change by the Multipurpose Modelling of Forest Management Planning

Rasoul Yousefpour & Marc Hanewinkel

The present study examines the application of simulation and optimization tools to the state of the art planning of multipurpose forest management adapted and mitigated to climate change. The prediction of the evolution of forest stands in different ages and affected by silvicultural interventions were simulated by a modern forest growth model "TreeGrOSS". This simulator is adjusted for Norway spruce (Picea abies Karst) and encompasses a juvenile module for European Beech (Fagus Sylvatica L.) which is suitable for the analysis of alternative scenarios. Scenarios were defined basically according to the approach of Hanewinkel (1996) for the conversion management of pure Norway spruce towards mixed spruce-beech forests. Post-Simulation planning of a forest enterprise was conducted with the authoritative multi-criteria optimization tool "RiskOptimizer" which is able to solve stochastic complex large-scale problems. The applied approach of the simulation and optimization made it possible to deal with the interactions of conflicting goals of multipurpose forestry to come up with the actual problem of global climate change. Carbon sequestration by means of biomass conservation as an adaptation strategy to climate change and biodiversity enhancement with native species as mitigation strategy both were evaluated by Faustmann formulae. The benefit-cost calculations were transferred to the whole region of Baden Württemberg in south-western Germany to provide as a guide for the forest decision-makers. Effects of finite and infinite decision alternatives (small /large -scale decision space), linear and non-linear objectives/constraints, spatial unit of observations (stand or forest enterprise), and risk analysis of economic uncertainties (i.e. interest rate, regeneration cost and wood prices) were analysed in four consecutive steps of the study. Finally, a balanced solution was found which introduces a combination of different silvicultural interventions for adapting to/ mitigation of climate change with the partial conversion of Norway spruce towards beech-spruce forest.

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Incorporating a process based Norway spruce model with economics and optimization

Sami Niinimäki, Olli Tahvonen and Jari Perttunen

This study links a process based growth model for even-aged Norway spruce (Picea abies [L.] Karst.) with economical optimization. Earlier studies on detailed forest management optimization on Norway spruce have applied less advanced statistical-empirical growth models. One main benefit from using a process based growth model is its large range of validity; the optimization results are not restricted to some limited states determined by the limitations in empirical data. In addition, the detailed structure of the growth model enables the inclusion of timber quality and its dependence of the size and quality of branches. The model describes the growth and optimal management of Norway spruce over all relevant site types and latitudes in Finland. The optimized variables include the initial stand density, the number, type and intensity of thinnings and the optimal rotation period. The results show the optimality of thinnings from above. The initial seedlings structure planting density and timber quality specifications are shown to have major impacts on economic returns and optimal management actions.

Keywords: Norway spruce model, ecological-economical optimization, process based growth

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Importance of the Financial Situation for the Growth of a Forest Machine Entrepreneur

Juho Soirinsuo and Pekka Mäkinen

The main focus of this study was to investigate the impact of the financial situation as well as the importance of internal financing for economically sound growth among forest machine entrepreneurs in Finland, with the aid of their financial statements for 2001-2006. Thirty-two limited companies that showed an increase in turnover during this period were investigated. The companies were classified into three groups based on their financial position in 2001: Profitable and Stable, Mediocre, and Weak. The financial situations of these three groups in 2001 were compared with 2006. The study showed that the relative position of these groups did not change significantly between 2001 and 2006. Those companies that were in a weak economic position in 2001 found themselves in an even more difficult situation in 2006. The results indicated that growth seems more likely to reinforce the economic situation of the company as it was before the growth took place. Therefore, when considering a growth strategy, the company must first concentrate on improving its economic position and business model.

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Forests Multiple Use Management

Renato Rosa

The possible conflict between carbon sequestration and biodiversity has put biodiversity in the centre of the literature debate. In contrast to the usual Hartmann approach, biodiversity considerations are introduced into a multiple species, multi-vintage forest sector model with endogenously determined timber prices and land use allocation. Biodiversity is modelled focusing on structural diversity, i.e, age classes and species distribution. We show that transition dynamics are strongly a!ected, contaminating both timber and land markets. Moreover, di!erent ecological forest structures have distinct impacts on optimal land use distribution, therefore, a!ecting also timber prices. Finally, we observe major changes in optimal timber management.

About the Relevance of FAUSTMANN Calculations in Public Forests of Hesse, Germany

Armin Offer

Taking the framework conditions for the management of public forests of Hesse as a starting point, the difficulties that practitioners have in deriving benefits from optimisation calculations according to Faustmann are discussed in the following.

The calculated economic parameters for the State forest of Hesse show that forestry in Hesse allows only a low internal rate of return on capital (0.1% for Scots pine up to 1.3% for Douglas fir) and that the land expectation values are, apart from Douglas fir, negative (e.g. oak, rotation period 180 years, p: 1.5%, - € 12,800/ha). Profit-making goals could be better realised by the cultivation of more productive tree species, shorter rotation periods and the choice of alternative thinning regimes.

Why are forests still being purchased in Hesse and why don't forests owners decide in favour of a more profitable management of their forests? An attempt will be made to explain this apparently economically inconsistent behaviour.

The main reasons are seen in the precedence given to motives that are not timber production orientated, the complex system of management objectives in public forests, the extremely long production times eliminating the time preference problem and the strict sustainability principle that has proven its importance in particular with regards to an extremely uncertain prognosis for the future.

The methods that have been used for investment calculations so far only supply partial optima and do not take into account the feedback effects and emergence problems that result from the transition from stand to the forestry enterprise level.

The marketing of conservation services from the forest is increasingly achieved at prices that are considerably higher than the value of the timber produced. This means that other assessment and optimisation approaches are called for. More strongly profit-orientated forest enterprises, increasingly successful demands from conservationists for "reparation" to nature, more unmanaged forests, a reduction of the timber supply in Germany, and, in the long-term, a probable increase of timber imports make it clear that there is a problem of national economic optimisation to solve.

The analysis of woodland prices shows that neither the land expectation value nor the capitalised forest rents are important decision-making criteria for forest purchasers. The often dominating non-timber-orientated purchasing motives require a more comprehensive explanatory model and justify using methods for the estimation of the market value that are not completely consistent with the dynamic investment theory.

All in all, the impression remains that the Faustmann concept has an important didactic and heuristic value for forestry practitioners in Germany, as it teaches the "art of weighing and measuring". Under the given framework conditions, however, management decisions in public forests need to be further optimised by communicative methods as defined by Habermas.

Keywords: Faustmann, multifunction, sustainability, woodland price, Hesse, Germany

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Applications of the tree-level Faustmann formula in tree-marking

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The present research has provided certain applications of the tree-level Faustmann formula in tree marking, particularly in determining tree target diameter according to characteristics of trees (quality), stands (productivity) and economic factors (real discount rate). The application examples were presented for beech trees placed in a pure beech uneven-aged stand of northeastern France. As expected, the impact of the tree quality and productivity on target diameter were found to be positive while the real discount rate had a negative impact. For a real discount rate of 2.5 %, the tree target diameter has been found to vary from 35 cm up to 65 cm according to its characteristics.

Keywords: Faustmann formula, Land expectation value (LEV), Target diameter, Productivity, Real discount rate, Tree quality.

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The evaluation of forest crop damages due to climate change.An application of the Dempster-Shafer method

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Abstract. In order to assess climate change risk of damage in forestry areas, Dempster Shaffer theory of evidence and fuzzy measures were applied to develop a framework for the assessment of economic forest damage. Following the definition of risk supported by the Intergovernmental Panel on Climate Change risk, it has been defined a function of hazard and vulnerability/resilience lines of evidence. The results of the hazard and vulnerability assessment were used to develop an economic framework based on Faustmann studies. The model of analysis has been implemented through a spatial analysis procedure applied to raster maps. Faustmann method has been implemented together with the maps of the hazard and of the vulnerability/resilience degree, in order to quantify in monetary terms two possible costs to be supported: the first one expressed as the expected damage to the forest crop on the basis of the current timber assortments obtained and the second one referred to the possible expenses to be supported in order to mitigate the risk. The framework was then tested on Tuscany forestry crops.

Keywords: Dempster Shaffer theory of evidence, Climate change, Forestry, Fuzzy sets, Spatial analysis, Risk.

When to cut a tree

by Fritz Helmedag[*]

Abstract

For about two centuries, the optimal rotation period in forestry has been debated intensively. According to the meanwhile prevalent opinion, the so-called Faustmann condition solves the problem because it maximizes the present value of woodland. The result, however, contradicts the 'principle of maximum yield', i.e. it is productively inefficient. The article develops Faustmann's approach further and provides an objective function suited to reconcile available cutting rules.

Keywords: Renewable resources, optimal rotation period, Faustmann condition, maximum sustainable yield

JEL-classification: Q23, D92

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TAXATION, LIFE-TIME UNCERTAINTY AND NON-INDUSTRIAL PRIVATE FOREST-OWNER'S DECISION-MAKING

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Abstract
The nonindustrial private forest (NIPF) owner's harvesting, consumption and bequest decisions are investigated under inheritance and capital income taxes using a two-period model. The impact of the forest-owner's age is introduced into the analysis through a parameter of perceived probability of surviving through a future period. This allows us to study the impacts of ageing on consumption and harvesting decisions as well as to see how the impact of taxes changes over the forest-owner's lifetime. The results show that current consumption typically increases with the age of the forest-owner if bequests are more heavily taxed than consumption. In general, we find that tax effects are dependent on the forest-owner's age. Age tends to intensify the increasing effect of the forest bequest tax on harvesting. The same is true with respect to the decreasing effect on harvesting of the inheritance tax imposed on non-forest assets. Furthermore, the forest-owner's age tends to intensify the effect on harvesting of the capital income tax imposed on forest assets, but diminishes the effect on harvesting of the capital income tax imposed on non-forest assets.

Did Pressler Understand how to Use the Indicator Per Cent?

by Peichen Gong and Karl-Gustaf Löfgren1

Umeå University
and Swedish University of Agricultural Sciences,
January 2009.

Abstract:

by Peichen Gong and Karl-Gustaf Löfgren

A classical problem in forestry is the determination of the optimal rotation. This problem was solved during the 19th century, by German forest mathematicians. Martin Faustmann deserves some of the fame. However, he did not explicitly derive the conditions for an optimal solution. His contender is Max Robert Pressler. He invented the concept of Indicator Per Cent, which can be used to determine whether a stand is mature for harvesting or not. Did Pressler fully realize this? Having analyzed some of the relevant literature our answer is no.

Keywords: Optimal rotation, Die Weiserprocent (The Indicator Per Cent).
JEL-Codes: B16, Q23

Calculation of the Value which Forest Land
and Immature Stands Possess for Forestry
under the generalized Faustmann formula

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Abstract

As timberland investors seek higher returns on their investments and turn over their forest
holdings more frequently, the bare land value of timberland at the beginning and the end of a
rotation often could be dramatically different. The generalized Faustmann formula was
developed to accommodate such situations and determine the value of the bare land at the
beginning of a rotation. In this paper, the formula for determining the value of the land any time
between the beginning and the end of a rotation is developed. In addition, the forest value
formula under the generalized Faustmann formula is developed. It is further shown that the
income approach and the cost approach arrive at exactly the same forest value both
mathematically and numerically. Numerical example shows that the value of the land is
increasing at a progressively higher rate from the beginning to the end of the rotation, contrary to
the common practice of using a constant rate of appreciation to approximate the value of the
land. The approximation method will cause an over-valuation of the land value and thus an
under-valuation of the standing timber. As a result of this under-valuation, when the timber is
harvested, tax over-payment will occur.

Cancelled???

Optimizing Joint Production of Timber and Carbon Sequestration of Afforestation Projects

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Abstract

Optimizing harvesting decisions has been a matter of concern in forestry literature for centuries. However, in some tropical countries, growth models for fast-growing tree species have been developed only recently. Additionally, environmental services of forests gain importance and urge for being integrated in forest management decisions. We determine the impact of a joint production of timber and carbon sequestration on the optimum rotation of a fast growing species in north-western Ecuador, comparing different optimization approaches and taking the latest developments of the Kyoto Protocol into account. We find that payments for carbon sequestration have substantial impact on the rotation length: in contrast to an optimum of 15 years when focusing on timber production, only, joint production leads to a doubling of the rotation length, which means that timber harvest should be postponed until the end of the carbon project.

New solution in forest market valuation issue: Faustmann's formula in forest real estate valuation

Markku Airaksinen & Simo Hannelius

Abstract

The aim of this study was to find out the suitability of the summation approach to determine the market value of a forest property in situations, where valuation targets are fairly large forest properties (area at least 10 hectares) and to investigate factors that affect the correction of the total value and its size. Such studies, which apply the summation approach based on target specific field inventories, have never before been carried out in Finland because of the expensive data collecting. Observation data consisted of 810 forest property sales made all over the country during years 1983-84, 1995 and 2007.

According to estimated price models the most effective factor that affected the market price of a forest property was the sum value of the target without the expected value, and that the correction of the total value used to correct the sum value to reach the market price, can be distributed to the parts of the sum value, in which case the values of such parts of the sum value in the forest real property market are to be valued.

The study showed that the estimated econometric models could be use in valuation of the market value. The correction of the total value was reduction on average, which in the two earlier samples was 40-50 % and in the sample of year 2007 about 10-20 %, indicating that competition and stumpage prices have increased on the market.

Results of old valuation solutions based on Faustmanns' theory have led to overestimated values in Finnish conditions. The main reason for that is to lower rates using discounting. Valuation of forest properties is possible using either comparison or income approaches. Both these methods can also be combined as a hybrid. The first one uses price information and data of sold properties on market conditions and cash flow based on growth and yield models of forests. In the second you can solve the discounting rates, which makes net present values equal to the market prices. This market oriented discounting rates, as investors' subjective time preferences, can be used as base in all forest growing areas.

An expert system in line with Heyer's (1887) idea will be developed to solve the problems in forest real estate valuation. The income approach method will be based on inventoried forest stand characteristics, simulated growth models by sites and the main tree species, estimated stumpage prices and the costs of civil culture. The method meets the requirements for the comparison approach in the sense that the internal logic of price formation is sought from

reference material and the interest solution corresponds to the recommendations of the *International Valuation Standards* (IVS).

Empirical results show that real world behave different than perfect capital markets, where Faustmann´s formula should be use. That's why Faustmann´s summation approach like it is used in Finland does not explain human behaviour in valuation situations.

Review of the impacts of risk and uncertainty on forest management

S., Bhagwat, R.J. Brazee, R. Rusteberg, R. Ravikrishnan

Abstract

The impacts of risk and uncertainty on optimal rotation ages, forest harvest scheduling and other aspects of forest management have been studied extensively over the past two decades. The purpose of this paper is to review and summarize some of the most significant research lines for both incremental and catastrophic risk and uncertainty on forest management.   Topics reviewed include risk aversion, price risk, fire risk, hurricanes, ice damage, uncertain policy environments, and public goods.

Dynamic waves and the harvest of multiple rotations

R.J. Brazee, H. Meilby

Abstract

Since the European settlement the forests of North America have been dynamic, and far from a Faustmann steady state or normal forest. A common micro-geographic pattern has been the harvest of forests near and accessible to agricultural and urban areas first, followed by the harvest of forests far and inaccessible to agricultural and urban areas. Forest management following this micro-geographical pattern has been complicated by natural regeneration. Specifically, managers often face the choice of harvesting more distant or more inaccessible stands that have been harvested less recently or harvesting less distant and more accessible stands that have been harvested more recently. Models that describes the trade-offs between harvesting different rotations with different volumes and different transportation costs are presented. The efficiency conditions for switching between rotations are derived. A numerical simulation is presented to describe the gains from efficient management.

FURTHER GENERALIZATION OF FAUSTMANN'S FORMULA FOR STOCHASTIC INTEREST RATES

Joseph Buongiorno and Mo Zhou

Abstract. Markov decision process (MDP) models generalize Faustmann's formula by recognizing that future stand states, prices, and other variables, including the interest rate, are known only as probabilistic distributions. The objective function is the expected discounted value of returns, over an infinite horizon, in a stochastic environment. It gives, like Faustmann's formula, the land or the forest value (land and initial stock). In MDP models, the laws of motion between states, including the changes in interest rates, are Markov chains. Faustmann's formula is a special case where the probability of movement from one state to another is unity, and where the interest rate is constant. MDP models apply whether the stand state is bare land, or any state with trees, be it even- or uneven-aged and single or multi-species. Decisions that maximize the land or forest value depend only on the current system state, and to each state corresponds one single best decision. Numerical solutions are obtained by dynamic programming, or by linear programming in primal or dual form. An example shows the potential effects of recognizing variations in interest rate on the planned land expectation value, and the cost of ignoring them in management.

Keywords: economics, risk, Markov chain, optimization, decision making.

Understanding Sustainability as a Landscape Goal and Process: A Framework for Economic Modeling (or Understanding) and Analysis.

John Fedkiw

Abstract

Sustainability is becoming a universal goal across the world and for individual nations and their societies. It is a holistic societal goal of broad landscape proportions across multiple ownerships. It involves policy bounds and limits for sustainable use and management of the landscape but also a second criterion, decision or choice about what to sustain within those bounds over the long-term across the landscape and it multiple ownerships. It calls for a cultural change in the way forest use and management is planned and practiced across the multiple ownerships. This landscape level goal and process has not yet been defined or differentiated in concrete terms. Economic understanding and analysis requires a concrete framework or model for this new evolving process and understanding.

This new process of landscape planning and coordination is now defined as Landscape-level Forest Resource Management in the Minnesota approach to sustainable forests and more recently as Landscape Forestry for short. Stakeholders reaching across multiple and diverse ownerships, communities, public jurisdictions and citizen interests are deeply vested in the functional aspects of forests and the many resources within them. An awakening led by wilderness and environmental interests focused highly urbanized citizenry on the course and cumulative outcomes of forest use and management across the broad landscape. A renewed public awareness is recognizing that the landscape and its resources, in the sense of dependency as opposed to ownership, belong to all the people and their diverse interests and needs.

Keywords. Landscape forestry, sustainability, awakening

Cogongrass Control and financial returns for Non-Industrial Private Forest Landowners in the United States Mid-South

Donald L. Grebner, Gregory S. Amacher, and Stephen C. Grado

Abstract

Invasive plant species are increasingly occupying land area that could be used in other productive capacities such as growing timber or agricultural crops. In the United States Mid-South, Cogongrass (*Imperata cylindrica* (L.) Beauv.) has been steadily spreading throughout the region over the last century. It is an aggressive plant species that can dominate a site and greatly inhibit the establishment and growth of native plant species. We evaluate alternative management control regimes and the reduction in soil expectation values that can occur on infested sites when control is not implemented. A simulation approach is used to evaluate six management control regimes using either aerial or ground-based applicators with pine afforestation using Mississippi as a case study. Results show that spraying 14.7 oz Accord Concentrate, 1.7 oz Arsenal AC, with 7.4 oz of surfactant and afforesting to pine yields the highest land expectation value and lowest reduction in soil expectation value.

Key words: invasive species, Cogongrass (*Imperata cylindrica* (L.) Beauv.), financial analysis, herbicide control

Faustmann and the Alternative Test Approach

By

Patrice Harou
And
Chin-Long Zheng

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The Faustmann approach to forest valuation, as all great classic piece of work, stays relevant in our time as it was in the mid of the nineteen century. This is true in forestry as in other sectors of the economy where the cash flow analysis to prepare private or public investments is still today the standard by which the efficiency of public and private projects, programmes, and policies is estimated.

To the extent that social and ecological aspects are taken into consideration to identify the investments and if necessary are included in the cash flows, this approach duly incorporates the concerns of sustainable forestry.

The important difference of today's decision in forest investments when compared to the mid nineteen century is that our biophysical and socio-economic context changes much more rapidly. A simple periodic revision of the cash flow estimates to manage the forest using the Abandonment Test was proposed by Harou, 1985[2] and Harou and Chin-Long Zheng 1985[3]. It can be used in both a deterministic and stochastic analysis of the forest cash flows and it will lower the risk inherent to the investment when compared with a purely static Faustmann analysis

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[2] "Including Feedback Mechanisms into Forestry Decisionmaking." P. A. Harou. 1985. Canadian Journal of Forest Research 16(31):580-584.

[3] "Management ' bv Feedbacks, " P. A. Harou and Ch. Zheng (original in Japanese). 1985. Journal of Forest Planning Study 60 (6-15):71-73.

Some of today's contexts in which the Abandonment Test combined with Faustmann cash flow analysis is particularly relevant will be illustrated from cases in North America, Europe and Asia.

Investment decisions under uncertainty - A methodological review on forest science studies

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Abstract: Several parametric and non-parametric approaches have been developed to value financial assets. Yet, financial valuation techniques have only slowly percolated into disciplines concerned with the management of ecosystems. Particularly in forest management, decision-makers find themselves often confronted with extremely long time horizons and severely uncertain information. This requires careful valuation approaches, which are often underrepresented or even completely lacking in forest management. This paper gives a comprehensive overview on techniques for financial decision-making under uncertainty and develops future research needs.

First, we analyzed the approaches of expected utility, option pricing, stochastic dominance, downside risk and robustness as possible opportunities to draw decisions on forest investments and gave a short review about forestry related applications. Afterwards we discussed the suitability of the presented approaches to support decisions in forestry and concluded that robust optimization techniques have to be developed further, especially since erroneous financial data is likely to occur as well as deviations from the assumption of normality. For the time being the maximization of the financial robustness was probably the most adequate approach for many long-term decisions in forestry, such as selecting the optimum tree species composition. Further development of this approach seems possible and necessary.
Finally, we come to the conclusion that even though it is intuitively clear that many long-term decisions should consider uncertainty, adequate financial valuation is not developed enough in forest science. In the case of Central Europe, this might be an effect of the dominance of ecological research in forest science. Consequently, an intensification of the analysis of uncertainty in forest decision-making is necessary.

Key words: Uncertainty, diversification, mean-variance, option pricing, stochastic dominance, downside risk, lower partial moment, information-gap decision theory, robustness

Economic value of forest genetic diversity in the face of climate change

Jette Bredahl Jacobsen*, Aske Skovmand Bosselmann, Erik Dahl Kjær, Bo Jellesmark Thorsen

Abstract.

Due to the long tree-rotation in forestry, adaptation to climate change can not be done between rotations but needs to be done within a rotation. This is a challenge for forestry and point at the importance of the genetic material.

Forest genetic research has traditionally been aimed at improving the use value of forests related to wood production, including breeding and provenance trials with selection for general adaptation across a range of environmental conditions. Often, when production is the aim forest owners select a single or a few provenances recommended for specific localities based on results from tree improvement programmes. However, climate change may alter the environmental conditions in a specific site within the time span of a rotation thereby rendering an unforeseen change in optimal provenance.

The value of diversification is well known in economics, e.g. the value of risk reduction through diversification in a portfolio of assets on the stock market. However, the economic value of genetic diversity in forests goes beyond the risk reducing effects and includes e.g. option values when several clones or species are mixed in the same forest stand. Applying data from clonal trials with Norway spruce in Denmark and Sweden trial this paper aims at exploring the economic value of having several different clones either as separate stands or mixed in the same forest stand; this in order to hedge against the uncertain changes in environmental conditions induced by climate change.

Based on the knowledge of differences of growth between clones on different locations, we use a dynamic growth model to model growth with stochastic changes of growth conditions. By the use of simulation and dynamic optimisation we are able to show that diversity within stands not only lowers variation in case of climate change, but if planted in the same stand also increases the expected value. This is due to the possibility of removing trees that on the way proves less successful to the observed change and let the growing space be taken over by others. Furthermore, we see that if we apply forward looking adaptive management, we may increase the expected value further as we keep trees in the stand which may perform better if climate changes.

Even though we are looking at what may be perceived as a genetically quite narrow material (clones from only one specific species), we are able to demonstrate the potentially large gains from securing a reasonable level of genetic diversity. This is of importance both for the forest owners, but also for society as forests produce many other products than wood, e.g. recreation, biodiversity, etc. which is at risk of disappearing or be lowered if climate change causes severe damage to existing forests. Thus it may not only be a single-stand problem, but rather a regional problem.

The causal relationship between the price, the imported, exported volume and the domestic production in round wood market. An empirical evidence in the Greek round wood sector"

Th. Koutroumanidis, E. Zafeiriou, Garyfallos Arabatzis

Abstract

This study aims to determine the factors affecting the producer price of the round wood. As a proxy for the producer price, the industrial round wood price is used. The factors examined as determinants of the producer price are the produced volume, the imported and the exported volume of the round wood in the Greek sector. The implementation of Johansen cointegration technique has indicated a sole long – run relationship between the variables studied. Additionally, the implementation of the vector error correction model has shown a significant speed in the long –term equilibrium, while the Granger causality test has shown that the producer's price is strongly affected by the imported volume while the domestic production is determined by the volume of exports. Finally, the producer prices are determined and also determines the exports and the imports of the Greek wood sector. All those results are consistent with the classic economic theory supply – demand.

JEL Classification Numbers: Q23, P23, C22

Key Words: Round wood market, Greece, Cointegration technique, Granger causality

Optimization of the stand level management taking account climate benefits of the harvested wood products

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In this study management of the pine is optimized at the stand level taking into consideration simultaneously climate benefits of using wood products instead of fossil carbon intensive products and fossil fuels, carbon sequestration of the standing stock as well as harvesting revenues.

Forest growth is predicted using process based growth model PipeQual. Using branch and growth predictions from the growth model as an input, proportions of different sawn wood grades and by products of harvested stems are predicted with models developed in the previous study. Combining the predictions of sawn wood grade proportions to the information of the end uses of different sawn wood grades and average life cycle lengths of the products, carbon storage of the harvested wood products can be incorporated to stand level analysis. We also investigate the effect of both material and substitution effects of end products to study if taking account reductions of the CO_2 emissions due to decrease in use of wood material or biofuels instead of more carbon intensive products would affect to the optimal forest management compared to cases where only timber management or/and carbon storage is taken into consideration. Also soil carbon is included to analysis. End product distribution models allow us to study the effects of forest management to the quality of wood material and further, the use of wood material. Sensitivity analysis is made for substitution factors, carbon price as well as interest rate used to discount both net revenues from harvests and CO_2 emission reduction benefits.

Impact of the New Zealand Emissions Trading Scheme on forest valuation

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Abstract

The New Zealand ETS poses challenges for forest valuation. A Faustmann LEV can be calculated for the two recurring cashflow streams – one associated with forestry operations and the other associated with annual carbon trading. However the requirement to surrender carbon units (a) for removals at the time of harvest; and (b) for the subsequent decay of residues, means that the carbon component of crop value is negative from about mid-rotation. This negative value persists after harvesting when there is no forestry crop value to offset it.

The risk of catastrophic events, particularly wind storms, reduces the profitability of forestry under the ETS because of the loss of forest crop and the need to surrender carbon units prematurely. Both the forestry and carbon components of LEV and crop value decrease as the probability of a catastrophic event increases.

An alternative "trade to the long-term average" approach to carbon trading calls for a different approach to forest valuation. The non-recurring nature of the carbon cashflows suggests that they should not be included in the calculation of LEV. Rather it may be better to treat the carbon trading opportunity as a separate asset or liability.

Carbon sink economics: examples from forestry in Europe

Maria Nijnik

Climate change mitigation forestry initiatives in Europe are directed primarily towards woodland expansion, forest management for carbon capture and storage, and towards an increasing use of wood as a substitute for both, fossil fuels and carbon intensive materials in construction. There is a great deal of uncertainty, however, on how to raise the cost-efficiency of carbon sequestration forestry based projects, how to overcome their market limitations and where to place afforestation and woody biomass production in the context of land use. This paper analyses these aspects with a particulr focus on economic opportunities and challenges of moderating carbon emissions through forestry development. The analysis of the role of forestry to mitigate climate change is particularly relevant to countries and regions that have a potential for new tree-planting or natural woodland expansion, and where the cost-effectiveness of afforestation and forest management, as well as social acceptability of carbon sequestration forestry options are hot topics. By addressing the case studies from forestry in the United Kingdom, the Netherlands, Slovakia, and Ukraine, this paper analyses whether forestry can offer a a low-cost opportunity for carbon sink.

The results indicate that although carbon sink in European forests that could be accounted under the Kyoto Protocol is moderate, forestry projects have relevance for carbon budgets in individual countries where wooded cover has a potential to grow, as in the UK, Ukraine and Slovakia. The results suggests that over and above other climate policy measures, an enhancement of carbon 'sinks' and 'reservoirs' in forests is meaningful, and the inclusion of carbon sequestration forestry projects in climate policy activities is viable in these countries. The carbon sequestration potential of afforestation, for example in Ukraine, especially in the Wooded Steppe region, and in the UK, in some regions in Scotland, is deemed to be substantial. And although this potential is restricted by institutional and socio-economic factors, the results of economic assessment of opportunities to mitigate climate change through forestry in the UK, Slovakia and Ukraine suggest that this policy measure is likely to be competitive with other means of removing carbon from the atmosphere. The choosing of most appropriate species and management regimes (diffeent across regions in these countries) is important for saving economic costs. Important factors that influence the results are discount rates and time horizon considered in the models. The general conclusion is also that along with the carbon sequestration potential of afforestation, the level of land-use integration and the stage of institutional development play important roles for effective implementation of climate policy measures.

Economic Analysis of Agricultural Land Use Integrated with Forestry: A Hypothetical Application in Turkey

Mehmet PAK

The main land use activities in Turkey are agriculture, livestock and forestry. At the moment these activities are developing separately. Agricultural land is severely limited because of the rough terrain, thus forest land is cleared for new fields and 61% of present agricultural land is poor quality, often steeply sloping, eroded and stony, and 53% of this is not suitable for cultivation at all.

There are serious problems between farmers and the Forestry Department, because of the identification of boundaries between forests and agricultural land that have not yet been cleared up. Integration of forestry and agriculture may be a solution of these problems, but there is no considerable application of any type of integration in Turkey. Agroforestry as a kind of integration is a new concept for Turkey.

It is possible to apply some type of integrated land use systems properly. An application of integration between forestry and agriculture may be theoretically developed as follow. A 625 ha area of farm land is considered that is situated in the south of Turkey and has been used for agriculture and belongs to a farming organization. Despite the fact that the productivity of some part of the land is very low, the farmer has been used for cropping and uncontrolled animal grazing. There are several options for the farmer to improve his agricultural production. First option for the farmer is to sell part of his farm to the Forestry Department and invest to develop agricultural production from the remaining area. Second option is to plant part of the farm for productive forest by taking advantage of available grants, and third option is to plant small strips or areas of the land with trees to create general shelterbelts for livestock.

Options 1 and 2 may provide additional benefits by sharing the cost of roads and fences. The third option provides some protection against wind and snow. In this case, shelterbelts are expensive to fence and are difficult to manage for the production of high class timber.

In the first two options, it is possible to integrate agriculture and forestry with different proportions. Before starting integration, there are some tasks which have to be done. Firstly, a land survey should be done and the land should be divided into blocks. For example, the land may be divided into 25 blocks. Secondly, the selection of agricultural and forest blocks is essential task for integration.

An outline of the farm is drawn up on a square basis for coding of information and divided into 25 ha squares. A vegetation survey of the farm is carried out, and coded onto the grid. Soil information is also coded in a similar way. Altitude zones are determined from the contour map and coded into the grid. Access codes are worked out for those grid squares containing a road and fencing codes are worked out on the basis of the number of sides of a block that are fenced.

In this application, all forestry is more beneficial for the farmer, but as forestry takes a long time to produce timber and wood, the farmer can not use the whole land as forestry. The main objective of the farmer was to use the land for grazing and to provide more revenue from this farm.

According to the results, the farmer can provide more benefit than from all unimproved and improved agriculture by integrating his farm with forestry. There will also be indirect benefit from afforestation of agricultural area. There is no doubt that the shelter provided by the forestry blocks to the farm margins would effectively be created for this farm.

Faustmann theory, steady state analysis and application to an evolving world.

Jean-Luc PEYRON

The basic idea of the paper is to start from the Fautmann formula, then to discuss and analyse a variation of each parameter (afforestation or reforestation costs, product price, harvest volume, discount rate, land value, risks, environemental factors. Finally some scenarios could be compared.

Optimal rotation with declining discount rate

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In recent years it has been argued, from many perspectives, that the further into the future a value flow occurs, the lower is the appropriate discount rate for it. This viewpoint can be, and has been, formalised in various ways, and has been applied to evaluating forestry investments of given durations. When the optimal duration of investment is *itself* the issue, new problems arise. Discontinuous changes of rate give stepped or cusped net present value functions, with discontinuous changes in optimal rotation. Lower discount rates make subsequent rotations longer than earlier ones, and more valuable than they would otherwise be. This affects the optimal length of earlier rotations, which in turn affects the discount rate profile applicable to later ones. In the absence of analytical solutions for the optimal *sequence* of rotations, numerical protocols are needed. If the change of discount rate is due to *expected* changes of circumstance that are *actually* realised, then the optimal sequence of rotations will remain as initially determined. If, however, it is due merely to the particular time perspective of the present generation, rotations will be revised by future generations. This will lead to the same sequence of constant rotations that would be deemed optimal at the current short-term discount rate.

The multiple effects of carbon values on optimal rotation

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It is generally accepted that non-consumptive benefits which increase with a forest's age will lengthen the optimal forest rotation. The value of keeping carbon sequestered in forest biomass has become a much-discussed exemplar of such values. At some proposed prices for sequestered carbon, the rotation may be extended indefinitely. However, the potential use of forest biomass as an energy source, displacing combustion of fossil fuels, might favour shorter rotations, since no premium is then due on larger tree sizes. In contrast, use of sawn timber to displace structural materials with high embodied carbon release gives advantage to longer rotations, which produce a high proportion of sawn timber. The effects of rotation length on soil carbon, and the fossil carbon volatilised in harvesting operations, are further complicating factors. Including a price for all these carbon effects may result in optimal rotations longer than those based only on timber value, but much shorter than those based on timber plus the value of carbon in forest biomass. The lower discount rates that have often been advocated for carbon flux values complicate the issue, but may not lead to an optimal rotation much longer than that based on traditional timber values.

Economics of the Plant Species Used in Homestead Agroforestry of Southern Bangladesh

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ABSTRACT
Agroforestry combines agriculture and forestry technologies to create more integrated, diverse, productive, profitable, healthy and sustainable land-use systems. This study was performed in three union of Chhagalnaiya Upazila (Sub-district; administrative entity) under Feni district, Southern Bangladesh with a view to identify the tree resources, utilization pattern and economic return of major fruit and timber tree species. Information collected from a total of 45 households ranging from marginal, small, medium and large categories. Number of plant species increased with the increase of homestead area. A total of 39 plant species were recorded from the homegarden, of which 23 were fruit and 16 were timber tree species. Considerable number of vegetables was also planted under the shade of the homestead trees. The investment analysis showed that average benefit-cost ratios were greater than one, net present values were positive and internal rate of returns were more than 10%. Long term investment on horticulture and timber tree species is highly profitable if species like *Swietenia mahagoni* and *Tectona grandis, Spondias pinnata, Syzygium cumini* and *Areca catechu* were planted.

Keywords: agroforestry, Bangladesh, fruit tree, homegarden, timber tree

NNAMTSUAF – USING THE RECIPROCAL OF THE FAUSTMANN FORMULA TO FOSTER ENVIRONMENTAL COMPLIANCE IN BRAZIL

Carlos Antonio Alvares Soares Ribeiro, Márcio Lopes da Silva, Naisy Silva Soares, Ângelo Marcos Santos Oliveira, Charles Worthington MacIntyre

This GIS-based study analyzed the economic impact which results from law enforcement of the Brazilian Forestry Code by addressing the delimitation and implementation of areas of permanent preservation (APP) in the Alegre River basin in the Brazilian state of Espirto Santo. Using Faustmann's formula, our study has estimated the periodic economic contribution by activity within areas of permanent preservation. The diverse topography and dominant agro-pasture landscape of the study area make for an ideal setting to examine the myth that full compliance with current environmental legislation severely hinders small-scale rural production. Employing the GIS methodology for automatic delimitation, the APP in the upper thirds of hills, hillsides with slopes greater than 45°, springs and their surrounding areas, banks of water courses and along the ridge lines were identified. By linking this information with a land use - land cover database, areas with a legally conflicting use were determined. It was found that 77% of the Alegre River basin lies in areas of permanent preservation, and of those, only 23% are currently managed under compliance with the law. Using a predetermined market value for land in the study area and the Faustmann's formula, it was then possible to calculate the remuneration received by farmers operating in these protected areas. The total value of area in the Alegre River basin which is in a legally conflicting use was determined to be R$ 8,322,066. When divided by the total area, an average of R$ 1,142/ha is derived. Hence, a faithful observance of the Forest Code and its areas of permanent preservation in the Alegre River basin would deprive the local economy an amount equivalent to R$ 137.01/ha/year or exactly R$ 10.83/ha/month. Given recent research demonstrating a willingness to pay for the integrity of APP, this study should encourage an implementation of policies with incentives for environmental preservation, even on the municipal level.

Made markets: entrepreneurial rent-seeking and institutional change in the forestry sector

Achim Schlüter, Liviu Nichiforel

The paper aims to enhance the understanding of the role played by institutional entrepreneurship, by means of rent-seeking in the evolution of forestry markets. Forestry markets are analysed using heterodox approaches of economic theory that see markets as a set of institutions that emerge spontaneously from complex, largely uncoordinated processes, which oppose "human actions" to "human design". The institutional design of markets allows for institutional changes by way of innovation which means that actors can make a profit from violating institutional practices in a socially legitimized way (Beckert, 1999:787). In this respect, the main emphasis of the paper is that the creation and evolution of markets is shaped by the interplay between profit-seeking and rent-seeking activities performed by market actors. The conventional entrepreneurial activity, recognised since Schumpeter, leads to the introduction of new combinations of resources and technology into the market (Douhan and Henrekson, 2007:4). At the same time, since markets are o*rganized and structured* by institutions, rent-seeking activities are expected to occur from entrepreneurs perceiving opportunities to capture rents by changing the institutional boundaries of the market. Consequently, forestry markets cannot simply emerge and evolve, but they are the result of a form of entrepreneurship that reaches beyond product or technological innovation (Lawrence et al., 2002:283). The proposed research takes into account that the efficacy and efficiency of forestry markets depends on how 'the rules for markets' and 'the rules within markets' are created, maintained or transferred. Decisive rules of the game in forestry markets are property rights which determine marketability and enforcement options. Rent-seeking is thereby perceived as the entrepreneurial creation or discovery of rents, resulting from efforts spent in ongoing market and political processes to influence the allocation of property rights in a continuous path-depended spontaneous evolution (Benson, 2005:109). Hence, this research proposes a framework for analysing entrepreneurial rent-seeking activities in political processes and market transactions intended to create opportunities for profit-seeking through a redefinition of property rights.

Keywords: rent-seeking, institutional entrepreneurship, property-rights, forestry markets

An economic evaluation of strategies for the conversion from even-aged to near-natural forestry in a conifer dominated forest in Denmark

Erik Schou*, Jette Bredahl Jacobsen

Abstract.

In recent years conversion to near-natural forestry has been initiated in many European forests - main reasons for this are lack of ecological and economical stability in present forests. A conversion will in general imply an increase in stand heterogeneity. To achieve this present stands need to be harvested gradually. When using target diameter harvesting as a mean of conversion one cannot do this strictly due to the narrow diameter distribution of most stands. Either termination of the old stand has to be accelerated or prolonged compared to the optimal rotation age. The study investigates the economic impact of different conversion strategies in conifer dominated forests when transforming the forest management system from a traditional even-aged to a near-natural mixed species system. A simulation approach will be used. Strategies will be represented by various target diameters and harvest cycles. A stationary Markov chain combined with a dynamic yield table is used to model implications of the different scenarios for a Danish forest where transformation has been initiated recently. The analysis is carried out for a group of adjacent stands in the forest – a forest development type. Results are thus achieved on an aggregated stand level with the main species being Norway spruce, European beech, Sitka spruce and Douglas fir. The long term-economic performance of the different strategies is measured in terms of expectation value at the beginning of the conversion period. Short term-implications will be evaluated by liquidity measures. The overall purpose of this study is to contribute to the description of how to carry out transformation to near-natural forestry in a specific case, thereby providing forest managers with an example of the economic consequences of their actions in relation to conversions.

Natural risk modelling in silvicultural decision models: A survival function approach

K. Staupendahl and B. Möhring

1. Introduction and problem outline

Natural hazards, caused by storms, droughts and insects, are – to different extent – an integral part of forest ecosystems (OTTO 1994, pp. 322). However, to forest managers they constitute considerable risks, since they interfere with scheduled operating procedures and objectives, cause additional costs for salvage-harvesting and replanting and decrease revenues from timber sales. As a result of climate change, a considerable increase of risks is expected, especially caused by lower levels of precipitation during the vegetation periods and more frequent droughts and storms (FEDERAL ENVIRONMENT AGENCY 2008). Since the end of the 1980s, scientific publications dealing with the causes and scope (e.g. KÖNIG 1996) as well as with economic implications of natural hazards in forest management were correspondingly numerous.

Accordingly, in his review article NEWMAN (2002) refers to publications, which address the integration of risks into the FAUSTMANN model, in order to determine the optimal rotation age. BUONGIORNO (2001), for example, describes the stochastic influenced development of a forest using a Markov Decision Process (MDP) model, which implicates discrete transition probabilities. The objective is to determine the best decision policy, which maximises the soil expectation value. Numerical solutions for this purpose are found using either successive approximation or linear programming. KUBOYAMA and OKA (2000) analysed long term data to climate induced forest damages from the national forest insurance of Japan, in order to derive empirical, age class dependent damage probabilities. By means of Monte Carlo simulations (cf. METROPOLIS and ULAM 1949) and using these probabilities they determine the optimal rotation age. HOLECY and HANEWINKEL (2006) as well derived empirical probability functions for the occurrence of forest calamities, based on the analysis of times series of forest maps, and modelled these probabilities with the Weibull function (cf. also PIENAAR and SHIVER 1981). DIETER (2001) calculated risk influenced soil expectation values, using Monte Carlo simulations like KUBOYAMA and OKA (ibid.), and determined the risk adopted optimal rotation age for beech and spruce in southern Germany. He describes the risk by means of survival functions, which model the chronological sequence of survival probabilities depending on tree species and site conditions. Similar approaches were pursued by KNOKE and WURM (2006) and BEINHOFER (2007), e. g. First considerations of these findings in the forest practice were proposed by KURTH et al. (1987), KÖNIG (1999) and KOHNLE et al. (2008a, 2008b). However, standardized forms of quantification of natural risks and risk management systems have yet to be established in Germany (cf. GADOW 2000, GAUTSCHI 2002). Considering the large economical impact of natural risks on forest management, namely on the selection of tree species, thinning practices and rotation cycles, this seems surprising.

This is the essential starting point of the present article. The objective is to develop an applicable "standard" method for quantifying calamity influenced survival probabilities of forest stands. Therefore the authors use the so called survival function, whose theoretical fundamentals are described briefly in the context of the survival analysis. In this article the survival function follows the Weibull distribution, described by the correspondent function. However, it is modified in a way that makes it easy to interpret the coefficients. Thus, they indicate the level and chronological sequence of risk. Furthermore a method is shown, that allows the immediate calculation of the "annuity under risk". It supersedes the application of iterative or numerical methods like the Monte Carlo technique or linear programming. Finally it is shown, by means of calculations with different survival functions, how the costs of risks and the risk-adjusted optimal rotation age can be determined. This approach, the authors hope, will contribute to the enhancement of decision-making in forestry (cf. DEEGEN 1994) and will promote the integration of risks into practical forest planning and evaluation.

Sequester or Harvest – the Optimal Use of Managed Forests to Mitigate Climate Change

Lauri Valsta

Forests as carbon reserves and as sources of renewable materials are vital for the greenhouse gas balance of the earth. Numerous studies have assessed the biological and economic potential of forests for mitigating climate change. Several of them have evaluated the benefits of utilizing forest resources for material needs while some show that certain types of forests might provide greatest benefits when left uncut. This study analyses the optimal mitigation and economic benefits of forests and shows under which circumstances it is optimal to store carbon into forests or to utilize forests for material and energy. The study shows that the solution to this problem depends on two parameters: Forest carbon utilization benefits (avoided fossil emissions when wood is utilized) relative to fossil emission costs, and the annual value of forest carbon storage (which is connected to the interest rate). Boreal Scots pine and Norway spruce stands are used as cases in the analysis. A numerical simulation-optimization model provides optimum forest management or non-management. For typical parameter values, forest carbon utilization benefits need to be 0.5 to 1.0 relative to emission costs to merit forest harvesting. The higher the interest rate, the higher the required carbon utilization benefit. Wood material substitution in construction often implies high carbon utilization benefits (higher than wood energy substitution) and in that case the optimum forest management for the climatic goal becomes rather similar to optimum management for the economic goal.

The Value of expiring credits based on arbitrage pricing theory

Klaus Wallner

The valuation of expiring credits for carbon sequestration issued by forestry projects within the Kyoto frame was neglected in the past years. After the decision at the UNFCCC-Conference in 2006 to issue only expiring certificates for sequestration the discussion ceased. Up to now the whole mechanism constructed for expiring credits wasn't tested in practice because there weren't projects on the horizon. With the upcoming decision for a Post-Kyoto treaty in December this year the future of the concept of expiring credits is at stake. But up to now three projects are already registered, two are requesting registration and many more are at the stage of validation. The first expiring credits will be issued at the end of 2011 and therefore it would be interesting to have a closer look on what is a fair price for this type of credits.

For valuation an approach based on the arbitrage-pricing theory is developed. It could be shown that arbitrage possibilities exist if the value is calculated only considering the time preference between a permanent and an expiring credit as the existing approach proposes.