



Unit 4.05.00



INSTITUT TECHNOLOGIQUE

International Symposium

How to both harvest and preserve forests more or better?

Paris, 26-30 May 2010

Abstracts



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Economic approach of biodiversity and ecosystem services; contribution to public decision

Jean-Michel Salles, Lameta, Montpellier, France, Vice chair of the Task Force established in the frame of the Strategic Analysis Center on this subject, sallesjm@supagro.inra.fr

Taking into account the impact of collective choices on ecosystems and biodiversity has been until now a qualitative question.

Following the great Environmental Forum initiated in 2008 by the French government (“Grenelle de l’Environnement”), the Strategic Analysis Centre established a Working Group to analyse knowledge and proposals for a quantitative approach of biodiversity in socio-economic projects.

Economic valuation of biodiversity raises many conceptual and practical difficulties. The Working Group tried to identify operational answers to them. Finally, the report adopts an approach to provide minimal “benchmarks” to reflect the impacts of projects on ecosystem services.

The presentation will clarify the rationale behind these choices. It will also explain the precautions taken by the Group for the use of these values, particularly in terms of temporal and spatial perspectives, and as regards selection procedures.



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Forest biodiversity and economic valuation

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The current crisis of biodiversity decrease has led the public authorities to look for the most relevant tools to limit this erosion. Among the two axes of effort set up within the framework of the 'international year of the biodiversity' (2010) is the assessment of the economic value of the biodiversity and the services returned by the ecosystems. Moreover France has a very particular role to play on this problem, due to its vast and varied terrestrial and marine ecosystems and by its level of economic development. And forests are among the richest sources of biodiversity.

But the first difficulty is that the word "biodiversity" is a very used, but rarely defined term. It is even possible to show that it is not possible to give it a rational and axiomatic definition, which would take into account some common concepts as the notion of key species or the notion of relative abundance.

The second difficulty is that the concept of value is often confused with both those of price and of cost. And this can moreover lead to major consequences because the biodiversity having no price, many consider it has no value.

Moreover, it is not possible simply to let markets find equilibriums in this domain, because the biodiversity is a public good (nobody can be prevented from taking advantage of the biodiversity and, to make it simple, the usage of this good by a person does not decrease the possible use by another one). On top of these problems, the asymmetries of information and also the constitution of monopolies would prevent the creation of a simple market in this field.

Two series of values can be defined: the first one related to the direct anthropological use of the biodiversity which are based on the three pillars of general sustainability (economic, social and environmental). We give as examples the variety of the consumable products, the option and quasi-option values or the functions of protection against natural hazards.

The second series of values is more indirectly connected to human beings: value of existence, ecological value, value of a constituent of the biodiversity to allow the sustainability of the ecosystem (stability, viability or resilience); we insist on the fact that these values are indirectly connected to human beings or to societies and that they are not intrinsic to biodiversity. Finally we notice in passing that the nature is not always friendly.

We present then three classic methods of evaluation (contingent evaluation, transport costs, hedonist prices) and some additional methods (avoided expenses, transfer of profit, market values). The spatial characteristics are essential in this evaluation (fragmentation of habitats, blue and green frames). Finally we present two general limitations to this process of economic evaluation:

- It is by its nature contingent to the date at which it is done, while generally we try to preserve the biodiversity on the long term.
- The current biodiversity is the resultant of previous disturbances. How to take into account future desirable and undesirable disturbances?

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Irreversibility and uncertainty in multifunctional forest management allocation

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This paper examines the implications of irreversibility and uncertainty in managing multifunctionality in two forest areas. On each forest area, the irreversibility concerns three management regimes: a Clear-cutting regime is more irreversible than implementing a Mixed regime, which, in turn is more irreversible than a full Preservation. The uncertainty is linked to the lack of information on future environmental policies affecting the forest areas. We compare two alternative management schemes that achieve multifunctionality in two different ways: one alternative consists of implementing mixed regime in each of the two forest areas, the other alternative consists in fully preserving one forest area and clear-cutting the other one. We give conditions for choosing between these alternatives within a framework that favors as little as possible the choice of a mixed regime in both forest areas.

We obtain a benchmark scenario where all the advantages that are not directly related to the irreversibility among regimes and the adaptability to environmental policy are not playing in the arbitrage.

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Economic research and studies in the Centre on economics, energy and foresight studies.

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The content and change of British forestry: economic research priorities and why these are important.

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Conservation or Development? Preservation or Utilization? A reduced (relative) emphasis on material production, combined with an increased emphasis on the provision of environmental services, has characterised forestry in Europe and North America at the end of the 20th – beginning of the 21st centuries. A fundamental change of emphasis from production to the provision of multiple benefits from forest ecosystems has occurred in Britain (Nijnik and Mather, 2008). Multi-functional forestry requires a broader stakeholder involvement in decision-making processes. The major reason lies in the necessity to prevail over differences in end-user interests and to avoid or resolve possible conflicts. This paper presents an assessment of demand for forest ecosystem goods and services and stakeholder vision of the content and future of British forests. Research tools and major outcomes of the research carried out at the Macaulay Land Use Research Institute (UK) (Miller *et al.* 2009) are discussed using examples from the European Commission VISULANDS and ALTER-NET projects, in which participatory techniques, including those of visualization (VRT) were applied, complemented by CVM and Q-methodology (Nijnik and Mather, 2008 ; Nijnik *et al.* 2008). The study was based on our consultation with end-users – followed by the sequential application of quantitative economic research methods. Where possible, the opportunities and challenges identified and explained by using analytical approaches were negotiated, as part of the deliberative process, and were fed back to the relevant module of the research for resolution. The applied combination of techniques has proven successful for outlining the areas of consensus and conflict between people, and in specifying, selecting and evaluating forest policy options. The methodology enabled a conceptualisation of public involvement in decision-making which can be adjusted and employed in other similar studies.

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Forest management and policies in front of biomass, energy, climate and biodiversity issues.

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Historically, agriculture and energy objectives have had strong consequences on forest lands and management. Today, because of climate and energy challenges for the future, agriculture and forestry are subject to deep changes. The demand for forest products could be enhanced. It is desirable in many circumstances as long as forest management is applied in a sustainable way. There are probably different possible forest management and this presentation discusses these possibilities from an economic point of view and around main questions. What will be the future prices of energy and wood in the medium term? How can forestry contribute to energy and up to which level of removals? What kind of silviculture could be implemented in the short and long ranges with which trade-offs and synergies between biomass and biodiversity?

Analysts generally recognise that energy will become more expensive either because of a rarefaction or because taxation and probably both. The past experience of oils crisis during the seventies showed that not only the price of fuelwood increased, but also the price of sawtimber. This is important because not only short-rotation coppices can contribute to energy needs but also the use of some woods that were abandoned in forest, the harvest of overmature trees, the reduction of the rotation age, the harvest of trees outside forest, wood residues in sawmills and pulp and paper industries, and also technological progresses. Some resources should be technically available but have not been used because of economic and other constraints. In order to remove them, a strong increase of the stumpage price should be necessary or a high price elasticity. Trade-offs have to be found between biomass and biodiversity but conflicts may occur only if one goal is very highlighted against the other. In other cases, it could be useful to have incentives to increase removals when biodiversity is not threatened or regulations avoiding a decrease of biodiversity where it is not high and biomass is profitable. In the long run, several silvicultural strategies could be implemented favouring biodiversity or biomass. But a strategy allowing the whole set of possibilities and trying to implement all of them where they are efficient should probably be considered.

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Seasonality of Prices

The Example of German Timber Prices

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This work was supported by the Hanns-Seidel-Stiftung and the German Federal Ministry of Education and Research.

The seasonality in wood prices, especially round wood prices, is a well known fact. Scientists and participants on the round wood market often hint at this effect. But till now no one did detailed research on it. This leads to the fact that seasonality is still a black hole in the round wood market, whereas this phenomenon has been carefully studied in other markets like tourism or clothing. Here the determinants causing seasonality have been detected and studied. Research conducted on them where either based on the question how these determinants develop and how they can be influenced or on the question how to adapt business behavior to maximize profits. Due to the high impact of the wood business on the overall economy it astonishes that no research was made on the phenomenon of seasonality in wood prices.

The aim of this presentation is to bring some light in the shadow of seasonality in that branch of the economy. From a statistic point of view seasonality is a component of a time series and can be either multiplicatively or additively connected with the other components of the series. The main target is to do some detailed research on the determinants causing the seasonal component of the round wood price time series. Traditionally, seasonality is caused by two types of reasons which are called institutional and natural seasonality.

Natural seasonality is attributed to the climatic variation during the year. Institutional seasonality is considered to be caused by human being, with the stereotypical reasons being religious holidays or vacation time for example. In literature and practice many ideas and legends exist about what is causing the seasonality of round wood price. Based on these and on the theoretical causes of seasonality in general, an economic model will be formed. An econometric analysis of the model will follow as well as an analysis of the seasonal pattern. A final discussion of the results and the methods applied concludes the talk.

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Medium term strategies to improve the quality of Mediterranean forests: the case of Valtiberina, Tuscany.

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In several countries of the Mediterranean Europe, forest productions are scarcely competitive on the markets. The survival of the enterprises of the sector depends, mainly, from a public aid that in the future will decrease progressively. Thus, it becomes necessary to revitalize a sector which, otherwise, will incur a quick decline. The problem is mostly linked to the typology of available forest resources, that, for the case of Central Italy, are mainly represented by aged coppices, with sporadic tree species presence with mesophytic broad-leaves such as mountain maple, linden tree, ash tree and yew tree.

Thus, this study examined a territory where those phenomena are particularly accentuated, the Valtiberina, in Tuscany. In this context, it has been suggested to the forest stakeholders and to the local public administrators a dynamic approach to the problem in order to identify the possible solutions. The basic idea is to propose to the harvest enterprise a forest management methodology specifically devoted to the sporadic tree species conservation and improvement. This will make it possible to improve the quality of forest crop in order to obtain, in the long term, qualitative forest crops able to achieve better prices on the national and international markets.

The silvicultural approach proposed is ascribable to “tree’s silviculture”, that is an approach developed from the beginning of last century (Michealis 1907, Ducellier 1930, Moller 1931) for facing both the progressive lowering in the timber prices and the strong increase in the cost of labour. But, how is it possible to realize them, since these forest management for the sporadic tree species conservation show a negative stumpage value?

In such a situation, thus, the best approach for the identification of the possible solutions is to propose dynamic strategies for the working out of the problem, that are the detection of the product sectors that, in the short term, in consequence of limited investments, allow the obtaining of a fair profitability from the forest productions and that, at the same time, produce an improvement and a diversification of the forest production in the long term.

In this context, the development, in the short term, of the forest-wood-energy chain can surely represent an interesting opportunity for the promotion and the economic valorization of the forest resources available at the present time in Valtiberina, and it can jointly allow the development of punctual forest regulations able to improve the quality of sporadic tree species.



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The suggestion of producing energetic products and services to the Valtiberina enterprises which use wood products, in the current situation of strong market globalization, means, first of all, to think over a set of questions regarding the needs and desires of the clients, the products which can satisfy those questions and the opportunities and threats offered by the environment: economic situation, national and international regulations, available technologies, etc..

Thus, it was necessary to develop an analysis which could help in the evaluation of the compatibility between the demand and both the available resources at local level (structural and financial ones) and the ideas and innovative suggestions which were thought to put into practice: in other words, the analysis should evaluate both if the suggestions we want to introduce on the market are really what the market is looking for and if the environmental conditions are favorable or not to the development of these same suggestions.

For these reasons, a dynamic SWOT analysis has been developed, in order to identify the aims of the enterprises that actively participated to the study and capable of defining both the more efficacious strategies for the exploitation of the environmental opportunities and the strengths of the local enterprises as regards the current scenarios, of medium and long term.

The analysis was carried out in three phases: the *PEST analysis*, (Political, Economy, Sociology and Technical analysis), for the identification of both the current market situation and the factors which play a role on it; the *SWOT analysis*, for the joint evaluation of the positive and negative factors which take place both inside and outside the wood chips market; the *Map Knowledge development*, for the development of a set of cognitive maps which set the strengths against the weaknesses and the opportunities against the threats, in order to clearly summarize the results deriving from the previous analyses, thus highlighting the market dynamics.

The study turned out to be functional for the definition of the programmatic actions of the Rural Development Plan of the region Tuscany in the medium term, giving useful indications for the definition of the financing measures to be activated (structural investments, *etc.*), measures able to promote both the forest biomass market and the quality silvicultural interventions.

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Comparison of various sources of uncertainty in stand-level net present value estimates.

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The net present value is the indicator used for measuring superiority of alternative chains of forest stand management in timber management or in joint production timber and amenity benefits. However, there are various sources of uncertainty that affect ex-ante net present value estimates. The objective of this study is to compare the relative importance of various sources of uncertainties in determining the net present value of forest stands and forested property. This was achieved by performing stand-level simulations that take into account: i) input data errors (airborne laser-scanning data vs. ocular standwise field inventory data), ii) stochastic future development of timber assortment prices and iii) errors in stand-level growth projection models. The starting point of the study is a simulated forest estate comprising 40 stands of various types sufficiently represented (e.g. with respect to species composition, development class distribution, and site quality). Stochastic timber price models were formulated, employing geometric mean-reverting principles.

The results show that sources of uncertainty all had significant effects on the probability distribution of the net present value of the stand. The relative standard deviations of stand net present values averaged 8% for stochastic timber price, 29% for errors in standwise field inventory data, 26% for errors in airborne laser-scanning data and 33% for errors in growth projection models when applying a 3% discount rate. When all three sources of uncertainty were analysed simultaneously, the highest average standard deviation was 47.4%. Interestingly, errors in the growth projections and the quality of inventory data contributed more to the variation in stand net present value than fluctuation in timber price did

Our modeling approach makes it possible to compare various sources of uncertainty and to set confidence intervals for net present value estimates. This approach can also result in information on which sources of uncertainty are the most important ones and need special consideration.

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Impact of the presence of risk of destructive event on forest silviculture.

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In order to determine the optimal cutting, Faustmann (1849) proposed a formalism based on the expected discounted income. Many authors have successively improved or reformulated in the absence of risk (Ohlin 1921, Pearse 1967, Clark 1976). Clark (1976) has applied this method by coupling a model of forest that described the evolution of the volume of wood. The risk of destruction has been introduced to forest stands by Martell (1980) and Routledge (1980) in discrete time. Thereafter, Reed (1984) has studied the optimal forest rotation in continuous time with the risk of fire. Buongiorno (2001) proposed a generalization of Faustmann approach using Markov Decision Process Models. Peyron and Heshmatol-Vezin (2003) were interested in natural risks incurred by forests in discrete time. More recently, Goodnow et al. (2008) characterized for ice-damaged stand necessary conditions to change management decisions.

For the absence of risk of destructive events, all the production cycles are carried out to the same cutting age. When the risk of destructive event exists and is taken into account, we assume, as most authors cited above that the operator systematically decides to interrupt the current cycle and begins a new cycle. The first question that follows is about the impact of presence of a risk destructive on silviculture. A second question, which is linked to the first, is : what is the consequence of silviculture over the rotation period ? To take into account thinning in the calculation of the land value we used a model of population dynamics. Contrary to Salo and Tahvonen works (2003) based on age- structured models, we consider a simplified model of average individual type to study more specifically the impact of a risk of destruction on silviculture.

For different density dependent growth (an eucalyptus stand and a beech stand) and using the optimal rotation period, with simulation examples we highlight the influence of the presence of risk of destructive event on optimal thinning and optimal cutting age.

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Forest carbon and management impacts on optimal rotation ages for Loblolly pine in the Southern US.

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Forests have figured significantly in deliberations over how to mitigate the effects of increasing atmospheric CO₂. Forests have been touted as a source of raw material for cellulosic ethanol as well as a key element in carbon sequestration efforts globally. Interestingly, these two carbon-focused alternatives could provide contrasting incentives for forest landowners. This paper reports on an analysis of changes in optimal rotation length for U.S. southern pine brought about by the two CO₂ mitigation opportunities for forest landowners. Following a review of the current and potential carbon sequestration programs available to U.S. landowners, a series of simulated loblolly pine (*Pinus taeda* L.) management regimes are presented. Four production regimes were examined: “timber production only”, “carbon sequestration only”, “joint production of timber and carbon”, and “joint production of timber, carbon, and biomass”. The Forest Vegetation Simulator (FVS) model, developed by the USDA Forest Service, was used to simulate growth and yield of timber and carbon under selected management scenarios. A sensitivity analysis was conducted to determine the financial tradeoffs associated with carbon sequestration using Land Expectation Value (LEV).

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Optimal rotation and stochastic interest rate.

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We examined effect of stochastic interest rate on the optimal forest harvesting under both random walk and mean reverting stochastic interest rate and include multiple age classes, forest owner's consumption-saving decision and risk aversion. Compare to the deterministic Faustmann approach both random walk and mean reverting interest rates shorten the optimal rotation. When forest owner is a borrower there is incentive to consume immediately as much as possible and pay the loan back later, and if he faces a high enough interest rate borrowing will approach zero and become optimal to finance present consumption by earlier cutting. For a saver forest owner growth rate of expected value of financial asset under uncertainty is higher than under certainty, thus to finance future consumption it may be optimal to harvest younger stands. Including risk aversion changes the optimal rotation dramatically. If the forest initial state is consist of just one stand age risk aversion under stochastic interest rate will smooth the age classes which mean clear cutting part of a class age may be optimal. When the initial age class is shorter than Faustmann rotation, with random walk process, increasing risk aversion and uncertainty shifts the decision form total removal to partial cut of age class while under mean reverting increasing risk aversion and uncertainty change the decision from no cut to partial harvest. When the initial stand age is equal the Faustamnnian rotation risk aversion will imply postpone harvest of part of a forest for next period and lengthen the rotation. Under risk aversion initial wealth and subjective time preference of forest owner will affect the optimal cutting share. Also under risk aversion timber price and planting cost will affect the harvest share at higher timber price and lower planting cost the harvest share is more.

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The economic effect of reduced regeneration investments on forest stand value – exemplified for European Beech

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Strongly decreasing stumpage prices of European beech logs during the recent years and the effects of the financial crisis naturally motivate forest owners to seek cost reduction options that include regeneration costs. Regeneration costs for natural regeneration cover cleaning, soil preparation, supplementary planting, weeding, fencing and precommercial thinnings. Cost reductions imply potential degradation of the future stock and will cause diminishing forest stand value when certain regeneration threshold investment levels are encountered. The economic effect of various regeneration cost reduction choices are investigated assuming rational investment behaviour of the forest owner according to Faustmann theory. Various analysis approaches are considered and preliminary results are presented. Implications concerning climate change, environmental and socio-economic issues are assessed heuristically.

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Forest profitability measurement: a pilot project to extend FADN to forestry sector in Italy

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While forest area covers almost one third of Italy, the forestry sector has a marginal economic role in the country, due to different reasons including the declining timber market value, the highly fragmented private ownership and the consequent abandonment of mountain-forest areas.

Such marginality has been reflected also by a general decline of the forestry and forest operations entrepreneurship and by a loss of interest in collecting statistical and economic data over forest profitability.

Recently, within the framework of the Rural Development Programme of the European Union, Italian regions have started to implement systematically forest related policies with the aim of: increasing competitiveness of existing forest enterprises, improving land and environmental conditions in forest areas and diversifying the mountain rural economies. Among the beneficiaries of forest related policies there are forest owners, agro-forest farms and logging enterprises. At the halfway of RDP 2007-2013, the EU and – consequently - national and regional administrations are requiring to measure and evaluate the socio-economic impact of their policies and related disbursements.

The National Institute for Agricultural Economics, already responsible for the Farm Accountancy Data Network in Italy and in charge of developing evaluation tools for the RDP impacts in the agricultural sector, is working for expanding the survey to the forestry sector, creating a sort of “FADN-FOR”.

To achieve this target, main actions will be: i) defining the population of forestry, agro-forestry and logging enterprises to be investigated; ii) deepening the analysis of agro-forestry firms (farms producing at the same time agricultural and forest products) which are not completely recorded by FADN¹ but which, in Italy, own about 30% of the national forest land; iii) adapting the accounting scheme to include the peculiar aspects of the forestry production (including non timber forest products and services).

To support the data collection process, a new accounting software for agricultural enterprises - GAIA[®] – will be probably upgraded in order to include the forestry sector.

Among the others, specific problems we are facing in doing such operation, regards:

- Evaluation and accounting of growing forest stock value
- Multi-year yields accounting (which imply to account gains and losses).

We did not reach final results nor conclusions, yet. But we are available to share our proposals and to learn from other European experiences.

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¹ According to the EC Regulation establishing FADN (79/65/EEC), “forestry activities” are intended only as the “non-agricultural” ones.



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Community forestry for legacy: the Licara's strategy in climate change mitigation in Kalinga Province, Philippines.

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The Liwan Calaoacan Reforestation Association (LICARA) is a non-stock and non-government organization operated by 49 dedicated and environment conscious ethnic farmer members covering 75 hectares land area that used to be denuded, marginal and idle grassland in Rizal, Kalinga, Philippines.

After 5-years of operation, the outcome showed that there was a gigantic development of the Community-Based Forest Management (CBFM) project. The soils becomes fertile, the biodiversity of soil flora and fauna increases and socio-economic condition of the farmers increases too as the project contributed in global sequestration of carbon emissions.

Various forest tree species like *Gmelina arborea*, *Switenia macrophylla*, *Gliricidia sepium*, *Pterocarpus indicus*, *Leucaena leucocephala*, and other species are planted along the periphery of the farmers' farms that served as live fence and boundary plants while fruit trees *Mangifera indica*, *Carica papaya*, *Musa sapientum*, and other fruit species and agronomic crops like *Phaseolus lunatus*, *Vigna unguiculata*, *Phaseolus vulgaris* and others are planted in each farm. The low lying areas in the farm are cultivated with rice (*Oryza sativa*) where water is being supplied from the communal small water impounding project (SWIP) in the area. The SWIP is also maintained as fish pond, swimming pool for the duckery and cattle.

The products in the farm are all organically produced. Compatible agronomic crops with the higher story plants are also raised underground and served as other source of income and the vitamins and minerals daily source of the farmers.

Cattle and small ruminants are also raised by the farmers in semi-confinement and cut-and-carry methods of feeding as another source of income and the protein source of the farmers' family.

To date, the farmers from the nearby communities are duplicating the LICARA's experience.

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Agroforestry for life: its environmental contribution in climate change mitigation in Kalinga Province, Philippines.

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Agroforestry as a practice in Kalinga Province, Philippines is a tradition that passed from generations to generations and became a way of life to the people of Kalinga. Various agroforestry systems in Kalinga province evidently contributed to the household economy of the farmers while indirectly contributing to forest cover restoration and in mitigating global climate change.

The Agroforestry farming systems in Kalinga represent various crop combinations of farm enterprise, cropping system, livestock, fisheries, forestry, poultry and the resources available to the farmers to raise them for food and for profit. Agroforestry components interact with each other and to their environment without dislocating the ecological and socio-economic balance while attempting to make a profit or provide food for the farmer and the farmer's family. The traditional multistory agroforestry farming system noted to be the most widely adopted agroforestry farming systems in the province of Kalinga with various crop combinations and it diverge from farms of the tribes and the location of the farm as to aspect and altitude.

The upper canopy is composed of light-demanding species and the lower strata composed of diverse agronomic crops that provide food for the day-to-day needs of the people. The diversity index varied as to farm location, altitude, and exposure respectively.

Agroforestry system is a potential carbon sink that absorb CO₂ and has the capacity to accumulate carbon and release oxygen. The investigation showed that carbon storage varies from site, altitudinal zonation and crop diversity.

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Facing the deforestation process in the south of Ecuador, from an economic point of view.

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South Ecuador is one of the “hottest” hotspots in biodiversity but unfortunately, the deforestation rate is the highest among South American countries. Land use conflicts occur frequently, forest areas are cleared by slash-and-burn practices and then utilized as pastures, this practice results in a dramatic decline of biodiversity and a high risk of soil erosion.

Based on data collected in the buffer zone of the Podocarpus National Park located in the southern part of Ecuador, we carried out a research analyzing land use options at farm level to improve both financial yields for farmers and conservation goals based on the argument that increasing the financial robustness of land use can reduce the demand of land for pasture while mitigating the deforestation process.

For this purpose we applied modeling and optimization techniques merging financial and sustainability considerations into the analysis:

In a first step, we developed an **Ecological– Economic Farm Diversification** (EEFD) concept, re-integrating unproductive land into active management to find an optimum mixture of land shared between “**pasture**”, “**reforestation**” and “**selective logging**” in a time frame of 40 years; we then compare our model and the classical system of production in economic terms.

The key activity in halting deforestation is the accumulation of “new” natural resources through wasteland reforestation with native species. Following the optimized management path under EEFD, farmers can achieve a 65% increase in profit from their land (US\$20,680 ± 2,260, discounted at a risk-free 5%, versus US\$12,560 ± 2,560 with the classical system).

In a second step, we applied the financial theory of portfolio selection to design several combinations from four land use options in various proportions. We consider risk correlations obtained from Monte Carlo simulations; we then compute the efficient frontier as combinations of the considered land use options achieving the maximum Net Present Value (NPV).

The outcomes show that the mixed land use portfolio improved NPV and reduced risk compared to the conventional single pasturing system, demonstrating that diversification may generate positive effects that increase the incomes of farmers while decrease income volatility. In order to identify the optimal land use portfolio we maximized the reward to variability, i.e. the quotient formed by the average net present value and the portfolio standard deviation.

In this way our first results *are* promising, showing that diversification at farm level helps to enhance farmer’s economy while achieving some conservation objectives like halting deforestation, this constitutes another step in the way trying to reach a sustainable development.



Seed transfer policy issues for forest management under climate change: where do tropical countries stand?

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The role of forests to capture carbon dioxide from the atmosphere to mitigate climate change is clear but there is less agreement on the policies needed to create forests from seeds in a modified climate. Many recommendations for forest survival under climate change aim to spread risks by combining locally several seed sources and different tree species. In principle, it is desirable that reforestation and afforestation programs would serve both goals of fixating carbon and protecting local biodiversity, but this is seldom the case in tropical countries where most plantations are made with exotic species. Research from the last 15 years begins to provide guidelines to choose seeds for a certain site that are potentially adapted to climate change, but the majority of these studies are on temperate trees whilst tropical species remain largely understudied. For instance, recent studies that explicitly include climate change for tropical tree provenance tests were found to be concentrated in Mexico and for subtropical mountain genera (*Pinus* and *Quercus*) only. International regulations on seed movement are within the framework of open markets principles allowing free movement of seeds between countries provided minimum standards are followed. Such policies can benefit temperate countries for which the number of important forest tree species is reduced and widespread, but are less useful in tropical forests with high species diversity and more restricted distributions. Hence, the high endemism of tropical areas implies that many countries should internally manage seed conservation and seed transfer plans. Moreover, open seed markets may increase the risks of species invasions, as acclimation tests to evaluate the potential of invasiveness is not explicitly contemplated in most regulations. Aggressive and widespread funding policies of studies on tropical tree adaptation to climate change will not only help reduce the low diversity of many present day plantations in the tropics but provide many added benefits of higher biodiversity ecosystems.

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The impact of improved agricultural technology on tropical deforestation.

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The rising concern about tropical deforestation and its adverse consequences, such as climate change, biodiversity loss, soil degradation and reduced timber supply, has led to a sharp increase in the number of studies about tropical forest loss. Not only natural scientists, but also more and more economists are trying to model why, where, and when forests are converted to other land uses. Comparatively little research has been devoted so far to the question whether technological change in tropical agriculture has a forest-saving or a forest-clearing effect. In this paper, the main theoretic arguments for answering this question are outlined. In order to analyse the farm-level effects of technological change, we look at the case where farmers are fully integrated into perfect output and input markets as well as at the subsistence (or full-belly) case. Then we consider the aggregate effects of all farmers' decisions. These macroeconomic effects can either diminish or enlarge the effects on the farm-level.

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Which market-based instruments to preserve forest biodiversity?

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Some measures in favor of biodiversity are costly to the forest owner while both he and the rest of the society share the benefits; which does not lead to sustainable paths. Another reason to the non-sustainable production of goods and services derived from biodiversity is the difficulty to correct market failures related to such public goods. Traditionally, the response to these failures is a regulation by the public sector to avoid overuse and here, biodiversity erosion. In recent decades, the predominant instrument in the European community to achieve the objectives of sustainable use of natural resources has been the use of regulations through environmental laws. Due to budgetary constraints, the choice of measures and strategies is not only based on their environmental effectiveness, but also on their monetary efficiency. Thus, given that most regulatory mechanisms are costly to the public and private sectors, market-based instruments are becoming increasingly important because they offer new, less expensive, perspectives to achieve the biodiversity objectives and can be used to supplement traditional regulatory measures.

Through an analysis of the international literature on economic incentive experiences to preserve forest biodiversity and to maintain or increase environmental services provided by forests, this paper review the market-based instruments which encourage forest owners to preserve biodiversity on their land. This analysis shows that different instruments lead through regulation enforcement or through voluntarism to a sustainable resource use or to the preservation of the biodiversity and its associated services. Regulatory measures are generally used to protect endangered species or natural areas rich in species, by prohibiting their use or by setting restrictions on access. They have the advantage of being the most direct way to achieve a short-term environmental objective, but they are expensive and sometimes economically inefficient. Market-based instruments offer new perspectives to achieve the objectives in terms of biodiversity at a lower cost. Subsidies are one of the most used instruments, especially in agriculture and forestry and are widely used in the preservation of habitats and ecosystems, compared to the protection of fauna and flora. Charges are used extensively in the field of water management and are widely used as grants with respect to fauna and flora. Markets for environmental services are rare, but payments for environmental services are developed, mainly for the protection of biodiversity, the scenic beauty, services related to watershed and to carbon. Future researches will focus to these markets and more particularly to procurement auctions, which are one of the most efficient mechanisms of payment.

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On production costs of biodiversity zones on arable land and in forests adjacent to fields.

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Biological diversity in agricultural environments has decreased as a result of intensified farming and monoculture. In the European Union, the measures of agri-environment support schemes aim at responding to this decrease, but novel and cost-effective measures to safeguard and conserve biological diversity are required.

This study compares costs and income losses incurred to a private landowner from biodiversity zones established on the border of a field and on the border of a forest adjacent to a field. The purpose of the biodiversity zone located in a forest abutting to a field is also to increase the diversity of species in the agricultural environment and to produce meadow-like habitats particularly suitable for pollinators offering ecosystem services to humans.

A biodiversity zone on the border of a field refers to a 25-m wide zone covered by perennial grasses. An alternative for the biodiversity zone established on a field is a biodiversity zone established in the border of a forest. This zone is also 25-m wide and it consists of a 5-m wide meadow-like treeless part and a 20-m wide transitional zone. The 5-metre wide zone closest to the field is immediately deforested and kept treeless with clearings repeated every 6-7 years. The 20-metre wide transitional zone deeper in the woods is thinned to the basal area of 8 m²/ha and the trees of the transitional zone are managed with light selection fellings every 20 years.

Establishing and managing biodiversity zones incur extra costs and income losses and thus decrease a landowner's net income streams, since land previously used solely for agriculture (or forestry) is transferred to the joint production of crops and environmental benefits (or wood and environmental benefits). The production costs of biodiversity zones are calculated by subtracting the present values of net income streams from biodiversity zones from the present values of net incomes received from the corresponding fields and forests managed according to the current practices and recommendations.

There was large variation in the amount of private costs and income losses caused by the biodiversity zones established in southern Finland. The costs on arable land depend on the productivity of the field and the cultivated crop mix. In forests, the variation in production costs of pollinator habitats resulted from soil productivity as well as the structure and volume of trees at the starting point.

Currently, as the world market price of grain is low, it may often be viable for the landowner to establish biodiversity zones on the field rather than in the forest. In addition, biodiversity zones established on the field are also more easily returned to production than ones established in the forest.



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Management of the private forests regarding the owners' attitudes towards forest preservation: case of Slovenia.

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The problem of how to harvest more timber and simultaneously preserve forests has been explored from many perspectives in recent years. The one discussed here is that of private forest owners, their forest activities and their cooperation with governmental and nongovernmental forest organizations that have the power and responsibility to make decisions about conservation and sustainable, pro-natural management of forests (regardless the ownership), and that act as counselors for private owners. In Slovenia, where 58% of the total area (2.025,47 ha) is covered with forests, 73% of the forest area is privately owned. A large number of the private forest owners (about 300,000) control very fragmented and small properties (the average ownership is only 2,6 ha), lack horizontal and vertical links to forest owners' associations, and are unaware of the importance of wood and nature preservation – presenting serious obstacles to professional silviculture, optimal forest operations, and consequently better preservation of private forests.

Private forest management is influenced by a number of natural parameters, owners' willingness to harvest and their ability to implement necessary silvicultural and preservation practices according to forest management plans. It also depends on the cooperation of private forest owners with different governmental and non-governmental institutions that can enhance or even inhibit the development of private forests. In this context, we focused our research on private owner management activities in their forests (harvesting, silviculture and protection – dependent variables), and on the forest owner membership in different associations (associated, not associated – independent variables).

The data were acquired from institutional sources (data base (index) of forest owners, property size, allowable cut, implemented management and protection practices, etc.) and from surveys (stratified sampling by property size) to obtain information about owners' membership in forestry associations (322 returned surveys). The data were analyzed by crosstabs, multiple logistic regression and other statistical multivariate procedures (ANOVA, Kruskal-Wallis test, etc.) with SPSS.

Besides many interesting and often surprising results, the most important findings were:

- associated owners harvest more and execute less silvicultural and protection practices than unassociated owners
- owners who harvest more, and execute more silvicultural and protection practices expressed stronger positive attitudes towards forest (nature) preservation
- owners with strong positive attitudes towards nature preservation are already or intend to become active associated members
- the quantity of timber removal is strongly statistically related to the amount of growing stock, cooperation with other private forest owners, and obtaining information and support from associations.



Forest status and uses.

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The legal status of natural environment ought to be totally neutral in terms of préservation, but the most of the terms appears to be harmful, rarely positive.

The studies of foreign system might suggest new directions of enviromntal managment: law in this field is not too difficult to export. But laws which apply to the forest are based on social and cultural history and social representations.

Legal status is based on two things: the organisation of legal system and the way it defines the environment and its protection. The definition is that of the lawyer who fits a specific reality into one or other legal category. The forest is aturally one of these categories, either in terms of its dimensions, or of constituent elements.

The legal system as it is applied to the forests is full of contradictions, and the ecological, social and économic functions both traditional or news uses are often in conflict with each other. At some point the law has to make a choice between competing functions, or reconcile them. A good exemple of these contradictions is the field of civil responsibility.

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The “non cutting” management: a case study contributing to the debate of sustainability forest policy.

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Contrast between public and private interests in forest management is animating the cultural and scientific debate in recent years.

Silviculture is a tool for managing forest ecosystems. In the past it had the aim of timber production only, but in recently years, it tends to find new definition aims to support the multiple use of forests.

In some circumstances, however, Public Authorities have adopted the strategy of stopping any active forest management, introducing strict regime of protection of forests in order to enhance the functions of non-wood forest, using the financial tool for compensating the income losses of property owners from not cutting. This strategy reflects a relevant case of absolute forest preservation policy. In the range of the silvicultural scale is the upper limit where the management is excluded at all.

Through the analysis of case study on a forest firm of public owner located in the Lazio Region (Italy), it is determined the impact that this approach has generated into the ecosystem.

The absence of ordinary final cutting of the coppice, has lead to a thick standing with a considerable amount of biomass, in excess of the location’s natural capacity. The resulting ecological instability has lead to the development of primary and secondary pathogenic infestation, particularly accentuated in enclosed areas at high elevations, reinforced by unfavorable climate trends (seasonal drought).

Comparing the present forest ecosystem with analogous ecosystem not under same restrictions, the results show the impact from environmental, economic and social point of view produced by this forest policy. Market and not-marked products, services and externalities area evaluated, using a comparative matrix, where some of them are expressed in absolute value and others using the trend alone.

The prohibition of cutting, acting on the considered ecosystem governed as secondary coppice, has consequently reduced the ecological equilibrium and functionality. The main question that came from this experience is: could be this management way coherent with a sustainable forest policy?

The case study analyzed, highlights also the relevant role of Public Authority in the definition of sustainable forest management.

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Assessing changes in current and future demand for forest ecosystem services such as timber production and recreation with regard to an aging society and the national statistics system.

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Japan's population is decreasing, with a shift in demographics to more people in older age classes. Average life expectancy in Japan is high; in 2008 about 22% of the population was 65 years old or older. Demand for forest ecosystem services, primarily timber production and recreational opportunities, is shifting along with these demographic changes. Wood-based housing construction creates the largest timber demand in Japan, and forest recreation is one of the most valued forest services. We used national-level statistics and surveys to assess changes in the demand for timber and recreational opportunities with regard to an aging Japanese society. In addition, current problems regarding national statistical data analyses are presented. This study was conducted by using resampled microdata from the Housing and Land Survey (1993, 1998, and 2003), provided by the Research Centre for Information and Statistics of Social Science, Institute of Economic Research, Hitotsubashi University.

New construction starts for privately owned housing units have decreased in recent years, primarily due to changes in population structure, and the overall proportion of wood-based houses to total housing units has decreased. In Japan, elderly people tend to live in single-unit wooden houses. Our statistical analysis clarified that the percentage of households with an elderly person (65 years old or older) present, in relation to all households (specifically wood-based housing), rose from about 37% in 1993 to over 46% in 2003. Government policies providing for barrier-free improvements to older wooden houses have become increasingly necessary.

The increasing elderly population has also influenced the demand for forest recreation opportunities. It seems that the proportion of elderly persons using forest parks, forest trails, and public parks is increasing in comparison to families with children. However, many forest recreation sites, as currently designed, pose barriers to use by elderly people with physical limitations.

Data on demographic changes, housing, and recreational opportunities can be found, if only in part, in current national-level statistical reports and surveys. The need to assess all three sectors in relation to each other will become greater as Japanese society continues to age. Current national statistics on timber and other forest ecosystem services are devoid of this type of contingent assessment. To develop appropriate forest management policies in light of an aging society, statistical data standards for collection, analysis, and use must improve at all levels of government, including current national statistical reporting.

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Production capacity in oak high forests. Trade-offs between wood production, biodiversity preservation and attractiveness for recreation.

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Produce wood, preserve the environment, provide social services: all these goods and services are expected of the forests nowadays. Forests can sustainably produce them, but how much? These products are joined outputs in a production process composed of forest growth and management. Therefore, it is important to characterize how outputs are joined to set production goals.

In this paper, we simulate alternative management scenarios for *Quercus petraea* even-aged high forest at the stand scale. Then we estimate for each scenario the production of three goods and services: 1) the production of wood in terms of the net present value of an infinite series of rotations (NPVIS); 2) the preservation of biodiversity, using an indicator of the number of bird species potentially present in the forest (Bio); 3) the production of a recreation service, in terms of attractiveness for recreational activities (A). Lastly, we determine production possibility frontiers for the three two-output combinations.

We show that NPVIS and Bio or NPVIS and A are substitute products of forest management, but there are possibilities for producing both in the same forest. Bio and A are compatible to a certain extent. The methodology employed seems efficient to study multi-functionality at the stand level.

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Comparing profitability and governance for recreational wild mushroom picking in forest and timber production.

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In Italy, a substantial decreasing level of the domestic industrial timber production can be observed in the last two decades, both in absolute and relative terms of values and quantities. Unexpectedly, evidences of this trend can be found also in the richest forest areas of the country, like the North-East alpine regions, traditionally characterized by advanced organisational models in managing their forest resources. This is due to internal long-standing structural factors, including the highly fragmented forest estate, and external forces, including the strong competition on the global markets and the globalisation of forest issues. The level of biomasses for energy production seems to be more stable or slightly increasing, also because of the strong recent public policies supporting the use of renewable resources. Nevertheless, also for this kind of forest production, locally, forest entrepreneurs are constantly reducing their market power in influencing prices and factors allocation, while they are facing low levels of profitability.

On the other hand, in the same two last decades, in Italy as in other European countries, an increasing demand for Non Wood Forest Products and environmental services can be reported, with the Payment for Environmental Services (PES) schemes as important emerging economic instruments for improving the forest market value. This increasing demand might lead to new challenging fields of activities for innovative forest entrepreneurship initiatives, which require new types of governance. By means of a multiple case-study approach, the paper analyze four experiences in the North-East Alpine area of Italy and Northern Apennines, illustrating the significant increment of forest products added value connected with recreational Wild Mushroom picking activities. The more complex and well structured is the organizational model adopted by forest entrepreneurs in managing their forest for multiple-functions (such as for recreation based on wild mushrooms picking, instead than only for timber production), the higher is the capacity of local forest entrepreneurs to keep their forest under control while getting better levels of profitability. A final comparison is carried out between the timber production and the income generation of wild mushroom picking on the basis of a common indicator of profitability.

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